

3D Laser Snapshot Sensor LJ-S8000 Series

User's Manual

Please read this manual before using this device.

After reading the manual, please store it in a safe and easily accessible place for future use.



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Support site
www.keyence.com/support_ljs8000



Introduction

This manual describes the setup procedures required for connections and initial installation of the LJ-S8000 Series, as well as related information and product specifications.

Read this manual thoroughly in order to understand how the controller works and to maximize performance of the controller.

Always keep this manual in a safe place for future reference.

Please ensure that the manual is passed to the end user of the software.

Symbols

The following warning symbols are used to ensure safety and to prevent human injury and/or damage to property when using the system. 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 injury.
 Important	Indicates cautions and limitations that must be followed during operation.
 Point	Indicates additional information on proper operation.
 Reference	Indicates items to enhance system understanding and other useful information.

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Safety Information

General cautions

	<ul style="list-style-type: none"> This product must not be used for the purpose of protecting the human body or a part of the human body. This product must not be used in an explosion-proof area. Do not use this product for applications (power plants, aviation, railways, ships, vehicles, medical devices, recreational equipment, etc.) which could cause great harm to people and/or property.
	<ul style="list-style-type: none"> If this product is used in a manner not specified by this manual, the protection provided by the product 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. Take appropriate protective measures to ensure that the devices functions safely even in case of a malfunction without the product.
	<ul style="list-style-type: none"> Before starting or operating the system, check to make sure all Keyence functions are working properly. In the unlikely case that this product fails, take all safety precautions to prevent damage.
	<ul style="list-style-type: none"> If the system is operated beyond its published specifications or if the system is modified, its functions and performance cannot be guaranteed. Please note that when Keyence is used in combination with other instruments, its functions and performance may be degraded. Do not subject the controller or connected devices to a sudden change in temperature. There is the risk of condensation occurring.

Precautions for use

	<ul style="list-style-type: none"> Turn the main power supply off when performing cable connection or maintenance work etc. Failure to do so may cause electric shock. Pay attention to prevent foreign matter such as metal particles, dust, paper or wood chips from entering the inside of this unit. Failure to follow this may result in a fire, electric shock, malfunction or accidents. Use the specified voltage. Failure to do so may cause fire, electric shock or malfunction.
	<ul style="list-style-type: none"> Do not disassemble or modify the device. This may cause fire or electric shock. Mount the head on a metallic plate. The surface of the head may become very hot and cause burns.
	<ul style="list-style-type: none"> Do not apply any vibration or shock. When a strong vibration or shock is applied to the head, malfunction or the deterioration of the measurement accuracy can occur. Before making any connections/disconnection, be sure to turn off the power of this unit and connected devices. Failure to do so may result in a malfunction of the controller or connected devices. Do not turn off this instrument when settings are being modified. Otherwise, all or part of the program settings may be lost. Do not block the ventilation holes of the unit or surrounding devices. Increase of internal temperature could cause failure. You are advised to back up the settings to prevent data loss in the event of system trouble or failure. Due to mild fluctuations in the air, the measured value may fluctuate. In this case, take the following countermeasures. <ul style="list-style-type: none"> Enclose the measurement area with an appropriate enclosure. Agitate the air between the measurement point and the workpiece more strongly with a fan. Do not operate this device near lighting fixtures. If the unit must be used in such a location, install a light shielding board or similar device so that the light will not affect the measurement. Wait approximately 30 minutes after the power is turned on before using the LJ-S8000 Series. Otherwise, the measured value may gradually fluctuate as the circuit is not immediately stable after the power is turned on. A change in the ambient temperature may cause the measurement to fluctuate. Be sure to keep the temperature stabilized. When the ambient temperature changed by 10°C, it takes 60 minutes for the distribution of internal temperature to equalize.

Measures to be taken when an abnormality occurs

	<p>In the following cases, turn the power off immediately. Using the unit in an abnormal condition may cause fire, electric shock, or product malfunction. Contact your local KEYENCE office for repair.</p> <ul style="list-style-type: none"> If liquid, including water or chemicals, or debris enters the unit. If the product is dropped or the case or cover glass is damaged. If smoke or a burning smell emits from the product.
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Operating environment and conditions (precautions on installation)

 WARNING	<p>To use the unit properly and safely, avoid installing this unit in the following locations. Failure to do so may cause fire, electric shock or malfunction.</p> <ul style="list-style-type: none">• Locations that contain moisture or dust, or that are poorly ventilated.• Locations where the unit is exposed to direct sunlight or temperature increases.• 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• Locations that are prone to static electricity
 NOTICE	<ul style="list-style-type: none">• Keep the machine and cables as far as possible from high voltage lines and power lines. Otherwise, noise may cause malfunction or accidents.• When connecting the cables, make sure to bundle the protective material, such as a spiral tube from outside. If they are bundled directly, the load applied to the cables may be concentrated on the connector, which may cause a disconnection or short.• The controller and optional devices are precision components. To maintain performance, do not subject them to vibration or shock. <p>In the following cases, foreign matter such as dust and debris or water and oil could cause differences in the measurement values.</p> <ul style="list-style-type: none">• Adhesion on the protective glass: Blow off the dirt on the cover glass with clean air. If dirt persists, wipe the glass surface gently using a soft cloth moistened with alcohol.• Adhesion on the target object: Blow off the dirt with clean air, or wipe the surface gently using a cloth.• Intrusion of floating or sprinkled dust or dirt into the light-axis range: In this case, take corrective action with a protective cover or air purge.

Maintenance

 NOTICE	<ul style="list-style-type: none">• Do not wipe the unit with a wet wipe, benzene, or thinner.• If the unit has any dirt on it, wipe it off with a cloth moistened with a mild detergent, and then wipe with a soft dry cloth.
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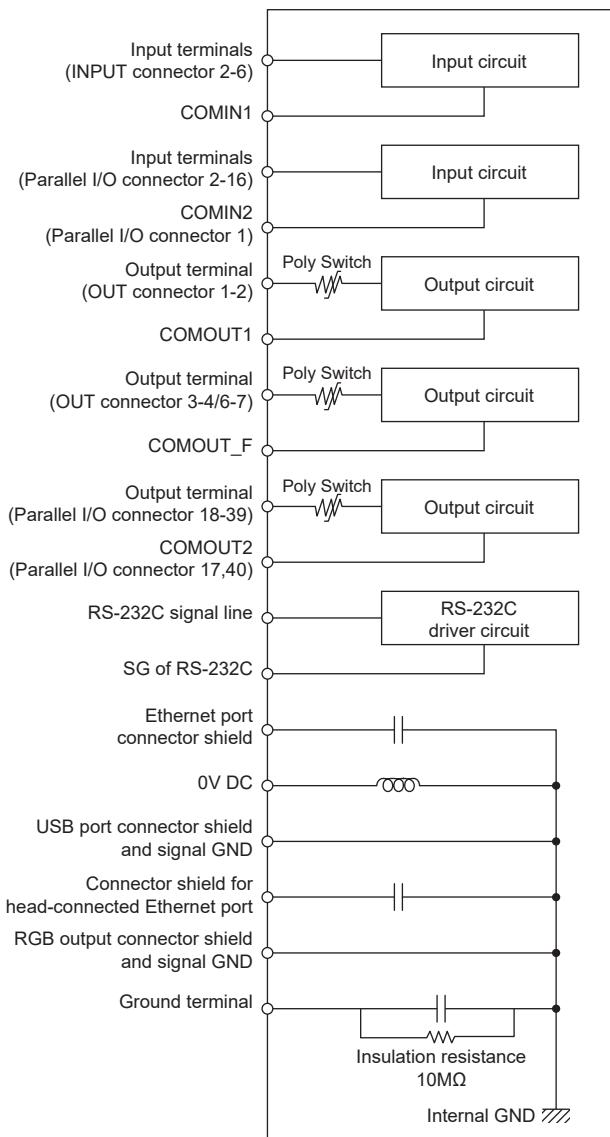
Caution on wiring



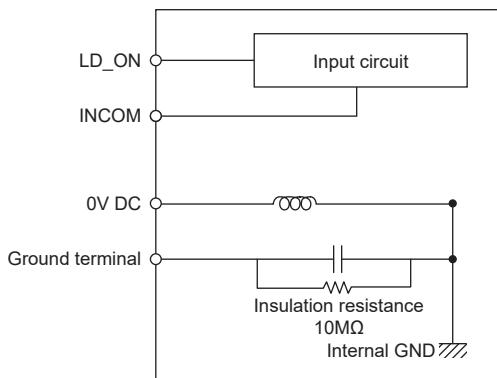
Some of the I/O circuits of the controller are common internal terminals. Exercise caution to avoid a potential difference between the common internal terminals due to the wiring or potential difference between the external devices. There is a risk of fire occurring.

Insulated condition between each I/O circuit

Controller



Head



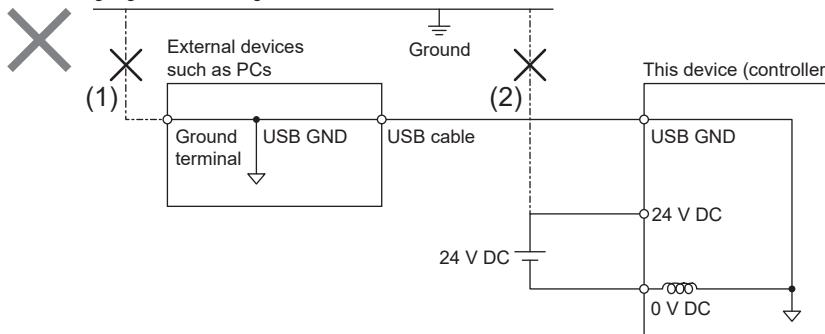
NOTICE

When you use the head connecting it to the LJ-S8000 Series controller, only the LASER_ON (LD_ON) terminal is effective.

0 V DC, connector shield and signal GND of the USB port and connector shield and signal GND of the RGB output are common through a choke coil. Exercise caution to prevent a potential difference in the external devices such as PC or PLC. If a potential difference occurs, use the power supply of the controller with insulation on the external device side.

Notes on the + grounding environment

When using the Simulation Software or the Terminal Software by connecting the controller to a PC via USB in a + grounding environment, exercise caution to prevent the USB terminal from becoming + grounded through an external device.



Use external devices as a PC (1) or the power supply of the controller (2) with insulation on the + ground terminal.

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 the European Union and in the United Kingdom.

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

- Applicable standard (BS) EN61326-1, Class A
- This product is designed for use in industrial environments.
- All of the cables used to connect the controller and external device should not exceed 30 m.
- Be sure to connect the ground terminal to a grounding.

Remarks:

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.

- Overvoltage category I
- Use this product under pollution degree 2.
- Use this product at the altitude of 2500 m or less.
- Indoor use only.
- Mount the head on a metallic plate.
- Use a power supply equipped with the protective function against overcurrent of 8 A or higher.

FCC Regulations

This product complies with the following regulations specified by the FCC.

- Applicable regulation FCC Part 15 Subpart B Class A
- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1)This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- FCC CAUTION
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Best Management Practice for Perchlorate Materials - California only

This product uses components containing perchlorate material. When you ship this product or your end-product installing this product to California, you must label or mark the following statement on the exterior of all outer shipping packages and on consumer packages or you must include the following statement in an instruction manual or MSDS accompanied with the product.

"Perchlorate Material – special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate/."

Safety Precautions on Laser Product

The laser class of the heads that will be connected to this unit are classified as follows:

Models	Wavelength	IEC60825-1, FDA(CDRH) Part1040.10 ^{*1}	
		Output	Laser class
LJ-S015			
LJ-S025			
LJ-S040			
LJ-S080			
LJ-S160			
LJ-S320			
LJ-S640			
	405nm	10mW	Class 2M

*1 The laser classification is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No. 56 of the FDA (CDRH).

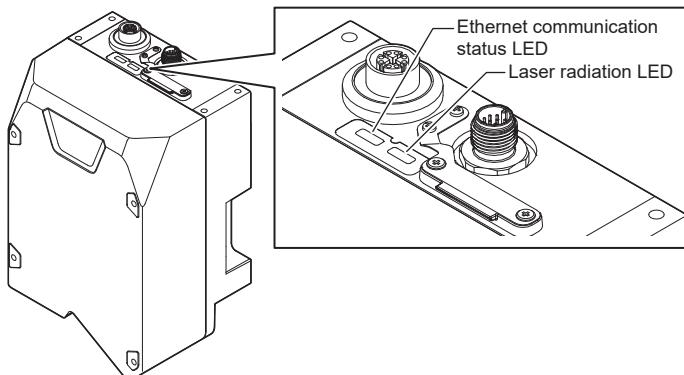
 WARNING	<ul style="list-style-type: none"> • Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Follow the instructions mentioned in this manual. Otherwise, injury to the human body (eyes and skin) may result. <p>Class 2M</p> <ul style="list-style-type: none"> • Do not stare into the direct or specularly reflected beam. • Do not direct the beam at other people or into areas where other people unconnected with the laser work might be present. • Be cautious of the path of the laser beam. If there is a possibility that the operator may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. • Install this product so that the path of the laser beam is not at the same height as that of human eye. • Do not direct the beam into an area where telescopic optical instruments (for example, telescopes and binoculars) are likely to be used. Viewing the laser output with telescopic optical instruments may pose an eye hazard. • Laser emission from this product is not automatically stopped when it is disassembled. Do not disassemble this product.

Safety equipment for LJ-S Series

This unit is equipped with the following laser safety features.

Ethernet communication status LED and laser radiation LED

Indicates the head EtherNet communication and laser radiation statuses with LEDs.



Warning labels

The position of the warning labels on the LJ-S Series head as well as the information written on them are displayed below.

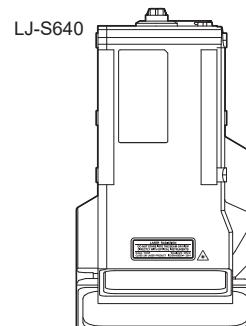
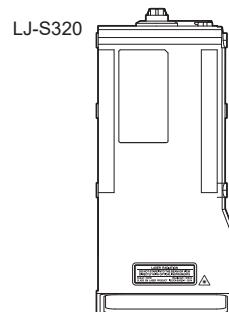
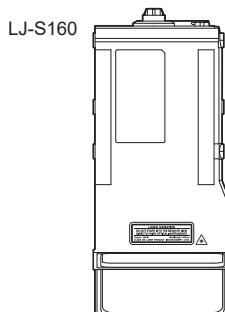
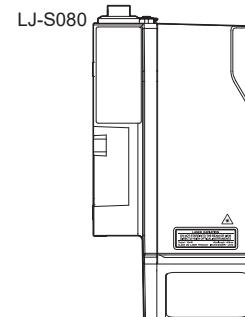
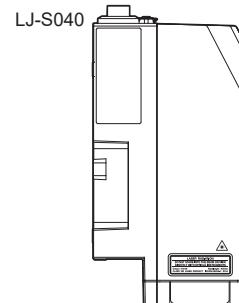
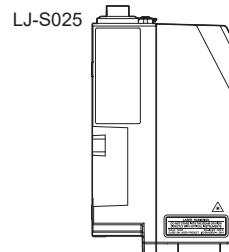
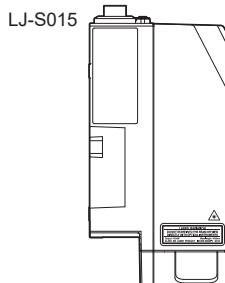
The IEC (English) warning labels are attached to the unit when shipped from the factory. Warning labels other than IEC (English) are included. Use the warning label that is suitable for the destination and affix it to the specified position

Information displayed on warning labels

- LJ-S015/LJ-S025/LJ-S040/LJ-S080/LJ-S160/LJ-S320/LJ-S640



Warning label attachment positions



Version update notes

Ver. 2.2.0000 (December 2024)

- Supports sensor heads LJ-S160/LJ-S320/LJ-S640
- Supports translucent peak processing (Page 4-8)
- SLOPE added to laser intensity control (Page 4-8)
- Supports Spanish (Mexico)

Ver. 2.1.0000 (September 2024)

- Supports Chinese (traditional), Korean, Thai, German, French, Italian, Czech, Hungarian, and Polish
- Supports X-direction skipping (Page 4-4)
- Supports PROFINET unit (CB-NPN20EA)

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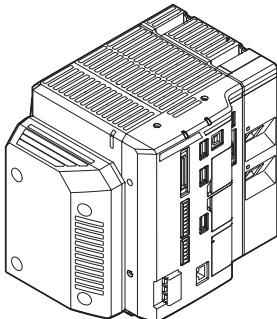
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Checking the Package

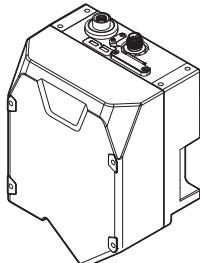
Standard Set

- LJ-S8002
- Controller



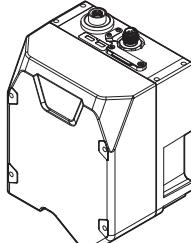
- LJ-S015

- Head



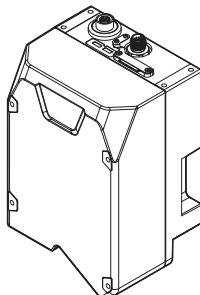
- LJ-S025

- Head



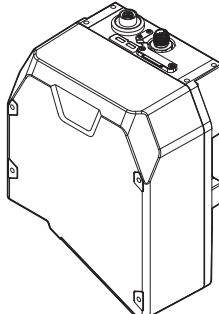
- LJ-S040

- Head



- LJ-S080

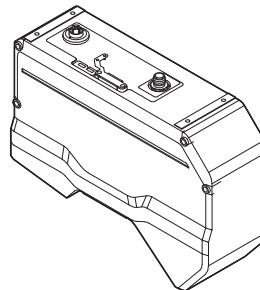
- Head



- SD card
(4 GB, mounted in the SD1 slot of this unit)
- Dedicated mouse
- Instruction Manual

- LJ-S160

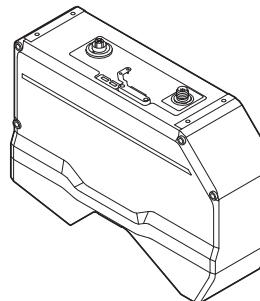
- Head



- Warning labels
- Screws (M5 × L20) 4 pieces
- Screws (M5 × L90) 4 pieces

- LJ-S320

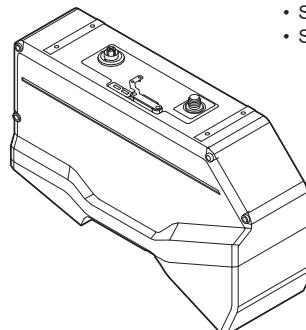
- Head



- Warning labels
- Screws (M5 × L20) 4 pieces
- Screws (M5 × L90) 4 pieces

- LJ-S640

- Head



- Warning labels
- Screws (M5 × L20) 4 pieces
- Screws (M5 × L90) 4 pieces

- Ethernet cable for the head

- OP-88835: 2 m
- OP-88836: 5 m
- OP-88837: 10 m

- Ethernet cable for the L-shape head

- OP-88825: 0.2 m

- Power I/O cable for the head

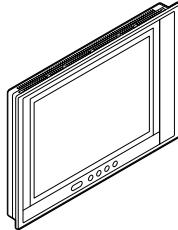
- OP-88949: 2 m
- OP-88950: 5 m
- OP-88951: 10 m

- Power I/O cable for the L-shape head

- OP-88826: 0.2 m

List of Options

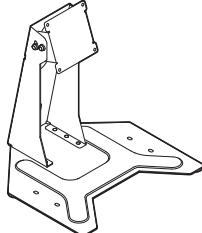
- LCD monitor (CA-MP120)



- Monitor cable
(OP-66842: 3 m cable, OP-87055: 10 m cable)



- Monitor stand (OP-87262)



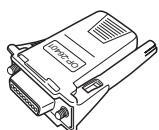
- RS-232C cable (2.5 m, straight)



- RS-232C conversion adapter



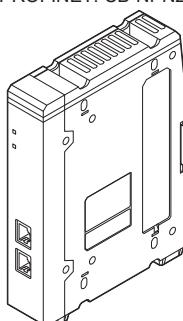
Please select according to the connected device.
↳ "Preparing the PLC" (Page 9-30)



- USB cable (OP-66844: 2 m)

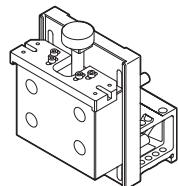


- Communication expansion unit
 - EtherCAT: CB-NEC20E
 - EtherNet/IP: CB-NEP20E
 - PROFINET: CB-NPN20EA

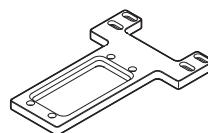


- Adjuster (OP-88956)

• Screws (M6 × L15) 4 pieces

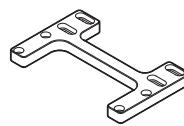


- Mounting Plate A (OP-88960)



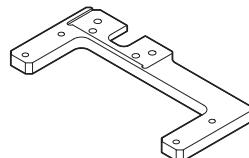
• Screws (M4 × L12) 4 pieces

- Mounting Plate B (OP-88961)



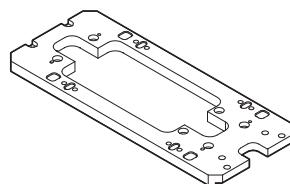
• Screws (M4 × L12) 4 pieces

- Mounting Plate C (OP-89041)



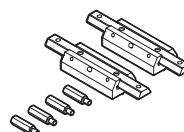
• Screws (M6 × L15) 4 pieces

- Mounting Plate D (OP-89042)



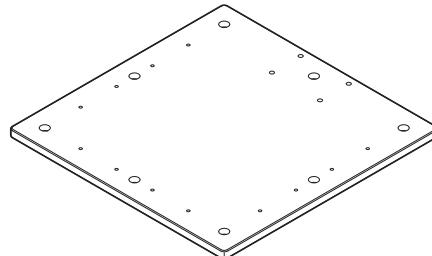
• Screws (M5 × L12) 4 pieces
• Screws (M6 × L15) 4 pieces

- Mounting rail set OP-89040

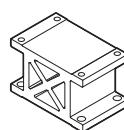


• Screws (M4 × L8) 4 pieces
• Screws (M5 × L12) 4 pieces

- Base plate (OP-88957)

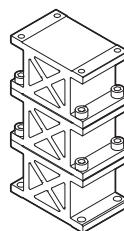


- Block: 1 piece (OP-88958)



• Screws (M6 × L15) 4 pieces

- Block: 3 pieces (OP-88959)

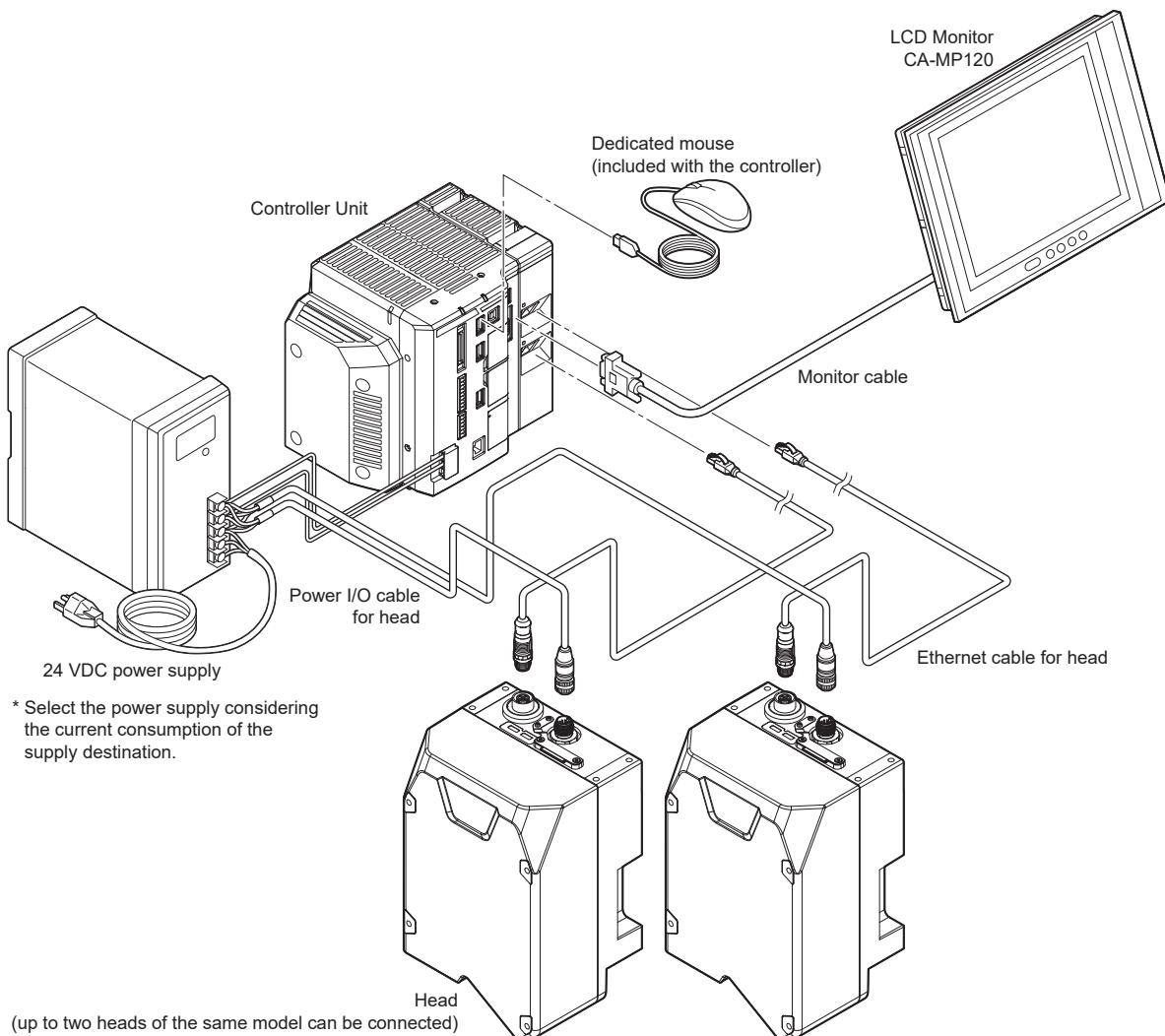


• Screws (M6 × L15) 4 pieces

For details of the dedicated stand and OP jig, see below.
www.keyence.com/LJS8000ops

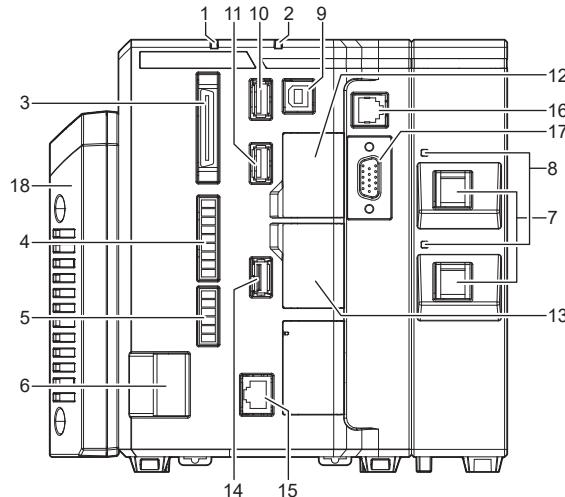


System Configuration



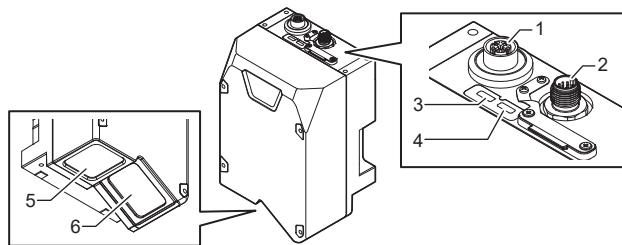
Part Names and Functions

Controller (LJ-S8002)



No	Name	Function																		
1	POWER LED	Lights up in green when power is correctly supplied to the unit.																		
2	ERROR LED	Indicates the controller status. (Light off: In normal operation state; Light on (red): Error)																		
3	Parallel I/O connector	The parallel I/O Interface connection (40-pin) used in signal input/output.																		
4	Output terminal	Terminal for external output (9-pin).																		
5	Input terminals	Terminal for external output (6-pin).																		
6	Power and ground terminals	Used to connect power (24 VDC) and the ground wire to the system.																		
7	Head A port (upper port) Head B port (lower port)	The port used to connect the Ethernet cable for the head to the controller. NOTICE Use the head A connector if you use only one head.																		
8	Head indicator LED	Lights up according to the communication status of the head. <table border="1"> <thead> <tr> <th>Light state</th><th colspan="2">Communication state</th></tr> </thead> <tbody> <tr> <td>Off</td><td>No Link</td><td>Ethernet is not connected.</td></tr> <tr> <td>Lit (green)</td><td>Link (1,000 Mbps)</td><td>Ethernet is connected (1,000 Mbps)</td></tr> <tr> <td>Flashing (green)</td><td>Activity (1,000 Mbps)</td><td>Ethernet data is being transmitted (1,000 Mbps)</td></tr> <tr> <td>Lit (red)</td><td>Link (10/100 Mbps)</td><td>Ethernet is connected (10/100 Mbps)</td></tr> <tr> <td>Flashing (red)</td><td>Activity (10/100 Mbps)</td><td>Ethernet data is being transmitted (10/100 Mbps)</td></tr> </tbody> </table>	Light state	Communication state		Off	No Link	Ethernet is not connected.	Lit (green)	Link (1,000 Mbps)	Ethernet is connected (1,000 Mbps)	Flashing (green)	Activity (1,000 Mbps)	Ethernet data is being transmitted (1,000 Mbps)	Lit (red)	Link (10/100 Mbps)	Ethernet is connected (10/100 Mbps)	Flashing (red)	Activity (10/100 Mbps)	Ethernet data is being transmitted (10/100 Mbps)
Light state	Communication state																			
Off	No Link	Ethernet is not connected.																		
Lit (green)	Link (1,000 Mbps)	Ethernet is connected (1,000 Mbps)																		
Flashing (green)	Activity (1,000 Mbps)	Ethernet data is being transmitted (1,000 Mbps)																		
Lit (red)	Link (10/100 Mbps)	Ethernet is connected (10/100 Mbps)																		
Flashing (red)	Activity (10/100 Mbps)	Ethernet data is being transmitted (10/100 Mbps)																		
9	USB connector	The port used to connect the USB cable.																		
10	USB port for mouse	The port used to connect the included dedicated mouse. NOTICE Do not connect anything other than the dedicated mouse into the USB port for mouse. When other devices including a commercial USB mouse are connected, it may result in a breakdown or malfunction of the controller and/or connection device.																		
11	USB port for mouse (Backup)	Backup port to connect the USB mouse.																		
12	SD 2 slot	Insert (options) SD card (for storing inspection settings and measurement data).																		
13	SD 1 slot	Insert SD card (for storing inspection settings and global settings). The supplied SD memory card (CA-SD4G : 4GB) is inserted as SD card 1.																		
14	USB HDD port	Connect USB 3.0 or USB 2.0 compatible hard discs. NOTICE The unit's power GND (0 V) is shared in common with the connector shield and signal GND. If there is a potential difference with the connection for the USB HDD, this may result in breakdowns or malfunctions of the unit and the USB HDD. Reference If there are concerns about the potential difference with the connections, use a USB HDD which supports bus-powered drives. The power feeding capability of the bus power of the unit is 900 mA (USB3.0-compliant). Contact the manufacturer of the USB HDD to check whether the USB HDD works on bus power. Do not use a USB hub as it may lead to insufficient power supply and/or lower data transfer rate.																		
15	Ethernet port	The port to connect the Ethernet cable.																		
16	RS-232C port	The port to connect RS-232C cable (OP-26487: 2.5 m, sold separately).																		
17	RGB output terminal	The port to connect the external monitor.																		
18	Heat radiation fan	An intake fan for controller cooling is installed.																		

Head



No	Name	Function		
1	Ethernet cable connector for head	The port to connect the Ethernet cable for head.		
2	Power I/O cable connector for head	The port to connect the power I/O cable for head.		
3	Ethernet communication status LED	Lights up or flashes according to the communication status of the device.		
		LED status	Ethernet communication status	Details
		Lit (green)	1000Mbps Link - No Activity	The device is connected at 1,000 Mbps, but no data is being transmitted
		Flashing (green)	1000Mbps Link - Activity	Data is being transmitted at 1,000 Mbps.
		Lit (red)	100/10Mbps Link - No Activity	The device is connected at 100 Mbps or 10Mbps, but no data is being transmitted
		Flashing (red)	100/10Mbps Link - Activity	Data is being transmitted at 100 Mbps or 10 Mbps.
		Off	No Link	A connection is not established.
4	Laser radiation LED	Lights or flashes while the device is in operation.		
		LED status	Head status	Details
		Lit (orange)	Starting	Lights up for a period of time before the trigger or command can be accepted.
		Lit (green)	Operating normally	Lights when the device is operating normally.
		Lit (red)	Error	Lights up when normal startup is not possible or when a system error occurs during startup.
5	Transmitter	Emits the laser beam for measurement. This part is protected with a glass cover.		
6	Light receiver	Receives the laser beam for measurement. This part is protected with a glass cover.		

Communication Expansion Unit (CB-NEC20E/CB-NEP20E/CB-NPN20EA)

EtherCAT Unit (CB-NEC20E: option)

No	Name	Function
1	Connector on controller side	Install the communication expansion unit on the right side of the controller. Point Only one EtherCAT unit can be connected to the controller.
2	RUN indicator lamp (RUN)	Indicates the EtherCAT communication state (green). • ON: OPERATIONAL state. The PDO communication and mailbox communication are properly running. • Flashing (single flash) ¹ : SAFE-OPERATIONAL state. • Flashing (blinking) ² : PRE-OPERATIONAL state. • OFF: INIT state. *1: Repeats 0.2 seconds ON → 1 second OFF. *2: Repeats 0.2 seconds ON → 0.2 seconds OFF.
3	ERR indicator lamp (ERR)	Indicates the error state of the EtherCAT communication (red). • Flashing (double flash) ¹ : Watchdog timeout. • Make sure that the master is properly connected. • Make sure that the master is running normally. • Flashing (blinking) ² : Configuration error. Make sure that no irregular process data object is assigned to the Sync Manager. • OFF: No error has occurred. *1: Repeats 0.2 seconds ON → 0.2 seconds OFF → 0.2 seconds ON → 1 second OFF. *2: Repeats 0.2 seconds ON → 0.2 seconds OFF. Reference When [External Input Request] is not assigned to the process data object, the LED lighting state does not change even when the connection with the master is disconnected.
4	IN port	Connect a LAN cable.
5	OUT port	Connect a LAN cable.

EtherNet/IP Unit (CB-NEP20E: option)

No	Name	Function
1	Connector on controller side	Install the communication expansion unit on the right side of the controller. Point Only one EtherNet/IP unit can be connected to the controller.
2	Network Status LED (NS)	Indicates the EtherNet/IP communication status. <ul style="list-style-type: none">• Not lit: The power is turned off or the IP address has not been set.• Lit in green: A connection has been established.• Blinks in green: No connection has been established.• Lit in red: A fatal error (such as duplicate IP addresses) has occurred.• Blinks in red: A time-out occurred during connection.
3	Module Status LED (MS)	Indicates the status of the communication expansion unit. <ul style="list-style-type: none">• Not lit: The power is turned off.• Lit in green: The scanner is in the Run state and is being controlled.• Blinks in green: The device has not been set or the scanner is in the Idle state.• Lit in red: A serious malfunction (such as the EXCEPTION state and fatal errors) has occurred.• Blinks in red: This is a recoverable malfunction. The module has been set but the saved parameters are different from the parameters that are being used.
4	P1 port	Connect a LAN cable.
5	P2 port	Connect a LAN cable.

PROFINET Unit (CB-NPN20EA: optional)

No	Name	Function
1	Connector on controller side	Install the communication expansion unit on the right side of the controller. Point Only one PROFINET unit can be connected to the controller.
2	Network Status LED (NS)	Indicates the PROFINET communication status. <ul style="list-style-type: none">• Not lit: The power is turned off. A connection between I/O and the controller has not been established.• Lit in green: A connection between I/O and the controller has been established and the unit is in the RUN state.• Blinks in green one time: A connection between I/O and the controller has been established, but the unit is in the STOP state or IO data is not normal.• Blinks in green: Identification of network nodes is being performed from the engineering tool.• Lit in red: A serious internal error has occurred. (Use this in combination with the Module Status LED lighting in red.)• Blinks in red one time: The Station Name has not been set.• Blinks in red two times: The IP address has not been set.• Blinks in red three times: The settings specified from the I/O controller differ from the actual settings.
3	Module Status LED (MS)	Indicates the status of the communication expansion unit. <ul style="list-style-type: none">• Not lit: The power is turned off or the communication expansion unit has not been initialized.• Lit in green: The initialization of the communication expansion unit is complete.• Blinks in green one time: A diagnosis event exists.• Lit in red: (When the Network Status LED is lit in red) A serious internal error has occurred. (When the Network Status LED is not lit in red) The communication expansion unit is in the EXCEPTION state.• Lights in red and green alternately: The firmware is being updated. Do not turn the power off. Turning off the power during this phase may lead to malfunctions.
4	P1 port	Connect a LAN cable.
5	P2 port	Connect a LAN cable.

Chapter 2 Installation and Connection

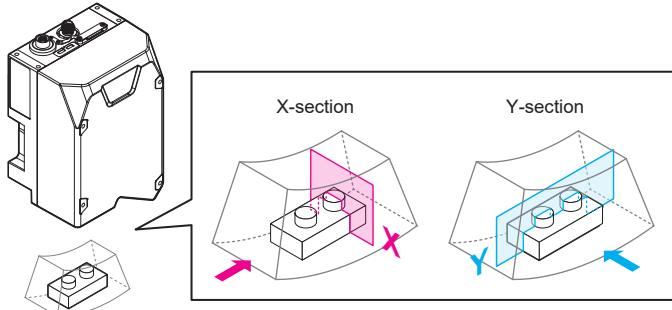
Mounting the Head	2-2
Installing the Controller Unit	2-4
Inserting and Removing an SD Card	2-7
Connecting and Removing the USB HDD	2-8

Mounting the Head

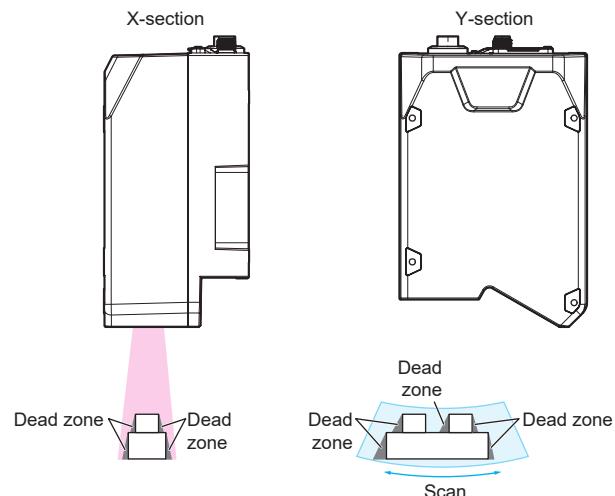
Be sure to read the installation cautions carefully and install the head correctly.

Installation cautions

The sensor head uses a fan-shaped laser beam and optical light receiver system, and the optical light system can scan rotationally to capture images. Dead zones are created if the laser beam irradiating the target object and the laser beam reflected from the target object is blocked from entering the receiver. Make sure that the dead zone does not affect the measurement result.



● X-section/Y-section dead zones



Mounting the Head

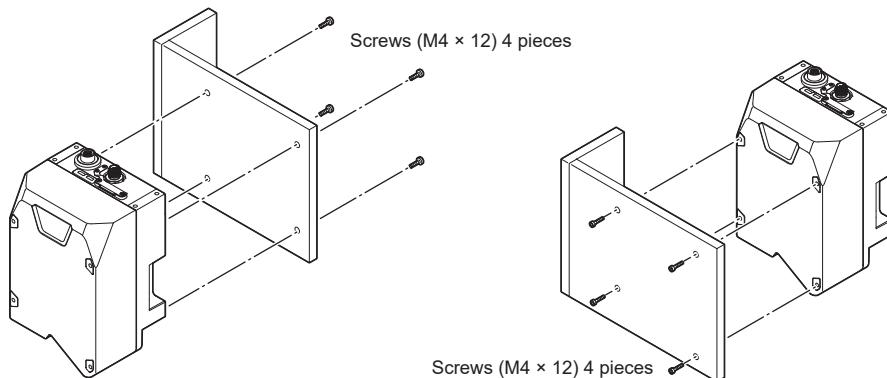
Align the head and the target object distance in reference to the LJ-S Series head measurement range and secure it to the metal plate via the screws provided with the head.

For details of the dedicated stand and OP jig, see below.
www.keyence.com/LJS8000ops



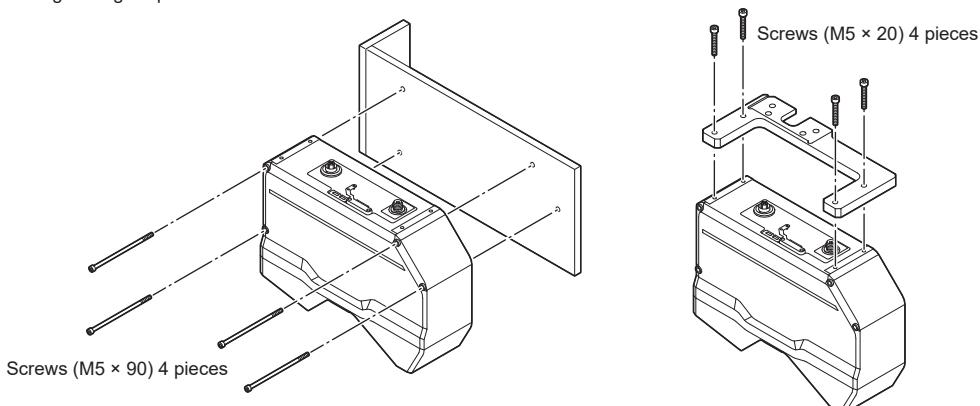
● LJ-S015, LJ-S025, LJ-S040, LJ-S080

Tightening torque: 0.8 to 1.2 Nm



● LJ-S160, LJ-S320, LJ-S640

Tightening torque: 1.5 to 2.0 Nm



Connecting the Head to the Cable

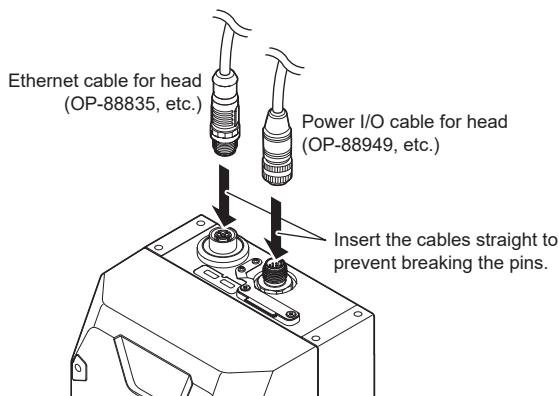
NOTICE

- The round connector of the cable must be inserted all the way into the receptor with their cutouts aligned, and the fixing ring then must be fully tightened. A faulty connection may cause failure or malfunctions of the head.
- Insert the connector so that it does not tilt, tighten it with your hand, and then firmly tighten it with a tool such as pliers.
- If the tightening is weak, the connector may be loosened by vibration etc., leading to contact failure or head connection error.

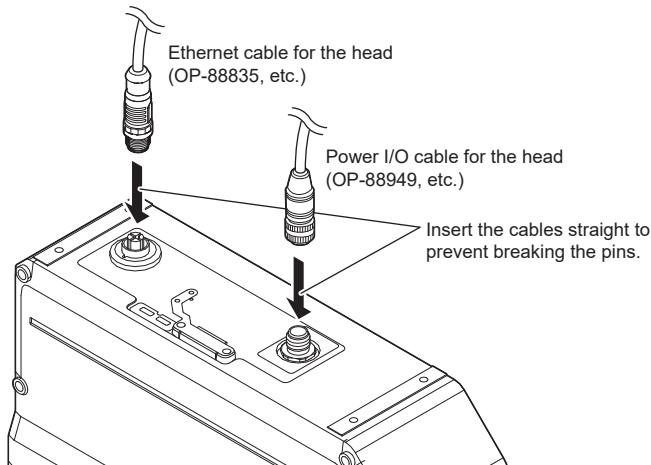
1 Adjust the orientation of the connector, then push it all the way in while slowly turning.

- Tightening torque: 1.2 to 1.5 Nm

● LJ-S015, LJ-S025, LJ-S040, LJ-S080



● LJ-S160, LJ-S320, LJ-S640



2 Connect the Ethernet cable for head to the controller and the power I/O cable for head to the power supply.

Installing the Controller Unit

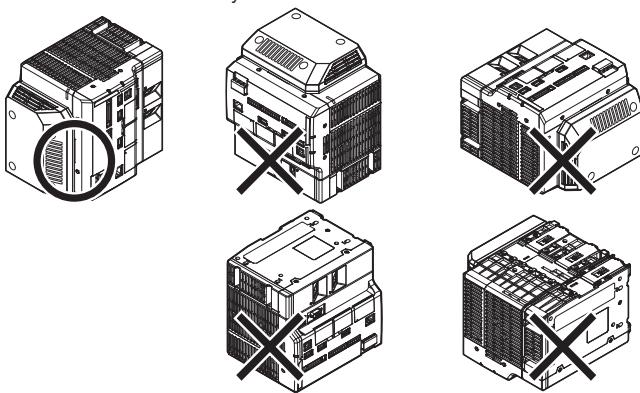
Install the controller to the DIN rail, or use the holes on the bottom of the controller to secure it with screws.

NOTICE

- Do not install the controller in a location with lots of dust or water vapor. The controller does not have a mechanism to protect it from dust or water. Dust or water entering the controller can cause damage to the controller.
- Turn off the controller when connecting or disconnecting an expansion unit, cable or terminal block. Connecting or disconnecting an expansion unit, cable, or terminal block while connected to a power source may damage the controller or peripheral devices.

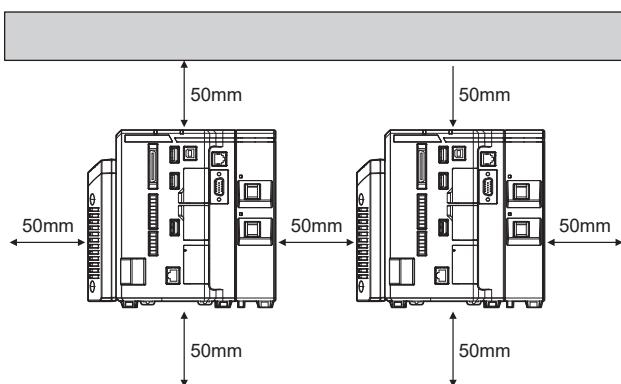
Caution on direction of controller mounting

The controller should be installed in the direction of the circled figure below. Do not install the controller in any other direction.



Precautions in regard to cooling the unit in the installation site

- For proper ventilation, allow a space of 50 mm or more on top of the controller and a space of 50 mm or more on both sides. Keep the space free of objects for 90 mm or more in the front of the connector panel in order to connect the cables safely.
- If you mount two or more controllers side by side, allow a space of 50 mm or more between the controllers and a space of 50 mm or more on top of the controllers.



*If a space of 50 mm or more is secured in the bottom direction by mounting a DIN rail, etc., it can be used at a higher ambient temperature.

NOTICE

- Do not block the air vents (top and bottom) on the controller body. Doing so may cause heat to build up inside the unit, resulting in malfunction.
- If the temperature in the control panel (temperature at the upper front of the controller) exceeds the rating of the operating ambient temperature, secure ventilation by forced air cooling or widening the distance from the ambient, and lower the operating ambient temperature below the rating.
- When mounting on the bottom, secure ventilation from the bottom to the top, for example, by providing a through hole at the vent position on the bottom of the controller unit.

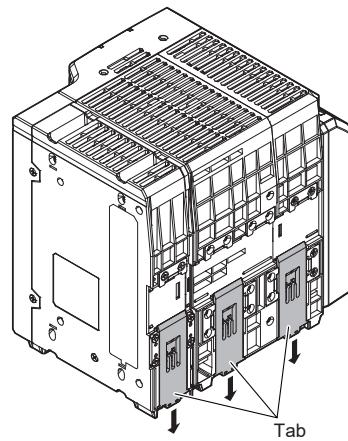
Installing the controller

NOTICE

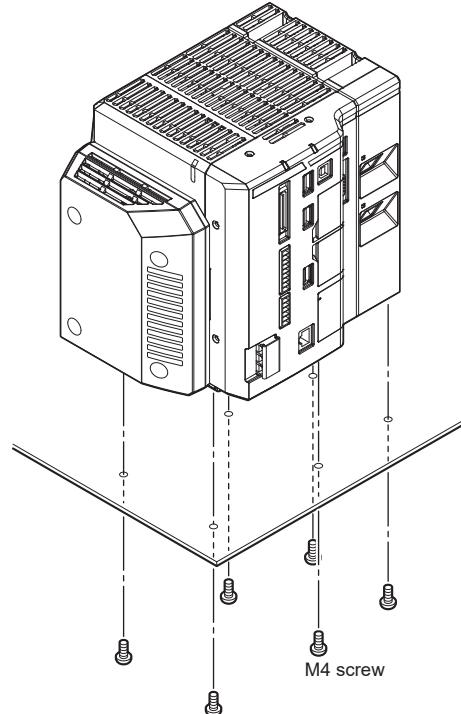
- Mount the controller in a stable location that is free from vibration.

Mounting the controller to the DIN rail

The controller is designed to be mounted on a DIN rail. Pull the tab on the bottom in the direction of the arrow to mount or dismount the controller.



Mounting using the bottom panel



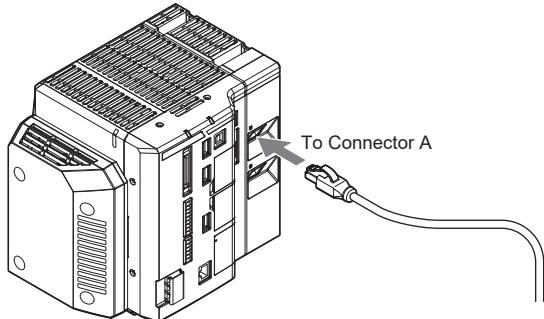
Connecting the Controller to the Head

NOTICE**Notes when connecting cables**

- Make sure that there is no power to the controller before connecting the cables. Connecting a cable or terminal block while power is supplied may cause damage to the head or peripheral devices.
- The LASER_ON terminal is shorted when the power I/O cable for the head is shipped. If the laser ON terminal of the head is open, the laser will not turn on.
- Bundle the cables with protective material like a spiral tube. Direct bundling will concentrate the load on the bindings of the cable, which can result in cable damage or short circuit.
- In the absence of other specifications, the minimum cable bend radius (R) should be 4 times the external diameter (6 times is recommended). Additionally, repeated flexing and twisting should be avoided.

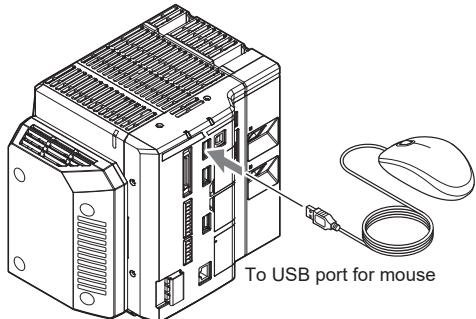
1 Connect the LJ-S Series head(s) to the head ports on the controller.

Connect to connector A if only one head is used.

**NOTICE**

Do not connect any device other than LJ-S Series head as it may cause a failure.

2 Connect the dedicated mouse to the USB port for the dedicated mouse on the controller unit.



3 Connect the monitor to the RGB output terminal on the controller unit.

NOTICE

The unit's power GND (0 V) is shared in common with the connector shield and signal GND. If there is a potential difference with the connection for the external monitor, this may result in breakdowns or malfunctions of the unit and the connected external monitor. (Recommended monitor: CA-MP120)



The monitor output of this unit is XGA (1024 x 768 pixels). If a commercial RGB analog monitor other than an XGA monitor is used, the display quality may worsen depending on the monitor's specifications. The resulting images may not be displayed properly.

Installing the Communication Expansion Unit

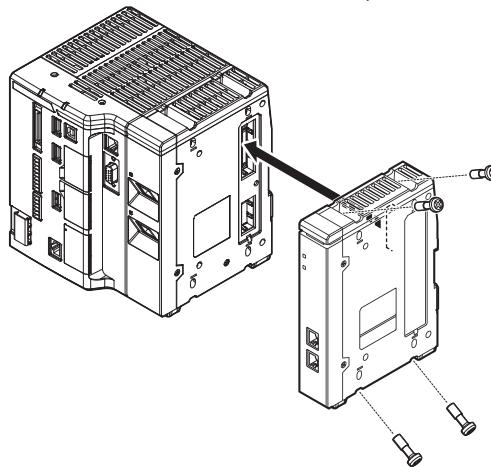
NOTICE

- Turn off the controller when connecting or disconnecting an expansion unit. Connecting or disconnecting an expansion unit while connected to a power source may damage the controller or peripheral devices.
- When an expansion unit is not connected, keep the connector protection cover attached. Using the controller with the connector exposed may cause damage to the controller.

Installing the Communication Expansion Unit

When using communication via a communication expansion unit, use an optional communication expansion unit (EtherCAT: CB-NEC20E, EtherNet/IP: CB-NEP20E, PROFINET: CB-NPN20EA).

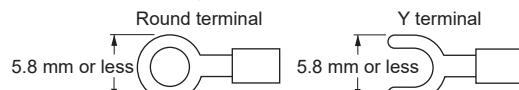
Remove the protective cover from the expansion unit connector on the right side of the controller and install the communication expansion unit.



Connecting the power source to the controller

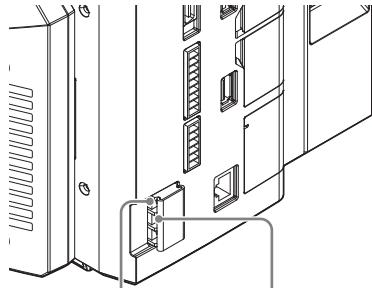
NOTICE

- Use electrical wiring AWG14 to AWG22.



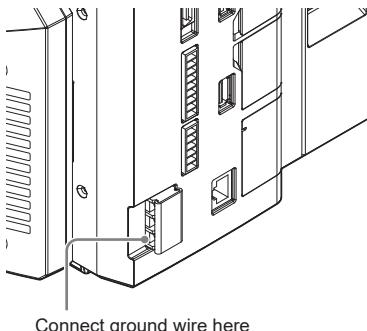
- Make sure to connect the frame ground terminal for the 24 VDC power source to a type D ground.
- Tighten the screws with a torque of 0.5 to 0.75 [Nm].

1 Connect 24 VDC and 0 V to the power terminals.



Connecting to 24V DC Connecting to 0V DC

2 Connect the ground wire to the grounding terminal.



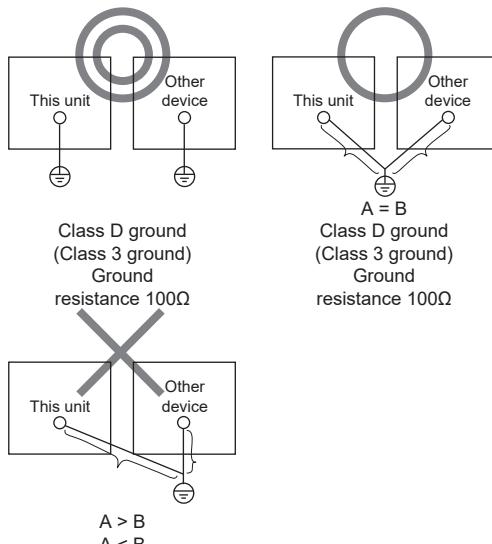
Connect ground wire here

Point

The head and controller are connected by supplying power to the head at the same time as the controller or by supplying power to the controller after supplying power to the head.

NOTICE

- Ground each device separately.
- Use a Class D ground.
- Keep ground resistance to 100Ω or less.
- Keep the ground wire as short as possible.
- If it is not possible to ground each device separately, ground them together. However, make sure that the electrical cables are the same length.



How to use the terminal block

This section explains how to use the terminal block.

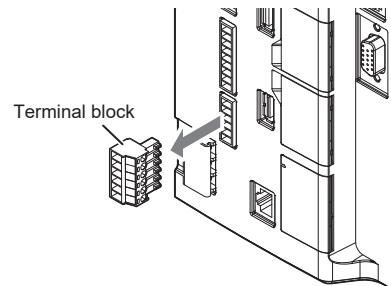
CAUTION

Use a wire with 80°C or higher temperature rating.

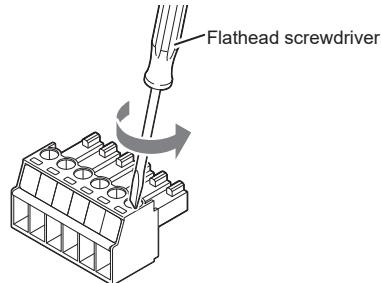
Point

- Use a flat head screwdriver to connect the power supply to the input terminals.
- Use a torque of 0.25 N·m or less to tighten the screws.
- Use electrical wiring AWG16 to AWG28.
- Do not solder (pre-solder) the processed end of the wire.
- The wire should be inserted all the way into the terminal block.
- Attach the wire to the terminal block directly, without using a solderless terminal, etc.

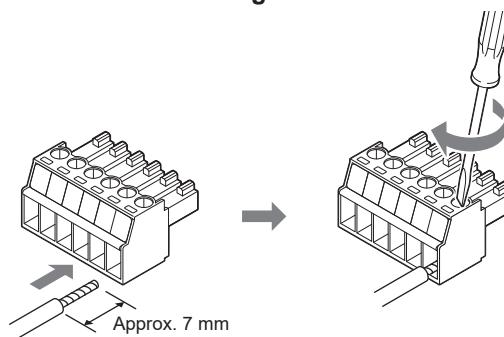
1 Remove the connector terminal block from the controller.



2 Loosen the screw of the connector terminal block using a flat head screwdriver.

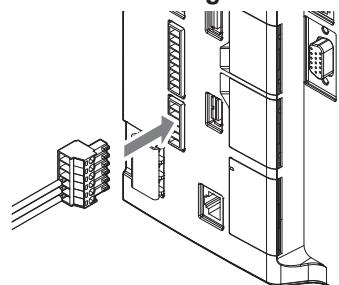


3 After stripping the insulating sheath 7 mm, insert the wires and then tighten the screws.

**Point**

Pull the wire gently to check that it has been secured properly.

4 After connecting all the necessary wires, securely insert the connector terminal block into the I/O connector as far as it will go.



Inserting and Removing an SD Card

Users can save the program settings or captured image data on an SD card.

NOTICE

- Since the SD memory card uses flash memory as a storage element, repeated reading and writing may reach the end of life and the stored data may be lost. Back up the saved data on the SD card to another storage media on a periodic basis.
- SD card 1 contains the unit's environment settings and other data necessary for the unit to operate. Make sure it is inserted at startup and when powering up.
- Data that must be loaded by swapping SD cards should be stored on SD card 2.

Supported SD card models

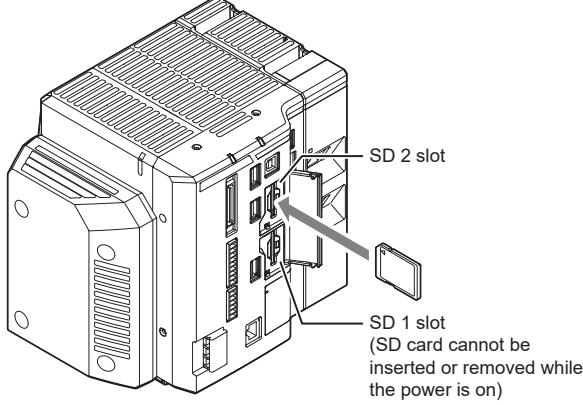
Our OP-87133 (512 MB, sold separately), CA-SD1G (1 GB, sold separately), CA-SD4G (4 GB, sold separately) and CA-SD16G (16 GB, sold separately) are supported on the controller. Note, the controller ships with CA-SD4G inserted in the SD1 slot.

NOTICE

- Do not use with SD card models other than shown above. Doing so may result in data loss or setting data damage.
- For details about file management and formatting in an SD card, refer to □ "Manage Files" (Page 7-32).

Inserting an SD card

Insert an SD card into the SD1 and SD2 slot of the unit so that the triangle inscription is on the top of the card.


NOTICE

- Be sure the card is oriented correctly when inserting it. Inserting the card in the wrong direction may damage the data and SD card.
- The access drive light lights up while there is an SD card in the drive.
 - Green: An SD card is inserted and accessible.
 - Red: The SD card is being accessed.
 - Not lit: The SD card is not accessible (the SD card can be removed from the slot).
- When inserting the SD card into the SD1 slot, first turn off the controller. Make sure the SD card 1 is loaded at startup and when powering up.

Removing an SD card

Choose the [Remove SD Card 2] operation, and then press the SD card in the SD2 slot inward to release and remove the card.

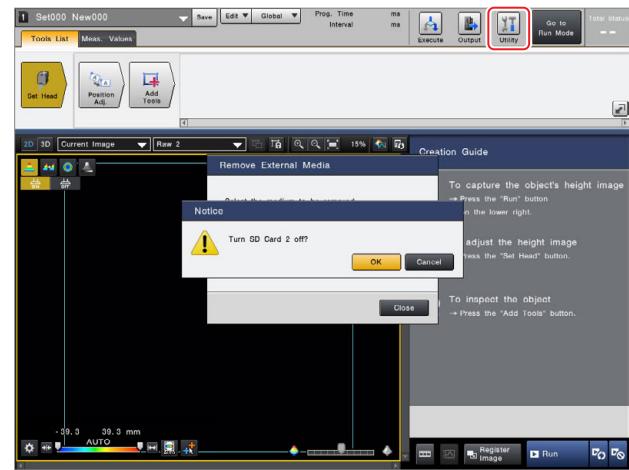
NOTICE

- Take the following steps to protect the SD card and the data it contains.
- If you remove the SD card using a procedure other than that specified, or if power is turned off when the card is being accessed, any writing task will stop resulting in a possible loss of data or damage to the SD card.
- SD card 1 should not be removed while the controller is turned on. When removing it, make sure to turn off the unit first.

1 Select [Remove External Media] > [SD Card 2] from utilities.

A confirmation message appears.

2 Click [OK].



The LED indicator turns off, indicating that SD card 2 can now be removed.

3 Remove the SD card from the unit's SD2 slot.

Connecting and Removing the USB HDD

The USB HDD can be used to save the inspection results, captured image data, etc.

- NOTICE**
- The unit's power GND (0 V) is shared in common with the connector shield and signal GND. If there is a potential difference with the connection for the USB HDD, this may result in breakdowns or malfunctions of the unit and the USB HDD.
 - The data stored on the USB HDD may be lost due to end of service life or failure. Back up the saved data on the USB HDD to another storage media on a periodic basis.

Reference If a potential difference is expected to occur with the connection destination, make sure to use a USB HDD that supports bus power.

The power feeding capability of the bus power of the unit is 900 mA (USB3.0-compliant). Contact the manufacturer of the USB HDD to check whether the USB HDD works on bus power.

Do not use a USB hub as it may lead to insufficient power supply and/or lower data transfer rate.

Supported USB HDD

A USB2.0 or USB3.0 external HDD can be connected to the USB HDD connector of the unit.

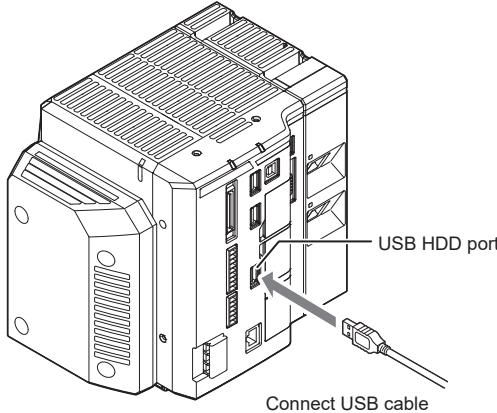
However, this does not mean all external HDD products compliant with this standard are guaranteed to function correctly with this unit.

NOTICE The maximum disk capacity that can be recognized on this unit is 2 TB. If multiple partitions exist on the USB HDD, only the partition detected first by the unit will be recognized as a disk.

Point The power-saving function featured on some USB HDD products may cause slower data writing speed from the unit. It is recommended to disable any function that is equivalent to the power saving function.

Connecting USB HDD

Connect the USB cable corresponding to the USB HDD to be connected to the USB HDD connector (blue terminal) of the unit.



NOTICE Use a USB cable that supports the connected USB HDD. Correct operation of the controller and/or the USB HDD cannot be guaranteed when another type of cable is used. Contact the manufacturer of the USB HDD for the supported USB cables.

Important Be sure to format the connected USB HDD with this unit before using it.

↳ "Checking and formatting SD cards and USB HDD (Memory Utility)" (Page 7-34)

The controller may not be able to correctly recognize the USB HDD in its factory default configuration and/or formatted using a PC.

Point In this unit, the USB HDD can only be connected to the USB HDD connector with the blue terminal. The USB HDD cannot be connected to the MOUSE (USB) connector with a black terminal or any other USB connectors.

Removing USB HDD

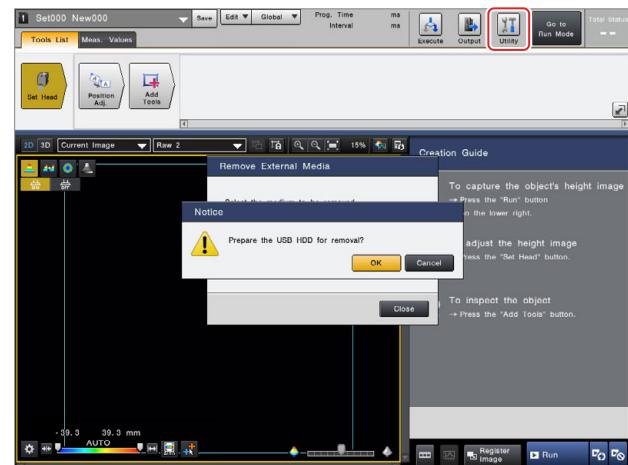
Remove the USB cable and the USB HDD after executing [Remove USB HDD].

- NOTICE**
- Be sure to follow the procedure to protect the USB HDD and the data it contains.
 - If you remove the USB HDD using a procedure other than that specified, or if the power is turned off while the USB HDD is being accessed, the file saving operation will stop resulting in a possible loss of data or damage to the USB HDD.

1 Select [Remove External Media] > [USB HDD] from utilities.

A confirmation message appears.

2 Click [OK].



3 When the confirmation screen appears to notify that it is ready for removal, select [Close] to close the confirmation screen.

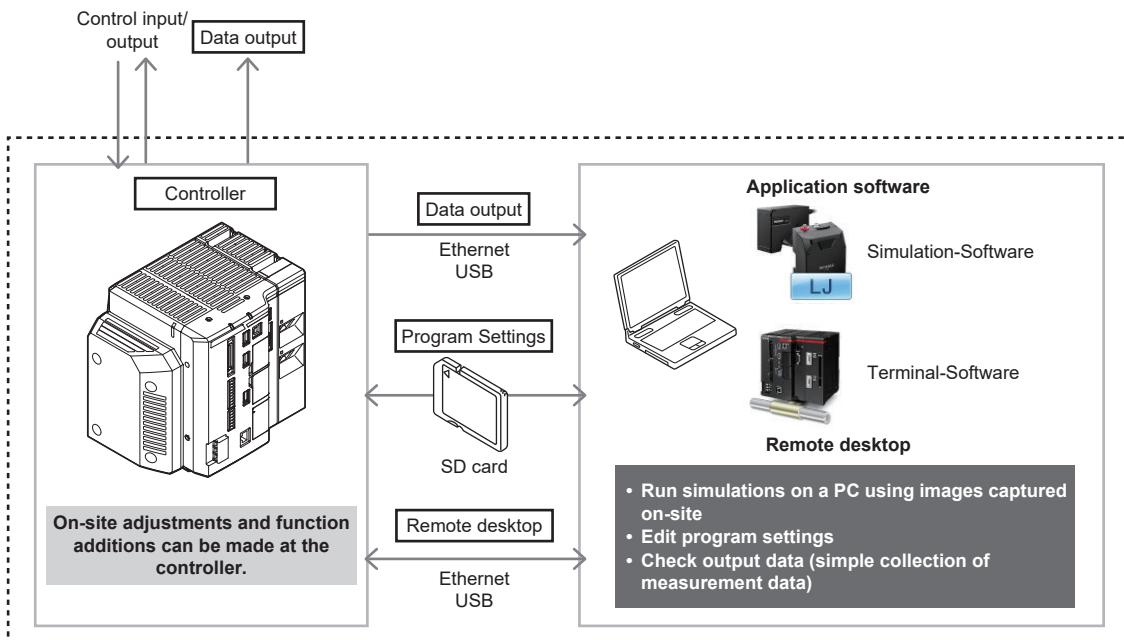
The USB HDD can be removed.

Chapter 3 Basic Operations and Settings

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Device Overview

This series consists of a controller that performs processing according to settings and software (LJ-H1X) that performs simulation on a PC and receives output data.



● LJ-S Series controller (this product)

An execution environment that performs processing according to settings for the acquired height image and shading (contrast) image.

The system programming and measurement execution can be completed using the mouse.

● LJ Series Simulation-Software

This is simulation software especially created for the LJ Series.

The settings can be adjusted by simulating the measurement by loading the inspection settings created with the LJ-S Series and the images (height image and shading (contrast image) taken. It also supports the downloading and uploading of programs using a network connection.

● LJ Series Terminal-Software

This is communication software especially created for the LJ Series.

The measurement result output from the controller can be received and saved in txt format. The image output can also be received. Remote monitoring and remote control of the controller through the remote desktop can also be performed.

Device Operation Flow

The flow of inspection/measurement using this machine is as shown below.

Prepare for measurement

Connect the head, monitor, etc. to the controller.

□ "Chapter 2 Installation and Connection" (Page 2-1)

Set up imaging settings for the measurement conditions

Adjust the capture conditions as necessary.

□ "Capture Settings" (Page 4-6)

Register the standard image

Register the standard image to be used as reference for configuring settings.

□ "Register image for measurement (standard image registration)" (Page 3-15)

Set up the tools

Set the tools as appropriate for the inspection purpose.

□ "Measurement Tools" (Page 5-15)

Configure the following as necessary:

- "Position Adjustment Settings" (Page 5-96)
- "Calculation" (Page 5-95)
- "Overview of Output Settings" (Page 6-4)
- "Execute Condition" (Page 6-2)

The setting values which can also be put in the custom menu.

□ "Custom Menu" (Page 3-37)

Register the Operation Screen (Chapter 7)

Configure the Run Mode screen display as needed.

□ "Operation Screen Setting" (Page 7-21)

Set up the operating environment (Chapter 8)

Configure overall operation of this machine common to all inspection settings, such as communication control settings and account settings.

□ "Chapter 8 Global Settings" (Page 8-1)

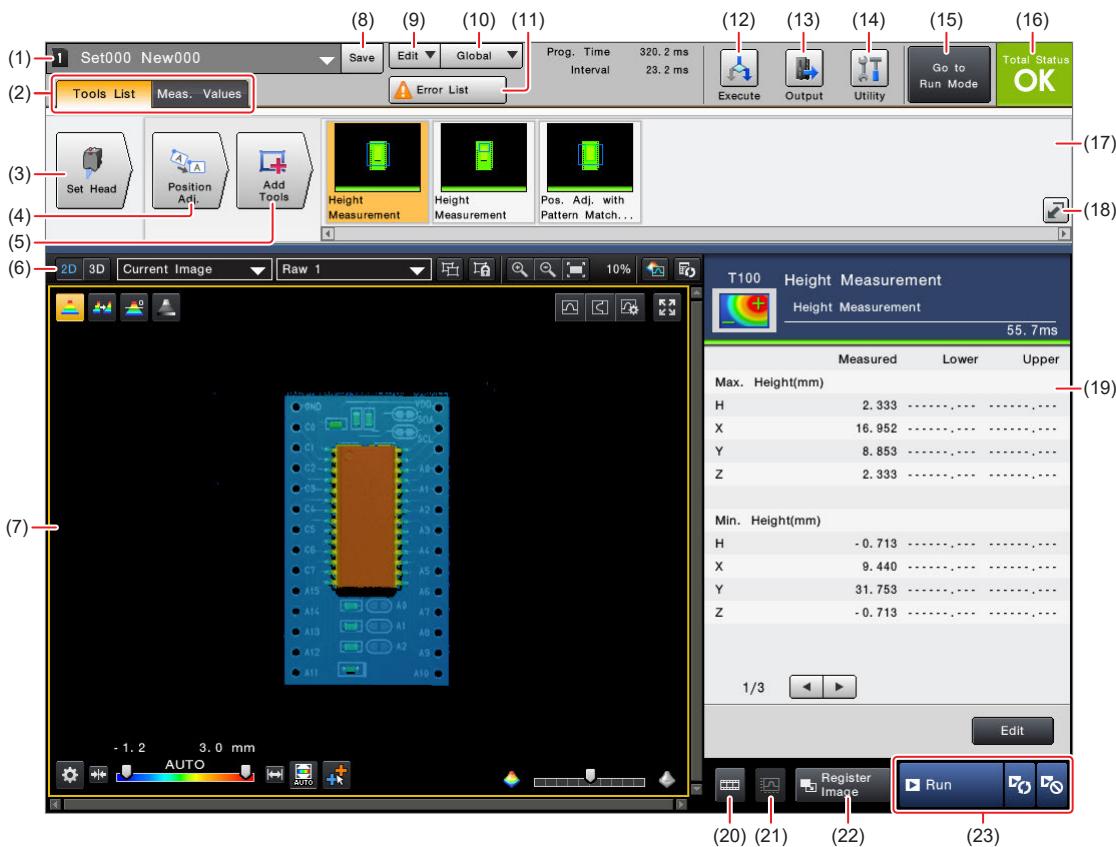
Perform trial operation (Chapter 7)

- Check if the intended evaluation can be correctly performed under the set measurement conditions.
- Optimize the settings using the utility to optimize the setting parameters for [Statistics], [Batch Test], and so on.

□ "Chapter 7 Utility" (Page 7-1)

Screen View

Setup mode screen



(1) Settings management menu

Opens the menu related to program settings such as change, add new, copy or delete.

(2) [Tool List]/[Measured Value List]

Toggles between the [Tool List] and [Measured Value List] displays.

(3) [Set Head] button

Configure the capture settings of the head.

(4) [Position Adjustment] button

Add tools necessary for position correction. Also, open the setting that links the correction source and the correction destination for the position correction.

(5) [Add Tools] button

Add tools to perform various measurements.

(6) View bar

Change the screen display method.

(7) Data Screen

Display the captured height image and shading (contrast) image.

(8) [Save] button

Saves the program setting currently edited.

(9) [Edit] menu

Displays the edit menu for the selected tool.

(10) [Global] menu

Opens the Global Settings .

(11) Setting error list button

This is displayed only if a setting error occurs. The condition of the error can be confirmed.

(12) [Execute] button

□ "Execute Condition" (Page 6-2)

(13) [Output] button

□ "Overview of Output Settings" (Page 6-4)

(14) [Utility] button

□ "Chapter 7 Utility" (Page 7-1).

(15) [Go to Run Mode] button

Changes the system to Run mode.

(16) Total Status

Display the Total status.

(17) Tool bar

Display the tools set in the examination setting.

(18) [Display Tool List] button

Displays a list of the set tools.

□ "Displaying the list of tools/groups" (Page 3-19)

(19) Result data display

Displays the result of the tool currently selected.

(20) [Image Strip] display button

Displays the [Image Strip].

□ "Image Strip Settings" (Page 7-29)

(21) Profile display button

Switches the display profile ON/OFF when the profile measurement tool is selected.

(22) [Standard screen registration] button

Display the [Standard screen registration] screen.

(23) Trigger button

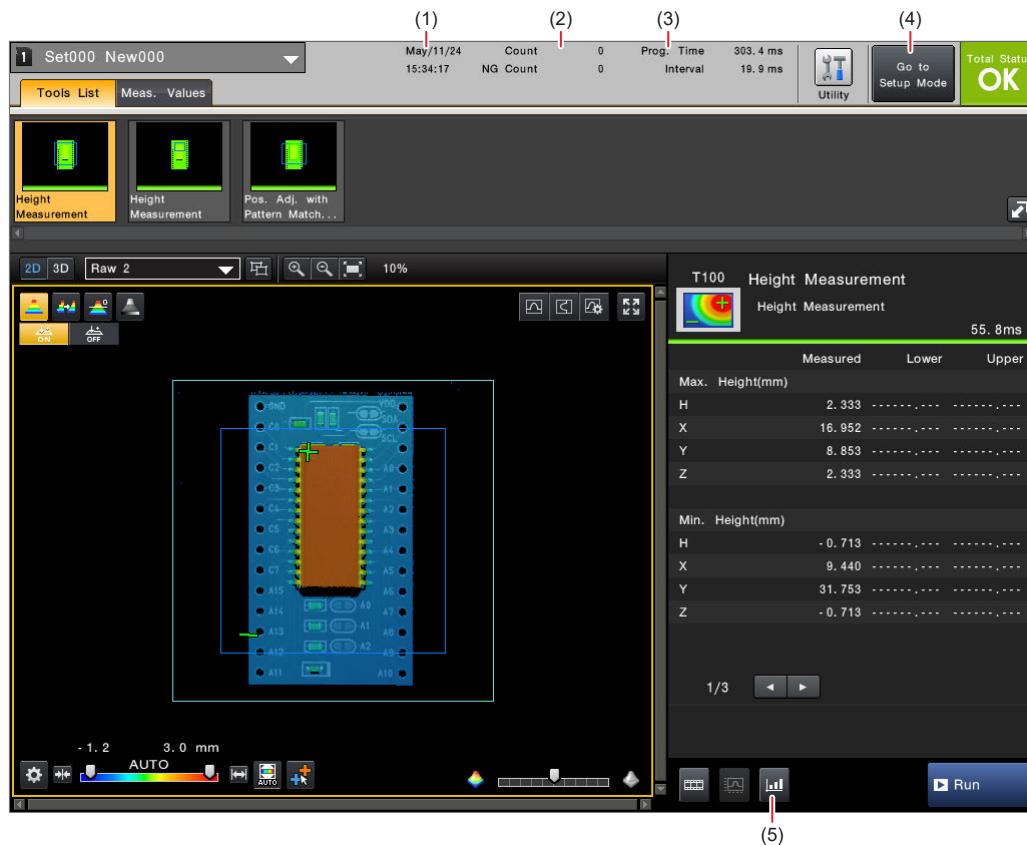
Retrieves the image and executes a measurement.

Click the button to measure.

Click the button to measure continuously.

Click the button to stop continuous trigger.

Run mode screen



(1) Date and time display

Displays the date and time when the measurement was last performed.

(2) [Count/NG Count display]

The cumulative number of measurement and the cumulative NG count are displayed.

(3) Program Time

Processing time when the last measurement was performed (time from trigger input to the end of image processing) is displayed.

Reference The interval time can be checked in the imaging settings.
 Capture Settings (Page 4-8)

(4) [Go to Setup Mode] button

Switch to Setup mode.

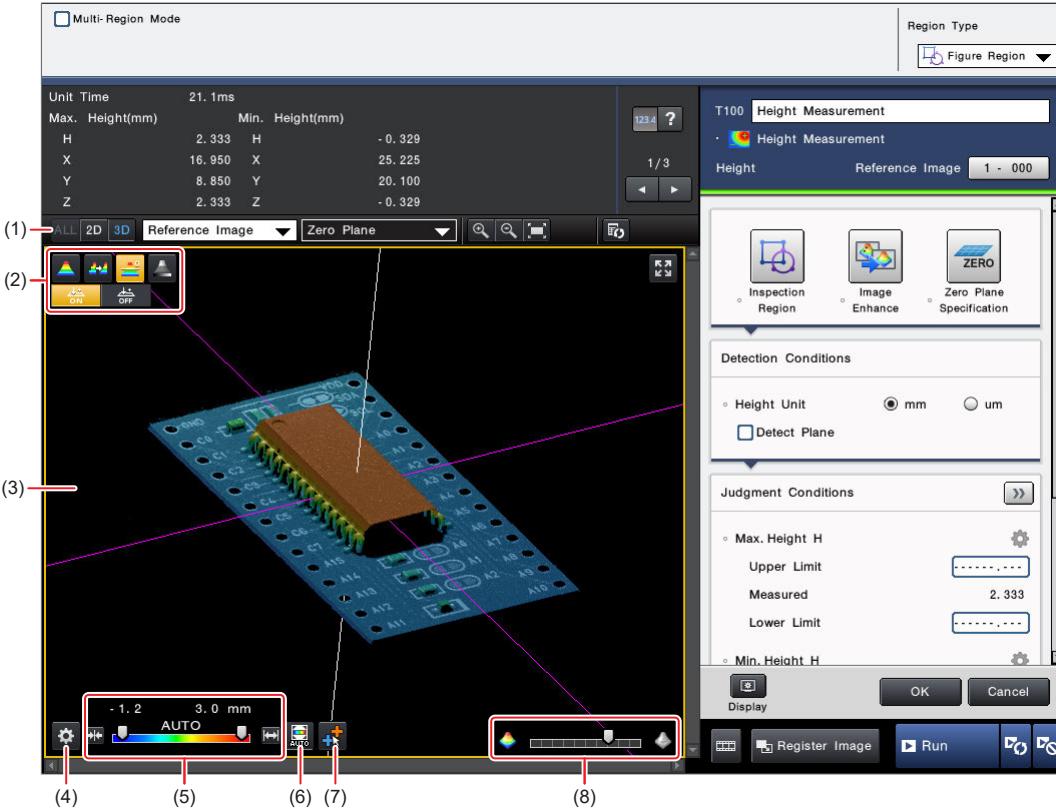
(5) Statistics button

Displays "Statistics" (Page 7-25).

3D Screen

We will explain the operations unique to 3D images displayed on the data screen.
For details about operations common with 2D images, refer to ["Screen View" \(Page 3-4\)](#).

Point The description displayed on the data screen differs depending on the type of tool, settings, display type etc.



(1) Switching 2D Display/3D Display

Switch the 2-dimensional image/3-dimensional image display.
Depending on the tool, it can be switched to [ALL] where the 2-dimensional image and 3-dimensional image are displayed simultaneously on 2 screens.

(2) Display type switch

Switch the type of display image.
Associated with the display type switch of the VIEW bar.

(3) 3D image

The 3D image can be moved/rotated by dragging it.

(4) Options

The menu of the option settings, which can be used with images currently being displayed, is displayed.

["3D Screen Options" \(Page 3-7\)](#)

(5) Color bar

Can change the color display method and range of the height (Z-axis direction).

: Auto fit region

Slider: Can specify maximum and minimum.

: Reset

(6) Auto fit

Display colors are refreshed with the upper and lower limits being specified by the height range of the captured area.

(7) Specify the display color

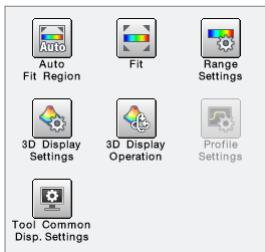
A crosshair cursor appears on top of the image.

- If [Upper and lower limits] is selected for [Method], clicking two points on the screen refreshes the display color with the upper and lower limits being specified by the height range of the specified two points.
- If [Range specification] is selected for [Method], clicking two points on the screen refreshes the display color with the upper and lower limits being specified by the height range in the rectangle determined by the two points.

(8) Height/contrast blend ratio settings

Sets the blend ratio of the height image and concentration image blends of the 3D image.

3D Screen Options



Auto Fit Region

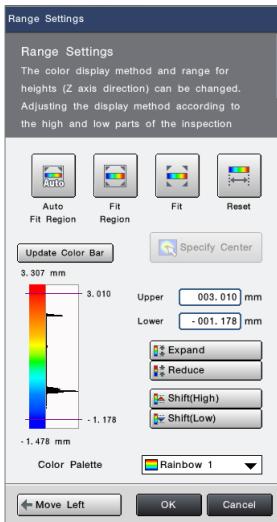
Displays color to match the range of the height currently displayed.
Automatically performs offset fit every time the screen is refreshed.

Fit

Displays color to match the range of the height currently displayed.

Range Settings

Can change the color display method and range of the height (Z-axis direction). Adjust the display method to match the highs and lows of the work to be inspected to make it easier to check the measurement target range.



Auto Fit Region/Fit Region/Fit

The color of the color bar is made to fit the image.

Reset

Displays color to match the limits of the height measurable range.

Color bar

Specifies the maximum and minimum by dragging the color bar. Click "Update Color Bar" to refresh so the position of the maximum and minimum fits the color bar.

Specify Center (2D Display Only)

Specifies the center of the display range of the height.

Upper/Lower:

Can specify the maximum and minimum of the display range of the height using a numeric value.

Expand/Reduce:

Maximize/minimize the display range of the height.

Shift(High)/Shift(Low):

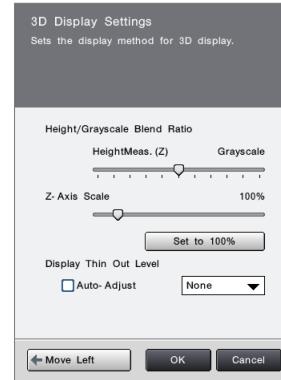
Shift higher or lower without changing the breadth of the display range of the height.

Color Palette:

Choose the color display type of the height.

3D Display Settings:

Set the display method of the 3D display.



Height/Grayscale Blend Ratio

Set the rate at which the contrast image blends with the height image.

Z-Axis Scale

The height display magnification is set in the range between 0 and 50,000%. Convenient as it allows you to observe by zooming in small concaves/convexes.

Display Thin Out Level

Thin out level for the data to be used for the 3D display is set. The smaller the thinning level, the more the target can be displayed in high detail. Enable [Auto-Adjust] to change the display thinning level to the most appropriate level according to the maximization/minimization of the observation target.

3D Display Operation

Display the display method guide of the 3D display.
The 3D image can be displayed using a button operation.

Power On and Initial Set-Up

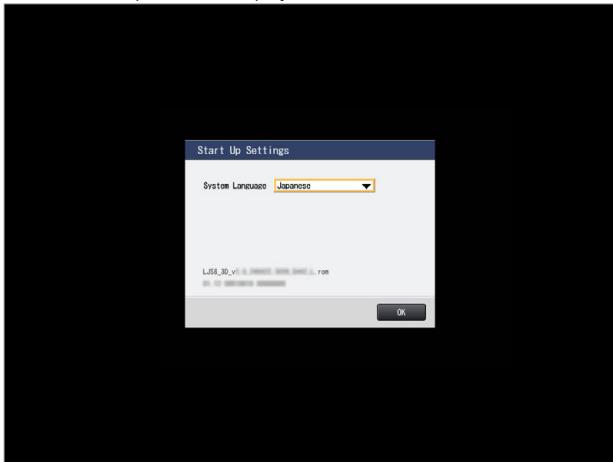
This section describes the operation when power is supplied to the controller in the initial state after purchase.

 If the inspection settings have already been set, the operation may differ from the one described below.

Selecting a Language

1 Check the wiring for errors and then turn on the power.

The initial startup screen is displayed.



If nothing is displayed on the monitor, check the following items.

- Is the power supply connected correctly?
- Is a suitable 24 VDC power supply used?
- Are the "+24 V" and "0 V" of the power supply input terminals connected in reverse?
- Is the monitor cable connected correctly?
- Is the monitor power supply on?
- Does your monitor support XGA (1024 x 768 pixels) and vertical frequency of 60 Hz?

2 Select the language you want to use in the "System Language" field.

3 Click [OK].

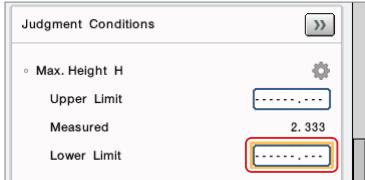
The Setup mode initial screen is displayed.

Entering a Number or Text

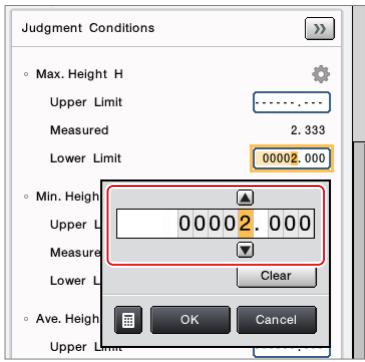
Entering a Number

To enter values for setting values etc., use the procedure described below.

1 Click the field to enter a value.



2 Click the digit to change with the mouse and click the up/down button displayed on the screen. Or turn the wheel of the mouse to specify the desired value.



You can also click to enter on the numeric keypad.

3 When the value is changed, click [OK].

This confirms and enters the specified value.

- To cancel the change

In Step 3 above, click [Cancel] instead of [OK].

- When you want to return the value to the unset state ("-----") on the "Judgment Condition" screen

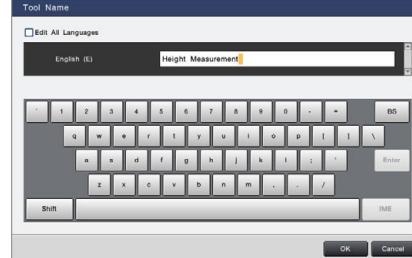
Select a value and click [Clear].

Entering Text

To enter text for setting name etc., use the procedure described below.

1 Click the field to enter text into.

The character input screen appears.



2 Specify the character to be entered.

The list of available characters appears.

3 Select the characters to input.



Check "Edit All Languages" if you want to enter a text string that automatically switches the language according to the display language when switching the display language of this machine.

- If [Edit All Languages] is checked, the editing screen for all languages that apply to the applicable string will open. When the string is edited after selecting the desired language field, the edited string will be displayed when switched to the applicable language.
- Automatically switches to the language input method according to the selected language.

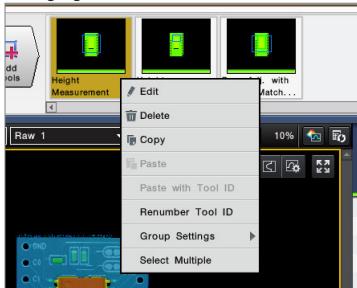
4 To complete the input, select [OK].

Context-Sensitive Menu (Context Menu)

In Setup mode, context-sensitive menus (context menus) can be used by pressing the right mouse button (right-clicking).

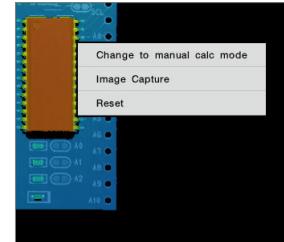
Context Menu Displayed by Right-clicking

The context menu displayed varies depending on the pointer location during right-click.



Menu displayed by holding the right button down (common context menu)

The common context menu is displayed by holding the right button down for around 1 second on the screen.



Context menu displayed on toolbar

Edit tool	Opens the editing screen of the tool you right-clicked.
Delete tool	Deletes the right-clicked tool.
Copy tool	Copies the right-clicked tool.
Paste tool	Duplicates and pastes the copied tool.
Paste with tool ID	Duplicates and pastes the copied tool by specifying its ID number.
Renumber tool ID	Renumerates the tool ID of the tool that is selected.
Group settings	Groups/ungroups the selected tools. You can also set the group judgment condition.
Select multiple	Selects multiple tools on the toolbar.

Context menu displayed on the image

In addition to the items displayed by right-clicking the toolbar, the following items are displayed.

Undo editing of the region	Restores the area size changed on the image.
Standard image registration	Opens the [Standard Image Registration] screen. □ "Register image for measurement (standard image registration)" (Page 3-15)

Context menu displayed in the text editing area

Restore	Cancels the previous text editing operation and restores it.
Copy	Copies the selected text.
Cut	Cuts out the selected text.
Paste	Pastes the copied or cut text.
Paste with tool ID	Duplicates and pastes the copied tool by specifying its ID number.

Depending on the operation status, these menu items may not be displayed or may not be selectable.

Common context menu displayed in Run mode

Image Capture	Saves the displayed screen as an image file on the SD card. To change the save format, etc., see □ "Image Capture Settings" (Page 8-13).
Change account	Displays □ "Change Account" (Page 7-31).
Reset	Used to perform reset operation.
Remove SD card 2	Prepares SD card 2 for removal.
Remove USB HDD	Prepares the USB HDD for removal.

Common context menu displayed in Setup mode

Recalculation settings (Automatic → Manual)	Change the re-calculation setting to "Manual" (if the current re-calculation setting is "Automatic").
Recalculate now	Executes re-calculation. (If the current re-calculation setting is "Manual".)
Recalculation settings (Manual → Automatic)	Change the re-calculation setting to "Automatic" (if the current re-calculation setting is "Manual").
Image Capture	Saves the displayed screen as an image file on the SD card. To change the save format, etc., see □ "Image Capture Settings" (Page 8-13).
Reset	Used to perform reset operation.

Start/Stop Operation

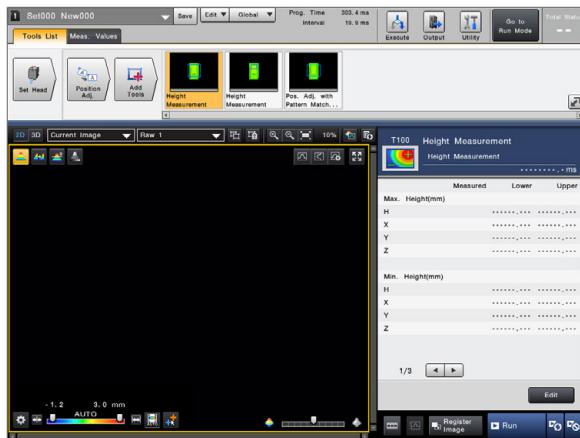
Start operation

1 Start power supply to this machine.

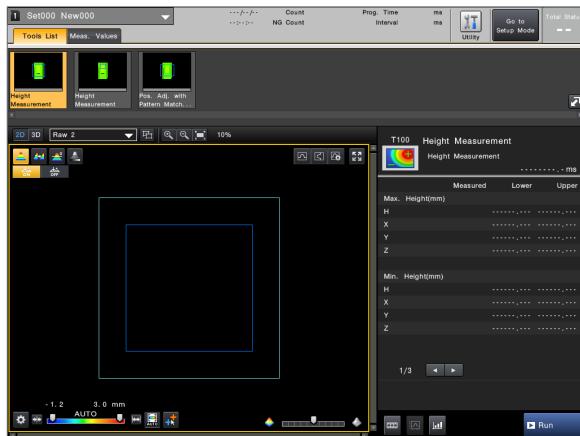
After the opening screen appears on the monitor, the Setup mode screen should appear.



The head and controller are connected by supplying power to the head at the same time as the controller or by supplying power to the controller after supplying power to the head.



2 Click the [Go to Run mode] button to switch the controller to Run mode.



3 Input the trigger.

Start image capture and judgment process under the inspection conditions set.

To start the Run mode from the beginning when the power is supplied

Select [Run Mode] in □ "Startup Mode Settings" (Page 8-16) to start in Run mode when the power is supplied.

To change the opening screen displayed at the start-up

- Save the image of the 1024 x 768 pixel 24-bit bitmap format as "Logo.bmp" in "lj-s/setting" of SD card 1. The saved image file is displayed as the opening screen when the LJ-S8000 series is started.
- If you do not want to display the opening screen, create a black-only image file with commercially available graphics software and save it as "Logo.bmp" in "lj-s/setting" on the SD card 1.

Stop operation

To stop the operation, turn off the power supply to the machine.



Turning off the controller while it is accessing an SD card may damage the card itself and/or corrupt the data that is being saved on the SD card.

To stop result output and only receive judgement output

- Click the setting mode switching button to switch the LJ-S8000 Series to Setup mode.
- Only the result output can be stopped in the Run mode by turning on the TEST input terminal.

When stopping imaging and image processing

Turn ON the EXT input terminal to stop acceptance of the trigger input.

Check Past Image in the Image Strip

Past inspection results are stored in the internal memory as "Archived image". Displays the image strip in which the archived image saved on the SD card/USB HDD/FTP server can be checked.

Reference For details on image strip display settings, refer to "Image Strip Settings" (Page 7-29).

Displaying image strip

1 Click the [Image Strip] display button.



The image strip appears.



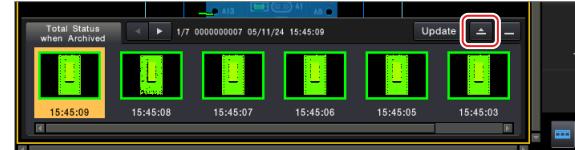
Click the [Image Strip] display button again to hide the image strip.

Reference Up to 1024 images can be displayed in the image strip.

Use the image strip in Run mode

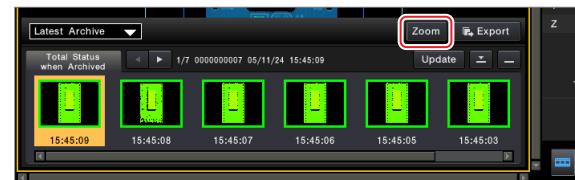
Archived images and external image files displayed on the image strip can be enlarged.

1 Select the target image in the image strip, and then click .

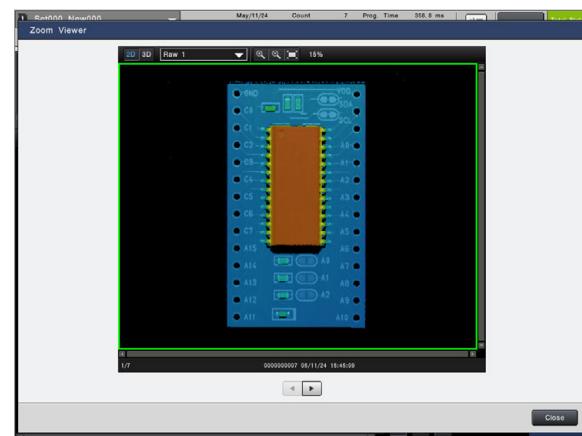


The Option toolbar appears.

2 Click [Zoom].



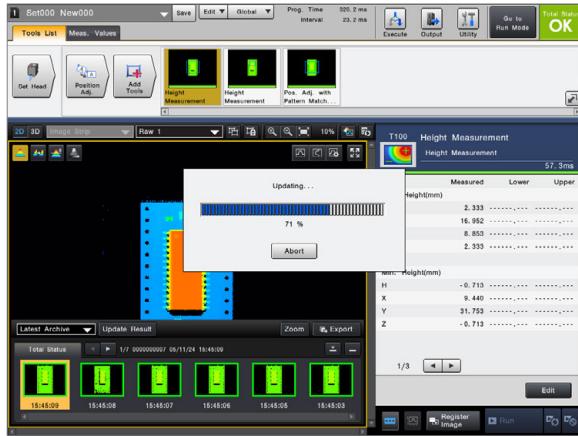
The [Zoom Viewer] screen appears.



Using the image strip in Setup mode

Re-measure the archived image with the latest settings

In Setup mode, when the image is selected on the image strip, the image is re-measured using the currently setting values. It is convenient as the measured results of the adjusted setting values applied to the past archived images can be verified.



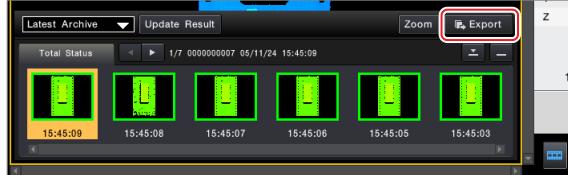
You can recalculate all the images by clicking and then clicking [Update Result] on the options bar.

Export archived images

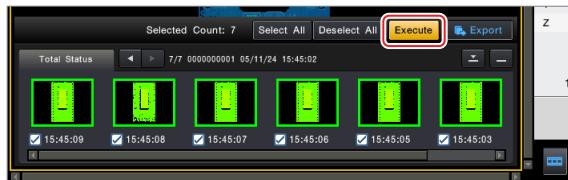
Write archived image to SD card or USB HDD.

Do not use with third-party SD cards. Doing so may result in data loss or setting data damage.

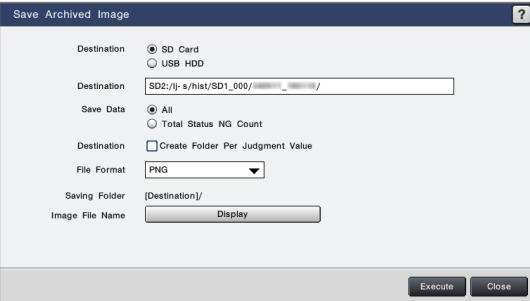
1 Click [Export] on the image strip.



2 Check the image you want to export, and then click [Execute].



3 Specify the save condition of the archived image.



● Destination

Select [SD Card] or [USB HDD].

● Destination

Specify the folder where the archived image is to be saved.

● Save Data

○ All

Exports all images.

○ Total Status NG Count

Writes out the image of measurement times for which the overall judgment is NG at the time of history accumulation.

● Destination

○ Create Folder Per Judgment Value

Check to categorize the image into "OK" or "NG" folder for each total judgment and output.

● Image File Name

Clicking the [Display] button will show the file name of the exported image. The file name will be as follows.

○ Height image

YYMMDD_HHMMSS_{number of measurements}_IMG_HEIGHT_{total judgment}.png

○ Shading (luminance gray) image

YYMMDD_HHMMSS_{number of measurements}_IMG_INTENSITY_{total judgment}.png

<Example>

241001_092309_000000001_IMG_HEIGHT_OK.png

4 Click [Execute].

Displaying magnified images

You can magnify the image selected in the image strip by clicking [Zoom] in the image strip.

Inspection/Measurement Condition Setting

This section describes the basic operation flow required to create an inspection setting on this machine.

- "Select the setting number (inspection setting)" (Page 3-14)
- "Register image for measurement (standard image registration)" (Page 3-15)
- "Setting the measurement conditions (tool)" (Page 3-16)
- "Edit the measurement area" (Page 3-20)
- "Height Extraction" (Page 5-4)
- "Height measurement filters (preprocessing)" (Page 5-10)
- "Position Correction Settings" (Page 3-34)
- "Managing Program Settings" (Page 3-35)

Select the setting number (inspection setting)

Mechanism of data retention of this machine

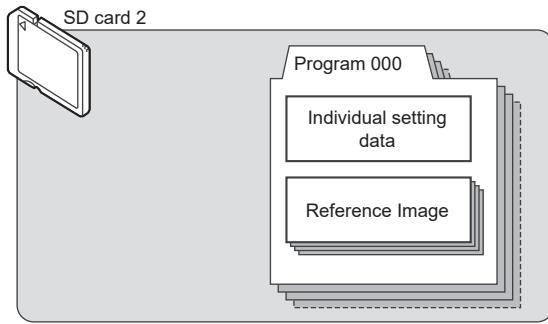
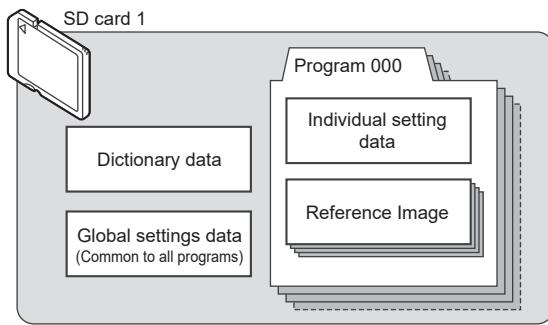
This machine manages various settings used for measurement processing with setting numbers. Various data files used in program settings are managed and saved as follows.

● Data specific to program settings

Setting data and standard image data are saved comprehensively (in group) in the folder for each inspection setting.

● Data common to all program settings

Configuration data and dictionary data are stored in a common folder among inspection settings.



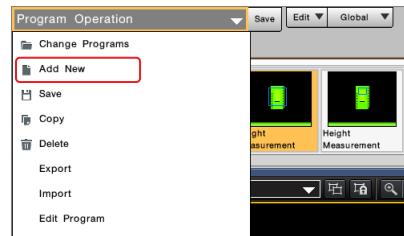
Reference

- Program settings 000 to 999 can be specified for SD card 1 and SD card 2, but the actual number of programs that can be registered varies depending on the SD card capacity or settings.
- When SD card 1 is removed, reference to the global settings is disabled and this machine does not operate correctly.
- The lifetime of the writing count of the SD memory card is 100,000 times. Writing to the SD memory card is performed when saving settings using the mouse or command.
- By formatting SD card 1, you can initialize the settings. You can format it via "Manage Files" (Page 7-32) in [Utility].

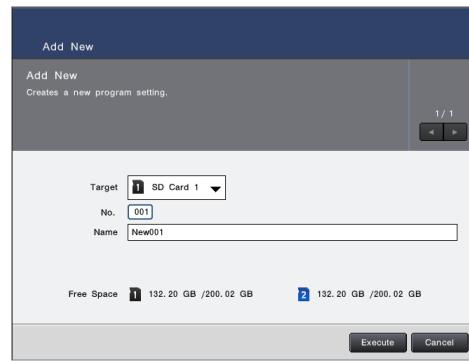
Adding new program settings

Add inspection settings required for measurement processing. From the [Program No.] menu select [New/Edit/Del Programs].

1 Click [Program Operation] > [Add New].



2 Specify the SD card for storing settings, program setting No., and program name, and then click [Execute].



A setting is newly created.

Changing to existing program settings

1 Click [Program Operation] > [Change Programs].



2 Select the examination setting to switch, and then click [OK].

This changes the program setting.

Reference

Program settings can be copied for other use or settings of other controller can also be used.

- "Managing Program Settings" (Page 3-35)

Register image for measurement (standard image registration)

Register an image to be used as the basis of measurement and judgment conditions, as a standard image.
These images are referenced when creating settings or measuring actual workpieces.

Register the standard image

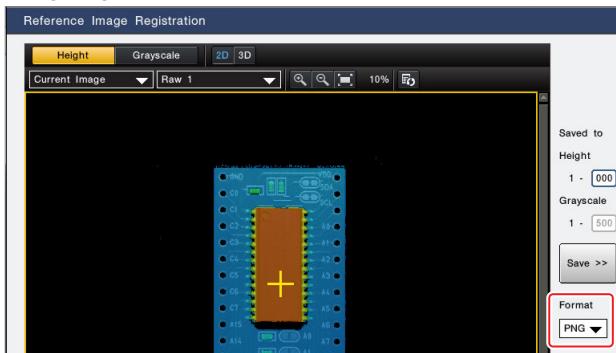
1 Click [Standard Image Registration].



2 Review the captured height and contrast images.

3 Select the format in which to save the standard image.

- BMP: Bitmap format
- JPG: JPEG format
- PNG: PNG format



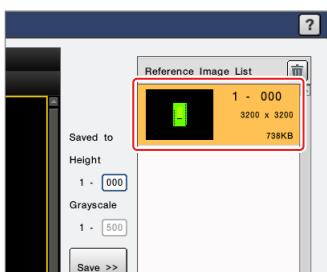
- Reference**
- For images registered with the JPEG format, the measurement results may differ from those of images registered with the BMP or PNG format due to image degradation attributable to compression.
 - Compression and decompression will be necessary if the JPEG or PNG save format is selected, so saving and importing the image will take longer than with the BMP format.

4 Click [Registration].



5 Click [OK].

The image currently displayed is registered with a specified registration number as the standard image. The height image and the shading (contrast) image are registered respectively in one registration.

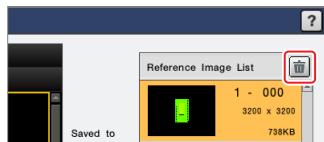


- The standard image is a set of height images and shading (contrast) images.
- The registration number for standard images is specified using the registration number for height images (0 to 399). The registration number of the shading (contrast) image is automatically registered as "number added 500".
- Standard images can be registered with up to 400 height image/shading (contrast) image sets.
- Since the standard images are saved on the SD card, the number of stored images vary depending on the SD card capacity.

Reference You can use "Image Strip Settings" (Page 7-29) to register any image from the archived image as a standard image.

Deleting registered standard images

On the [Standard Image Registration] screen, select the registered image and click , and then click [OK] on the confirmation screen.



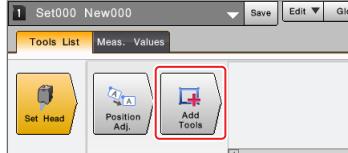
Or, right-click the registered image and select [Delete] from the context menu to delete it.

Setting the measurement conditions (tool)

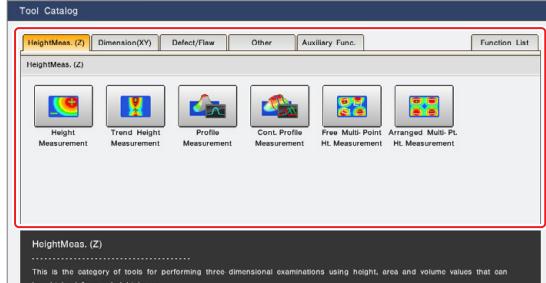
The LJ-S Series performs measurement by units referred to as a "Tool". The tools are classified into "Categories" based on their use. This section describes the methods to add/delete tools.

Adding a tool

1 Click [Add Tools] in Setup mode.



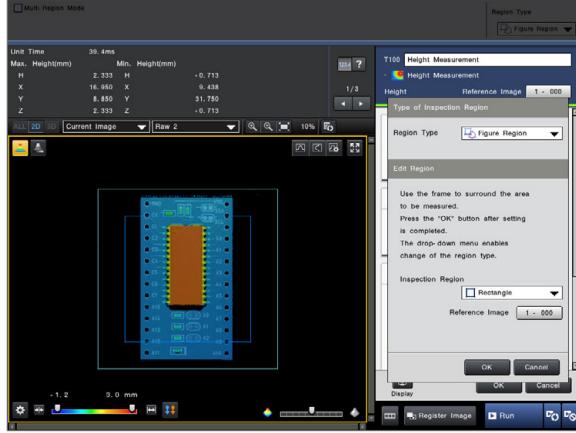
2 Select the desired tool.



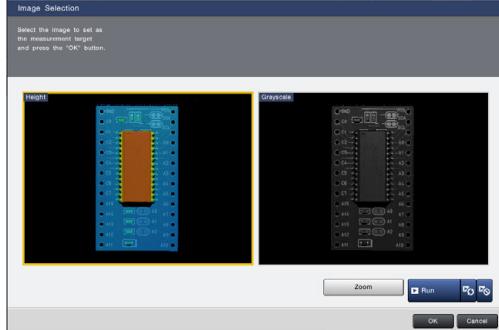
3 Specify a tool ID, and then click [Add].



Once the tool is added, the tool edit screen will appear.

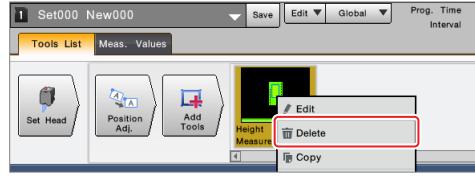


Reference When adding tools other than the height category, select either the height image or the contrast image to measure.



Deleting a tool

1 Right-click the desired tool for deletion on the toolbar and select [Delete].



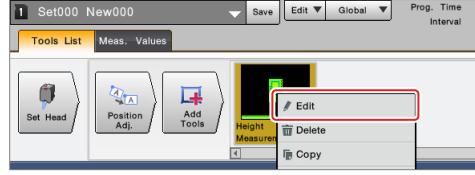
A confirmation message appears.

2 Click [OK].

The tool is removed.

Re-editing tools

1 Right-click the desired tool for editing settings on the toolbar and select [Edit].

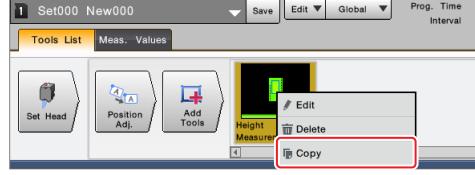


The tool edit screen appears.

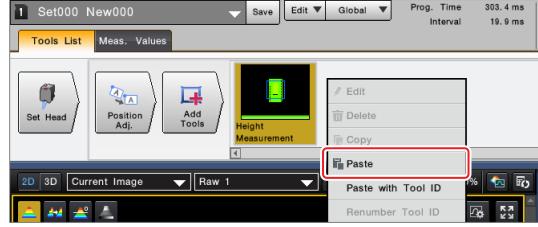
Reference Double-clicking the tool displayed on the toolbar is another way to display the edit screen.

Copying a tool

1 Right-click the desired tool for copying on the toolbar and select [Copy].



2 Right-click on the toolbar and select [Paste].



The tool selected in step 1 is copied and pasted.

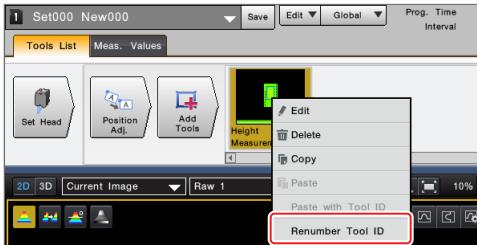
Reference When [Paste with Tool ID] is selected, a desired ID number can be specified for the copy of the tool to be created. (Usually, IDs are automatically allocated sequentially from the first.)

Renumbering the tool ID

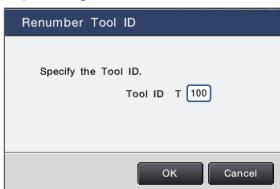
Point

- Multiple tools can be selected for collective renumbering. When selecting multiple tools and renumbering their IDs, the new tool IDs are assigned beginning from the tool with the smallest tool ID among the tools that are selected.
- “Selecting/deselecting multiple tools” (Page 3-17)
- The renumbered tool IDs are reflected also to the functions that refer to those tool IDs.

1 Right-click the tool for renumbering its tool ID on the toolbar and then select [Renumber Tool ID].



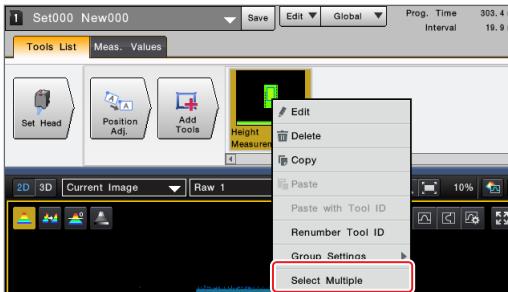
2 Specify a new tool ID, and then click [OK].



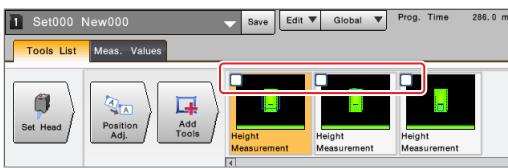
The tool ID is renumbered to the new tool ID.

Selecting/deselecting multiple tools

1 Right-click on the toolbar or on the image display and then select [Select Multiple].



2 Select or clear the check box at the upper left corner of the tool to select or deselect multiple tools.



Point

- Operations including copy/paste, deletion, group setting, and tool ID renumbering can be collectively performed for the multiple tools selected.

Operation for groups

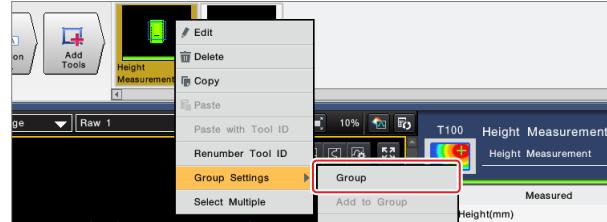
Grouping tools enables you to display grouped multiple tools together and make judgment by the judgment result of the grouped multiple tools (group judgment).

Point

- The upper limit of the number of groups that can be created is 32.

Creating a new group

1 Right-click the tool for grouping on the toolbar and then select [Group Settings] > [Group].



Reference

When [Group Settings] > [Group] is selected in a state where multiple tools have been selected beforehand, a group which consists of the selected tools can be created.

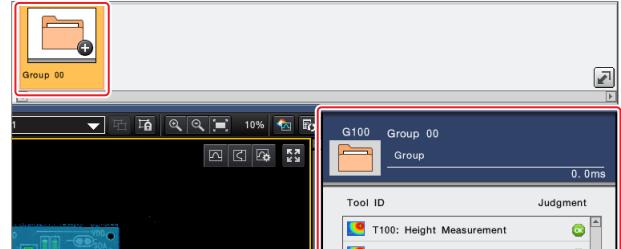
“Selecting/deselecting multiple tools” (Page 3-17)

2 Select [Create New Group], set [Group Name], and then click [OK].



The selected tool(s) is/are grouped.

The grouped tool(s) is/are displayed listed in the results data display area.



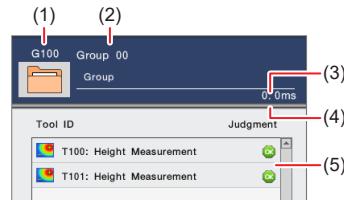
- Select [+] on the group icon to view the tools in the group. Click [-] to return to the original state.



- Selecting [Edit Group] enables you to edit the group name and group ID.

“Editing the properties of a group” (Page 3-19)

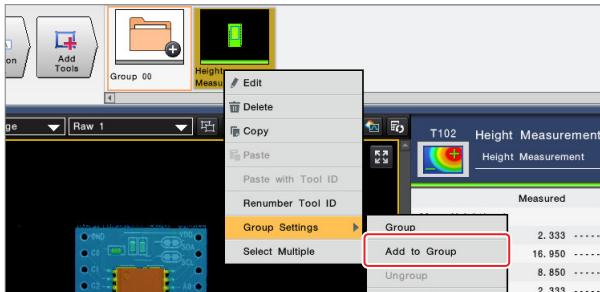
How to view the results display area of the group



(1)	Group ID
(2)	Group Name
(3)	Total measurement time of the tools within the group
(4)	Group judgment result (Green: OK, Red: NG)
(5)	List of the tools within the group

■ Adding a tool to a group

- 1** Right-click the tool that is to be added to a group on the toolbar and then select [Group Settings] > [Add to Group].

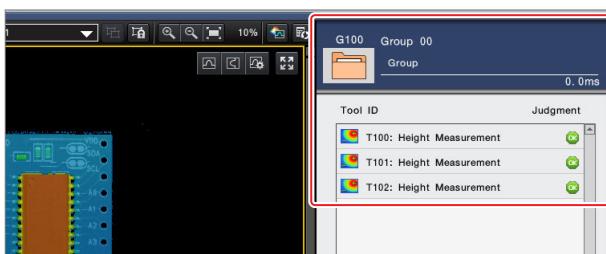


[Reference] When [Group Settings] > [Add to Group] is selected in a state where multiple tools have been selected beforehand, the selected tools can be collectively added to a group.
□ "Selecting/deselecting multiple tools" (Page 3-17)

- 2** Select [Add to Existing Group], select the group to which the tool will be added, and then click [OK].



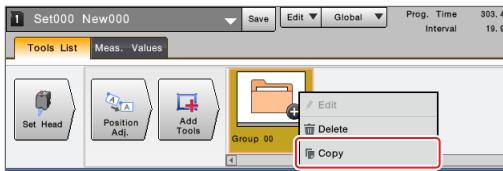
The selected tool is added to the group.
The added tool is listed in the results data display area.



■ Copying a group

A group can be copied together with the tools contained in it.

- 1** Right-click the group to copy on the toolbar and then select [Copy].

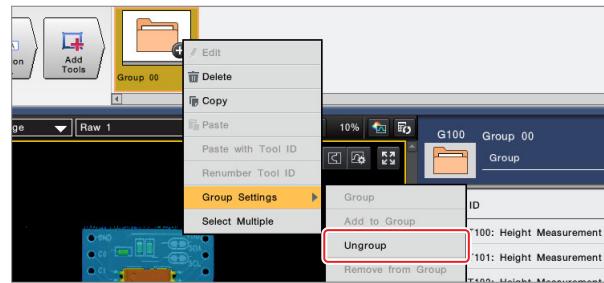


- 2** Right-click on the toolbar and then select [Paste].

The group selected in step 1 is copied and pasted to the end of the toolbar.

■ Ungrouping a group

- 1** Right-click the group for ungrouping on the toolbar and then select [Group Settings] > [Ungroup].

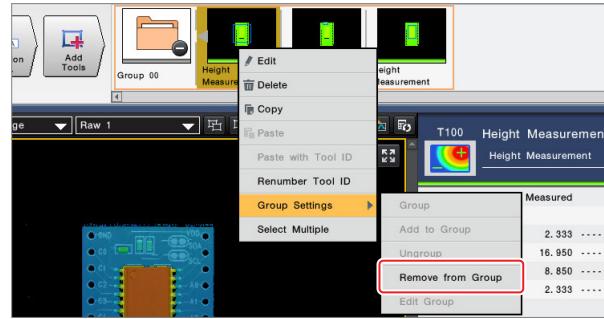


- 2** Click [OK].

The group is ungrouped.

■ Removing a tool from a group

- 1** Right-click the tool to be removed from the group on the toolbar and then select [Group Settings] > [Remove from Group].



[Point] If there is no tool left in the group after the tool is removed from the group, the group itself is cancelled.

[Reference] When [Group Settings] > [Remove from Group] is selected in a state where multiple tools have been selected beforehand, selected tools can be collectively removed from the group.
□ "Selecting/deselecting multiple tools" (Page 3-17)

- 2** Click [OK].

The selected tool is removed from the group.

■ Deleting a group

Deleting a group also deletes the tools contained in the group.

- 1** Right-click the group for deletion on the toolbar and then select [Delete].

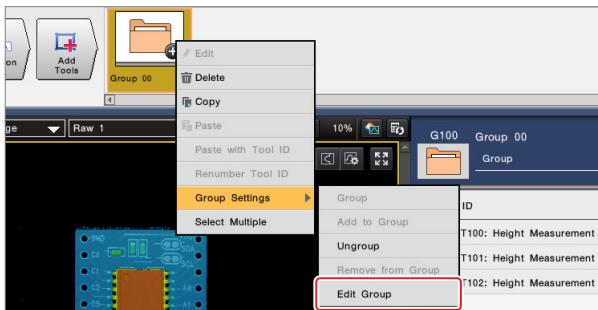


- 2** Click [OK].

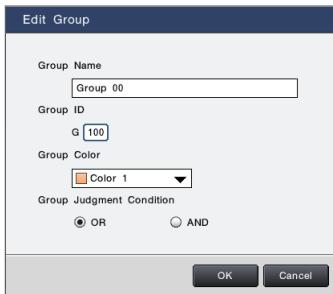
The group is deleted together with the tools in it.

■ Editing the properties of a group

- 1 Right-click the group whose properties are to be edited on the toolbar and then select [Group Settings] > [Edit Group].**



- 2 Edit the properties of the group.**



● Group Name

Set the name of the group.

● Group ID

Set the group ID.

● Group Color

Set the group color.

● Group Judgment Condition

Select the condition for the group judgment.

OR

The group is judged as NG if there is even just one tool within the group that is NG.

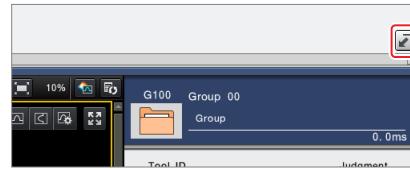
AND

The group is judged as NG when all of the tools within the group are NG.

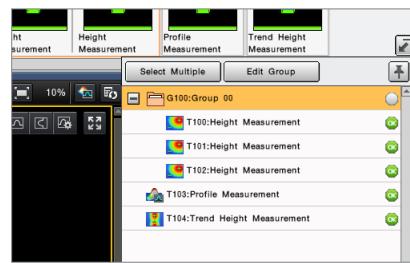
- 3 After completing the editing, click [OK].**

■ Displaying the list of tools/groups

- 1 Select on the toolbar.**



The tool list is displayed.



Reference

- Selecting [Select Multiple] displays check boxes on the left side of the list items. Place a check mark in the box of the desired items to collectively select them.
- When a group is selected in the list, [Edit Group] is displayed. Selecting [Edit Group] displays the [Edit Group] screen.

"Editing the properties of a group" (Page 3-19)

Points in tool editing

■ Displaying guides

To display the guide such as an explanation of the item selected or an explanation of the setting method, click the displayed on the tool edit screen.

■ Registering adjustment items on the custom menu

It is convenient to use the custom menu for frequently edited items or for limiting edit items.

The symbol is added to the item that is registered on the custom menu.

"Custom Menu" (Page 3-37)

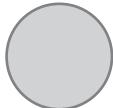
Edit the measurement area

This section is about how to edit the size and position of the inspection regions (including search region and pattern region) and the mask region specified for the measurement unit.

This unit supports the following types of measurement and mask regions.



Rectangle/Rotated Rectangle



Circle



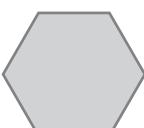
Oval



Ring



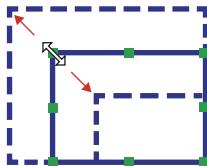
Arc



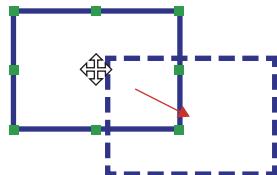
Polygon
(e.g. hexagonal)

Drawing a rectangle

- 1 Drag a green handle on the frame line to change the size.



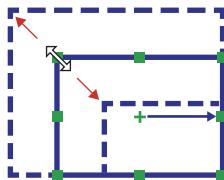
- 2 Drag from within the frame line to move the location of the region without changing the size.



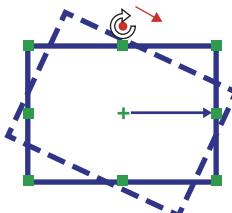
Reference After drawing, you can change the coordinates of Point 1 (upper left) and Point 2 (upper right) from the menu opened with .

Drawing a rotated rectangle

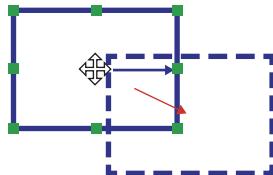
- 1 Drag a green handle on the frame line to change the size.



- 2 Drag the red handle to change the angle.



- 3 Drag from within the frame line to move the location of the region without changing the size.



Reference After drawing, you can change the width, height, XY coordinates of the center and rotation angle from the menu opened with .

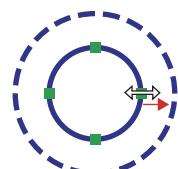
Drawing a circle

- 1 Specify the first point on the circle region to be created.

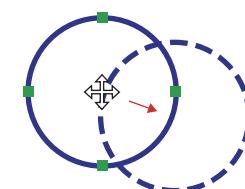
- 2 In a similar way, specify the second and third points.

A circle through 3 points is drawn.

- 3 Drag a green handle on the frame line to change the size.



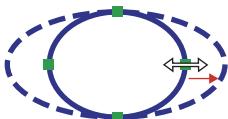
- 4 Drag from within the frame line to move the location of the region without changing the size.



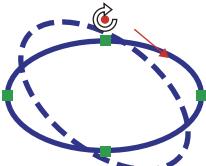
Reference After drawing, you can change the XY coordinates of the center and radius from the menu opened with .

Drawing an oval

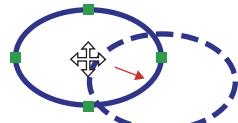
- 1** Drag a green handle on the frame line to change the size.



- 2** Drag the red handle to change the angle.



- 3** Drag from within the frame line to move the location of the region without changing the size.



Reference After drawing, you can change the XY coordinates of the center, Radius 1, Radius 2 and rotation angle from the menu opened with .

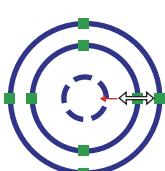
Drawing a ring

- 1** Specify the first point on the ring region to be created.

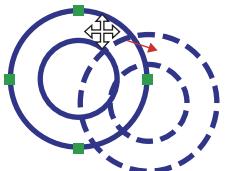
- 2** In a similar way, specify the second and third points.
A circle through 3 points is drawn.

- 3** Specify the position of the inner circle or outer circle.

- 4** Drag a green handle on the frame line to change the size.



- 5** Drag from within the frame line to move the location of the region without changing the size.



Reference After drawing, you can change the XY coordinates of the center, Radius 1 of the outer circle and Radius 2 of the inner circle from the menu opened with .

Drawing an arc

- 1** Specify the start point of the arc.

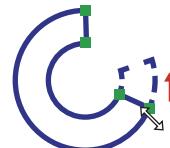
Since the cursor direction is the same as the direction of movement, a vertical cursor showing the same direction as the red arrow appears.

- 2** Specify the end point of the arc.

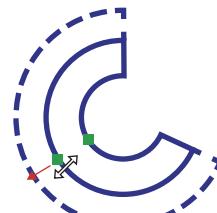
- 3** Specify the intermediate point of the arc.

An arc is drawn.

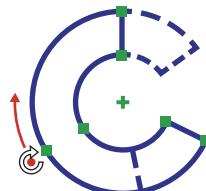
- 4** Specify the position of the inner circle or outer circle.



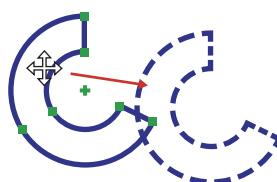
- 5** Drag a green handle on the frame line to change the size.



- 6** Drag the red handle to change the angle.



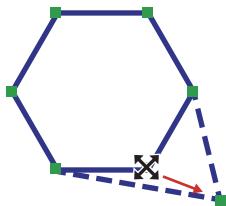
- 7** Drag from within the frame line to move the location of the region without changing the size.



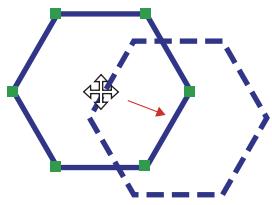
Reference After drawing, you can change the XY coordinates of the center, Radius 1 of the outer circle, Radius 2 of the inner circle, start angle and end angle from the menu opened with .

Drawing a polygon (hexagon)

- 1** Specify the start point of the polygon.
- 2** Specify vertexes (12 points maximum) continuously.
- 3** Click the start point again.
A polygon is drawn.
When 12 vertexes are specified, a polygon is drawn at that time.
- 4** Drag a green handle on the frame line to change the size.



- 5** Drag from within the frame line to move the location of the region without changing the size.



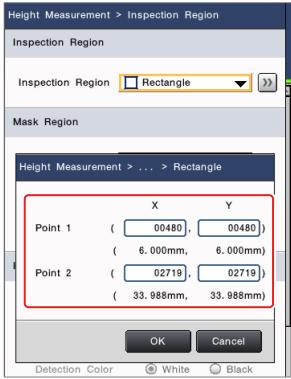
Reference Vertexes may be added/deleted from the menu opened with .

Drawing a measurement region by specifying values

- 1** Draw a region.
- 2** Click in [Inspection Region].



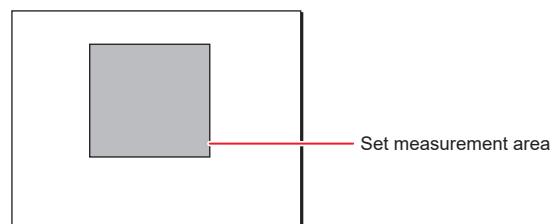
- 3** Change the values to edit the region shape.



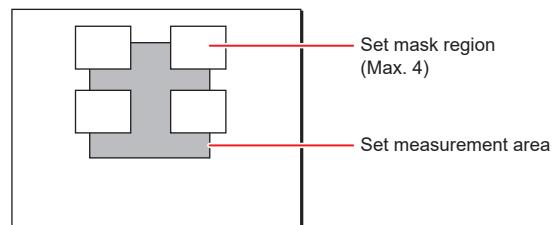
- 4** Click [OK].

Partially hiding the measurement region (Mask Region)

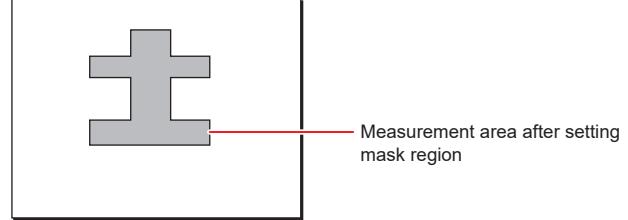
Up to four areas to exclude (mask regions) in the measurement region can be specified for each tool. This is useful when the target has a complicated shape or when an area needs to be excluded from the measurement.



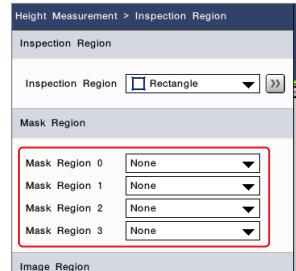
▼ Specify mask region



▼ The area covered by the mask region is excluded from the measurement area



- 1** Select the desired region shape for [Mask Region 0] to [Mask Region 3].



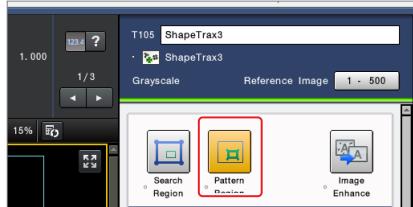
- 2** Draw it as in normal region.

Deleting unnecessary feature information/boundary information (Eraser Tool)

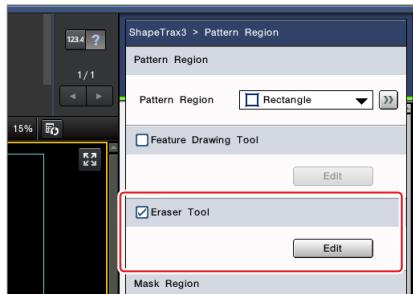
Deleting unnecessary feature information using ShapeTrax3A

When using tools based on ShapeTrax3 tool unnecessary detection edges within the range can be deleted as noise components by specifying any location on the standard image.

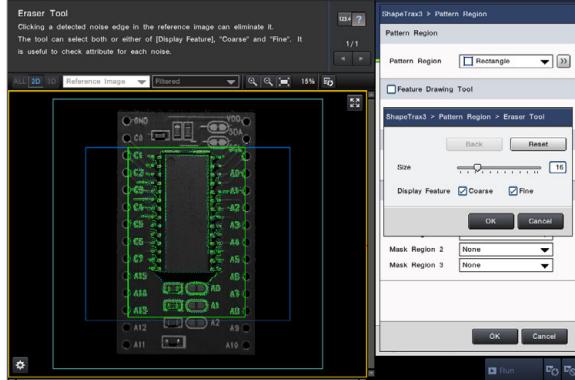
1 Click [Pattern Region] on the tool edit screen.



2 Select the [Eraser Tool] check box and click [Edit].



The [Eraser Tool] screen appears showing the edge information with green (fine features) and blue (coarse features).



3 Remove the unnecessary edge information while clicking.

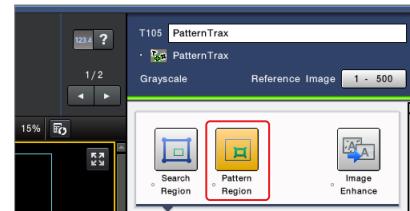
4 After completing the editing, click [OK].

- Reference
 - The range to erase at a time can be changed with the [Size] slider.
 - If you wish to display on the screen by specifying the type of display feature, select either [Course] or [Fine] for [Display Feature].

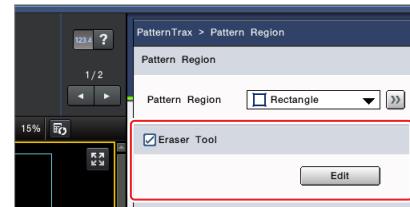
Deleting unnecessary feature information using PatternTrax

When using tools based on the PatternTrax tool tone changes within the range can be deleted by specifying any location on the standard image.

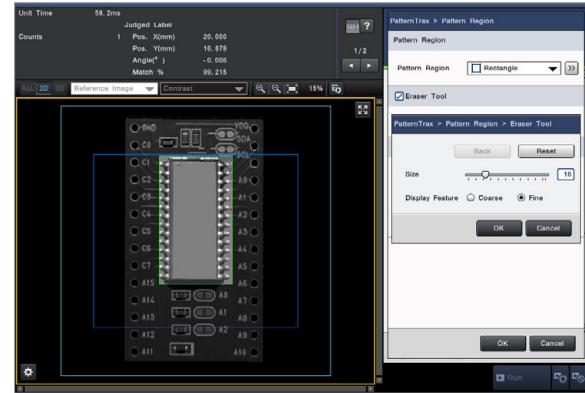
1 Click [Pattern Region] on the tool edit screen.



2 Select the [Eraser Tool] check box and click [Edit].



The [Eraser Tool] screen appears showing the boundary information of the image.



3 Remove the unnecessary tone change parts by tracing them while clicking the mouse.

4 After completing the editing, click [OK].

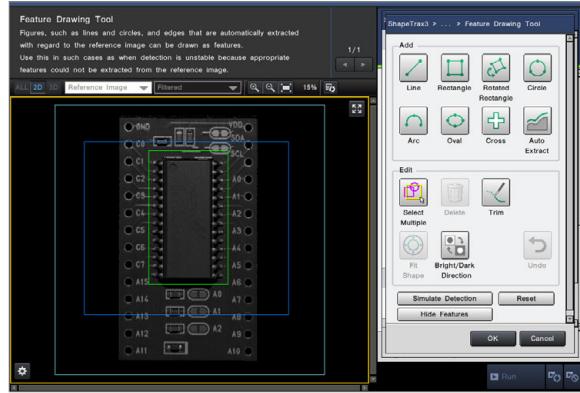
- Reference
 - The range to erase at a time can be changed with the [Size] slider.
 - If you wish to display on the screen by specifying the type of display feature, select either [Course] or [Fine] for [Display Feature].

Creating feature information from contour information of graphics or images using ShapeTrax3A (feature drawing tool)

When using tools based on ShapeTrax3A tool necessary features can be directly drawn and edited on the pattern inspection using the feature drawing tool. By doing so, a high-precision ShapeTrax3A measurement is possible even in cases such as those below where the appropriate features cannot be properly extracted from the image.

- The targets are adjacent to each other and the features cannot be properly extracted
- Unnecessary features are extracted due to overexposure or shadow of the background
- Targets, whose features cannot be properly extracted due to shading, are adjacent to each other

To use the feature drawing tool, select the [Feature Drawing Tool] check box using the [Feature Extraction Condition] screen, and then click [Edit].

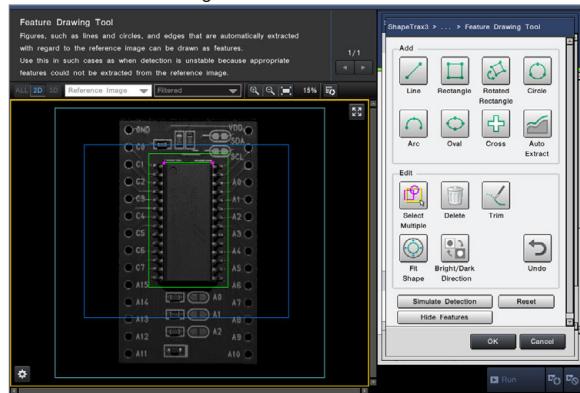


- This tool cannot be used simultaneously with [Eraser Tool].
- It cannot be used simultaneously with the "Mask Region".

Drawing a feature directly

If the feature cannot be extracted as expected, the feature that should be extracted can be directly drawn while viewing the image of the background.

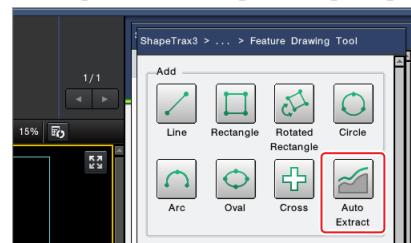
Click the button in the [Add] field and draw the feature using a graphic such as a line or rectangle.



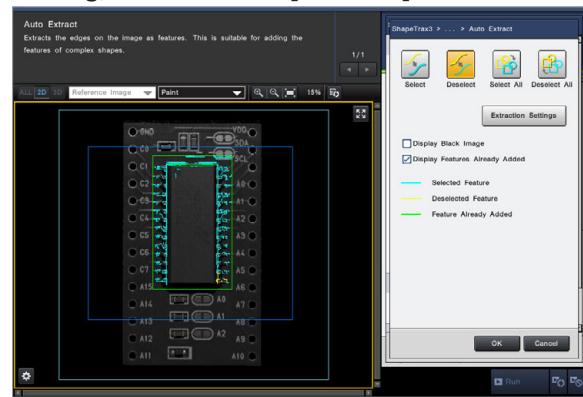
Correcting and using a feature extracted from the image

If drawing a feature using a graphic is difficult on a work shaped with difficult contours, it can be registered by correcting the feature extracted from the image.

1 Click [Auto Extract] in the [Add] field.



2 Choose the unnecessary features among the features automatically extracted from the image such as by encircling them as a region using click or drag, and then click [Deselect].



- If you accidentally deleted any necessary features, click [Select] to restore the features.
- Select the [Display Black Image] check box to make the background turn into a black image and editing of features easier.
- Select the [Display Features Already Added] check box to show features added before displaying the auto extract dialog in green. Switch between display/hide to easily distinguish features that you are trying to add using auto extract.
- Click [Extraction Settings] > [Paint] to paint the pixels in the luminance range at the specified position with the specified color (black, gray or white). You can extract features by painting some of the locations with low contrast and whose features were not extracted, or un-extract features by painting locations where unnecessary features were extracted. Click the position to be painted on the image and then adjust the maximum and minimum tone values in the painting range.

3 After completing the correction, click [OK].

Using other functions

Trim

Delete unnecessary parts of features by dragging the mouse to trace.

Bright/Dark Direction

You can specify the brightness direction (bright → dark, dark → bright) on the features created using the feature drawing tool and make the search stable.

Setting the brightness direction automatically

Automatically get the brightness information of directly drawn features and near features based on the standard image.

Setting the brightness direction to both directions

Set brightness information near all features to both directions.

Individual setting

Specify the brightness information (single direction, two directions) per feature manually.

Fit Shape

Automatically adjust the position of the directly drawn feature using the edge of the standard image as the standard.

Simulate Detection

Can verify if it can be stably detected using the created shape. The detection settings changed during verification is reflected as is on the settings of the tool.

Multi-region Mode

(Set Multi-regions as Measurement Regions)

With a multi-region mode enabled tool, more than one measurement region can be set and the measurement results for each region can be output and determined.

The detection conditions and judgment conditions can be common by measurement region, or can be specified individually for each region. 32 measurement regions at a time can be setup to support multi-product development and multi-point measurement.

Reference When using the same filter in multi-regions, you can specify the zero plane by using [Zero Plane of Other Tools], and select the [Also Refer to Preprocessing] check box to shorten the processing time.

Multi-region mode support tools

✓: Supported ✗: Not supported

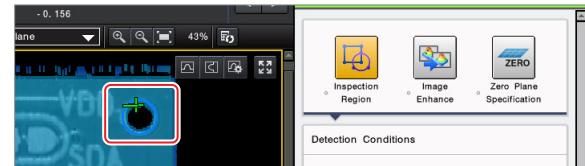
Tool	Multi-region mode support possible/not possible
Height measurement	✓
Trend Height Measurement	✗
Profile Measurement	✗
Continuous Profile Measurement	✗
Free Multi-Point Height Measurement	✗
Arranged Multi-Point Height Measurement	✗
Area	✓
Pattern Search	✗
ShapeTrax3A	✗
PatternTrax	✗
Edge Position	✓
Edge Angle	✓
Edge Width	✓
Edge Pitch	✓
Edge Pairs	✓
Defect	✓
Blob	✓
Grayscale Blob	✓
Profile Position	✗
Profile Width	✗
Profile Defect	✗
Intensity	✓
OCR2	✗
1D Code Reader	✗
2D Code Reader	✗
OCR	✗
Image Region Generator	✗

Enabling multi-region mode for the specified tool

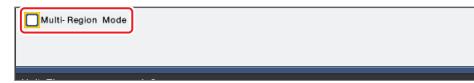
Use the following procedure to create multiple regions with the figure region (rectangle/rotated rectangle, circle, oval, circumference, arc and polygon) selected as the region type tool.

Tools With [Figure Region] Selected in [Region Type]

1 Create 1 figure region.



2 Select the [Multi-Region Mode] check box at the top of the screen.

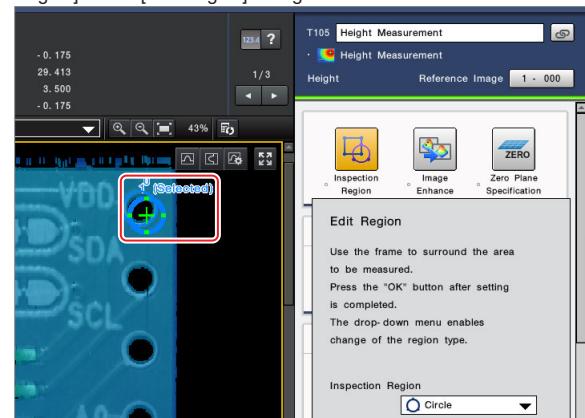


The mode will switch to Multi-Region Mode.

3 Click [Add] to add measurement regions.



A region of the same shape as the first region is added and the [Edit Region] dialog box will appear. The shape of the added measurement region can be changed in [Inspection Region] on the [Edit Region] dialog box.



4 When the added measurement region editing is complete, click [OK].

5 If necessary, repeat steps 3 and 4 to add additional measurement regions.

- When a region is added it is assigned a region number each time one is added. Individual regions can be switched by selecting the region number at the top of the screen.
- You can also bulk-move, resize, and align the regions added.
- Measurement results for each measurement region can be output and judged. In addition, you can share setting items such as detection conditions and judgment conditions, or set them individually.

"Communication/individualizing settings per region" (Page 3-28)

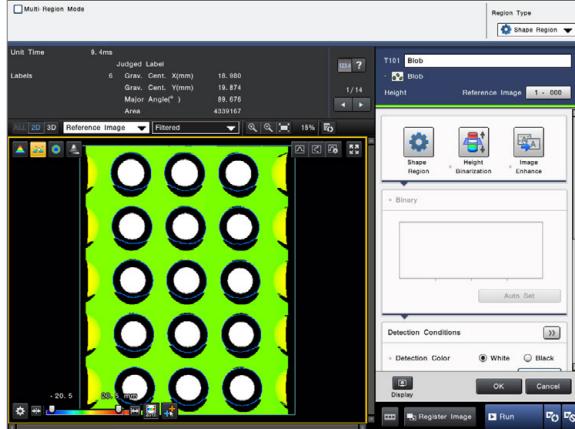
-
- Up to 32 measurement regions can be set.
 - To delete a region, select the region you want to delete, and then click "Delete".
 - If you set multiple regions and uncheck "Multi-Region Mode", all other regions will be deleted, leaving only the region with the smallest number.
 - You cannot change [Region Type] to [Shape Region] while in [Multi-Region Mode].

Tools With [Shape Region] Selected in [Region Type]

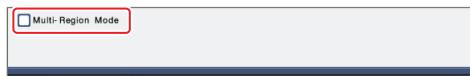
Use the following procedure to create multiple regions in the tool with [Shape Region] selected in [Region Type].

1 Set a shape region to create a state in which multiple regions can be extracted.

"Creating a Shape Region" (Page 3-31)

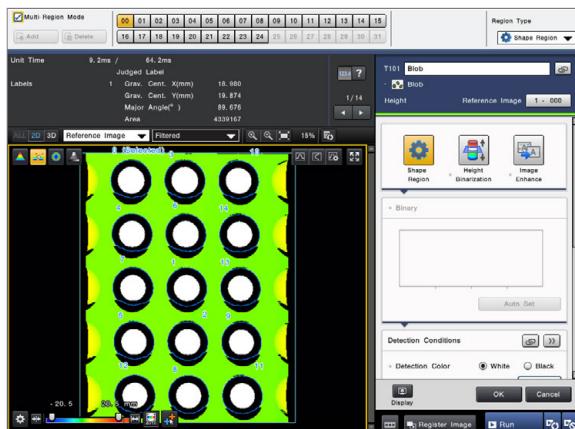


2 Select the [Multi-Region Mode] check box at the top of the screen.



The mode will switch to Multi-Region Mode.

A shape region consisting of multiple regions will be set as individual regions; and a region No. will be assigned to each region. Individual regions can be switched by selecting the region number at the top of the screen.



Each inspection region can output measurement results or be judged. Moreover, some settings items, such as detection and judgment conditions, can also be shared or set individually.

"Communication/individualizing settings per region" (Page 3-28)

- Point
 - Up to 32 measurement regions can be set.
 - To delete a region, select the region you want to delete, and then click [Delete].
 - If you clear the [Multi-Region Mode] check box after setting multiple regions, you will be returned to a single shape region.
 - You cannot change [Region Type] to [Figure Region] while in [Multi-Region Mode].

Batch adjustment of Regions (batch adjustment)

In multi-region mode, you can move, resize, and align multiple regions at once.



Batch adjustment is only available in [Multi-Region Mode] for [Figure Regions]. It is not available in [Multi-Region Mode] for [Shape Regions].

1 Then click [Batch Adjustment] at the top of the screen.



2 Click the button of the content you want to adjust.



"Move Regions" (Page 3-26)

"Resize Regions" (Page 3-27)

"Align Regions" (Page 3-27)

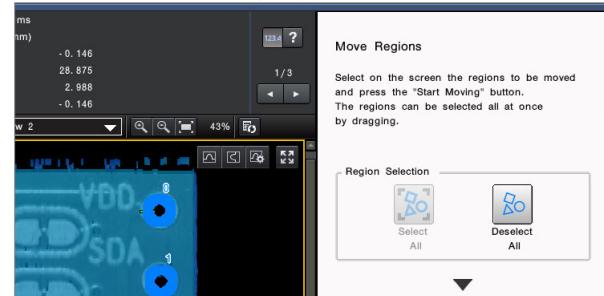
3 Once adjustment is complete, click [Close].

Move Regions

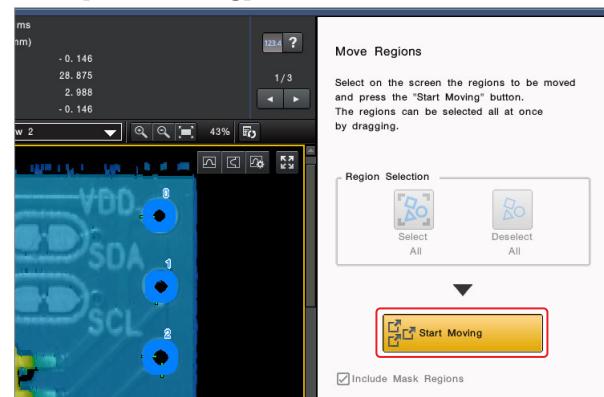
You can move the selected measurement regions in batches.

1 Select the region you want to move.

If you want to move any region, click "Deselect All" to clear the selection, and then click to select the region you want to move on the data screen.



2 Click [Start Moving].



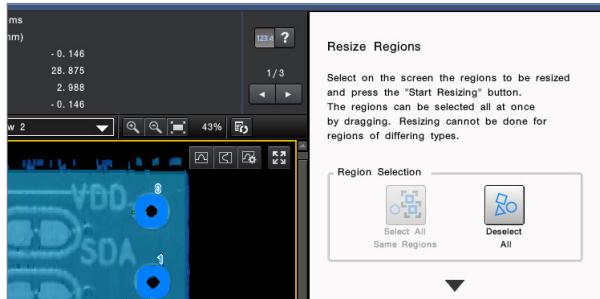
3 Drag the region on the image to move it.

4 When movement is complete, click [OK].

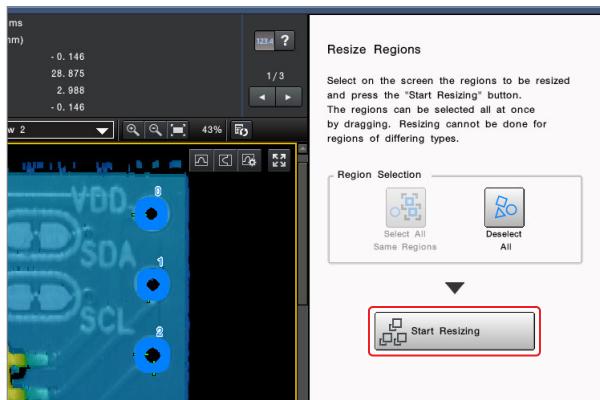
Resize Regions

You can resize selected measurement regions of the same shape in batches.

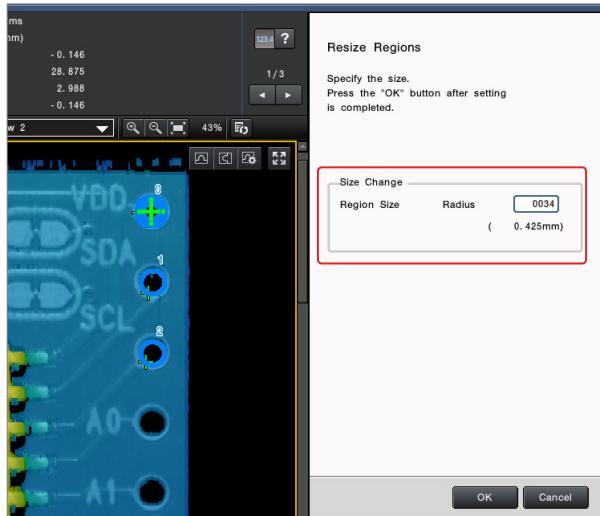
1 Select the region you want to resize.



2 Click [Start Resizing].



3 Click [OK] after resizing.

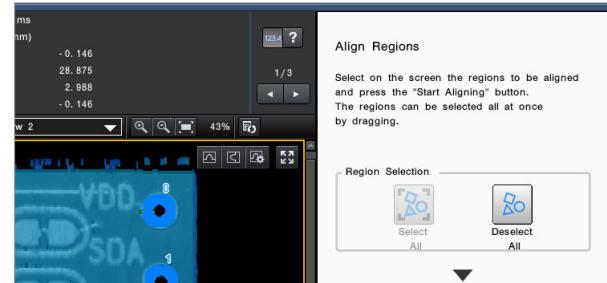


4 Click [OK].

Align Regions

Aligns the selected regions in a row.

1 Select the region you want to align.

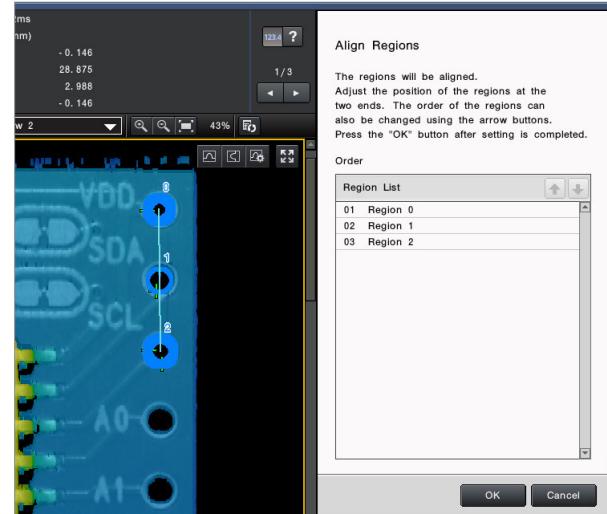


2 Click [Start Aligning].



3 If you want to move the aligned regions, drag the region on both sides of the region on the data screen.

You can also change the order of the regions in the dialog "Region List".



4 When alignment is complete, click [OK].

5 Click [OK].

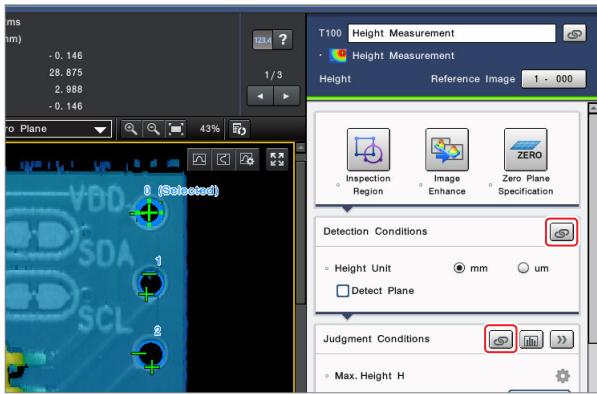
Communication/individualizing settings per region

You can set the tool name, detection condition, and judgment condition individually for each set region, and share it with other regions.



- To prevent mismatches in settings caused by setting changes when common settings are set, the combination of common and individual settings is limited in the detection condition and judgment condition.
 - If the shape of the measurement region is the same, a combination of detection condition: individual, judgment condition: common cannot be set.
 - If the measurement region is of a different shape, common settings are not possible.
- There is no limit to the communication/individual settings of tool names.

- Click on the button next to the tool name, detection conditions, and judgment conditions on the setting screen (): sharing settings, (): configuring individual settings).



- Select common or individual settings, and then click [OK].



If you select individual settings, you can set the detection condition and judgment condition for each region by switching the region No. at the top of the screen.

Judgment condition graph

You can check the judgment conditions set for each region in a graph display, and you can drag the upper/lower limit on the graph to change it. Also, it can be set in batches from the measurement values.

Checking the judgment condition of each region in the judgment condition graph

1 The judgment condition graph appears.

● Edit screen

Click in the [Judgment Conditions] field.



● Setup mode screen

Click at the bottom of the results data display area.

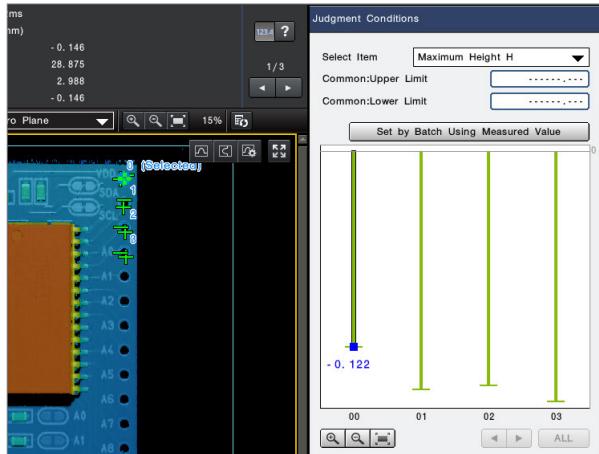


● Run mode screen

Click at the bottom of the results data display area.



2 Check [Judgment Condition Graph].



● Select item

For tools with multiple judgment items, you can switch between the judgment items.

● Upper/Lower:

If the setting of the judgment condition is common, the upper/lower common limit can be specified numerically in all regions. If the setting of the judgment condition is individual, the upper/lower limit can be specified numerically for each region.

The upper to lower limit range is represented by a blue band on the measurement graph. Drag the top and bottom edges of the blue band to change the upper/lower limit.

● Batch Setting Using Measured Value

By specifying the upper/lower offset value from the measurement value, the judgment conditions can be set in batches. For details, see "Setting judgment conditions from measurement values in batches" (Page 3-29).

● Measurement value graph

The measurement values for each region are listed in a graph. The graph is displayed in green if judgment is OK, and in red if judgment is NG. When you select a graph for each region, the measured values for the selected region are displayed. If the judgment condition settings are individual, you can set the judgment conditions of the selected regions.

● Operation buttons

- : Expands and reduces the measurement value graph scale.
- : Adjusts the scale so that the all of the largest graph of the measurement value graph is displayed.
- : If there are 8 or more regions setup, the measurement graph is displayed in multiple pages. Changes the page when the measurement graph is more than one page.
- ALL** : Displays the measurement graph for all regions on 1 page.

Setting judgment conditions from measurement values in batches

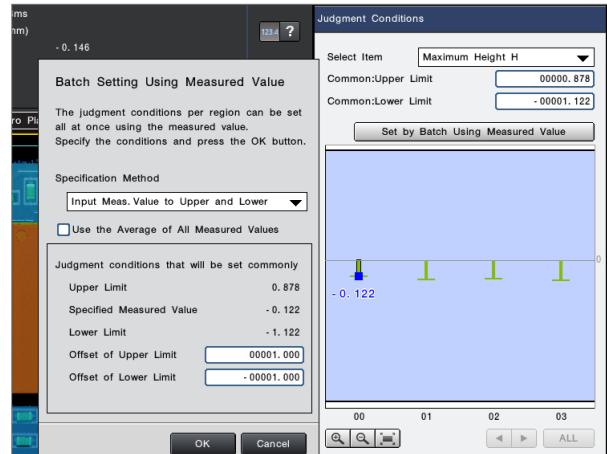
By specifying the upper/lower offset value from the measurement value, the judgment conditions upper/lower limit can be set in batches.

- If the judgment condition settings are individual, you can set the judgment conditions within the selected regions in batches.
- If the setting of the judgment condition is common, the upper/lower limit of all regions can be specified in batches.

1 Click [Batch Setting Using Measured Value].



2 Modify the settings as necessary.



● Specification Method

Select the judgment condition to specify.

○ Input Meas. Value to Upper and Lower

Select to specify a judgment condition for both upper and lower limits.

○ Enter measurement values in upper limits

Select to specify a judgment condition for upper limits.

○ Input Meas. Value to Lower

Select to specify a judgment condition for the lower limits.

● Measurement value to be specified will be the average value of the entire region

When enabled, the original measurement value is set as the average value of the entire region.

● Upper/Lower:

Displays the upper/lower limit set by the values specified in [Specified Measurement Value], [Offset of Upper Limit], and [Offset of Lower Limit].

● Specified measurement value

Displays the measurement value of the selected region, which is the upper/lower limit to be set. If [The measurement value to be specified will be the average value of the entire region] is valid, the average of the measurement value of the whole region is displayed.

● Offset of Upper Limit

Specify the upper limit value by the offset from [Specified measurement value].

● Offset of Lower Limit

Specify the lower limit value by the offset from [Specified measurement value].

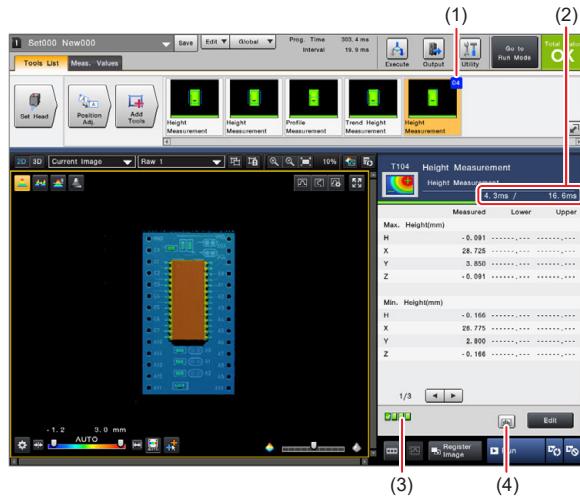
3 After completing the setting, click [OK].

The judgment condition is set in batches.

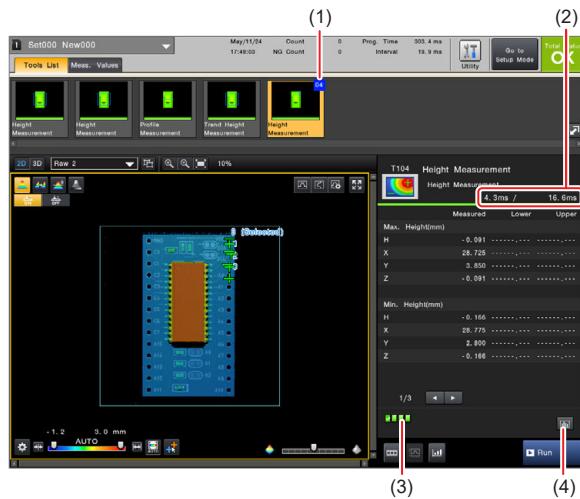
Screen display of information on multi-regions

With a tool that sets the measurement region in multi-region mode, you can see on the screen the number of regions that have been set and the specific information for each region.

Setup mode



Run mode



(1) Number of regions

The thumbnails on the toolbar display the number of regions that have been set.

(2) Measurement time

Displays the measurement time of the selected region.
[Measurement time of selected region] ms / [Total measurement time] ms

(3) Region changing:

You can change and display the measurement value of each region.

- █: Judgment OK region
- █: Judgment NG region
- █: Selected region

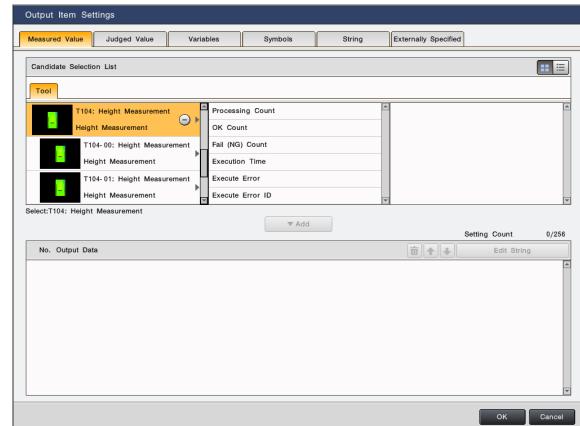
(4) Judgment condition graph

You can display "Judgment condition graph" (Page 3-29).
In operation mode, the judgment condition cannot be changed.

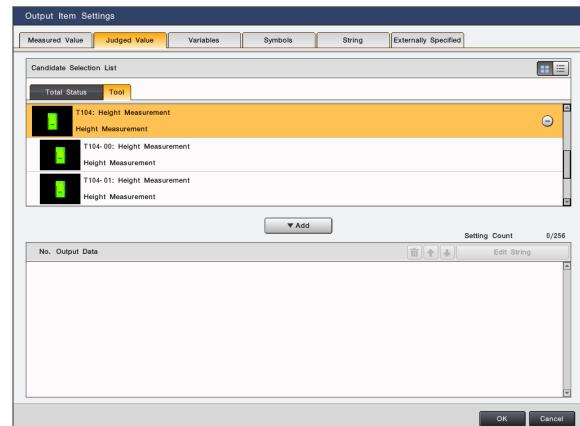
Multi-region output item settings (measured value and judged value)

As an output setting output item, measurement values and judgment values for each region can be selected.

Measured value



Judgment value



Creating a Shape Region

A shape region is created using the shape of a binary image acquired by converting a height image. It enables you to create regions matching the work shape. It is also useful when you wish to create a region with a complex shape.

Images That Can Be Used to Create a Shape Region

The images that can be used for creating a shape region are height images.

Creation Source Image	Availability
Height image captured using the LJ-S Series head	Supported
Grayscale image captured using the LJ-S Series head	Not supported

Tools Supporting Shape Regions

✓: Supported ✗: Not supported

Tool	Multi-region mode support possible/not possible
Height measurement	✓*
Trend Height Measurement	✗
Profile Measurement	✗
Continuous Profile Measurement	✗
Free Multi-Point Height Measurement	✗
Arranged Multi-Point Height Measurement	✗
Area	✓*
Pattern Search	✓
ShapeTrax3A	✓
PatternTrax	✓
Edge Position	✗
Edge Angle	✗
Edge Width	✗
Edge Pitch	✗
Edge Pairs	✗
Defect	✓*
Blob	✓*
Grayscale Blob	✓*
Profile Position	✗
Profile Width	✗
Profile Defect	✗
Intensity	✓*
OCR2	✗
1D Code Reader	✗
2D Code Reader	✗
OCR	✗
Image Region Generator	✗

Also supports "Multi-region Mode" (Page 3-25) for shape regions.

Creating a Shape Region

When adding a tool that supports shape regions, you will be able to use shape regions by selecting a height image as the measurement target image. You can create a binary image from the selected image and adjust the shape of the binary image to create a region.

Creating a Shape Region from Height Images

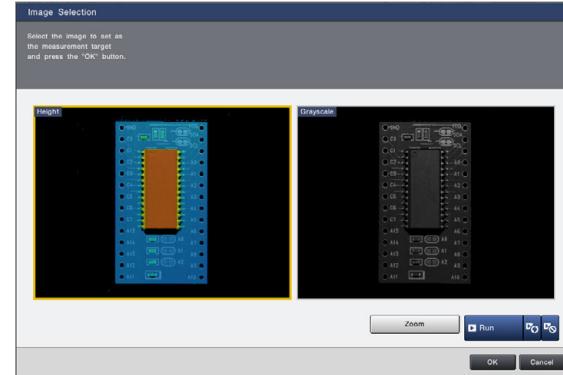


Shape regions can be used for both height and grayscale image inspection. Height image must be used for creating a shape region, even if the inspection is for grayscale image.

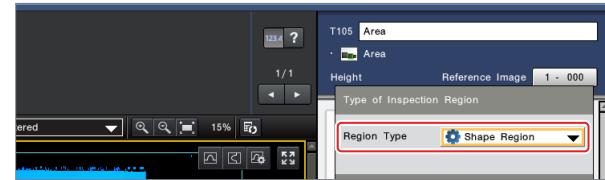
1 Add a tool that supports shape regions.

"Tools Supporting Shape Regions" (Page 3-31)

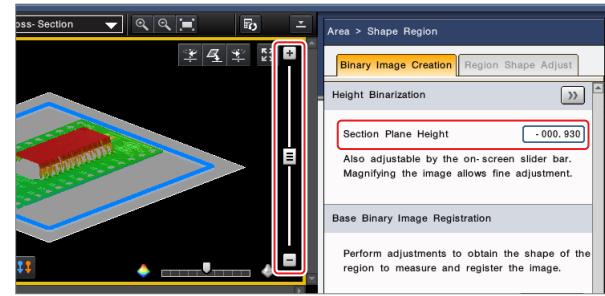
2 Select the image for inspection, and click [OK].



3 Select [Shape Region] in [Region Type] and click [OK].

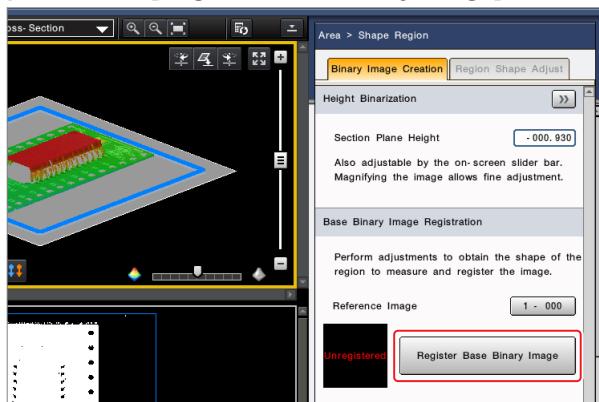


4 Enter a numeric value in [Section Plane Height (mm)], or adjust the section plane using the slider bar on the right side of the 3D display in such a way that the shape will be the shape to make into a region.

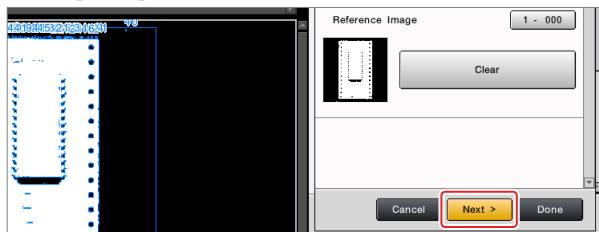


"Height Binarization" (Page 3-32)

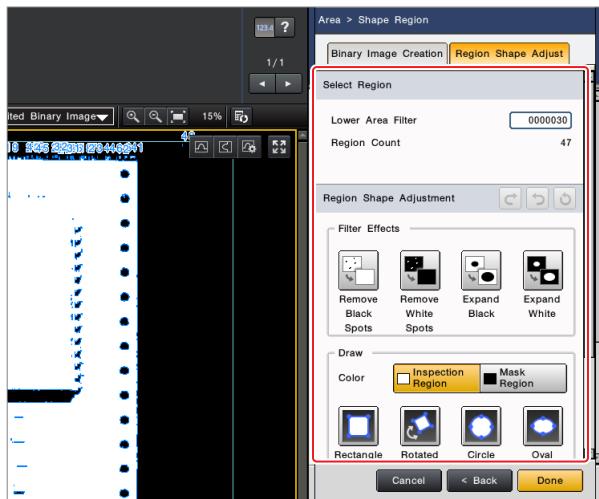
5 Once you have finished adjusting the section plane, click [Register Base Binary Image].



6 Click [Next].



7 Adjust the shape of the binary image.



- "Select Region" (Page 3-33)
- "Region Shape Adjustment" (Page 3-33)

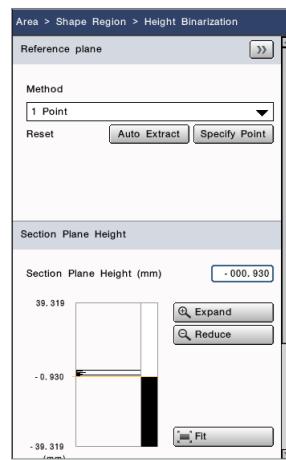
8 When adjustment is done, click [Done].

A confirmation message appears.

9 Click [OK].

A shape region has now been created.

Height Binarization



Extract reference plane

Method

Selects the method of extraction of the binarization section plane.

Specify 1 Pts.

Binarization will be performed on the plane that is parallel to the reference plane where the height of the specified point is its Z intercept. This plane does not change according to the current image.

Specify 3 Pts.

Binarization will be performed on the plane that is calculated using the three-dimensional information of the three specified points. This plane does not change according to the current image.

Real-Time (Plane)

Binarization will be performed on the plane that is the least square plane calculated from the three-dimensional information of the current image found in the set region.

Real-Time (Average Height)

Calculates the Z average of the input image within the specified region. Binarization will be performed on the plane that is parallel to the reference plane where the value that was calculated is its Z intercept.

Real-Time (Multiple Points)

Binarization will be performed on the plane that is the least square plane obtained from the average height data of each of the multiple points specified. A maximum of 10 points can be specified.

Real-Time (Free-form Plane)

Binarization will be performed on the curved plane that is estimated based on the extract size value.

Zero Plane of Other Tools

References the zero plane of other tools.

Detection Plane of Other Tools

References the detection plane of other tools.

Extraction Plane of Other Tools

References the extraction plane of other tools.

Auto Extract (1 Point and 3 Points Only)

- In the case of 3 Points, the binarization section plane is automatically extracted using [Real-Time (Plane)] with the [Extract Region] set to [Same as Insp. Region].
- In the case of 1 Point, the binarization section plane is automatically extracted using [Real-Time (Average Height)] with the [Extract Region] set to [Same as Insp. Region].

X Slope (3 Points Only)

Specifies the slope in the X-axis direction of the binarization section plane by the Z-direction slope amount per pixel (mm/pixel).

Y Slope (3 Points Only)

Specifies the slope in the Y-axis direction of the binarization section plane by the Z-direction slope amount per pixel (mm/pixel).

Extract Region (Real-Time (Plane), Real-Time (Average Height) Only)

Specifies an extract region separately when specifying the binarization section plane from a region other than the inspection region. The region specified here is used only for calculating the binarization section plane.

Mask Region (Real-Time (Plane), Real-Time (Average Height) Only)

Use a mask region to hide sections that you do not want to include in the calculation of the binarization section plane. The mask region specified here is used only when calculating the binarization section plane.

● Selection Size (Real-Time (Multiple Points) Only)

Specifies the acquisition range for the Z coordinate of each point. The Z coordinate of each point is the average of the Z coordinates found within the specified range.

● Extract Size (Real-Time (Free-form Plane) Only)

Specifies the size of the high and low parts to be extracted. As the extraction size gets smaller, tracking to steep curvatures increases, and more minute protrusions are extracted (however, the processing time becomes longer).

● Direction (Real-Time (Free-form Plane) Only)

Specifies the extraction direction of the binarization section plane.

● Referenced Tool (Zero Plane of Other Tool, Detected Plane of Other Tool, Extract Plane of Other Tool Only)

Selects a tool for referencing planes.

■ Section Plane Height (mm)

● Section Plane Height (mm)

Specifies the height of the binarization section plane. The part which the section plane cuts across will be binarized. The height can also be adjusted by using the slider bar on the 3D display. Finer adjustments can be made by zooming in.

● Make Specified Height and Up Black

(Not available with Real-Time (Free-form Plane))

Use this when you wish to make black the part that is in a position that is higher than the binarization section plane. When this is enabled, the pixels that are between the section plane and the specified height in the Z direction measurement range are made white.

● Offset from Section Plane Height (mm)

(Not available with Real-Time (Free-form Plane))

Makes the part that is higher than the specified height black. Specify the height from the binarization section plane.

● Reset

The height binarization settings will be reset to defaults.

● Copy Setup

Copy and set the height binarization settings already configured in another tool.

Select Region



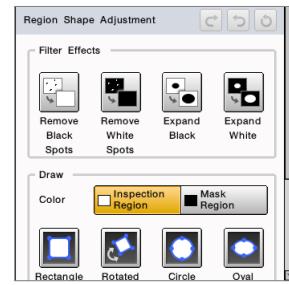
● Area Filter Lower Limit

Retains only the regions that are larger than the specified value. Set it to a large value when you wish to collectively delete small regions.

● Number of regions

Displays the number of regions that are created.

Region Shape Adjustment



● Filter Effects

Apply a filter to the binary image to adjust the outline.

● Remove Black Spots

Removes the black pixel noises. Applies the Remove Dark Noise filter on the binary image.

● Remove White Spots

Removes the white pixel noises. Applies the Remove Bright Noise filter on the binary image.

● Expand Black

Removes the white pixel noises by expanding the mask region. Applies the Shrink filter on the binary image.

● Expand White

Removes the black pixel noises by expanding the inspection region. Applies the Expand filter on the binary image.

● Draw

Draw white (inspection region) or black (mask region) on the binary image to adjust the region shape.

● Rectangle

Draws a rectangle in the specified color.

● Rotated Rectangle

Draws a rotatable rectangle in the specified color.

● Circle

Draws a circle in the specified color.

● Oval

Draws an oval in the specified color.

● Fill

Fills the area that was specified using the mouse. Select the color and then click on the screen. Multiple areas can be collectively filled by dragging.

● Freehand

Draws a line along the part traced using the mouse. Select the color and the thickness and then click on the screen.

● Reverse B&W

Use this when you wish to invert the black and the white of the binary image.

Position Correction Settings

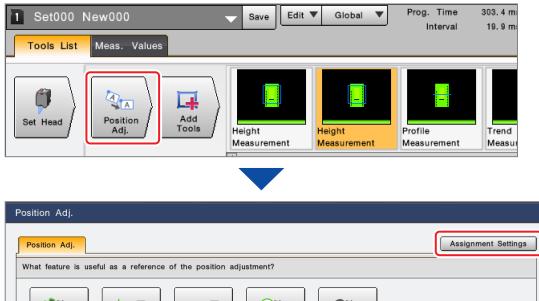
(Correcting the Position)

If the workpiece to be measured deviates with respect to the measurement area, the correction source tool measures the workpiece position and feeds back the position. By this correction processing, it is possible to move the position of the measurement area following the movement of the workpiece and measure correctly.

Reference If a tool is added using [Position Adj.] button, the following settings are unnecessary because the Position Correction settings are performed automatically.

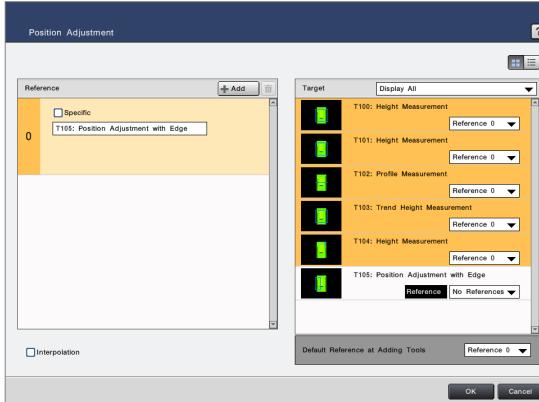
1 Create a tool to be the source of correction.

2 Click [Position Adj.] and then [Assignment Settings].



3 In the [Reference] field, select the tool to be the correction source.

If you check "Specific", you can correct misalignment of "X", "Y" and " θ " from the results of separate tools.



4 Select the correction source added in step 3 in the [Default Reference at Adding Tools] field at the bottom right of the screen.



After that, when a new tool is added, the added tool is set to be automatically corrected for mis-registration with the correction source set in step 4.

When setting the correction source individually for each tool

Click [+Add] for [Reference], add and set the position correction source, and then select the correction source for each tool in the [Target] field. If [Display only specified correction source] is selected from the drop-down menu [Target], only the tools related to the correction source selected in the correction source list will be displayed.

Interpolation

If the measurement area is fixed, even if the workpiece to be measured is slightly deviated, correct measurement will be difficult. In such a case, by specifying the correction source tool as a reference so that the measurement can be correctly performed, the measurement area position of the tool registered as the correction destination is corrected based on the positional deviation information of the correction source tool. This function is called misalignment correction function. In this machine, in addition to batch correction in which only one correction source tool is specified and applied collectively to the correction destination tool, individual correction to specify the correction source tool for each component (X, Y, θ) of positional deviation amount is possible. Enabling [Interpolation] suppresses distortion of the image and reduces the error of the measurement result of the correction destination tool. Interpolation processing can be enabled/disabled only for a grayscale image after height extraction or shading (contrast) image.

Tool available as reference

The below table indicates which tools can be specified as reference for position adjustment.

Tool (Reference tool)	Adjustment target	
Pattern Search	Position, angle	
ShapeTrax3A	Position, angle	
PatternTrax	Position, angle	
Edge Position	Position, angle	
Edge Angle	Center angle	
Defect	Grouping OFF	Position
	Grouping ON	Center of Gravity
Blob	Center of gravity, major axis angle	
Grayscale Blob	Center of gravity, major axis angle	
Profile Position	Circle/Line detection OFF	Position, angle
	Circle detection ON	Detection Circle Center
	Direct line detection ON	Line center, line angle
Profile Defect	Defect position, defect angle	
1D code reader, 2D code reader	Position, cord angle	
Mathematical Operations	ANS 0 to 2*	
Line Passing Two Points	Line center, line angle	
Bisection of Two Lines	Midpoint of Bisection, median angle	
Angle Between Two Straight Lines	Two Lines Intersection, best fit line 1 angle	
Line/V-Line Intersection	Intersection, line angle	
Two Lines Intersection	Intersection, best fit line 1 angle	
Center of Quadrangle	Center, best fit line 1 angle	
Midpoint of Points	Midpoint, line angle	
Circle Passing Three Points	Detection Circle Center	

*ANS0 is X, ANS1 is Y, and ANS2 is θ operation.

Managing Program Settings

Describes management method of saving, copying, deleting, importing/exporting, program editing, etc. of program settings.

- Reference For details on how to add new program settings and switching methods, refer to the following:
- "Adding new program settings" (Page 3-14)
 - "Changing to existing program settings" (Page 3-14)

Saving a setting

- 1 Click [Save] on the top left of the screen.**

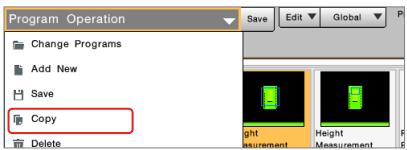


- 2 Click [OK].**

Settings are saved.

Copying a setting

- 1 Click [Program Operation] > [Copy].**



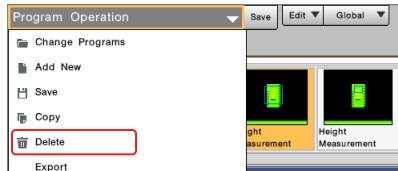
- 2 Select the copy source and copy destination inspection settings, and then click [Execute].**



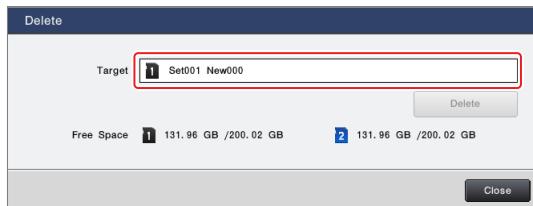
The program setting is copied.

Deleting a program

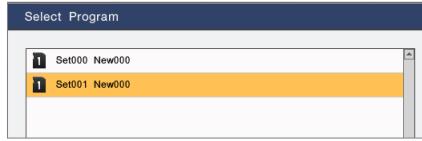
- 1 Click [Program Operation] > [Delete].**



- 2 Click [Target].**



- 3 Select the examination setting you want to delete, and then click [OK].**



Reference Currently active program settings cannot be deleted. To delete a program being edited at that point, change the program setting to a different one and then perform deletion.

- 4 Click [Delete].**

- 5 Click [OK].**

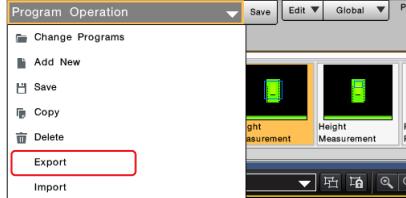
The program setting is deleted.

Writing settings to SD card

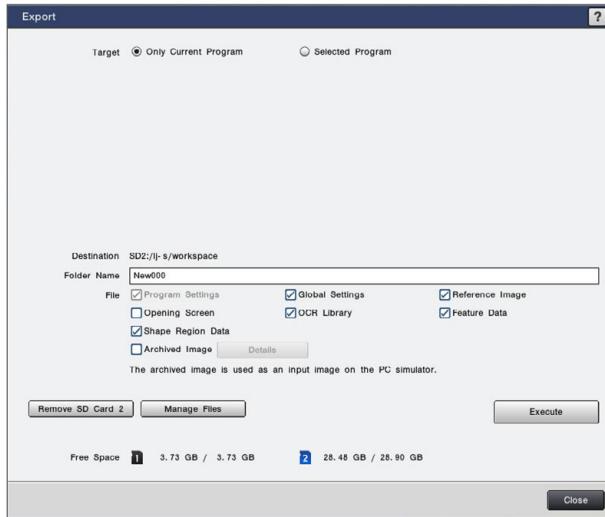
The test settings can be exported to an SD card and saved as a backup.

- Point** Do not use with third-party SD cards. Doing so may result in data loss or setting data damage.

1 Click [Program Operation] > [Export].



2 Specify the program setting and the target data for export.



● Program Settings

Program setting file (inspect.dat) including tools.

● Global Settings

Environment setting data (env.dat) such as input/output.

● Reference Image

This is the standard image (ref*.bmp).

● Opening Screen

Image data (Logo.bmp) of screen displayed at start-up.
For details, refer to "To change the opening screen displayed at the start-up" (Page 3-11).

● OCR Library

Dictionary data used by the OCR/OCR2 tools (dic*.dat).

● Feature data

Feature data (STF.tbd) for use with the ShapeTrax3A tool.

● Shape Region Data

The shape region data (RGN_SHP.dat) that has been created as the inspection region.

● Archived image

Exports images by specifying the number of images from the latest archived images (only when the export target is [Only Current Program]). You can also output archived images to [OK] or [NG] folder according to the total status.

3 Click [Execute].

Executes the exporting process.

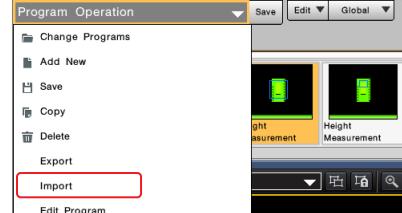
- Reference** For details, see the following.
- Remove SD card 2
 - "Remove External Media" (Page 7-35)
 - File Management
 - "Manage Files" (Page 7-32)

Loading settings from SD card

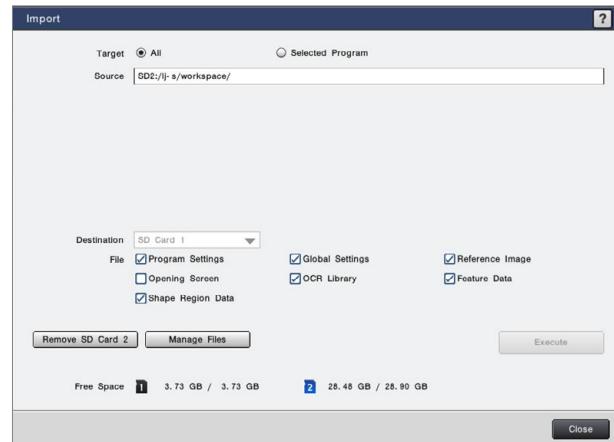
You can read the data exported by "Export" of this machine or [Export] of PC application (LJ-S Series Simulation-Software).

- Point** Do not use with third-party SD cards. Doing so may result in data loss or setting data damage.

1 Click [Program Operation] > [Import].



2 Specify the program setting and the target data for import.



3 Click [Execute].

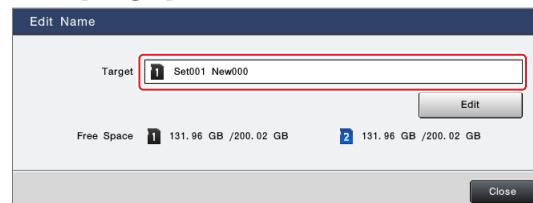
Executes the importing process.

Renaming a program

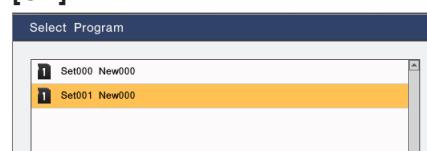
1 Click [Program Operation] > [Edit Program].



2 Click [Target].



3 Select the program setting to rename and click [OK].



4 Click [Edit] and enter a name.

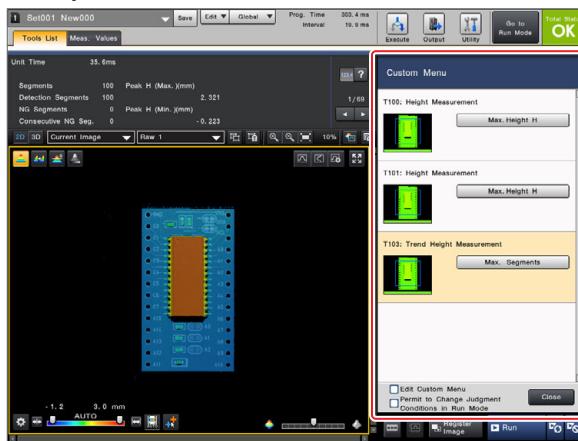
Custom Menu

Overview of custom menu

When parameters of each tool are registered in the custom menu, access to the frequently edited item can be easily gained.

With combination of Account Settings (page 8-17), the setting items that can be changed by an operator are limited to the custom menu items. It can be used in various ways.

Example of custom menu



Types of setting items that can be registered in the custom menu

The following items can be registered:

- Tool setting items
- Some of the setting screens included in tools
- Tool itself

Number of items that can be registered in the custom menu

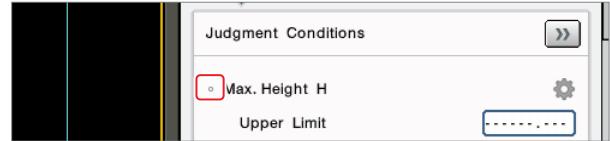
A maximum of 100 items can be registered in the custom menu.

Creating a menu that collected only necessary items

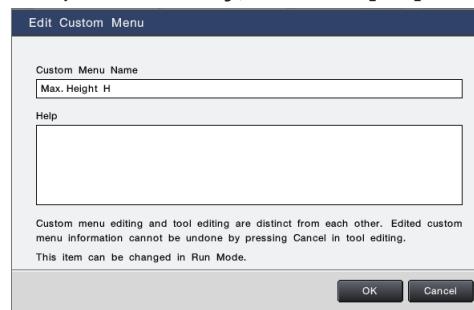
Registering items in custom menu

1 In Setup Mode, open the screen of the desired item to register in the custom menu.

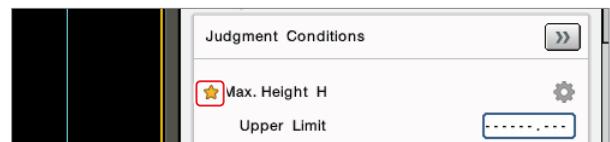
2 Click [✓] at the left of the item name.



3 Input the [Custom Menu Name] and [Help] (explanation displayed at selection of the menu item) as necessary, and click [OK].



When [✓] displayed before the item name selected in Step 2 is changed to registration is completed.



When registration in the custom menu is completed, the custom menu button is displayed on the right of the tool bar.



From the setting screen of the custom menu, judgment condition items which are not set cannot be made valid. When registering a judgment condition item in the custom menu, set the upper or lower limit in advance.

Using custom menu

1 Click [Custom Menu] on the right of the tool bar.

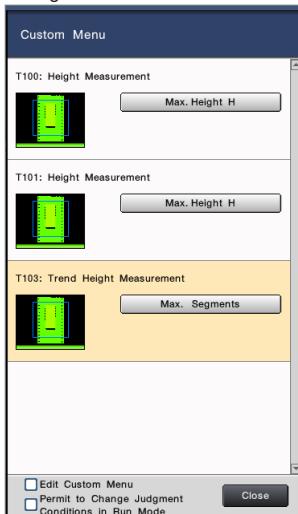


When the account is [User], it is not displayed.

"Set Account" (Page 8-17)

2 Click the desired item for adjustment.

The adjustment screen appears. Make adjustments similar to normal tool settings.



If [Help] is input during registration of the custom menu, click [?] displayed on the menu item. The items input as Help appear.

To use the custom menu in run mode

Check the [Permit to Change Judgment Conditions in Run Mode] at the bottom of the custom menu to allow the custom menu to be used in run mode.



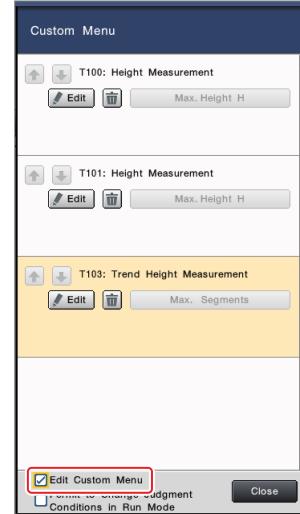
The only custom menu functions that can be used in run mode are adjusting the judgment conditions. The contents of the custom menu cannot be edited.

Editing custom menu

Custom menu details including change of display sequence on the custom menu can be edited.

The custom menu cannot be edited only if the account is [Admin].

1 Put a check mark on [Edit Custom Menu] at the lower part of the custom menu.



2 Edit the custom menu as necessary.

- Changing display sequence of the items in the tool**
Click or .
- Changing menu item name or Help**
Click [Edit] of the desired item for change.
- Deleting item**
Click of the items to delete.

3 After setting, uncheck [Edit Custom Menu].

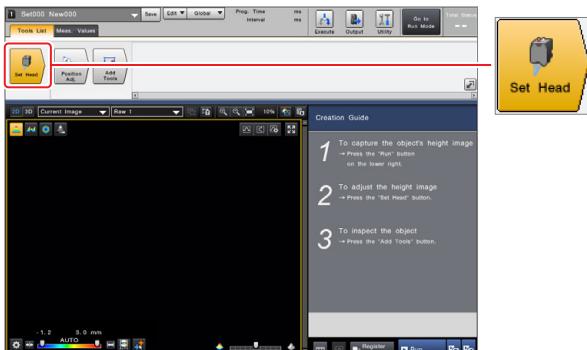
Chapter 4 Head Settings

Head Settings.....	4-2
Head.....	4-3
Capture Settings.....	4-6
Correction Settings	4-10
List of Settings.....	4-15
Speed Up	4-16

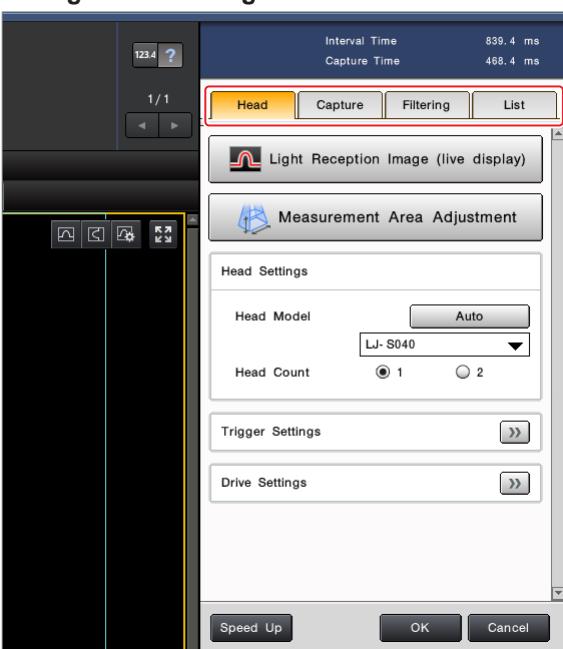
Head Settings

Configuring the Head Settings

1 Click [Set Head].



2 Configure the settings for the head.

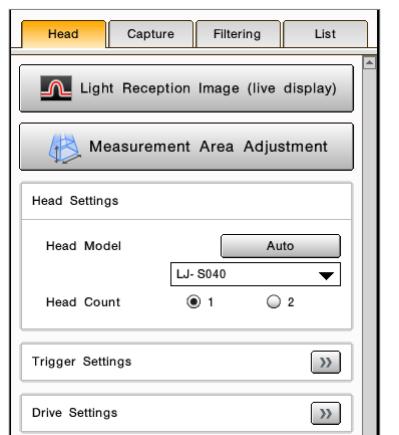


- "Head" (Page 4-3)
- "Capture Settings" (Page 4-6)
- "Correction Settings" (Page 4-10)
- "List of Settings" (Page 4-15)
- "Speed Up" (Page 4-16)

3 After completing the settings, click [OK].

Head

Configure the head settings.



- "Light Reception Image (live display)" (Page 4-3)
- "Measurement area adjustment" (Page 4-4)
- "Head Settings" (Page 4-5)
- "Trigger Settings" (Page 4-5)
- "Drive settings" (Page 4-5)

Light Reception Image (live display)

You can view the laser light reflected off of the target.

1 Click [Light Reception Image (live display)].



The received image is displayed.

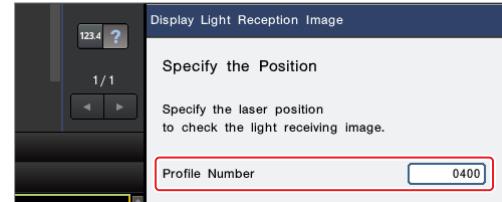


A laser is emitted on to the target and the reflection is captured by the sensor. If the profile of the target is not displayed, adjust the distance of the head relative to the target until the profile is appears.

2 Specify the point at which you want to check the received image.

Profile Number

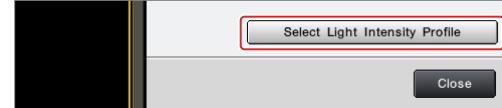
You can change the position of the emitted laser by specifying a profile number.



-
- By default, the laser emits perpendicularly downward.
 - If [Profile Number] is set to 1, the laser emits at the top of the 2D screen. If it is set to the maximum value, the laser emits at the bottom of the screen.

Select Light Intensity Profile

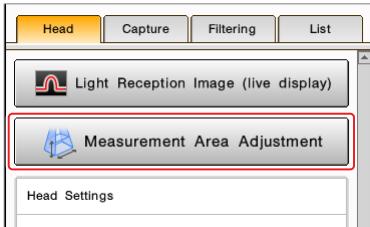
You can specify a profile position by clicking a point on the 2D screen.



Measurement area adjustment

Adjust the workpiece position and measurement area such that the object to be measured fits within the area.

1 Click [Measurement area adjustment].



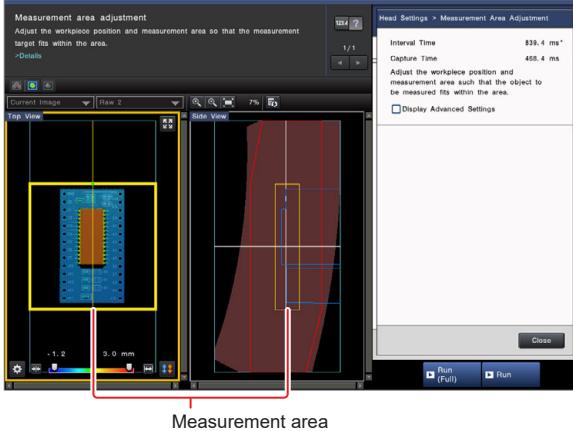
2 Click [OK] on the [Notice] screen.

3 Click [Run] or [Run (Full)] to capture an image of the measurement target.



4 Adjust the workpiece position and measurement area such that the object to be measured fits within the area.

Select [Top View] or [Side View] and adjust the position of the workpiece so that it fits within the measurement area (yellow frame).



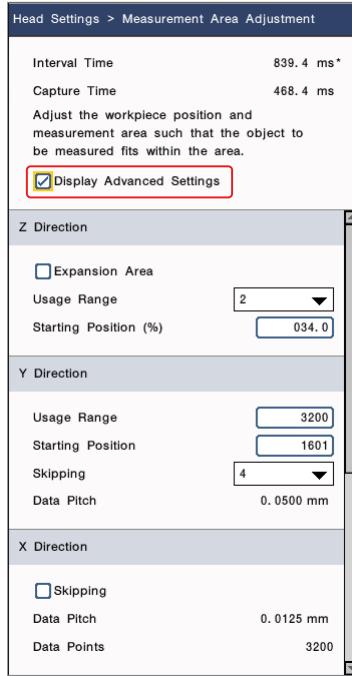
○ Changing the size

Drag and drop a side or an angle of the rectangle.

○ Moving the position

Drag and drop the inside of the rectangle.

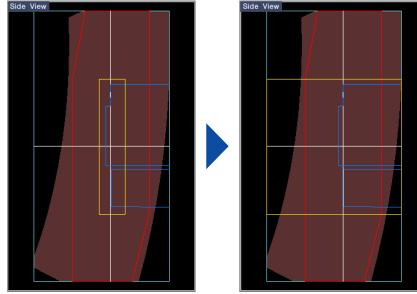
5 Configure the advanced settings as required.



● Z Direction

○ Expansion Area

The measurement area in the Z-direction can be extended to the entire area.



When [Expansion area] is enabled, the [Usage Range] and [Starting Position (%)] settings are not applicable.

○ Usage Range

This can be set when wide imaging mode is turned off. Select the Z range from [0 (wide)] to [10/11/12 (differs by head)]. Narrowing the measurement range enables the capture time to be decreased.

○ Starting Position (%)

Specifies the starting position for the Z range with a number.

● Y Direction

○ Usage Range

Sets the use range in the Y direction. Narrowing the measurement range enables the capture time to be decreased. Keyence recommends using near the center for accuracy and speed.

○ Starting Position

Sets the start position for the Y direction using a line number.

○ Skipping

Selects the skipping interval relative to the number of lines before Y skipping.

○ Data Pitch

Displays the Y data pitch.

● X Direction

○ Skipping

You can change the interval at which measurement data is acquired. Turning ON reduces head processing time, controller processing time, and image storage time, but it coarsens the data interval.

○ Data Pitch

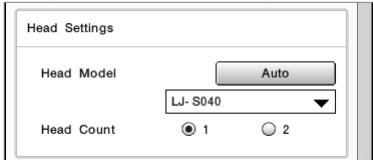
Displays the X data pitch.

○ Data Points

Displays the X data points.

Head Settings

Configure the connected head type.



● Head Model

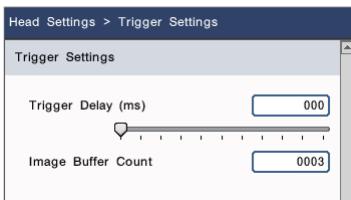
Select a head type.
Clicking [Auto] will automatically recognize the head type and number of heads.

● Head Count

Select [1] or [2] according to the number of heads connected.

Up to two heads of the same model can be connected.

Trigger Settings



● Trigger delay

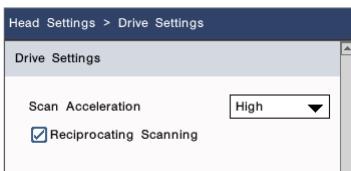
Sets the trigger delay time when starting the capture image.
If you connect two heads and enable [Specific] for each head, you can specify different trigger delay times individually for head A and head B.

Use this setting to specify different capturing start times for head A and head B to suit the application or reduce interference between heads.

● Image Buffer Count

Set the number of times of capture to secure as a buffer for prior capture.

Drive settings



● Scan Acceleration

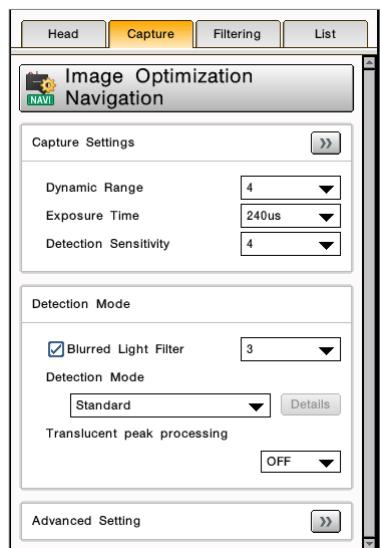
Sets the acceleration (High/Medium/Low) at the start/end of movement of the drive unit.
Setting low acceleration increases the capture time, but reduces the susceptibility to vibration.

● Reciprocating Scanning

Set to capture/not capture on both the outbound and inbound sides of the scan.
Turning this setting off increases the trigger interval length, but improves repeatability.

Capture Settings

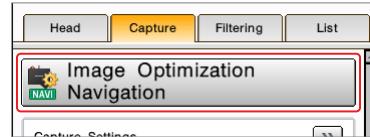
Configure the imaging settings.



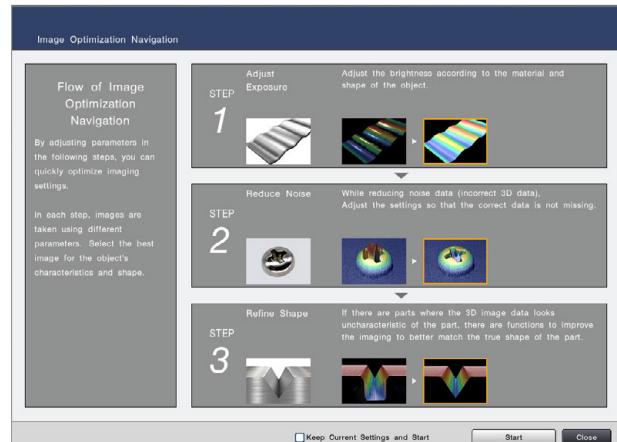
- "Image Optimization Navigation" (Page 4-6)
- "Capture Settings" (Page 4-8)
- "Detection Mode" (Page 4-8)
- "Advanced Setting" (Page 4-9)

Image Optimization Navigation

1 Click [Image Optimization Navigation].



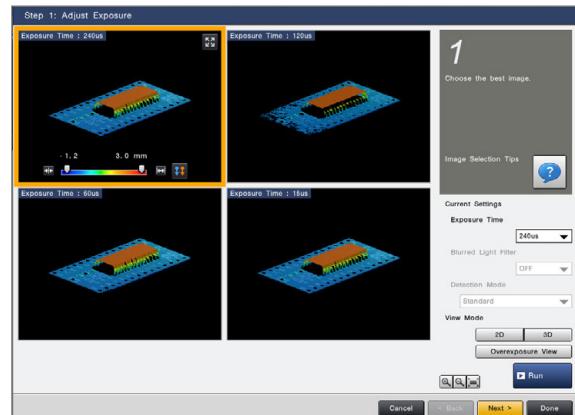
2 Check [Flow of Image Optimization Navigation] and then click [Start].



3 Perform [Step 1: Adjust Exposure].

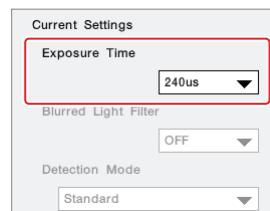
Adjust [Exposure Time] to a suitable brightness according to the material and shape of the object.

From the four candidates, select the image closest to the shape of the actual object.



The exposure time according to the selected image appears.

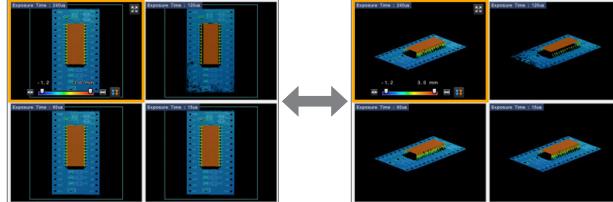
When any exposure time is selected, an image is captured at the selected exposure time and the display is updated to that image.



● View Mode

○ Switching between 2D and 3D display

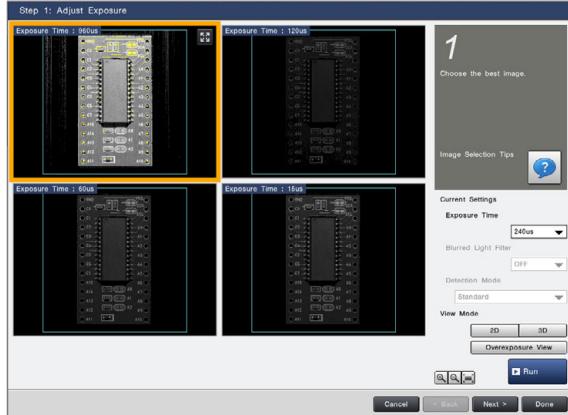
When configuring settings in the Easy Navigation for Image Capture Settings, you can switch the display of the height image (2D/3D).



○ Overexposure View

Selecting [Overexposure View] switches to the luminance image, and the saturated points are displayed in yellow.

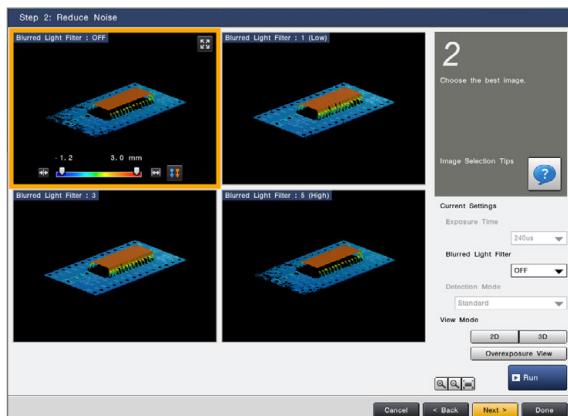
Select [Overexposure View] again to return to the original display.



4 Perform [Step.2 Reduce Noise].

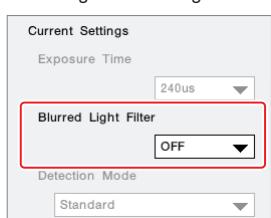
To reduce erroneous 3D data, add a blurred light filter.

From the four candidates, select the image closest to the shape of the actual object.



The blurred light filter strength (1-5) appears according to the selected image.

When any strength is selected, an image is captured at the selected blurred light filter strength and the display is updated to that image.

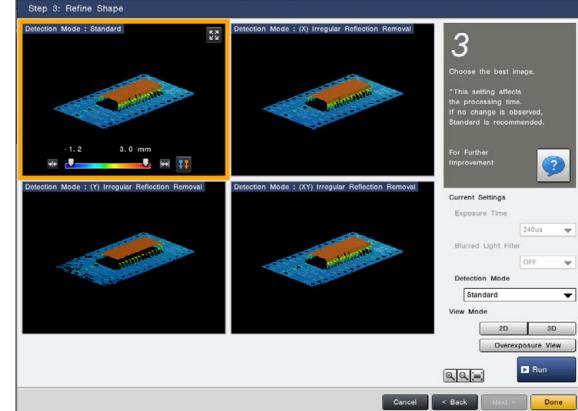


5 Perform [Step 3: Refine Shape].

Data close to the actual shape is obtained by suppressing the effects of multiple and diffuse reflections.

From the four candidates, select the image closest to the shape of the actual object.

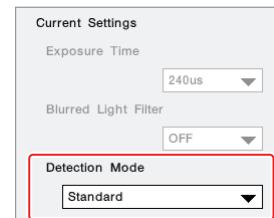
⚠ Point Select [Standard] (top left image) if it is not effective because it affects the processing time.



The peak type appears according to the selected image.

- Standard
- NEAR
- FAR
- (X) Irregular reflection removal
- (Y) Irregular reflection removal
- (XY) Irregular reflection removal

When any item is selected, an image is captured with the selected conditions and the display is updated to that image.

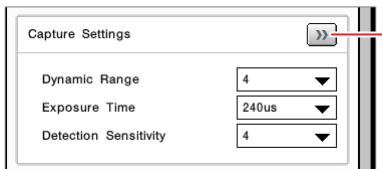


6 Configure the following settings as required.

- "Capture Settings" (Page 4-8)
- "Detection Mode" (Page 4-8)
- "Advanced Setting" (Page 4-9)

7 After the setup is completed, click [Done].

Capture Settings



Detailed settings

● Dynamic Range

Set [Dynamic Range] of the head capture sensor to between 1 and 9. A large value is useful if the difference in reflectance on the object is large. On the other hand, if you want to avoid false detections of weak light when there are multiple light reflections etc., setting the value low will aid in this.

● Exposure Time

Set the exposure time of the head capture sensor.
15μs / 30μs / 60μs / 80μs / 120μs / 160μs / 210μs / 240μs / 320μs / 380μs / 480μs / 640μs / 960μs / 1700μs / 4.8ms / 9.6ms

4.8 ms can be set only for LJ-S080.

● Detection Sensitivity

Set the threshold of received light amount to be detected as a peak. Higher values make it easier to detect as peaks. If you want to avoid false peak detections due to ambient light or multiple light reflections, set the value low. Set the head detection sensitivity between 1 (low) and 5 (high).

● Detailed settings

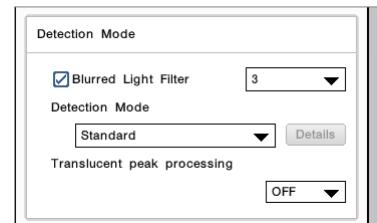
○ Laser Intensity Control

Sets the control laser light intensity (AUTO/MANUAL/SLOPE) and the upper/lower limit values of the control range (1 to 99).



[MANUAL] is the initial value for LJ-S015, LJ-S025, LJ-S040, and LJ-S080, and [SLOPE] is the initial value for LJ-S160, LJ-S320, and LJ-S640.

Detection Mode



● Blurred Light Filter

Select on or off for blurred light filter. If on is selected, set the strength of the blurred light filter to between 1 (weak) and 5 (strong).

Disturbance light and multiple reflection light are imaged as thick and dim light on the received image. Using this feature will not detect that dim light.

● Detection Mode

[Detection mode] sets which peak is selected when multiple peaks exist on the same X-coordinate.

○ Standard

Measure the peak with the maximum amount of received light.

○ NEAR

The peak which is closest to the head is measured.

○ FAR

The peak which is furthest from the head is measured.

○ (X) Irregular reflection removal ([Details] settings also available)

Preference is given to peaks with continuity in the X direction. Image compilation time is longer compared to Single capture/NEAR/FAR.

○ (Y) Irregular reflection removal ([Details] settings also available)

Preference is given to peaks with continuity in the Y direction. Image compilation time is longer compared to Single capture/NEAR/FAR.

○ (XY) Irregular reflection removal ([Details] settings also available)

Both (X) Irregular reflection removal and (Y) Irregular reflection removal are processed. Image compilation time is longer compared to other detection mode settings.

● Details

Click [Details] to set the details of [Irregular reflection removal].

○ Timeout (Irregular Reflection Removal)

Set the upper limit for irregular reflection removal processing time. If irregular reflection removal processing time exceeds the set value due to the state of the measured value, processing times out, and all data is invalidated.

○ (X) Irregular Reflection Removal : Intensity Filter

You can adjust parameters related to continuity in the X-direction. The closer to 3 (strong), the more continuity is judged as being present even in distant peaks.

○ (Y) Irregular Reflection Removal : Brightness Filter

If multiple peaks are detected, their brightnesses are compared, and if they differ by more than a certain amount, the darker peaks are excluded from the candidates. The smaller the value, the darker the peaks will remain.

○ (Y) Irregular Reflection Removal : Isolation Threshold

Sets the distance threshold to judge clumps as separated when recognizing peaks with continuity in the Y direction as a single clump. The greater the value, the more continuity is judged as being present even in distant peaks.

○ (Y) Irregular Reflection Removal : Cut Size

After separating peaks with continuity in the Y direction as a single clump, small clumps are judged as noise and removed. The larger the value, the bigger clumps will be removed.

○ (Y) Irregular Reflection Removal : Tilt Filter

After separating peaks with continuity in the Y direction as a single clump, clumps with a significant tilt are judged as noise and removed. The larger the value, clumps with a gentle tilt will be removed.

● Translucent peak processing

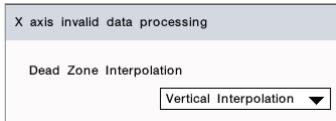
Select OFF/ON to disable/enable translucent peak processing.

If the object is translucent, light reflected from the surface of the object and light reflected from the inside of the object may both be received. In this case, the surface detected may be that of the inside of the target. Turning this function ON will help detect the reflection of the top surface.

Advanced Setting



● Detailed settings



○ Dead Zone Interpolation

Selects the processing method for the place that has become invalid pixels because the dead zone was caused in the measurement range due to the shape of the target.

- **OFF**
Does not interpolate blind spot data. A blind spot can be left as an invalid pixel.
- **Vertical Interpolation (default)**
Interpolate blind spot data horizontally from the nearest point.
- **Linear Interpolation**
Interpolate both ends of the blind spot data with a straight line.

Reference The blind spots at both ends in the X direction and the upper side in the Y direction are interpolated. Large blind spots on the lower side in the Y direction are not interpolated.

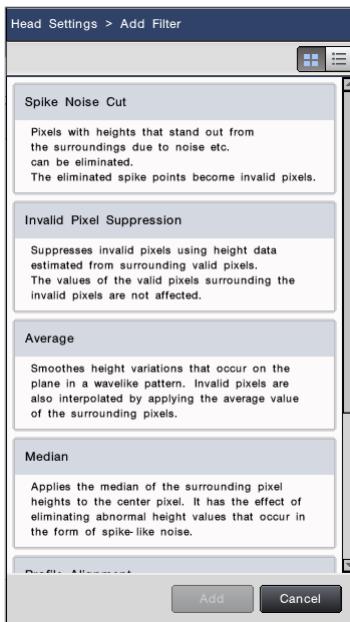
Correction Settings

Adding Height Image Filters

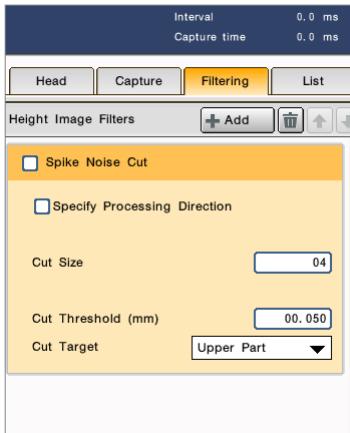
1 Click [Add].



2 Select the height image filter that you want to add, and then click [Add].



3 Configure the settings for the height image filter.



- "Spike Noise Cut" (Page 4-10)
- "Invalid Pixel Suppression" (Page 4-10)
- "Average" (Page 4-11)
- "Median" (Page 4-11)
- "Profile Alignment" (Page 4-11)
- "Dead Zone Noise Removal" (Page 4-15)

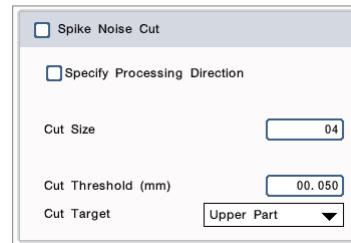
4 Repeat steps 2 and 3 to add a height image filter.



- When multiple filters are added, processing is performed sequentially from the top.
- You can change the order of the selected filters by clicking or .

Spike Noise Cut

When enabled, the pixels with prominent height due to noise, etc. can be removed. The removed protruding points become invalid pixels.



● Specify Processing Direction

If the processing direction is specified, place a check and then configure the processing direction in the [Processing Direction] field.

X

Eliminates continuous vertical protruding noise in the image, leaving continuous horizontal and protruding dots.

Y

Eliminates continuous horizontal protruding noise in the image, leaving continuous vertical and protruding dots.

XY individual

You can adjust the deletion size individually for each direction.

● Cut Size

Removes protruding noise below the specified size width.

● Cut Threshold (mm)

Removes the protruding points farther from the specified height with respect to the periphery as noise.

● Cut Target

Set the type of protruding point to be removed.

Upper Part

Removes only the protruding points that are high relative to the periphery.

Lower Part

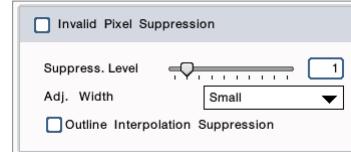
Removes only the protruding points that are low relative to the periphery.

Both

Removes both high and low side protruding points with respect to the periphery.

Invalid Pixel Suppression

When enabled, invalid pixels are suppressed with height data estimated from surrounding valid pixel values. Invalid pixel suppression does not affect the value of valid pixels around invalid pixels.



● Suppression Level

Specifies the suppression range of invalid pixels with an intensity (0: no interpolation to 9; a 10-step scale). The higher the intensity, the wider the range of invalid pixels can be suppressed.

● Adjustment Width

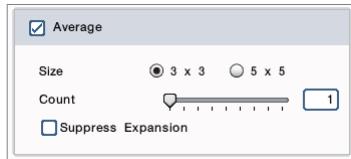
Selecting [Small] reduces the effect of the intensity, but allows you to fine-tune the degree of suppression of invalid pixels. The boundary between the remaining invalid pixels and valid pixels is as it is in [Small], and in [Big] interpolation is performed with invalid pixels at 0. (Default setting: Small)

● Outline Interpolation Suppression

Suppressing the contour of the height image from being fat by interpolation processing.

Average

When enabled, this setting smooths and stabilizes height variations that occur like undulations on a plane. Even for invalid pixels, it has the effect of interpolating by applying the average value of the surroundings.



● Size

Sets the filter size. 5×5 will be applied more strongly.

● Count

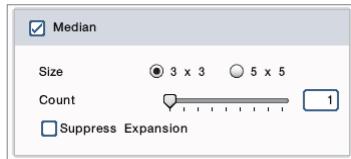
Changes the number of times the filter is applied.

● Suppress Expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Median

Applying the median of the heights of surrounding pixels to the center pixel has the effect of removing anomalous height values that occur like spike noise.



● Size

Sets the filter size. 5×5 will be applied more strongly.

● Count

Changes the number of times the filter is applied.

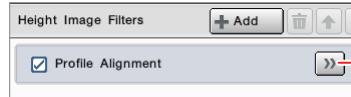
● Suppress Expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Profile Alignment

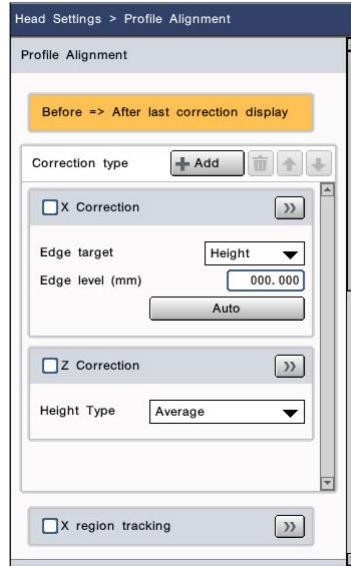
If this setting is enabled, it corrects deviation between the profiles of each line in the X, Z and θ directions. In an environment where the workpiece or head vibrates, the influence of vibration can be corrected.

1 Add [Profile Alignment] and then display the detailed settings.



2 Select [Correction type].

Select from the initial state of [X Correction] and [Z Correction]. You can also add [Theta Correction] and [Feature Correction] by clicking [Add].



- You can select multiple corrections as the correction process.
- When multiple correction processes are selected, the process is performed sequentially from the top.
- You can change the order of the selected correction process by clicking or .

3 Set [Correction type].

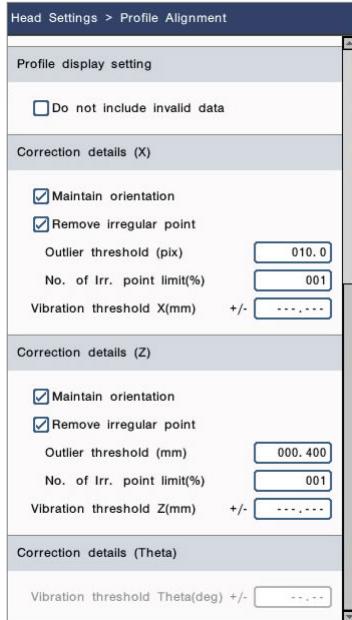
- "X Correction" (Page 4-12)
- "Z Correction" (Page 4-13)
- "Theta Correction" (Page 4-13)
- "Feature Correction" (Page 4-14)

4 Configure the detailed settings for [X region tracking].



"X region tracking" (Page 4-14)

5 Configure the following settings.



Profile display settings

Select the check box to not include invalid values.

Correction details (X)

Maintain orientation

Maintains the tilt in the Y direction of the detected edges.

Remove irregular point

Turning this option ON reduces effects caused by workpiece shapes such as burrs, noise or dust when calculating the degree of correction.

- **Outlier threshold (pix)**

A point is treated as an abnormal point when the deviation in the X direction of the previous and next profiles is larger than the specified number of pixels.

- **No. of Irr. point limit (%)**

If more than a set number of abnormal points accumulate, the cluster is treated as part of the intended workpiece shape, not abnormal points. Specify the maximum number of points to be treated as abnormal as a percentage of the number of points detected in the area.

Vibration threshold X (mm)

Set the maximum expected vibration. Lines where correction above this value is detected are treated as failed correction calculations and the value is interpolated from the previous and next correction values.

Correction Details (Z)

Maintain orientation

Maintains the tilt in the Y direction of the detected heights.

Remove irregular point

Turning this option ON reduces effects caused by workpiece shapes such as burrs, noise or dust when calculating the degree of correction.

- **Outlier threshold (mm)**

A point is treated as an abnormal point when the deviation in the Z direction of the previous and next profiles is larger than the specified number of pixels.

- **No. of Irr. point limit (%)**

If more than a set number of abnormal points accumulate, the cluster is treated as part of the intended workpiece shape, not abnormal points. Specify the maximum number of points to be treated as abnormal as a percentage of the number of points detected in the area.

Vibration threshold Z (mm)

Set the maximum expected vibration. Lines where correction above this value is detected are treated as failed correction calculations and the value is interpolated from the previous and next correction values.

Correction details (Theta)

Vibration threshold Theta (deg)

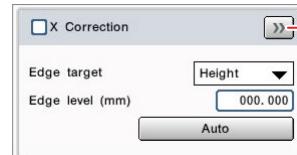
Set the maximum expected vibration. Lines where correction above this value is detected are treated as failed correction calculations and the value is interpolated from the previous and next correction values.

6 After completing the settings, click [OK].

Correction Method for Profile Alignment

X Correction

This method corrects position deviation in the X direction only, using the edges of the target object. The correction region of the edges is specified in a height image and the edge positions of the target for correction are detected.



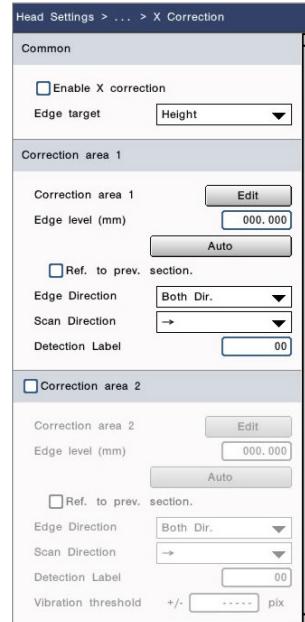
Edge target

Specify the target data (Height/Luminance) for edge detection.

Edge level

Set the height or luminance required for detection as an edge. This is set automatically if [Auto] is clicked.

X Correction: Detailed settings



Correction area 1

Correction area 1

The specified rectangular region is referenced at all times.

Ref. to prev. section.

If there is an object to correct Z (Z correction, correction, feature point correction) at the previous level, the edge level is treated as a value relative to the detected Z height. If there are multiple objects to correct Z at the previous level, the closest correction detection results are referenced. If there are no objects at the previous level, the edge level is treated as an absolute value.

Edge Direction

Specifies the profile change direction to be detected as an edge.

- **Both Dir.**

Both rising and falling are the measurement targets.

- **Rise**

Targets the direction crossing from bottom to top.

- **Fall**

Targets the direction crossing from top to bottom.

Scan Direction

Specify the direction for scanning for the edge within the measurement range.

Detection Label

Among the edge candidates that satisfy the conditions, specify the label to be selected, using a number.

Correction area 2

Correction area 2

When this option is enabled, another correction region can be added.

Vibration threshold

When two regions are set in the same line and there is at least a set difference between the correction values calculated for the two regions, one of the two will be judged as a detection of the intended workpiece shape or noise and the correction value will be calculated by interpolating from the previous and next correction values. Specify the maximum difference between the two vibration components treated as detected.

Z Correction

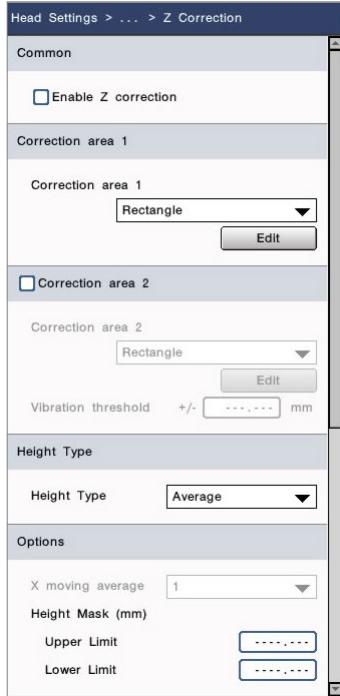
This method corrects deviation in the height (Z) direction only. The correction region of the height is specified in a height image and deviation in the height direction is detected.



Height Type

Select from Average, Peak or Bottom.

Z Correction: Detailed settings



Correction area 1

Set the region for calculating the amount of correction. Lines without an attached region are not corrected.

○ Rectangle

The specified rectangular region is referenced at all times.

○ Ref. to prev. section.

If there is an object to correct X (X correction, feature point correction) at the previous level, the shape of the correction area follows the X positions that are detected. The offset, width and upper and lower edge in the Y direction can be specified. If there are multiple objects to correct X at the previous level, the closest correction detection results are referenced.

○ Refer to X region tracking

The shape of the correction area follows the X positions detected by the X region tracing settings. The offset and width can be specified.

Correction area 2

When this option is enabled, another correction region can be added.

○ Vibration threshold

When two regions are set in the same line and there is at least a set difference between the correction values calculated for the two regions, one of the two will be judged as a detection of the intended workpiece shape or noise and the correction value will be calculated by interpolating from the previous and next correction values. Specify the maximum difference between the two vibration components treated as detected.

Options

○ X moving average

This can be set when the height type is Peak or Bottom. By applying a transfer average before calculating detection points, you can stabilize calculation results.

○ Height Mask (mm)

Heights outside the range specified here are eliminated when calculating the heights to be used as the correction target for each line profile.

Theta Correction

This method detects and corrects the tilt (θ angle) of each line profile. It also corrects deviation in the Z direction.

Set the reference for the tilts to be detected in "Correction standards". The correction region of the lines is specified in a height image and the tilt of the target for correction is detected.



Correction reference

Select the standard for detecting tilt.

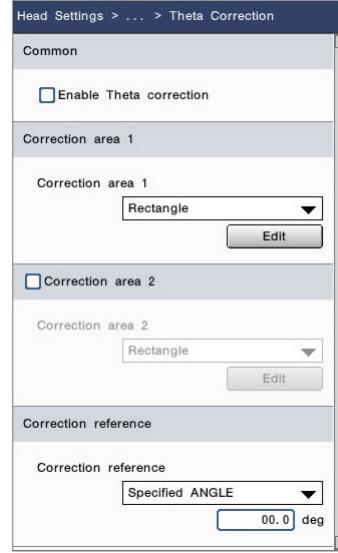
○ Specified ANGLE

Calculates the tilt relative to the specified angle. Specify 0° if you want the correction region to be horizontal.

○ Align with line-1

Calculates the tilt relative to the first profile for which tilt was detected.

Theta Correction: Detailed settings



Correction area 1

Set the region for calculating the amount of correction. Lines without an attached region are not corrected.

○ Rectangle

The specified rectangular region is referenced at all times.

○ Ref. to prev. section.

If there is an object to correct X (X correction, feature point correction) at the previous level, the shape of the correction area follows the X positions that are detected. The offset, width and upper and lower edge in the Y direction can be specified. If there are multiple objects to correct X at the previous level, the closest correction detection results are referenced.

○ Refer to X region tracking

The shape of the correction area follows the X positions detected by the X region tracing settings. The offset and width can be specified.

Correction area 2

When this option is enabled, another correction region can be added.

Correction reference

Select the standard for detecting tilt.

○ Specified ANGLE

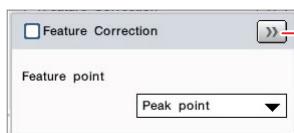
Calculates the tilt relative to the specified angle. Specify 0° if you want the correction region to be horizontal.

○ Align with line-1

Calculates the tilt relative to the first profile for which tilt was detected.

■ Feature Correction

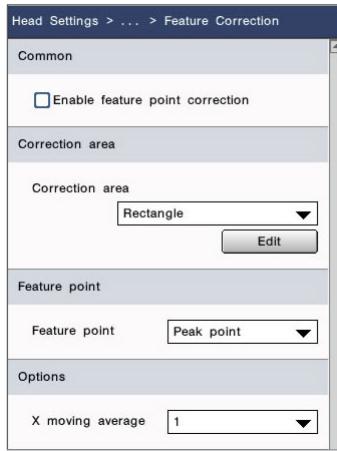
In this method, the height (Z) and position (X) of the feature point are detected, and the deviation between the height direction and the X direction is simultaneously corrected.
The correction region of the feature point is specified in a height image and deviation in the height and position of the feature point is detected.



● Feature point

Select from Peak Point, Bottom Point or Intersection Point (Line-Line).

■ Feature Correction: Detailed settings



● Correction area

Set the region for calculating the amount of correction. Lines without an attached region are not corrected.

○ Rectangle

The specified rectangular region is referenced at all times.

○ Ref. to prev. section.

If there is an object to correct X (X correction, feature point correction) at the previous level, the shape of the correction area follows the X positions that are detected. The offset, width and upper and lower edge in the Y direction can be specified. If there are multiple objects to correct X at the previous level, the closest correction detection results are referenced.

○ Refer to X region tracking

The shape of the correction area follows the X positions detected by the X region tracing settings. The offset and width can be specified.

● Feature point

Select the feature point type to be detected.

○ Peak point

The peak point is detected as a feature point.

○ Bottom point

The bottom point is detected as a feature point.

○ Intersection (Line-Line)

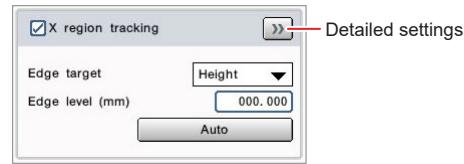
Detects an intersection (line-line) as a feature point.

● X moving average

This can be set when the feature point type is Peak Point or Bottom Point. By applying a transfer average before calculating detection points, you can stabilize calculation results.

■ X region tracking

The correction region of the edges is specified in a height image and the edge positions of the target for correction are detected. Correction regions for Z correction, θ correction and feature points can be set based on the edge positions that are detected here.



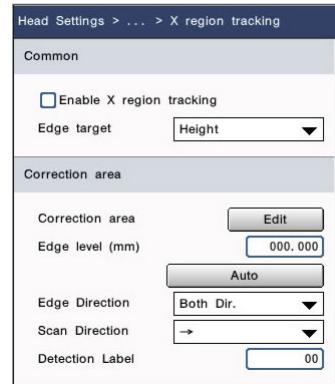
● Edge target

Specify the target data (Height/Luminance) for edge detection.

● Edge level

Set the height and shading required for detection as an edge. This is set automatically if [Auto] is set.

■ X region tracking: Detailed settings



● Correction area

Specify the edge correction region.

The points for the top left and bottom right corner of the rectangle can be specified numerically in [Edit].

● Edge Direction

Specifies the profile change direction to be detected as an edge.

○ Both Dir.

Both rising and falling are the measurement targets.

○ Rise

Targets the direction crossing from bottom to top.

○ Fall

Targets the direction crossing from top to bottom.

● Scan Direction

Specify the direction for scanning for the edge within the measurement range.

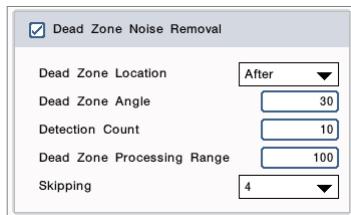
● Detection Label

Among the edge candidates that satisfy the conditions, specify the label to be selected, using a number.

Dead Zone Noise Removal

When enabled, allows for the removal of falsely detected data present within triangulated blind spots.

The removed pixels will become invalid pixels.



Dead Zone Location

Configures processing direction for 3D blind spot removal.

After

Select this when the work piece is proceeding from the laser side to the light-receiving side. (Typically, the blind spot is in the bottom of the image)

Before

Select this when the work piece is proceeding from the light-receiving side to the laser side. (Typically, the blind spot is in the top of the image)

After/Before

Select this when 2 heads are connected, the work piece is proceeding from the laser side to the light-receiving side of Head A, and the opposite direction for Head B.

Before/After

Select this when 2 heads are connected, the work piece is proceeding from the light-receiving side to the laser side of Head A, and the opposite direction for Head B.

Dead Zone Angle

Enter the angle of the light receiver in relation to the work piece. Change this to fine-tune the effect.

Detection Count

Determines whether the data is the height of the target object or noise data, based on the noise data height and specified blind spot angle. If the height is known, the size of the angle of the Y-direction from the blind spot angle is calculated. If there is valid data of the detection points or more within the data which has been calculated as the blind spot, that height data is treated as noise.

Dead Zone Processing Range

Enter a larger value for cases where a larger amount of noise data occurs in blind spots. However, the larger the specified value, the more internal processing will be required, so select a value which balances processing time with effect.

Skipping

Decimates the specified number of lines to refer to at calibration. The more the decimation point, the calibration speed increases.

List of Settings

Allows for confirmation of currency set parameters.

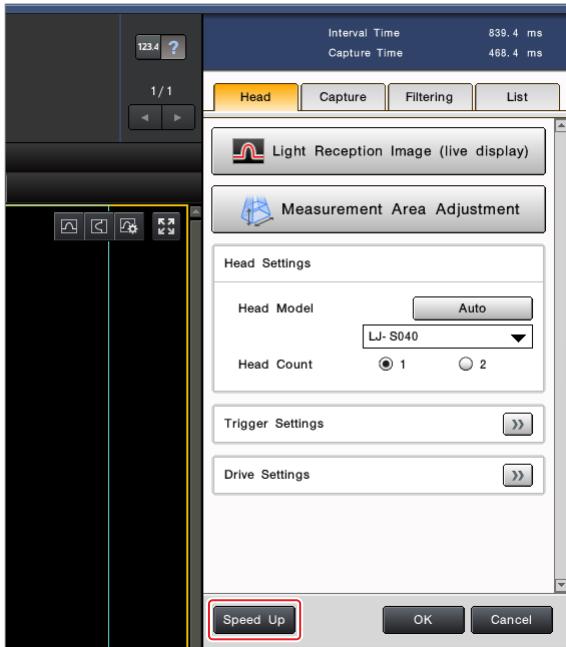
Values which have been changed from their defaults are shown in blue.

Head	Capture	Filtering	List
Head Settings			
Head Model LJ-S800			
Head Count	1		
Trigger Settings			
Trigger Delay (ms)	0		
Image Buffer Count	3		
Measurement Area Adjustment			
Z Direction			
Expansion Area	OFF		
Usage Range	2		
Starting Position (%)	34.0		
Y Direction			
Usage Range	3200		
Starting Position	1601		
Skipping	4		
X Direction			
Skipping	OFF		
Data Points	3200		
Drive Settings			

Speed Up

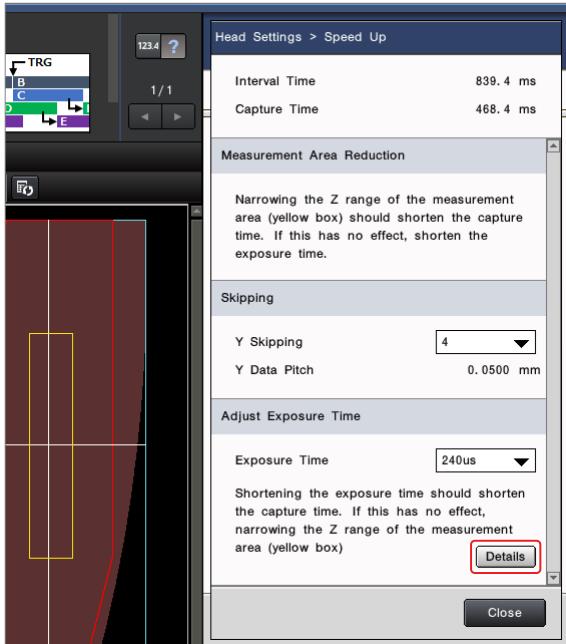
Adjusts settings related to speed UP.
Change each setting and adjust displayed items so that the maximum speed trigger period fits the specified trigger period.

1 Click [Speed Up].

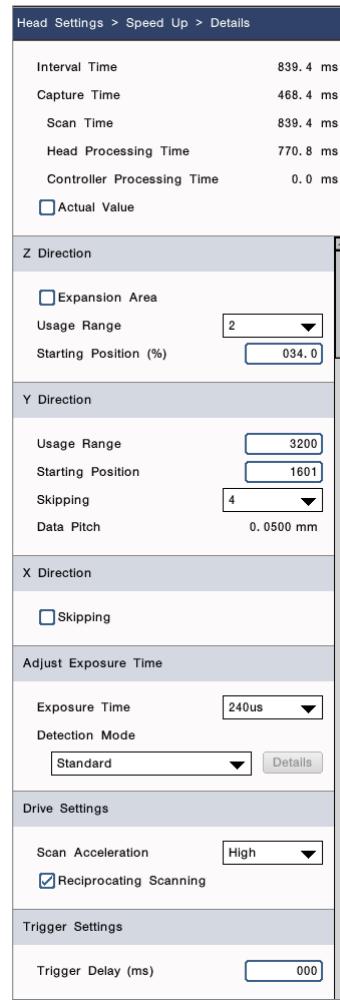


2 Click [OK].

3 Click [Details].



4 Configure the detailed settings for [Speed Up].



Actual Value

Selecting this check box measures and displays the actual time spent.

Reference The actual value is always displayed when [Detection Mode] is [(X) Irregular reflection removal], [(Y) Irregular reflection removal], or [(XY) Irregular reflection removal].

Z Direction

"Z Direction" (Page 4-4)

Y Direction

"Y Direction" (Page 4-4)

X Direction

"X Direction" (Page 4-4)

Adjust Exposure Time

"Capture Settings" (Page 4-8)

"Detection Mode" (Page 4-8)

Drive Settings

"Drive settings" (Page 4-5)

Trigger Settings

"Trigger Settings" (Page 4-5)

5 After completing the settings, click [Close].

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3D Inspection

The LJ-S Series is equipped with the following functions to process the height images obtained from the head. The combination of these functions allows for a wide variety of inspections to be performed.

● Tools for direct processing of height images without height extraction

- "Height Measurement" (Page 5-16)
- "Trend Height Measurement" (Page 5-18)
- "Profile Measurement" (Page 5-20)
- "Continuous Profile Measurement" (Page 5-39)

● Function for converting height images to gray scale images (height extraction) and processing with existing measurement tools

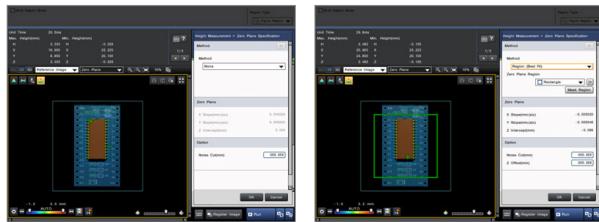
- "Height Extraction" (Page 5-4)

Height Measurement/Trend Height Measurement Tool

Inspection is performed using the obtained height data. Measurements can be made within the configured measurement area such as minimum height, maximum height, surface area of protrusions, and volume of protrusions etc. By specifying [Zero Plane] in the plane options, you can perform inspections more freely.

● Zero plane specification

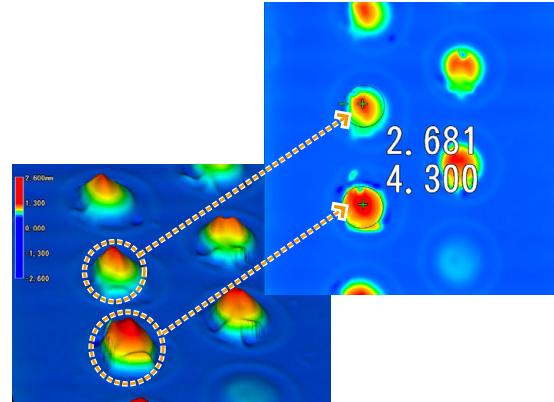
By specifying a [Zero Plane] to reference height measurement on for each individual work piece, you can guarantee reliable measurements even if the orientation of the work piece shifts.



- "Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

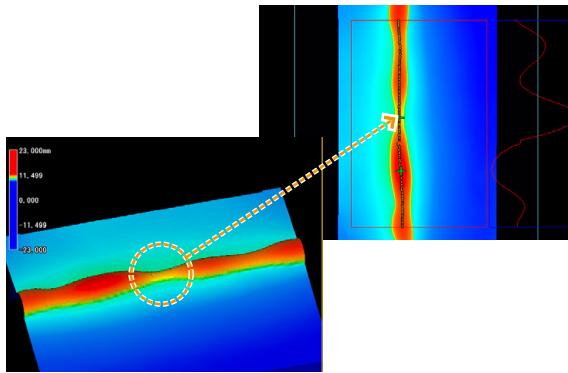
● Height/area/volume measurements

Measurements can be made of the surface area and volume within the region enclosed by the inspection region and zero plane.



● Trend height measurement

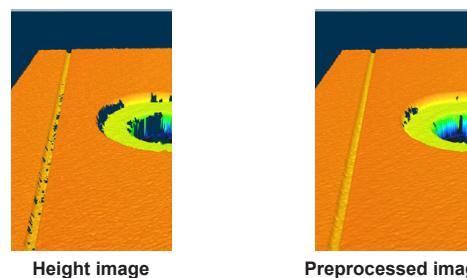
Performs numerous height measurements within a single specified region. A plane/circle can be detected from the maximum/minimum values and multiple height data between the maximum height calculated for each sub-region.



- "Trend Height Measurement" (Page 5-18)

● Pre-processing for height measurement

A reliable measurement can be obtained by utilizing pre-processing for height measurement (6 types: median, average, Gaussian, smoothing, invalid pixel suppression, spike noise cut).



Height image Preprocessed image

Measurements are unstable in grooves where there is a large difference in gloss, but applying preprocessing makes it possible to achieve stable measurements.

- "Height measurement filters (preprocessing)" (Page 5-10)

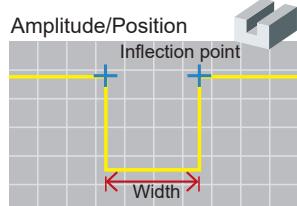
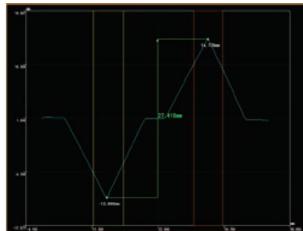
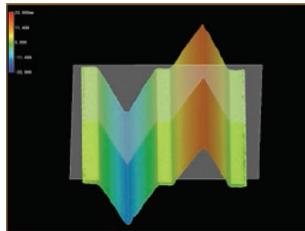
Profile measurement tool/Continuous profile measurement tool

Profile measurement

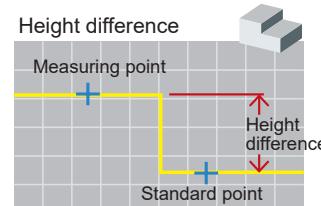
A specified location's cross-section can be measured for height, width, angle, cross-section area etc. X-Y-θ position adjustment can be used as well, so in-line dimension inspection is also possible.

Height measurement of peak and bottom points

The obtained (profile) cross-section's height/height difference, position, angle, cross-section area, count, and defect detection can be measured, and inspections can be performed such as dimension inspection and external appearance inspection, etc. Also, high precision inspection can be performed using plane correction.

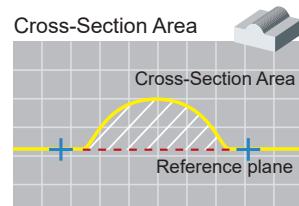
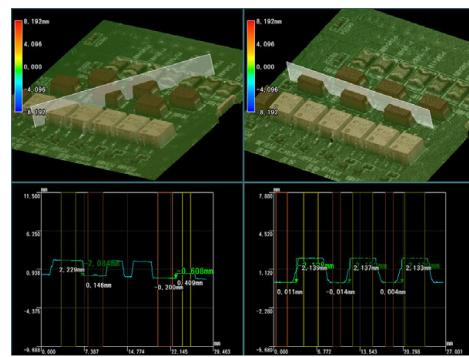


Measure the width and position of the specified condition.

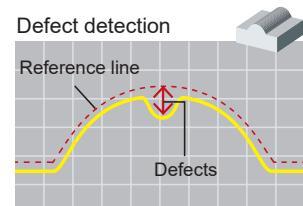


Measure the difference in the height of the measurement point for the reference point.

Height detection of circuit board components



Measure the cross-sectional area from the reference plane.



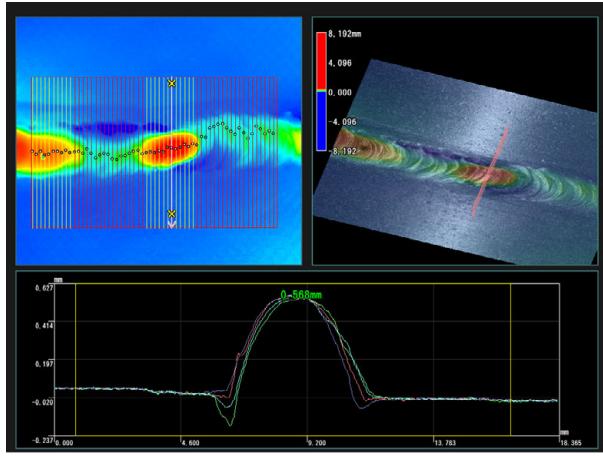
A circle, a straight line, and a free curve are used as a reference line, and a part with a large difference from the line is detected as a defect.

Continuous profile measurement

Minute changes in shape can be extracted from multiple cross-section profiles. Continuous measurement of profiles at an optional pitch within a specified region can be helpful for inspection of welds and other items which require continuity, as well as for inspecting solders which require inspection from 360°.

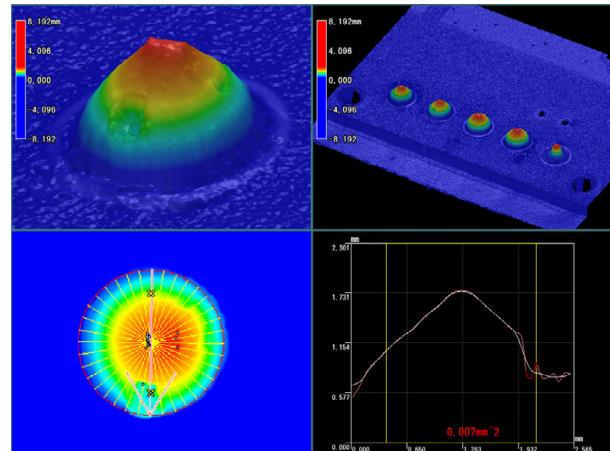
Weld shape inspection

Continuously measures the height and cross-section area, and finds the max. and min. values, producing a stable inspection.



Solder shape inspection

Inspects the form of a solder from 360°, allowing for the extraction of minute surface variations.



Height Extraction

What is height extraction/height binarization?

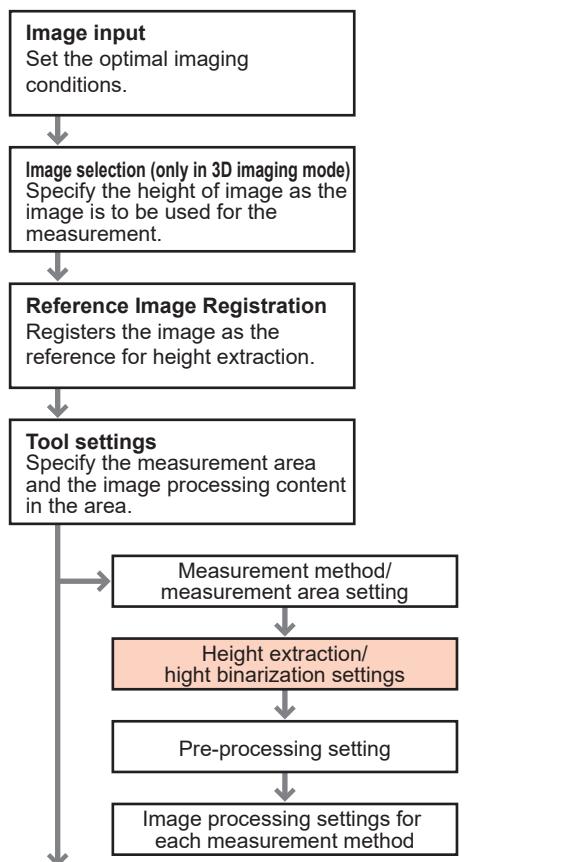
A variety of image processing can be applied by creating a gray-scale or binary image which emphasizes important heights from the obtained height image.

As pre-processing, this device takes an obtained height image and converts it to black-and-white (gray-scale or binarized) image. This pre-processing is called height extraction/height binarization.

Reference The reference plane is a virtual plane that passes through a position at a standard distance from the head.

Height extraction/height binarization settings

Height extraction/height binarization is configured during tool editing in setting mode.

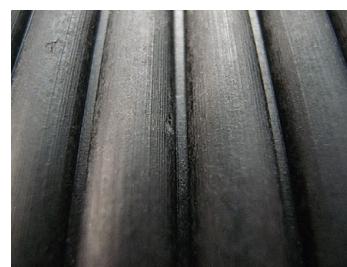


Instances where height extraction/height binarization is used

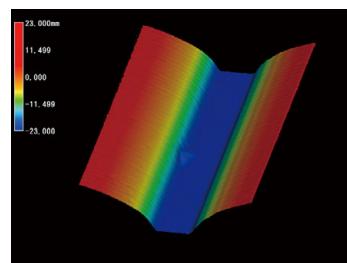
Height Extraction

With height extraction, once a plane is specified at any given height, a gray-scale image is created which expresses the high and low differences with respect to this plane in light and shade.

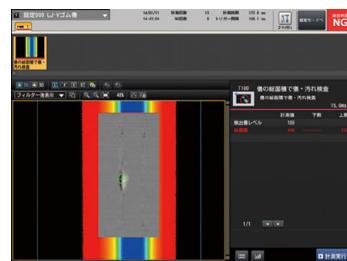
Using the free-form plane extraction function, protrusions along a curved surface can be effectively detected.



Inspection target (photo)



Acquired data

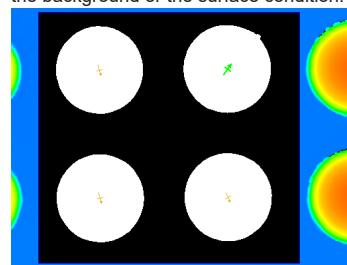


Measurement results displayed on screen by the controller
(example of using real-time extraction (free-form plane-based) in the height extraction of the defect measurement)

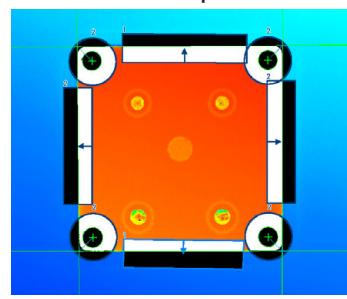
Height Binarization

Specify a plane of any height, and then generate a binarized grayscale image in which the areas higher than the plane are white and those lower than the plane are black.

Inspections can be performed regardless of the contrast difference with the background or the surface condition.



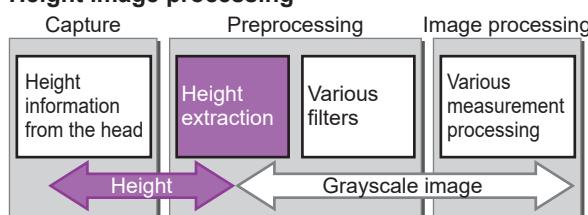
ON/OFF inspection



Dimension inspection

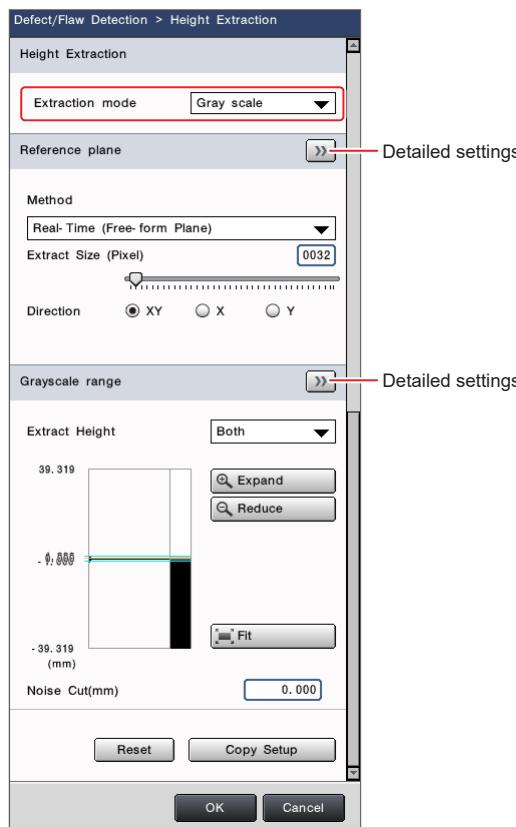
Flow of image processing

Height image processing



Height Extraction

If you set [Extraction mode] of height extraction to [Gray scale] in the measurement tool, the [Height Extraction] screen appears.
(example showing the [Height Extraction] screen in the defect tool)



Detailed settings

Detailed settings

Reference plane

Method

Select a height region extraction method.

1 Point

The extraction plane is a plane that is parallel to the reference plane has a Z-intercept at the height of the specified point. This extraction plane will not vary based on the input image.

3 Points

The extraction plane is a plane calculated based on the 3D data of 3 specified points. This extraction plane will not vary based on the input image.

Real-Time (Plane)

The extraction plane is the calculated least-squares plane using the 3D data of the input image within the specified region. The extraction plane will vary based on the input image.

Real-Time (Average Height)

Calculates the Z average of the input image within the specified region. The extraction plane is a plane parallel to the reference plane with a Z-intercept at that calculated value. The extraction plane will vary based on the input image.

Real-Time (Multiple Points)

The extraction plane is a plane found using the minimum-squares method from the average height data at each of many specified points. The extraction plane will vary based on the input image.

Real-Time (Free-form Plane)

The extraction plane is a curved plane estimated based on the extraction size value. The extraction plane will vary based on the input image.

Zero Plane of Other Tool

References the zero plane of other tools.

Detected Plane of Other Tools

References the detection plane of other tools.

Extract Plane of Other Tool

References the extraction plane of other tools.

The relationship between the desired extraction plane and input image is summarized below.

	Changes According to the Current Image	Does Not Change According to the Current Image
Plane Parallel to Reference Plane	Real-Time (Average Height)	Specify 1 Pts.
Arbitrary Plane	Real-Time (Plane/Multiple Points)	Specify 3 Pts.
Free-form Plane	Real-time (Free-form Plane)	-

Extract Region

Specify this when [Real-Time (Average Height)] or [Real-Time (Plane)] is specified for [Method].

If the extraction plane is specified outside of the measured region, the extraction region is specified individually. You can also set a mask region.

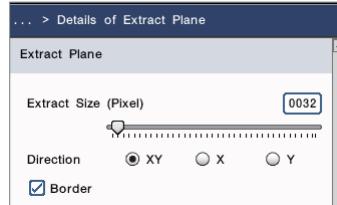
The region specified here is only used for calculation of the extraction plane.

Extract Size

When [Real-Time (Free-form Plane)] is selected in [Method], specify the size of the high and low parts you want to extract.

The smaller the extract size is, the better a steep curved surface is traced, and finer concave/convex parts can be extracted. (However, a longer processing time is required.)

Detailed Settings



Border

When [Real-Time (Free-form Plane)] is selected in [Method], select whether the processing is performed with reference to parts of the image outside the inspection region or not.

OFF

Performs the processing without referring to image parts outside the inspection region.

ON (initial configuration value)

Refer to and process images outside the area.

Grayscale range

Extract Height

Select the direction at the desired extraction height with regards to the extraction plane.

Upper Part

Select this option to specify the upper side of the extraction plane as the extraction region (the color tone of the extraction plane is set to 0).

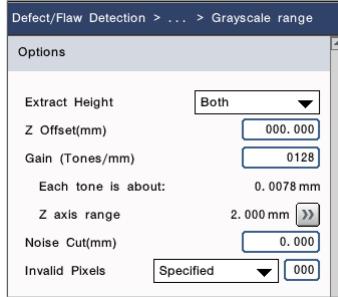
Lower Part

Select this option to specify the lower side of the extraction plane as the extraction region (the color tone of the extraction plane is set to 255).

Both

Select this option to specify both the higher and lower sides of the extract plane as the extraction range (the color tone of the extraction plane is set to 128).

Detailed settings



Z Offset (mm)

Specifies the offset value in the Z-axis direction of the extract plane.

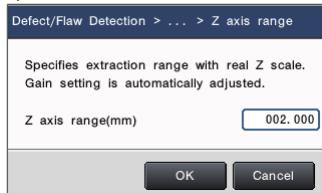
Gain (Tones/mm)

In the extracted image, specify the gradation value per 1 mm of height to be extracted.

The extract range is adjusted according to this tone.

Z axis range

A desired range of height extraction can be specified in actual size. The appropriate gain setting value is automatically calculated based on the specified value.



Noise Cut (mm)

Removes the range where the height from the extraction surface is less than the specified value as noise.

Invalid Pixels

Select color tone after extraction of invalid pixels.

Default

Treats as the height of the pixel which is furthest away from the extraction plane.

Background

Treats as the height of a pixel on the extraction plane.

Specified

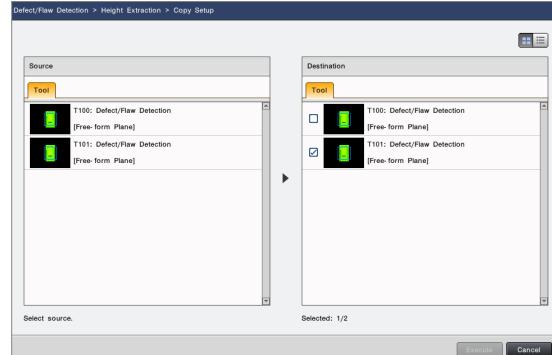
Sets a specified tone value.

Reset

Resets the height extraction settings.

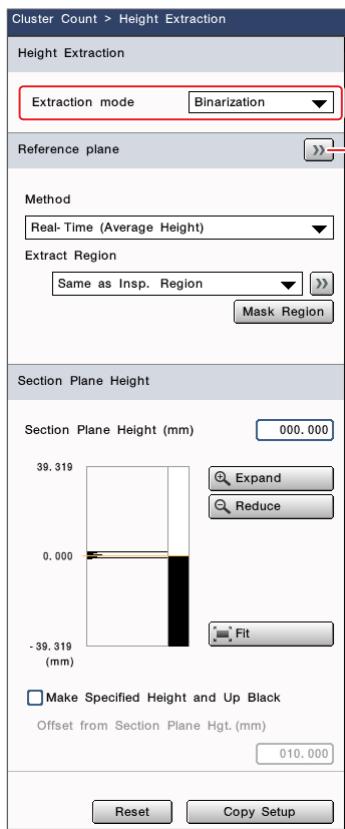
Copy Setup

Allows for the tool height extraction settings specified in [Source] to be copied to [Destination] tool.



Height Binarization

If you set the conversion mode of height extraction to [Binarization] in the measurement tool, the [Height Binarization] screen appears.
(example showing the [Height Binarization] screen in the quantity of clusters tool)



Reference plane

Method

Selects the method of extraction of the binarization section plane.

1 Point

Binarization will be performed on the plane that is parallel to the reference plane where the height of the specified point is its Z intercept. This plane does not change according to the current image.

3 Points

Binarization will be performed on the plane that is calculated using the three-dimensional information of the three specified points. This plane does not change according to the current image.

Real-Time (Plane)

Binarization will be performed on the plane that is the least square plane calculated from the three-dimensional information of the current image found in the set region.

Real-Time (Average Height)

Calculates the Z average of the input image within the specified region. Binarization will be performed on the plane that is parallel to the reference plane where the value that was calculated is its Z intercept.

Real-Time (Multiple Points)

Binarization will be performed on the plane that is the least square plane obtained from the average height data of each of the multiple points specified. A maximum of 10 points can be specified.

Real-Time (Free-form Plane)

Binarization will be performed on the curved plane that is estimated based on the extract size value.

Zero Plane of Other Tool

References the zero plane of other tools.

Detected Plane of Other Tool

References the detection plane of other tools.

Extract Plane of Other Tool

References the extract plane of another tool.

[Reference] The table below summarizes the relationship between the binarization section plane that you want to specify and the current image.

	Changes According to the Current Image	Does Not Change According to the Current Image
Plane Parallel to Reference Plane	Real-Time (Average Height)	Specify 1 Pts.
Arbitrary Plane	Real-Time (Plane/Multiple Points)	Specify 3 Pts.
Free-form Plane	Real-Time (Free-form Plane)	-

The linkage between [Zero Plane of Other Tool], [Detected Plane of Other Tool], [Extract Plane of Other Tool] and [Current Image] depends on the settings in the other tool.

Auto Extract

This option appears when [1 Point] or [3 Points] is selected in [Method].

- In the case of [1 Point], the section plane to binarize will be extracted automatically using the [Real-Time (Average Height)] settings with the extraction region set to [Same as Insp. Region].
- In the case of [3 Points], the section plane to binarize will be extracted automatically using the [Real-Time (Plane)] settings with the extraction region set to [Same as Insp. Region].

Specify Point

This option is specified when [1 Point], [3 Points] and [Real-Time (Multiple Points)] is selected in [Method].

Specify points on the 2D image after specifying the extraction size in [Extract Region].

X Slope

This option is specified when [3 Points] is selected in [Method]. Specifies the slope in the X-axis direction of the binarization section plane by the Z-direction slope amount per pixel (mm/pixel).

Y Slope

This option is specified when [3 Points] is selected in [Method]. Specifies the slope in the Y-axis direction of the binarization section plane by the Z-direction slope amount per pixel (mm/pixel).

Extract Region

This option is specified when [Real-Time (Plane)] or [Real-Time (Average Height)] is selected in [Method]. Specifies an extract region separately when specifying the binarization section plane from a region other than the inspection region. You can also set a mask region.

 The region specified here is used only for calculating the binarization section plane.

Reference Tool

This option is specified when [Zero Plane of Other Tool], [Detected Plane of Other Tool], or [Extract Plane of Other Tool] is selected in [Method]. Selects a tool for referencing planes.

Selection Size

This option is specified when [Real-Time (Multiple Points)] is selected in [Method]. Specifies the acquisition range for the Z coordinate of each point. The Z coordinate of each point is the average of the Z coordinates found within the specified range.

Extract Size

When [Real-Time (Free-form Plane)] is selected in [Method], specify the size of the high and low parts you want to extract.

 The smaller the extract size is, the better a steep curved surface is traced, and finer concave/convex parts can be extracted. (However, a longer processing time is required.)

Direction

When [Real-Time (Free-form Plane)] is selected in [Method], specify the extraction direction of the binarization section plane.

Border

When [Real-Time (Free-form Plane)] is selected in [Method], select whether the processing is performed with reference to parts of the image outside the inspection region or not.

- OFF: Performs the processing without referring to image parts outside the inspection region.
- ON (initial configuration value): Performs the processing with reference to image parts outside the inspection region.

Section Plane Height (mm)

Section Plane Height (mm)

Specifies the height of the binarization section plane. The part which the section plane cuts across will be binarized. The height can also be adjusted by using the slider bar on the 3D display. Finer adjustments can be made by zooming in.

Make Specified Height and Up Black

Use this when you wish to make black the part that is in a position that is higher than the binarization section plane. When this is enabled, the pixels that are between the section plane and the specified height in the Z direction measurement range are made white.

Offset from Section Plane Hgt. (mm)

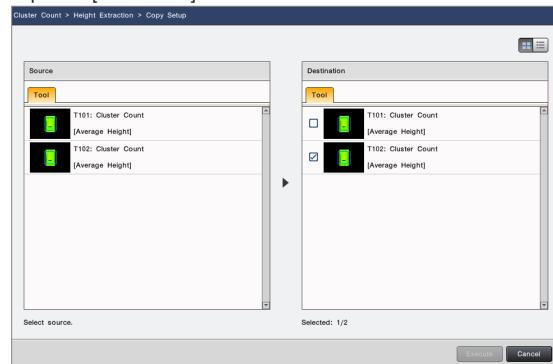
Makes the part that is higher than the specified height black. Specify the height from the binarization section plane.

Reset

The height binarization settings will be reset to defaults.

Copy Setup

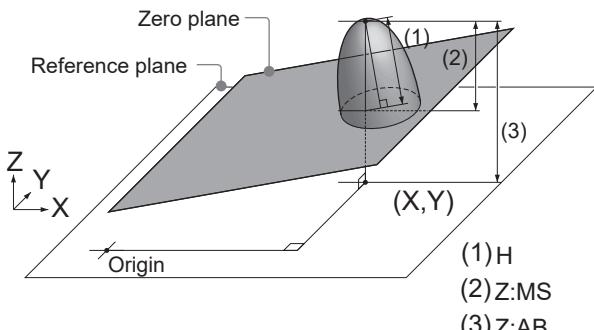
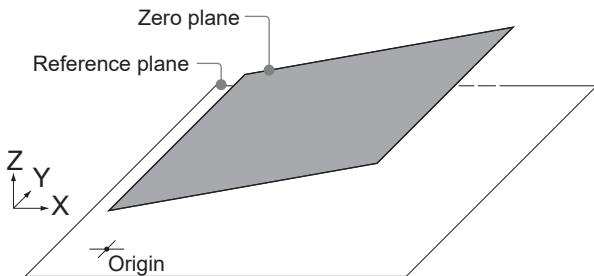
Allows for the tool height extraction settings specified in [Source] to be copied to [Destination] tool.



Specifying the Measurement Reference Plane (Zero Plane Specification)

The reference plane is a virtual plane that passes through a position at a standard distance from the head.

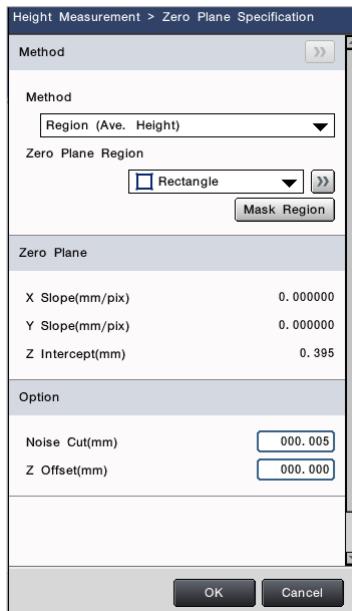
The zero plane is any plane which differs from the reference plane, and is specified when a 3D measurement standard is desired. In the 3D measurement data, both the measurements based off the zero plane (MS), and the absolute measurements based off the reference plane can be obtained. To take the example of height measurement tools, both Z and H are values output as height measurement results. Z is the height along the normal vector of the reference plane, and H is the height along the normal vector of the zero plane.



For details on the height measurement tool, see overview in □ "3D Inspection" (Page 5-2).

Reference When specifying the same plane as the zero plane by multiple tools, you can shorten the processing time by referring to [Zero Plane of Other Tool], [Detected Plane of Other Tool] and [Extract Plane of Other Tool].

(example showing the [Zero Plane Specification] screen in the height measurement tool)



1 Select the zero plane specification method in the [Method] field.

Zero planes that can be specified are as follows (excluding reference to other tools).

● None

The reference plane is the zero plane.

● Region (Best Fit)

The zero plane is the calculated least-squares plane using the 3D data of the input image within the specified region.

● Region (Ave. Height)

Calculates the Z average of the input image within the specified region. The zero plane is a plane parallel to the reference plane with a Z-intercept at that value.

● 3 Points (Real-Time)

The zero plane is a plane calculated based on the 3D data of the input image within the 3 specified points.

● Multiple Points (Real-Time)

The zero plane is a plane found using the minimum-squares method from the average height data at each of many (up to 10 points) specified points.

● Free-form Plane

The zero plane is a curved plane estimated based on the extraction size (if Free-Form Plane-Based is selected, H is the height along the normal vector of the reference plane, and height H is equivalent to Z:MS. Also, surface area is the surface area of the range in which convex/concave portions are projected in the reference plane) (only height measurement and trend height measurement tools).

● Zero Plane of Other Tool

References the zero plane of other tools.

● Detected Plane of Other Tool

References the detection plane of other tools.

● Extract Plane of Other Tool

References the extraction plane of other tools.

● User Specified

The zero plane (X slope, Y slope, Z intercept) is specified numerically.

The relationship between the desired zero plane and input image is summarized below.

	Changes According to the Current Image	Does Not Change According to the Current Image
Plane Parallel to Reference Plane	Average height-based	None, numerical specification
Arbitrary Plane	Plane, Real-Time 3-Point Specification, Real-Time Multi-Point Specification	-
Any curve	Free-form Plane	-

2 Specify the zero plane as per the specified method.

3 If the height from the zero plane will be removed as noise below a specified value, specify this in [Noise Cut].

The unit of the noise removal setting is the unit specified by the height direction unit.

Point This item can be set when using [Height Measurement] or [Trend Height Measurement].

4 If a Z-offset with respect to the zero plane will be specified, do so in the [Z Offset] field.

5 Click [OK].

Measurement results output

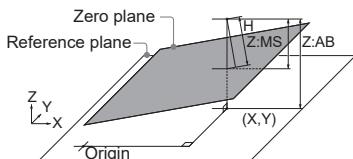
Plane Formula Info.

Outputs the X/Y slopes and Z intercept of the calculated zero plane and detected plane. The zero plane measurement value (MS) is a value which reflects [Scaling Correction].

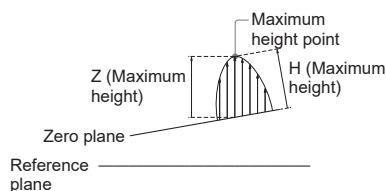
Max. Height/Min. Height (X, Y, Z, H)

Outputs the position coordinates of the max. height point/min. height point in the inspection region in full-scale values (mm or μm).

- Outputs two types of values (Z and H) as the height measurement result.
- Z is the height along the normal vector of the reference plane, and H is the height along the normal vector of the zero plane. However, if the method for specifying the zero plane is set to [Free-form Plane], H is the height along the normal vector of the reference plane.
- The Z-direction height has a measured value based on the zero plane (Z:MS) and absolute measured value based on the reference plane (Z:AB). If the method for specifying the zero plane is set to [Free-form Plane], height H will be equal to Z:MS.



- Maximum height/minimum height points are defined using the height in the Z direction based on the zero plane.
- Maximum height H/minimum height H is the height in the H direction of the maximum height point/minimum height point. However, if the method for specifying the zero plan is set to [Free-form Plane], the height in the Z direction is used.



Ave. Height (Z, H) []

Outputs the height information of the average height in the measurement region in full-scale values (mm or μm). The value of average height Z/H will be the average value of height Z/H within the inspection region.

Peak-to-Peak Height (Z, H) []

Outputs the height difference of the max. height point/min. height point in the measurement region (mm or μm).

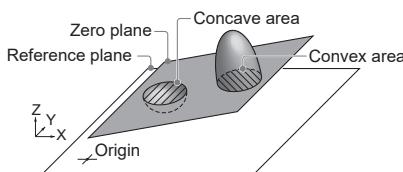
Valid Pixel Count

Outputs the valid pixel count in the measurement region.

Area

Outputs the convex area/concave area in the measurement region in full-scale value (mm^2).

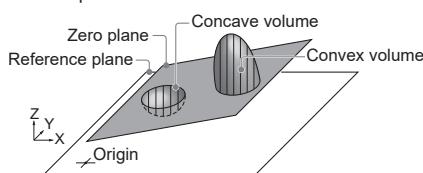
- A concave area is an area on the zero plane occupied by the section lower than the zero plane (opposite side of the head).
- A convex area is an area on the zero plane occupied by the section higher than the zero plane (head side). However, if the method for specifying the zero plane is set to [Free-form Plane], the surface area is the range formed via the projection of the area on the zero plane onto the reference plane.



Volume

Outputs the convex volume/concave volume of the measurement region (mm^3).

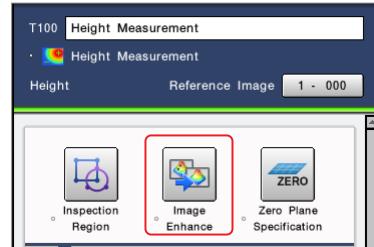
- The concave volume is the volume of the section lower than the zero plane (opposite side of the head) in the space between the detection points and zero plane converted to actual size value.
- The convex volume is the volume of the section higher than the zero plane (opposite side of the head) in the space between the detection points and zero plane converted to actual size value.



Height measurement filters (preprocessing)

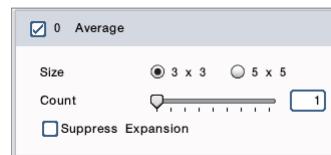
The following 6 types of filters are provided as height measurement filters.

- **Reference** When specifying the same plane as the zero plane by multiple tools and using the same filter, you can specify the zero plane by using [Zero Plane of Other Tools], and check the box for [Also Refer to Preprocessing] to shorten the processing time.



Average

Smooths and stabilizes height variations that occur like undulations on a plane. Even for invalid pixels, it has the effect of interpolating by applying the average value of the surroundings.



Size

Sets the filter size. 5×5 will be applied more strongly.

Count

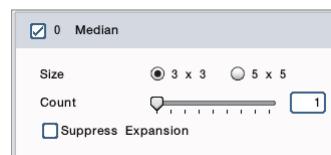
Changes the number of times the filter is applied.

Suppress expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Median

Applying the median of the heights of surrounding pixels to the center pixel has the effect of removing anomalous height values that occur like spike noise.



Size

Sets the filter size. 5×5 will be applied more strongly.

Count

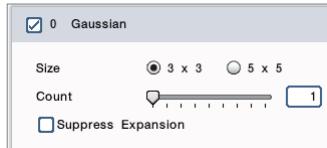
Changes the number of times the filter is applied.

Suppress expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Gaussian

This process reduces noise by applying heavier smoothing on pixels closer to the center. You can obtain more natural blur compared to [Average], but the noise reduction effect will be weaker.



● Size

Sets the filter size. 5×5 will be applied more strongly.

● Count

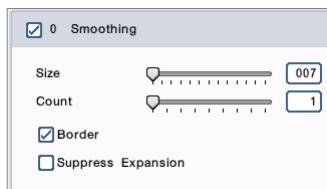
Changes the number of times the filter is applied.

● Suppress expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Smoothing

Pre-processing is equivalent to averaging, but increasing filter size has a stronger smoothing effect.



● Size

Sets the filter size.

● Count

Changes the number of times the filter is applied.

● Border

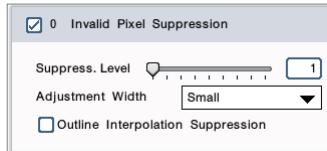
Put a check when processing including information outside the border..

● Suppress expansion

Reduces the effect of the height of image's outline being wider than it actually is by filter processing.

Invalid Pixel Suppression

Performs suppression by estimating the height data of invalid pixels for which height data could not be obtained using the pixel values of surrounding valid pixels. Invalid pixel suppression does not affect the value of valid pixels surrounding the invalid pixel.



● Suppression Level

The higher the suppression level, the wider the range of invalid pixels can be suppressed.

● Adjustment Width

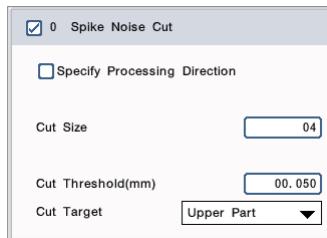
Selecting [Small] reduces the effect of the intensity, but allows you to fine-tune the degree of suppression of invalid pixels. The border between the remaining invalid pixels and valid pixels will not be interpolated with [Small], but will be interpolated with [Large] (interpolated with invalid pixel value 0).

● Outline Interpolation Suppression

Suppressing the contour of the height image from being fat by interpolation processing.

Spike Noise Cut

Removes pixels with a height that causes a spike from surrounding pixels due to noise (spike noise) etc.



● Specify Processing Direction

If enabled, the direction of processing can be specified.

- X

Eliminates continuous vertical protruding noise in the image, leaving continuous horizontal and protruding dots.

- Y

Eliminates continuous horizontal protruding noise in the image, leaving continuous vertical and protruding dots.

- XY individual

You can adjust the deletion size individually for each direction.

● Cut Size

Removes protruding noise below the specified size width.

● Cut Threshold

Removes the protruding points farther from the specified height with respect to the periphery as noise.

● Cut Target

Selects the type of spike point to be removed from [Upper Part], [Lower Part] or [Both].

Correction of measured values

Displaying measured values in actual size (scaling correction)

Specify a scaling correction value to handle measurements that have been converted into actual size values by displaying the screen, determining, calculating, external input/output, etc.

When settings are created by the controller, a scaling correction value is configured which is appropriate for the connected head model. If the head model to connect is updated after setting creation or head settings are newly created by the Simulation-Software, a scaling correction value will need to be reconfigured by the explanation below.

Automatically Obtain Scaling Coefficient from head

A scaling coefficient prepared in advance for each head can be applied.

1 Click [Utility] > [Scaling].



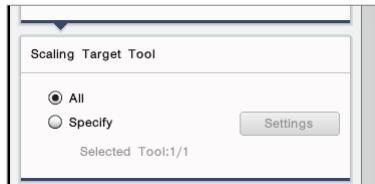
2 Click [Get Coefficient from the head].



A confirmation message appears.

3 Click [OK].

4 Select the tool to which you want to apply the scaling correction.



All

Specifies all tools for scaling correction.

Specify

Click [Settings] and specify the tool scaling correction.

5 After completing the setting, click [OK].

Convert measurements by multiplying them by a constant factor

The correction coefficient may also be freely specified.

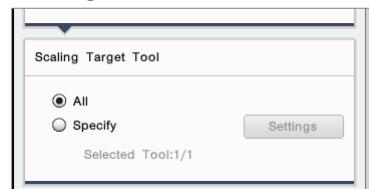
1 Click [Utility] > [Scaling].



2 In the [Coefficient] field, directly specify the correction magnification coefficient (how many 1 pixel be converted into).



3 Select the tool to which you want to apply the scaling correction.



All

Specifies all tools for scaling correction.

Specify

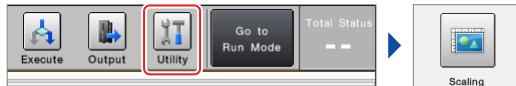
Click [Settings] and specify the tool scaling correction.

4 After completing the setting, click [OK].

■ Specify the desired physical size based on the actual measurement

The correction factor is obtained from the measurement result of the workpiece width or pitch interval whose actual size value is known. It is convenient to use a ruler or other tool to determine the length when the target's length is unknown.

1 Click [Utility] > [Scaling].

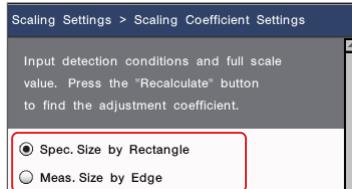


2 Perform imaging of something for which the actual dimensions are known.

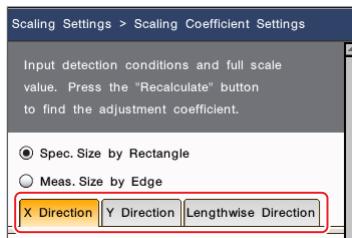
3 Click [Set Using Result & Full Scale].



4 Select how to specify the size.



5 Select the tab which will be the conversion target (X Direction/Y Direction/Lengthwise Direction).



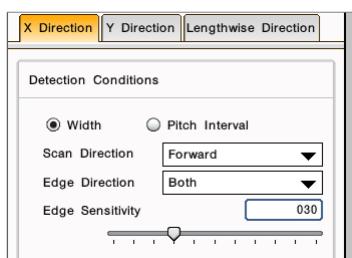
6 Measure the width or pitch interval of something for which the actual dimensions are known.

● When selecting [Spec. Size by Rectangle]

The actual value obtained by specifying the area along the captured workpiece is displayed in the [Actual Value] field.

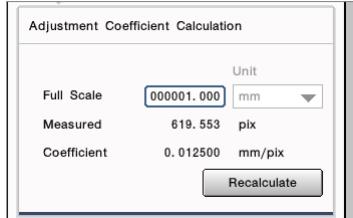
● When selecting [Meas. Size by Edge]

The actual value obtained by edge measurement (width or pitch) of the number of pixels in the specified direction of the workpiece is displayed in the [Full Scale] field.



For more information about measurement of edge, refer to □ "What is an edge?" (Page A-66).

7 Specify the measured width or pitch interval dimensions and units in the [Adjustment Coefficient Calculation] column, then click [Recalculate].

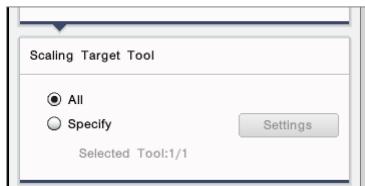


The scaling coefficient is automatically calculated.

8 Click other conversion target (X Direction / Y Direction / Lengthwise Direction) tabs and repeat steps 6 and 7.

9 After completing all conversion settings, select [OK].

10 Select the tool to which you want to apply the scaling correction.



● All

Specifies all tools for scaling correction.

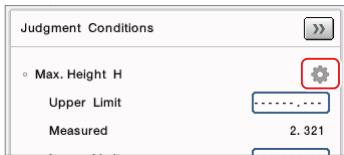
● Specify

Click [Settings] and specify the tool scaling correction.

11 After completing the setting, click [OK].

Correct Individual Measured Values (Measurement Correction)

Items for which a  is shown in the measurement tool's judgment condition setting field can be scaled to match the actual size of measured values.



With this machine, actual size can be obtained as measurement results, however, measurement results can also be corrected via the following two methods. This is useful for when the desired measurement location or zero plane cannot be directly specified.

- Correct Measurement Results by an Offset Value (1-Point Correction)
- Correct measurement results by an offset value after multiplying by a coefficient (2-point correction)

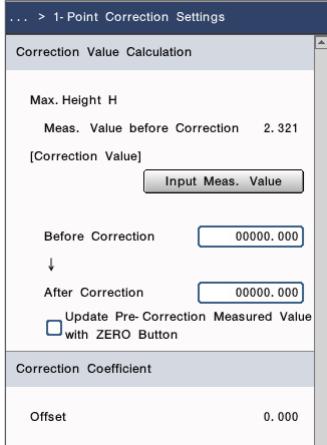
Correct Measurement Results by an Offset Value (1-Point Correction)

1 Click  of the items with measurements you would like to correct.

2 Click [Set] under [1 Point].



3 Click [Input Meas. Value], then enter the current measurement values in the [Before Correction] field.



4 Enter the post-correction measurement values in the [After Correction] field.

Offset on the measured value is calculated from the pre-correction and post-correction values.

 When [Update Pre-Correction Measured Value with ZERO Button] is selected, the [ZERO] button is displayed on the operation screen. Click the [ZERO] button to update the measured value of [Before Correction].

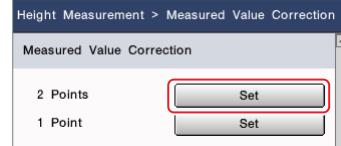
5 Click [OK].

Correct measurement results by an offset value after multiplying by a coefficient (2-point correction)

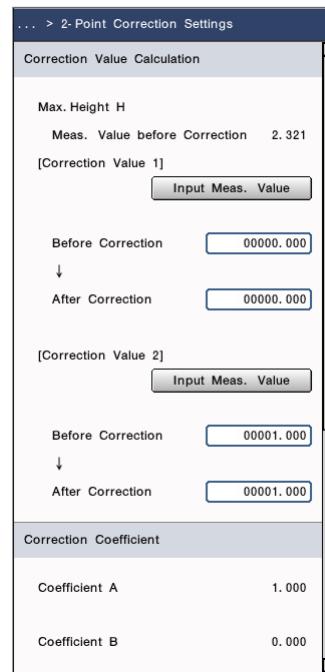
For both measured values, a pre-correction and post-correction value is configured, and correction coefficients A and B are calculated from those results.

1 Click  of the items with measurements you would like to correct.

2 Click [Set] under [2-Points].



3 Click [Correction Value 1] - [Input Meas. Value], then enter the current measurement values in the [Before Correction] field of [Correction Value 1].



4 Enter the measurement value post-correction in the [After Correction] field of [Correction Value 1].

5 Perform measurement once more.

6 Click [Correction Value 2] - [Input Meas. Value], then enter the current measurement values in the [Before Correction] field of [Correction Value 2].

7 Enter the measurement value post-correction in the [After Correction] field of [Correction Value 2].

Correction coefficients A and B are calculated from the corrected measured values using [Correction Value 1] and [Correction Value 2].

8 Click [OK].

Measurement Tools

The controller performs measurement by units referred to as a "Tool". This device provide a variety of tools, which are classified into "Categories" based on their use, such as "HeightMeas. (Z)" and "Defect/Flaw".

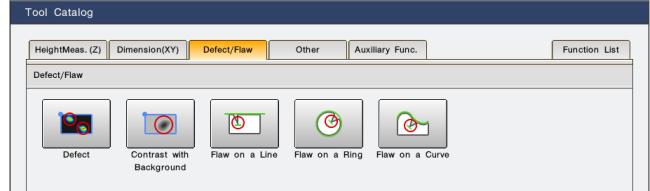
Tool Catalog

By selecting the inspection application and specific measurement method, the optimum tool for inspection can be used.

HeightMeas. (Z)

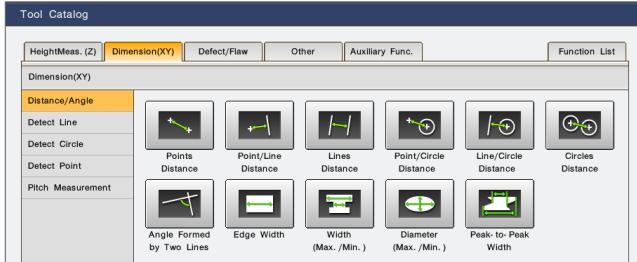


Defect/Flaw

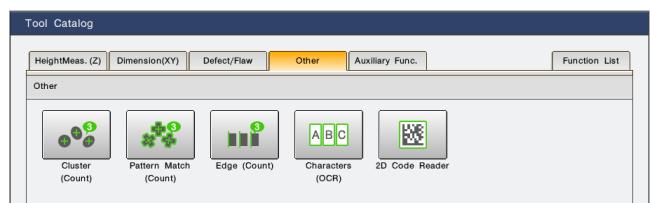


Dimension (XY)

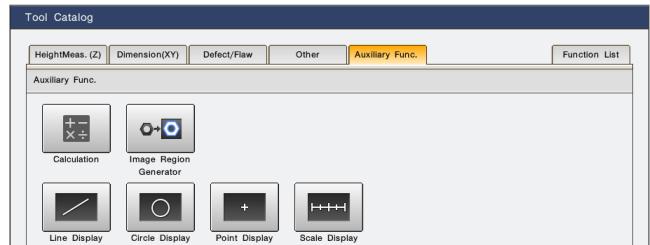
Distance/Angle



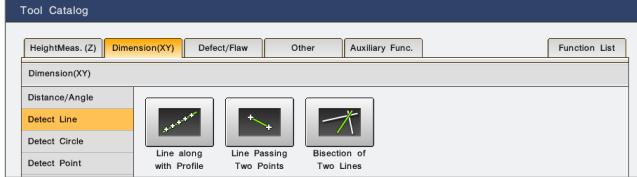
Other



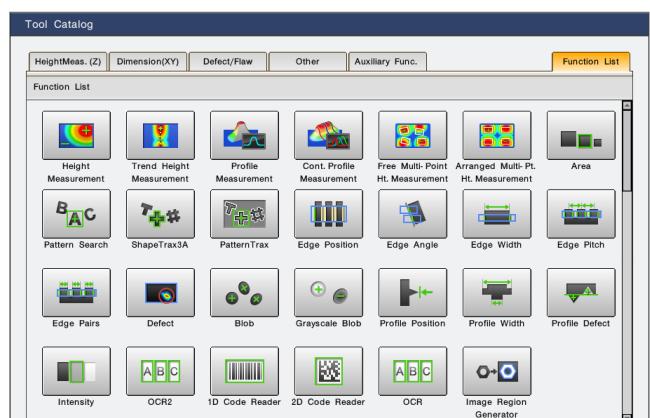
Auxiliary Func.



Detect Line



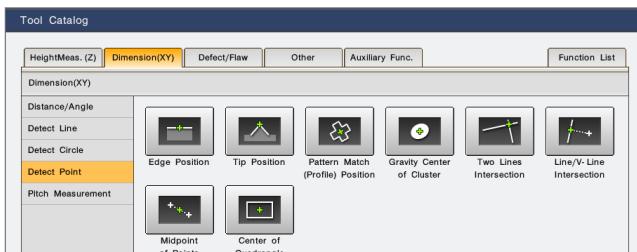
Function List



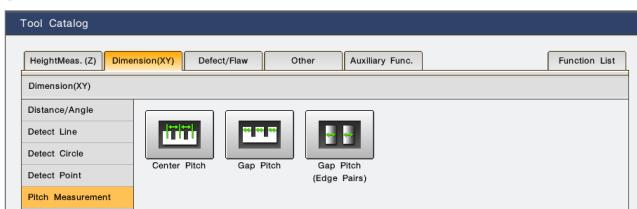
Detect Circle



Detect Point



Pitch Measurement

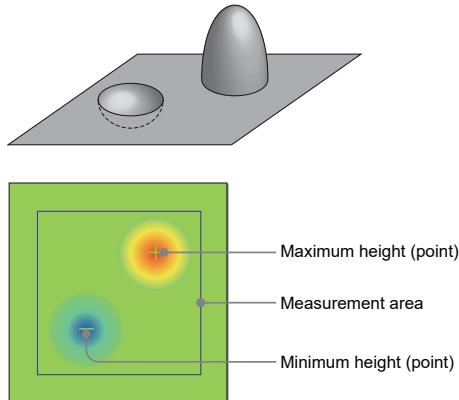


Height Measurement

What is [Height Measurement]?

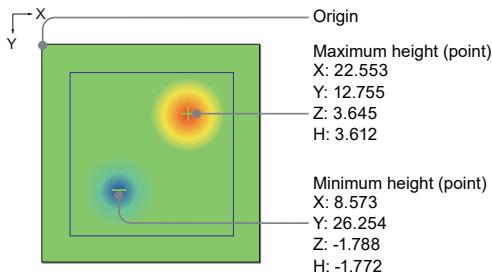
Measures the height, uneven area, and uneven volume with reference to the arbitrarily specified zero plane. The height H, uneven area, and uneven volume are converted to actual size values according to the set scaling correction factor.

Measurement Image



Measurement sample

When the measurement region is a rectangle



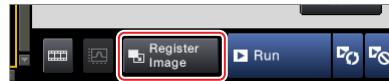
Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Register the reference image.



If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

3 Select the region type.

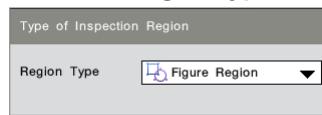


Figure Region

Lay out measurement region to surround the desired measurement area.

"Edit the measurement area" (Page 3-20)

Shape Region

Specifies the shape of a binary image created from a height image as a region.

"Creating a Shape Region" (Page 3-31)

4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



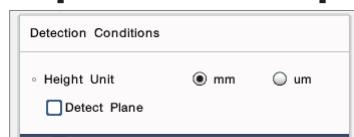
5 Set [Image Enhance] and [Zero Plane Specification].



"Height measurement filters (preprocessing)" (Page 5-10)

"Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

6 Set [Detection Conditions].



"Detection Conditions (Height Measurement)" (Page 5-17)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.

Judgment Conditions		
Max. Height H	<input type="button" value="..."/>	<input type="button" value="Settings"/>
Upper Limit	
Measured	2.321	
Lower Limit	
Min. Height H	<input type="button" value="..."/>	<input type="button" value="Settings"/>
Upper Limit	
Measured	-0.852	
Lower Limit	
Ave. Height H	<input type="button" value="..."/>	<input type="button" value="Settings"/>
Upper Limit	
Measured	0.395	
Lower Limit	

□ "Judgment Conditions (Height Measurement)" (Page 5-17)

Clicking displayed in measurement items allows for correction of individual measurement values.

□ "Correct Individual Measured Values (Measurement Correction)" (Page 5-14)

Detection Conditions (Height Measurement)

Setting item	Settings
Height Unit	Select either [mm] or [μm] as the unit for Z and H measurement results. If height unit is set to μm , noise removal and Z-offset units are also set to μm .
Detect Plane	The least squares plane is calculated and output from the 3D information of the input image in the measurement area.

Judgment Conditions (Height Measurement)

Setting item	Settings
Max. height	For the detected maximum height, specify the range to be judged as OK with [Upper Limit] or [Lower Limit]. The unit of tolerance for Z and H is the unit specified in [Height Unit] of detection condition.
Min. height	For the detected minimum height, specify the range to be judged as OK with [Upper Limit] or [Lower Limit]. The unit of tolerance for Z and H is the unit specified in [Height Unit] of detection condition.
Ave. height	For the detected average height, specify the range to be judged as OK with [Upper Limit] or [Lower Limit]. The unit of tolerance for Z and H is the unit specified in [Height Unit] of detection condition.
Peak-to-Peak Height	For the detected peak-to-peak height, specify the range to be determined as OK with [Upper Limit] or [Lower Limit].
Valid Pixel Count	Specify the range of effective pixel number to be judged as OK by [Upper Limit] and [Lower Limit]. The tolerance unit is the "number of pixels" of the measurement area.
Area	Specify the range of the concave/convex area judged as OK by setting [Upper Limit] and [Lower Limit]. The unit for tolerance is mm^2 .
Volume	Specify the range of the concave/convex volume judged as OK by setting [Upper Limit] and [Lower Limit]. The unit for tolerance is mm^3 .

Trend Height Measurement

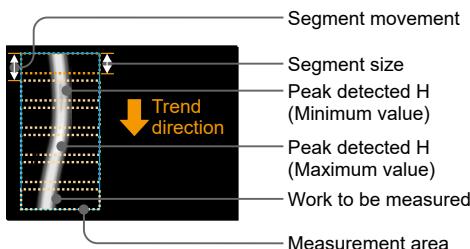
What is [Trend Height Measurement]?

Multiple segments can be placed in the measurement region to measure the height, area and volume for each segment. Additionally, a circle or plane in a 3D space can be detected using multiple height information groups obtained for each segment.

Measurement Image

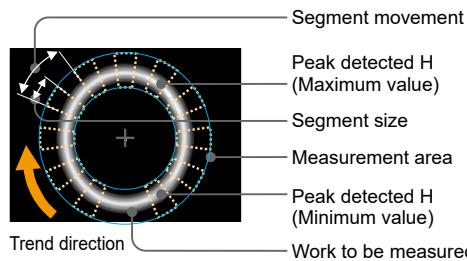
When the measurement region is a rectangle

- Target data: Peak
- Trend direction: ↓



When the measurement region is a ring/arc

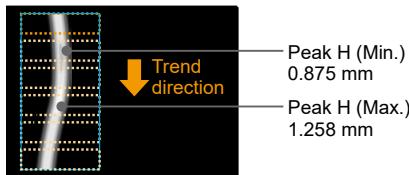
- Target data: Peak
- Trend direction: Clockwise



Measurement sample

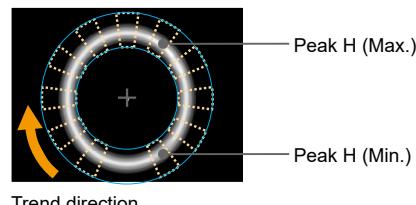
When the measurement region is a rectangle

- Target data: Peak
- Trend direction: ↓



When the measurement region is a ring/arc

- Target data: Peak
- Trend direction: Clockwise



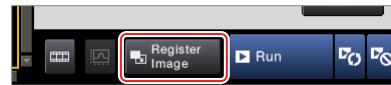
Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Register the reference image.

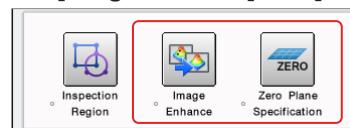


"Register the standard image" (Page 3-15)

3 Set [Inspection Region].

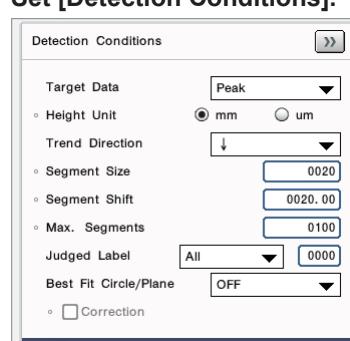
Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

4 Set [Image Enhance] and [Zero Plane Specification].



"Height measurement filters (preprocessing)" (Page 5-10)
 "Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

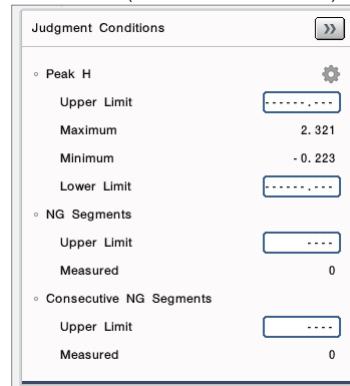
5 Set [Detection Conditions].



"Detection Conditions (Trend Height Measurement)" (Page 5-19)

6 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



"Judgment Conditions (Trend Height Measurement)" (Page 5-19)

Clicking displayed in measurement items allows for correction of individual measurement values.

"Correct Individual Measured Values (Measurement Correction)" (Page 5-14)

Detection Conditions (Trend Height Measurement)

Setting item	Settings
Target Data	Select the measurements to focus on. If peak (bottom, average) is selected, peak (bottom, average) is used for circle/plane detection. The position of the graphic display on the screen also varies depending on the maximum and minimum values of the selected item.
Height Unit	Select either [mm] or [μm] as the unit for Z and H measurement results. If height unit is set to μm , noise removal and Z-offset units are also set to μm .
Detection Target	Specify an object to be detected by the trend height measurement.
Trend Direction	Selects the movement direction for the segment for which height is to be measured. <ul style="list-style-type: none"> Selects between [\downarrow][\rightarrow] when the measurement region is a rectangle. If the measurement region is a rotated rectangle, only [\downarrow] is available (from the top side to bottom side) and it will link with the rotation direction of the measurement region. When the measurement region is a ring or arc, only [Clockwise] is available.
Segment Size	Specify the size of the segment in which the height is detected.
Starting Offset/ Starting Angle	Specify the amount (angle) to offset the start segment from the start edge of the measurement area. If there is no detected object near the boundary of the measurement area, the leading segment can be optimally positioned without changing the measurement area.
Segment Shift	Specify the amount of the segment shift for detecting heights in the trend direction. The smaller the segment shift value, the longer the processing time. At the same time, more segments can be placed within the same region.
Max. segments	Specifies the maximum number of segments that can be detected. Specify that "Max. segments" is larger than "Segment Count". The "Segment Count" changes in conjunction with the measurement area, segment size, and movement settings.
Judged Label	Specify the judgment target segment. <ul style="list-style-type: none"> Maximum: Specifies the segment with the maximum measured value as the judgment target. Minimum: Specifies the segment with the minimum measured value as the judgment target. Specified: Specify the segment of the specified No. as the judgment target. All: Specifies all segments as judgment targets. First, judges the measured value for each segment. Then, compares the number of segments judged as NG to the number of NG judgment condition segments or the number of consecutive NG segments, performing tool judgment.
Best Fit Circle/Plane	A circle or plane in a 3D space is detected from multiple height information groups obtained for each segment.
Correction	If this option is enabled, it reduces the noise influence.

Judgment Conditions (Trend Height Measurement)

Setting item	Settings
Detection Segments	Specify the range of the number of detected segments to be judged as OK with "Upper limit" and "Lower limit".
NG Segments	It can be set if "All" is selected on the judgment label. Specify the range in which the tool judgment is OK with "Upper limit" for the total number of segments judged as NG.
Consecutive NG Segments	It can be set if "All" is selected on the judgment label. Specify the range in which the tool judgment is OK with "Upper limit" for the successive number of segments judged as NG.
Peak H (Max.)/ Peak H (Min.)	Specify the range of the maximum value or minimum value of the peak detected for each segment to be judged as OK with "Upper limit" and "Lower limit".
Peak H	Specify the range of the peak detected for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Bottom H (Max.)/ Bottom H (Min.)	Specify the range of the maximum value or minimum value of the bottom detected for each segment to be judged as OK with "Upper limit" and "Lower limit".
Bottom H	Specify the range of the bottom calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Average H (Max.)/ Average H (Min.)	Specify the range of the maximum value or minimum value of the average height calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Average H	Specify the range of the average height calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Peak-to-Peak Height H (Max.)/ Peak-to-Peak Height H (Min.)	Specify the range of the maximum value or minimum value of the height between peaks calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Peak-to-Peak Height H	Specify the range of the height between peaks calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Valid Pixel Count (Max.)/ Valid Pixel Count (Min.)	Specify the range of the maximum value or minimum value of the effective number of pixels calculated for each segment to be judged as OK with "Upper limit" and "Lower limit". The tolerance unit is the "number of pixels" of the measurement area.
Valid Pixel Count	Specify the range of the effective number of pixels calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit". The tolerance unit is the "number of pixels" of the measurement area.
Concave Area (Max.)/ Concave Area (Min.)	Specify the range of the maximum value or minimum value of the concave area calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Concave Area	Specify the range of the convex area calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Convex Area (Max.)/ Convex Area (Min.)	Specify the range of the maximum value or minimum value of the convex volume calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Convex Area	Specify the range of the convex area calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Concave Volume (Max.)/ Concave Volume (Min.)	Specify the range of the maximum value or minimum value of the concave volume calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Concave Volume	Specify the range of the concave volume calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Convex Volume (Max.)/ Convex Volume (Min.)	Specify the range of the maximum value or minimum value of the convex volume calculated for each segment to be judged as OK with "Upper limit" and "Lower limit".
Convex Volume	Specify the range of the convex volume calculated for the judgment object segment to be judged as OK with "Upper limit" and "Lower limit".

Profile Measurement

What is [Profile Measurement]?

Allows for various measurements of a specified height image cross-section (profile).

For a profile obtained from a height image, sets what type (profile measurement type, page 5-25) of measurement, what (measurement target, page 5-30) to measure, and what range (measurement area, page 5-37) to measure.

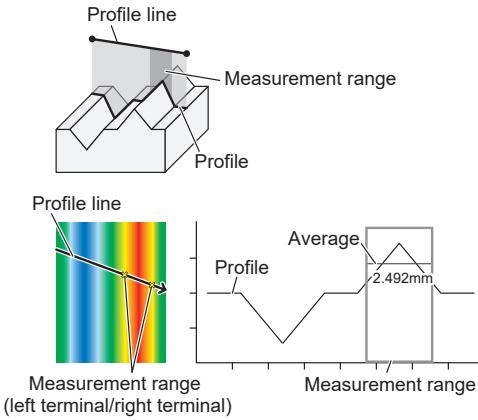


xxxxxxxxxxxxxxxxxxxx

Measurement Image

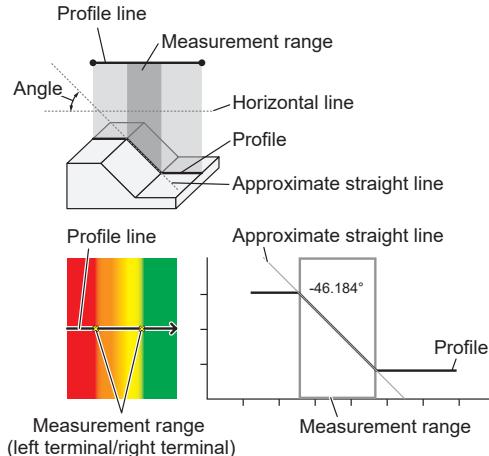
Profile measurement setting: [Height] (average)

Measure average height within measurement range



Profile measurement setting: [Angle from Horizontal]

Measure the angle between the profile and the horizontal line in the measurement range

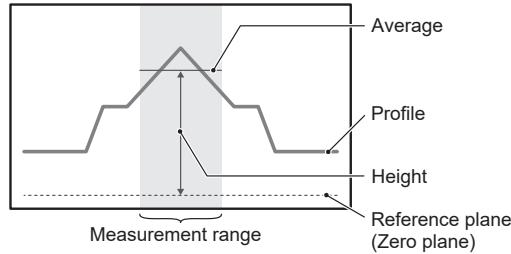


Usable Profile Measurement Types

General purpose

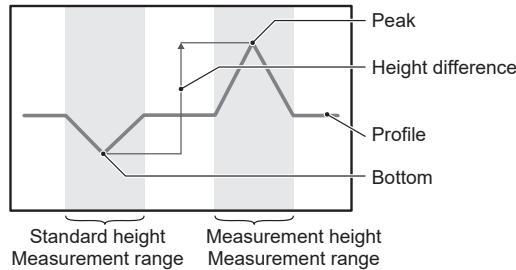
Height

Example: Measurement target: Average



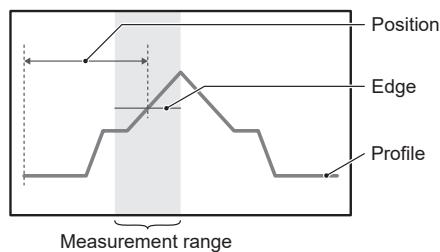
Height Difference

Example: Measurement target: Standard height: Bottom, Measurement height: Peak



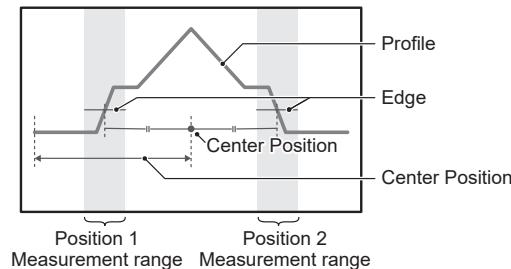
Position

Example: Measurement target: Edge



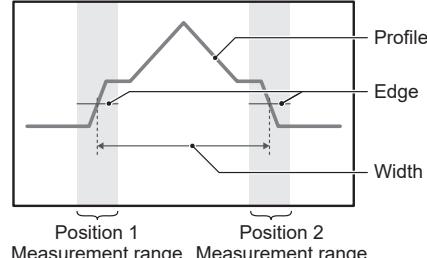
Center Position

Example: Measurement target: Position 1/Position 2: Edge



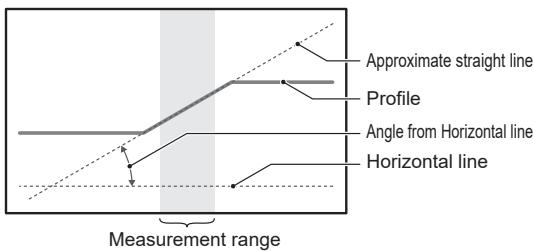
Width

Example: Measurement target: Position 1/Position 2: Edge



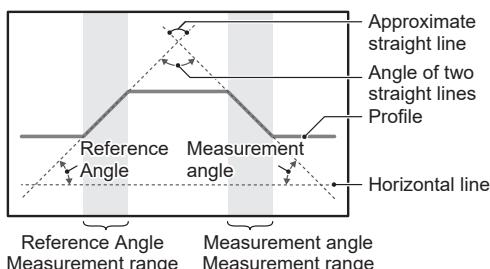
○ Angle from Horizontal

Example: Measurement target: Straight line



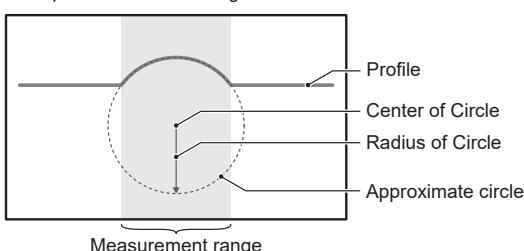
○ Angle Formed by Two Lines

Example: Measurement target: Reference angle: Straight line, Measurement angle: Straight line



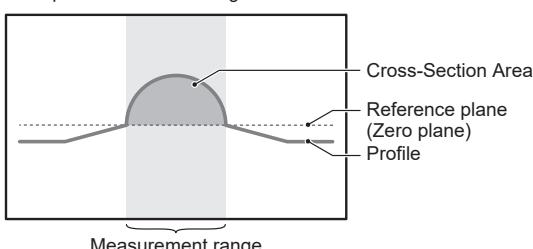
○ Radius of Circle

Example: Measurement target: Center of circle



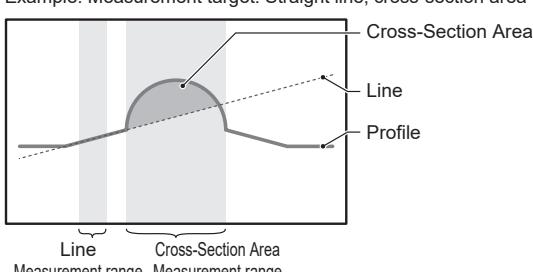
○ Cross-section Area

Example: Measurement target: Cross-section area



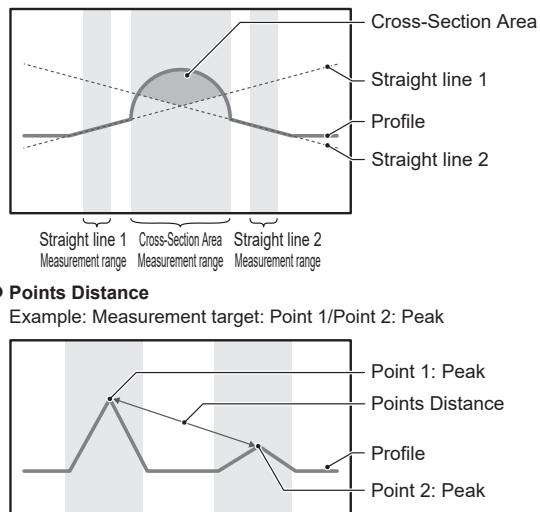
○ 1-Line Cross-Section Area

Example: Measurement target: Straight line, cross-section area



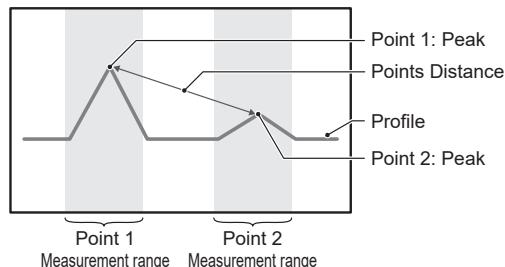
○ 2-Line Cross-Section Area

Example: Measurement target: Straight line, cross-section area



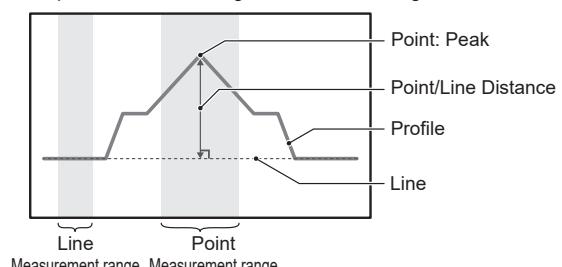
○ Points Distance

Example: Measurement target: Point 1/Point 2: Peak



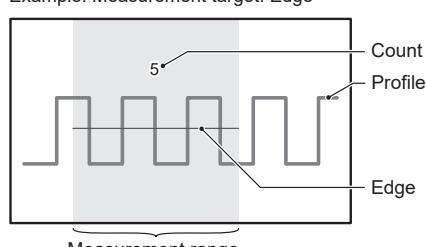
○ Point/Line Distance

Example: Measurement target: Point: Peak, straight line



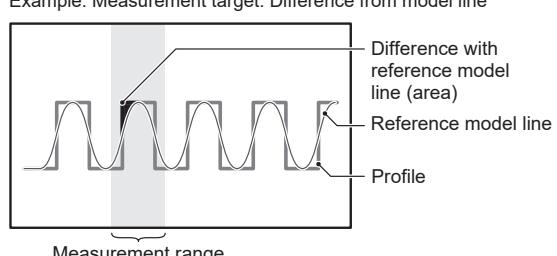
○ Count

Example: Measurement target: Edge



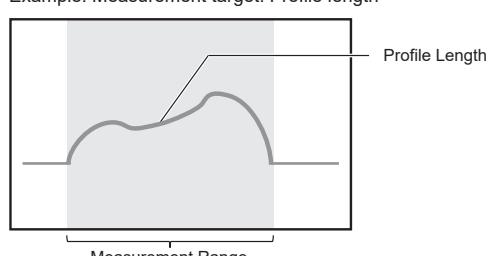
○ Defect detection

Example: Measurement target: Difference from model line



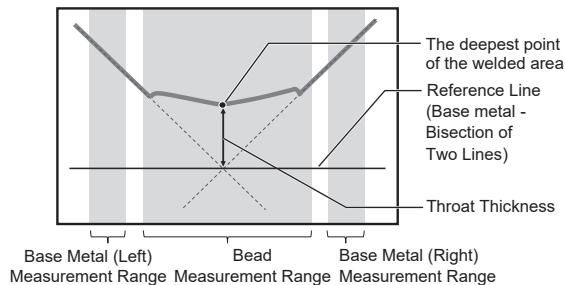
○ Profile length

Example: Measurement target: Profile length

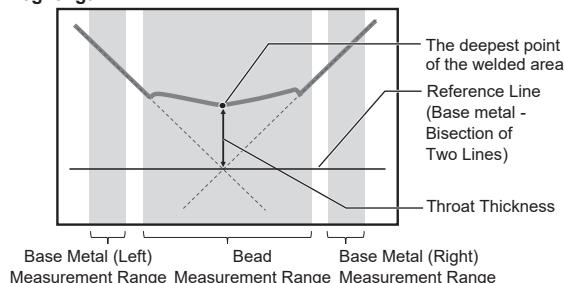


● For welding

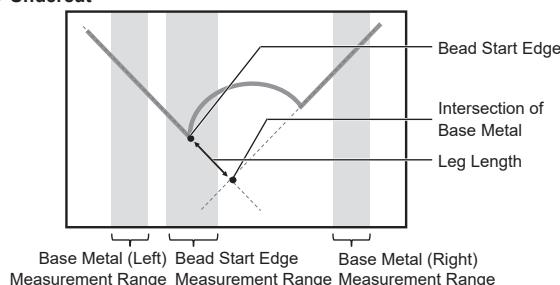
○ Throat Thickness



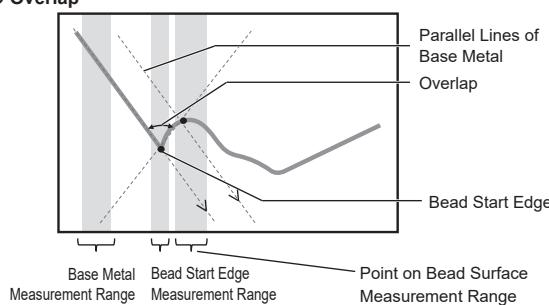
○ Leg length



○ Undercut



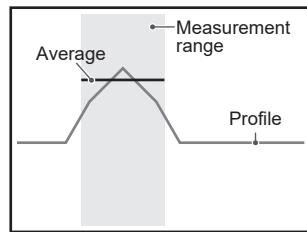
○ Overlap



Usable Profile Measurement Target Types

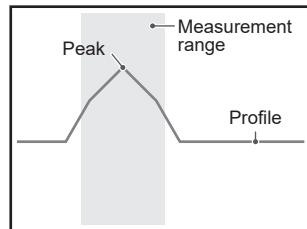
○ Average

Measures the average height of the profile in the measurement range.



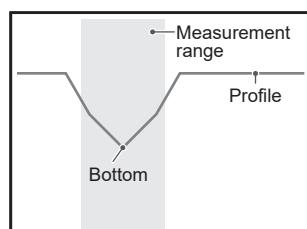
○ Peak

Measures the highest position/height of the profile in the measurement range. The peak for a reference (line or circle) can also be detected.



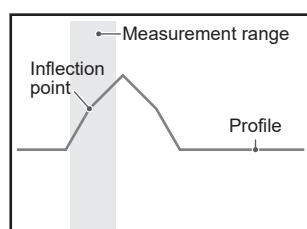
○ Bottom

Measures the lowest position/height of the profile in the measurement range. The bottom for a reference (line or circle) can also be detected.



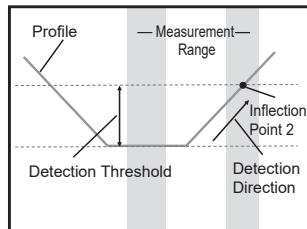
○ Inflection Point

Measures the position/height in the measurement range where the profile bends.



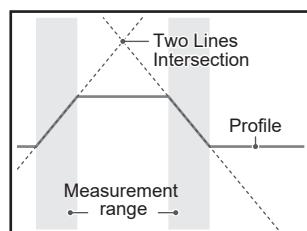
○ Inflection point 2

Measures positions and heights of profiles that are at or further from the detection threshold of a line or circle.



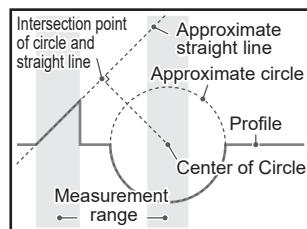
○ Two Lines Intersection

Specifies 2 measurement regions and measures the position/height at which 2 approximated straight lines calculated from the profile within each measurement region intersect.



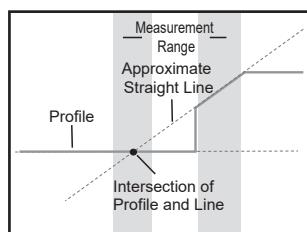
○ Circle/Line Intersection

Specifies a profile calculated from an approximated circle and a profile calculated from an approximated line, draws a line from the center of the circle to intersect the approximated line perpendicularly and measures the position/height of the intersection point.



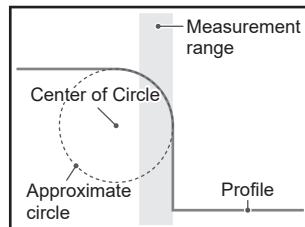
○ Profile and line Intersection

The intersection of approximate straight lines calculated from the profile and another profile in the measurement range is detected from another measurement range and the position and height are measured.

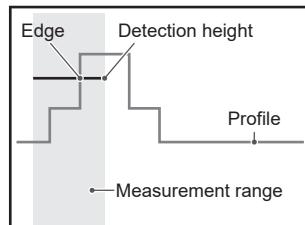


○ Center of circle

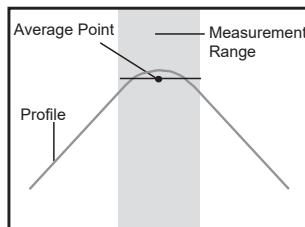
Measures the position/height of an approximated circle calculated from the profile in the measurement range.

**○ Edges**

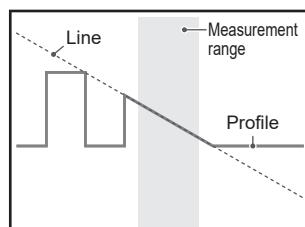
Measures positions which cross the selected [Detection Height] of the profile in the measurement range.

**○ Average Point**

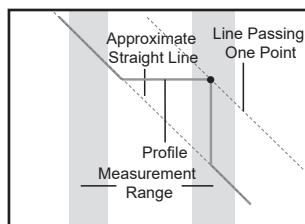
Detects the average profile height and center position in the measurement range.

**○ Line**

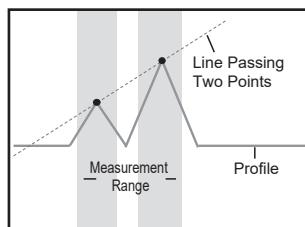
Calculates an approximate line from the profile in the measurement range. It is possible to specify the distance of the parallel translation. This is used for angle calculation and profile segmentation.

**○ Straight line passing through a single point**

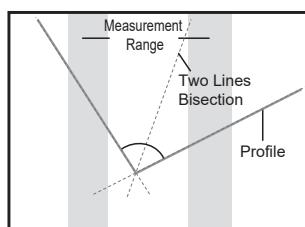
Detects an average line passing through a specified point. The line is parallel to the reference line. A line at a different angle, such as one perpendicular to the reference line, can be created by setting a tolerance angle.

**○ Line Passing Two Points**

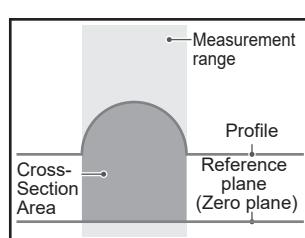
Detects a line passing through two different specified points. It is possible to specify the distance of the parallel translation.

**○ Bisector of Two Lines**

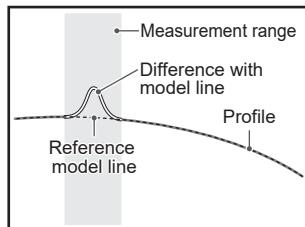
Detects a line bisecting two specified lines. It is possible to specify an angle rotating around the intersection between two lines or the distance between parallel lines.

**○ Cross-section Area**

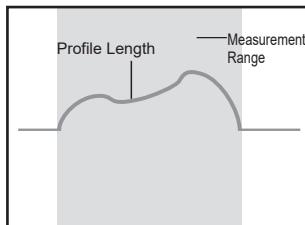
Measures the area of segmented regions of the profile in the measurement range. Additionally, by using a horizontal line or [Straight Line], it can measure the area of the measurement area, profile, or regions segmented by a horizontal line (straight line).

**○ Distance to Reference Line**

Measures the area of a region of the profile which differs from the model line within the measurement range, and the position/height of the point which is furthest from the model line.

**○ Profile length**

Measures the distance traversed by the profile in the measurement range.

**○ Auxiliary Target (Point)**

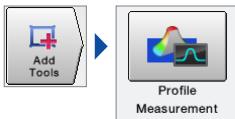
Refers to an auxiliary target for a point.

○ Auxiliary Target (Straight Line)

Refers to an auxiliary target for a line.

Flow of Settings

1 Add a tool.



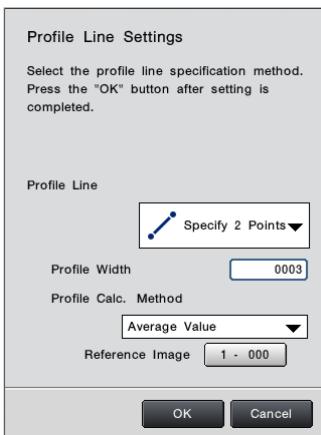
"Adding a tool" (Page 3-16)

2 Register the reference image.



"Register the standard image" (Page 3-15)

3 Select the type in the [Profile Line] field, then specify the profile line setting method.

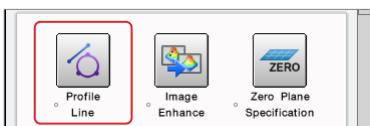


"Profile Line Settings" (Page 5-25).

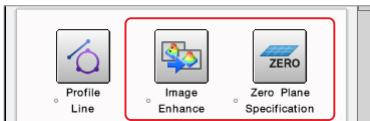
On the settings are completed, the [Profile Measurement] screen appears.

● Updating Profile Line Settings

Click the [Profile Line] button, and once the settings have been updated on the [Profile Line Settings] screen, click [OK].



4 Set [Image Enhance] and [Zero Plane Specification].



"Height measurement filters (preprocessing)" (Page 5-10)

"Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

5 Click [Add] and specify the items and judgment conditions of the profile to be measured.



"Profile Measurement Types" (Page 5-25).

● Deleting Profile Items

Select the items you would like to delete and click .

● Updating Profile Item Settings

Select the items you would like to update the settings for and click [Edit].

● Copying Profile Items

Select the items you would like to copy and click [Copy].

6 Configure the detailed settings in [Profile Measurement Settings].



For details, see "Profile Measurement Settings (Detailed Settings)" (Page 5-25).

7 Click [OK].

Profile Line Settings

Profile Line

Selects a specification method for the profile line.

Specify 2 Points

Specifies a start and end point in the image, and takes a profile line.

Vertical Line

Specifies a vertical straight line on the image and takes a profile line.

Horizontal Line

Specifies a horizontal straight line on the image and takes a profile line.

Circle

Draw a profile line in a circumferential direction on the image.

Profile Width

Specify a profile line width.

- Point** The number of profiles specified in [Profile Width] are obtained, and profiles to measure are obtained as per the settings in [Profile Calc. Method].

Profile Calc. Method

Specifies the profile calculation method to be used to acquire profiles for measurement from the profiles obtained through profile line on the height image and [Profile Width] settings.

Average Value

An average of obtained profiles is used as the profile for measurement.

Maximum Value

From the obtained profiles, the one with maximum pixels is linked and used as the profile for measurement.

Minimum Value

From the obtained profiles, the one with minimum pixels is linked and used as the profile for measurement.

Profile Measurement Settings (Detailed Settings)

Profile Shape Correction

Rotation + Projection

Even if the zero plane tilts in the direction of the cross section or perpendicular to it, there will be no shape distortion. Profile is rotated within the cross section, then a vertical cross section is projected onto the zero plane.

Rotation Only

Even if the zero plane tilts in the direction of the cross section, there will be no shape distortion.

Profile is rotated within the cross section based on its tilt. Used for measurement with a cross section parallel to the Z-axis.

None

The zero plane's height is subtracted to calculate the profile. If the zero plane tilts, there will be shape distortion.

Valid Pixel Border Processing

Select how to process the profile at the boundary between valid and invalid pixels. Affects only the edge and inflection point measurements.

Extend Up

Connect the upper limit and valid pixels.

Extend Down

Connect the lower limit and valid pixels.

None

Do not connect the profile in the border area. This will mean that edges and inflection points are not detected.

Profile Measurement Types

Height

Measures the [Height] of the profile in the measurement range.

Measurement Target

Specifies the measurement target for height measurement. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Average" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

- "Correcting Measured Values of Profile Measurements" (Page 5-38)

Judgment Conditions

Set tolerance (maximum and minimum) on measured heights. The unit for tolerance is [mm].

Height Difference

Measure the height difference based on the [Height] of the profiles detected in two measurement ranges.

Measurement Target (Reference Height/Measurement Height)

Specifies the measurement target for measurement of standard height/measurement height.

Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Average" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

- "Correcting Measured Values of Profile Measurements" (Page 5-38)

Judgment Conditions

Set tolerance (maximum and minimum) on measured height difference. The unit for tolerance is [mm].

■ Position

Measures the [Position] of the profile in the measurement range.

● Measurement Target

Specifies the measurement target for position measurement. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Edges" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured position. The unit for tolerance is [mm].

■ Center Position

Measure the center position based on the [Position] of the profiles detected in two measurement ranges.

● Measurement Target (Position 1/Position 2)

Specify the measurement target (Page 5-54) for measuring Position 1/Position 2.

Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Edges" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured center position. The unit for tolerance is [mm].

■ Width

Measure the width based on the [Position] of the profiles detected in two measurement ranges.

● Measurement Target (Position 1/Position 2)

Specifies the measurement target (Page 5-54) for position measurement. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Edges" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured width. The unit for tolerance is [mm].

■ Angle from Horizontal

Measure the [Angle] between a line on the profile and the horizontal in the measurement range.

● Measurement Target

Specify the measurement target for detection of lines. Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for line.

- "Straight line" (Page 5-34)
- "Straight line passing through a single point" (Page 5-35)
- "Line Passing Two Points" (Page 5-35)
- "Bisector of Two Lines" (Page 5-35)
- "Auxiliary Target (Line)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Judgment Conditions

Set tolerance (maximum and minimum) on measured angle from horizontal.

The unit for tolerance is [°].

■ Options

○ Angle range

Selects display range for the detected angle.

○ Angle Direction

• Counterclockwise

Calculates the angle in a counter-clockwise direction from the horizontal position.

• Clockwise

Calculates the angle in a clockwise direction from the horizontal position.

Angle Formed by Two Lines

Measure the [Angle] formed by the line on the profile on one measurement region and the line on the profile in the other measurement region.

Measurement Target (Reference Angle/Measurement Angle)

Specify the measurement target for detection of lines.

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for line.

- "Straight line" (Page 5-34)
- "Straight line passing through a single point" (Page 5-35)
- "Line Passing Two Points" (Page 5-35)
- "Bisector of Two Lines" (Page 5-35)
- "Auxiliary Target (Line)" (Page 5-36)

Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

Judgment Conditions

Set tolerance (maximum and minimum) on measured angle formed by 2 straight lines.

The unit for tolerance is [$^{\circ}$].

Options

Angle range

Selects display range for the detected angle.

Angle Direction

- Counterclockwise

Calculates the angle in a counter-clockwise direction from the horizontal position.

- Clockwise

Calculates the angle in a clockwise direction from the horizontal position.

Radius of Circle

Measures the [Radius of Circle] formed on the profile in the measurement range.

Measurement Target

Fixed by "Center of Circle" (Page 5-34).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for center of circle.

Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

Judgment Conditions

Set tolerance (maximum and minimum) on measured radius of circle.

The unit for tolerance is [mm].

Cross-section Area

Measure the area of the region surrounded by the profile and zero plane in the measurement range.

Measurement Target

Fixed by "Cross-Section Area" (Page 5-36).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for cross-section area.

Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

Judgment Conditions

Set tolerance (maximum and minimum) on measured cross-section area. The unit for tolerance is [mm^2].

Options

Detection target: Selects cross-section area detection target.

Convex/Concave

Calculates area by adding the area of regions above the standard height to the area of regions below it.

Concave Part

Calculates area of regions below the standard height.

Convex Part

Calculates area of regions above the standard height.

Integration

Calculates area by adding the regions, treating the area of regions above the standard height as positive, and the area below as negative.

1-Line Cross-Section Area

Measure the area of the region surrounded by a straight line and the zero plane in the measurement range.

Measurement Target (Straight Line)

Fixed by "Straight line" (Page 5-34).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for line.

Measurement Target (Cross-section Area)

Fixed by "Cross-Section Area" (Page 5-36).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for cross-section area.

Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

Judgment Conditions

Set tolerance (maximum and minimum) on measured cross-section area enclosed by 1 line.

The unit for tolerance is [mm^2].

Options

Detection target: Selects cross-section area detection target.

Convex/Concave

Calculates area by adding the area of regions above the standard height to the area of regions below it.

Concave Part

Calculates area of regions below the standard height.

Convex Part

Calculates area of regions above the standard height.

Integration

Calculates area by adding the regions, treating the area of regions above the standard height as positive, and the area below as negative.

■ 2-Line Cross-Section Area

Measure the area of the region surrounded by 2 straight lines and the zero plane in the measurement range.

● Measurement Target (Line 1/Line 2)

Fixed by "Straight line" (Page 5-34).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for line.

● Measurement Target (Cross-section Area)

Fixed by "Cross-Section Area" (Page 5-36).

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for cross-section area.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured cross-section area enclosed by 2 lines.

The unit for tolerance is [mm²].

● Options

Detection target: Selects cross-section area detection target.

Concave part

Calculates area of regions below the standard height.

Convex part

Calculates area of regions above the standard height.

■ Points Distance

Measure the distance based on [Points] of the profiles detected in two measurement ranges.

● Measurement Target (Point 1/Point 2)

Specifies the measurement target (Page 5-30) for point measurement. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Average" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured point-to-point distance.

The unit for tolerance is [mm].

■ Point/Line Distance

Measure the distance based on a [Point] on the profile detected in one measurement range and a [Line] detected on the profile in the another measurement range.

● Measurement Target (Point)

Specifies the measurement target for point measurement. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Average" (Page 5-30)
- "Peak" (Page 5-30)
- "Bottom" (Page 5-31)
- "Inflection point" (Page 5-31)
- "Inflection Point 2" (Page 5-32)
- "Two Lines Intersection" (Page 5-33)
- "Circle/Line Intersection" (Page 5-33)
- "Profile and Line Intersection" (Page 5-34)
- "Center of Circle" (Page 5-34)
- "Distance to Reference Line" (Page 5-36)
- "Auxiliary Target (Point)" (Page 5-36)

● Measurement Target (Straight Line)

Specify the measurement target for detection of lines.

Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for line.

- "Straight line" (Page 5-34)
- "Straight line passing through a single point" (Page 5-35)
- "Line Passing Two Points" (Page 5-35)
- "Bisector of Two Lines" (Page 5-35)
- "Auxiliary Target (Line)" (Page 5-36)

● Auxiliary Target

An auxiliary target can be used to measure the target with a combination of an auxiliary point and an auxiliary line. Select a point or line and then select the measurement target to be used.

A measurement target with an auxiliary target can be referenced as an auxiliary point or auxiliary line from another measurement target.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured point-to-line distance.

The unit for tolerance is [mm].

■ Count

Measures the number of measurement targets from the profile in the measurement range.

● Measurement Target

Specifies the measurement target (Page 5-30) to be counted. Select a method for specifying the measurement range and perform necessary settings. Then, set the measurement target [Detection Conditions] based on the specified measurement target.

- "Edges" (Page 5-30)
- "Inflection point" (Page 5-31)
- "Distance to Reference Line" (Page 5-36)

● Judgment Conditions

Set tolerance (maximum and minimum) on count number.

■ Detect detection

Detects difference from the profile within the measurement range and measures the amount of fault using the profile's [Reference Line].

● Measurement Target

Fixed by "Distance to Reference Line" (Page 5-36). Select a method for specifying the measurement range and perform necessary settings. Additionally, set [Detection Conditions] for the difference from model line.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.
 "Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured amount of fault. The unit for tolerance is [mm²].

■ Profile length

Calculates the distance traversed by the profile in the measurement range.

● Measurement Target

Fixed by "Profile Length" (Page 5-36).

Select a method for specifying the measurement range and perform necessary settings.

Additionally, set [Detection Conditions] for profile length.

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured profile lengths.

The unit for tolerance is [mm].

■ Throat Thickness

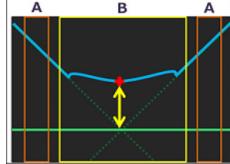
Calculates the thickness of the cross section minus the raised area of the welded metal (throat thickness) for fillet welding.

● Specify Measurement Range

Specify the measurement range according to the figure below.

A: Base metal (orange)

B: Bead (yellow)



● Measurement Target (Bead)

Fixed by "Bottom" (Page 5-31).

● Measurement Target (Base Metal)

Fixed as [Bisector of two lines].

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

For details on the setting method, see "Correcting Measured Values of Profile Measurements" (Page 5-38).

● Judgment Conditions

Set tolerance (maximum and minimum) on measured throat thickness. The unit for tolerance is [mm].

■ Leg length

Calculates the distance from the base of the fillet (joint root) to the tip of the fillet weld (leg length) for fillet welding. It is presumed that an auxiliary target is used.

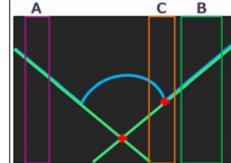
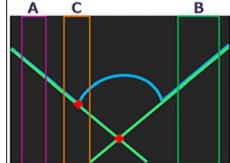
● Specify Measurement Range

Specify the detection region and then specify the measurement range according to the figure below.

A: Base metal (left) (purple)

B: Base metal (right) (green)

C: Bead start edge (orange)



● Measurement Target (Joint Root)

Fixed by "Two Lines Intersection" (Page 5-33).

● Measurement Target (Bead Start Edge)

Fixed by "Inflection Point 2" (Page 5-32).

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured leg length.

The unit for tolerance is [mm].

■ Undercut

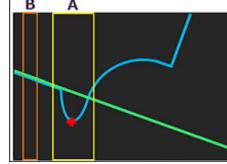
Calculates the undercut (the groove that is not filled with welding metal) from the base metal for fillet welding.

● Specify Measurement Range

Specify the measurement range according to the figure below.

A: Undercut (yellow)

B: Base metal (orange)



● Measurement Target (Undercut)

Fixed by "Bottom" (Page 5-31).

● Measurement Target (Bead Start Edge)

[Straight line passing through a single point], [Line Passing Two Points], [Bisector of two lines] or [Auxiliary Target (Line)] can be selected in addition to [Line].

"Straight line" (Page 5-34)

"Straight line passing through a single point" (Page 5-35)

"Line Passing Two Points" (Page 5-35)

"Bisector of Two Lines" (Page 5-35)

"Auxiliary Target (Line)" (Page 5-36)

● Measured Value Correction

Select [Settings] and adjust the measured values to match the actual size.

"Correcting Measured Values of Profile Measurements" (Page 5-38)

● Judgment Conditions

Set tolerance (maximum and minimum) on measured undercut.

The unit for tolerance is [mm].

■ Overlap

Calculates the angle of the line passing through the bead tip and overlap (the welding defect at the tip where the welding metal does not fuse with the base material) relative to the base metal for fillet welding. It is presumed that an auxiliary target is used.

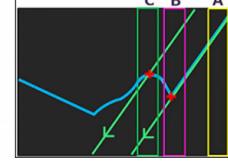
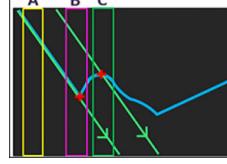
● Specify Measurement Range

Specify the detection region and then specify the measurement range according to the figure below.

A: Base metal (yellow)

B: Bead start edge (purple)

C: Point on bead surface (green)



● Measurement Target (Base Metal)

[Straight line passing through a single point], [Bisector of two lines] or [Auxiliary Target (Line)] can be selected in addition to [Line].

"Straight line" (Page 5-34)

"Straight line passing through a single point" (Page 5-35)

"Line Passing Two Points" (Page 5-35)

"Bisector of Two Lines" (Page 5-35)

"Auxiliary Target (Line)" (Page 5-36)

● Measurement Target (Approximate Straight Line of Bead Surface)

Fixed by "Line Passing Two Points" (Page 5-35).

● Judgment Conditions

Set tolerance (maximum and minimum) on measured overlap. The unit for tolerance is [°].

● Options

○ Angle range

Selects display range for the detected angle.

○ Angle Direction

• Counterclockwise

Calculates the angle in a counter-clockwise direction from the horizontal position.

• Clockwise

Calculates the angle in a clockwise direction from the horizontal position.

Measurement Target Settings

Edges

Specifies measurement range and edge detection conditions and measures edges within the region.

Measurement range

Specifies the range for measurement of edges.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

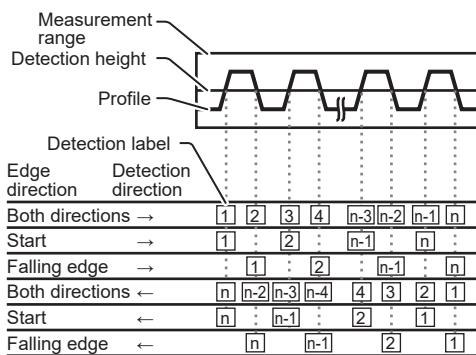
Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

Edge Detection Settings

Specifies edge detection conditions.



Detection Height

Specifies the height at which the profile crosses within the measurement range which is detected as an edge. If [Automatic Settings] is selected, the height at which edges are detected in the profile during display is set automatically.

Edge Direction

Specifies the profile change direction to be detected as an edge.

- Both Directions

Both rising and falling are the measurement targets.

- Rising

Crossings from the bottom to the top are the target.

- Falling

Crossings from the top to the bottom are the target.

Scan Direction

Specify the direction for scanning for the edge within the measurement range.

-

Scan from the left to the right of the displayed profile (from profile line start to end).

- ←

Scan from the right to the left of the displayed profile (from profile line end to start).

Detection label

Among the edge candidates that satisfy the conditions, specify the label to be selected, using a number.

Average

Specifies the measurement range and measures the average height of the profile in the measurement range.

Measurement range

Specifies the range for measurement of the average.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement. For details, see □ "Measurement Range Settings" (Page 5-37).

Average Point

Measures the average profile height and center position in the measurement range.

Measurement range

Specify the range for measurement of the average point.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

Peak

Specifies the measurement range and measures the maximum value of the profile in the measurement range. When a reference is used, the peak for the reference type can be detected.

Measurement Range (Peak)

Specifies the range for measurement of the peak.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

Reference

When this is enabled, the peak for the reference type can be detected.

Reference Type (Straight Line)

Specify the type of measurement target to be used as the reference.

Line

Uses a straight line as the reference.

Circle (Upper Side)

Uses the top half of a circle as the reference.

Circle (Bottom)

Uses the bottom half of a circle as the reference.

Refer to the other Measurement Target (Straight Line)

A measurement target can be referenced as a reference line or reference circle. An error occurs if an element other than a line or circle is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

Measurement Range (Reference)

Select the method for specifying the measurement range.

Specify Multiple Ranges (Reference)

If this option is enabled, another measurement range can be specified and approximated lines and circle can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

Options

Correction

If enabled, reduces the noise influence during circle or line detection.

Bottom

Specifies the measurement range and measures the minimum value of the profile in the measurement range.

Measurement Range (Bottom)

Specifies the range for measurement of the bottom.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

Reference

When this is enabled, the bottom for the reference type can be detected.

Reference Type (Straight Line)

Specify the type of measurement target to be used as the reference.

- Line**

Uses a straight line as the reference.

- Circle (Upper Side)**

Uses the top half of a circle as the reference.

- Circle (Bottom)**

Uses the bottom half of a circle as the reference.

Refer to the other Measurement Target (Straight Line)

A measurement target can be referenced as a reference line or reference circle. An error occurs if an element other than a line or circle is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

Measurement Range (Reference)

Select the method for specifying the measurement range.

Specify Multiple Ranges (Reference)

If this option is enabled, another measurement range can be specified and approximated lines and circle can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

Options

- Correction**

If enabled, reduces the noise influence during circle or line detection.

Inflection point

Specifies the measurement range and inflection point detection settings and measures the inflection points of the profile in the measurement range.

Measurement range

Specifies the range for measurement of the inflection points.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

Inflection Point Detection Settings

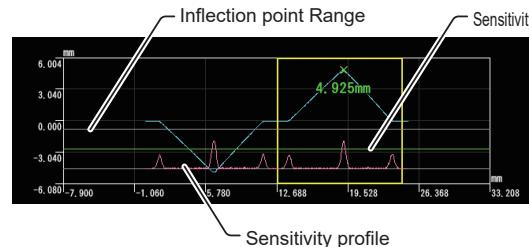
Set [Detection Conditions] for inflection point.

- Sensitivity**

A threshold value which determines at which point a change in the tilt of the profile (degree of bend) will be detected as an inflection point. While setting the sensitivity, a differential waveform (sensitivity profile) of the profile data is displayed to emphasize inflection points. Set the sensitivity between 1 to 100 such that the sensitivity profile of the desired detection points exceeds a threshold.

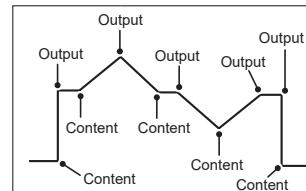
- Inflection Point Range**

Sets the display range for the inflection point graph. If the inflection point graph is concentrated, set the value to be large.



- Inflection point shape**

Specifies the profile change in tilt for inflection point detection.



- **Peak/Valley**

Both directions where the profile change in tilt reduces and those where it increases are treated as inflection points.

- **Peak**

Directions where the profile change in tilt reduces are treated as inflection points.

- **Valley**

Directions where the profile change in tilt increases are treated as inflection points.

- Scan Direction**

Specify the direction for scanning for the inflection points within the measurement region.

- →

Scan from the left to the right of the displayed profile (from profile line start to end).

- ←

Scan from the right to the left of the displayed profile (from profile line end to start).

- Detection label**

Out of all inflection point candidates which meet the conditions, specifies the label of detection targets with a number.

- No. of Points**

Set the number of pieces of data when calculating inflection points. Set a small value if you want to capture subtle inflection points. However, a small value may make detection unstable.

■ Inflection Point 2

Detects points where the profile intersects a user-defined line or circle.

● Detection Settings

Scan Direction

Specify the profile change direction to be detected as Inflection Point 2.

- **Upper right or Lower right**

Sets a profile that diverges to the top right or bottom right of the line or circle as the measurement target.

- **Upper left or Lower left**

Lower Left: Sets a profile that diverges to the top left or bottom left of the line or circle as the measurement target.

- **Upper Right**

Sets a profile that diverges to the top right of the line or circle as the measurement target.

- **Lower Right**

Sets a profile that diverges to the bottom right of the line or circle as the measurement target.

- **Upper Left**

Sets a profile that diverges to the top left of the line or circle as the measurement target.

- **Lower Left**

Sets a profile that diverges to the bottom left of the line or circle as the measurement target.

Detection threshold (mm)

Specify the distance from the line or circle where detection begins. Setting a large value prevents false detections caused by noise near the line or circle, but deviation from the line or circle is greater.

● Measurement Range (Point)

Specify the range for measurement of Inflection Point 2.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

● Type (Line/Circle)

Specify the type of measurement target.

Linear

Detects areas at or further away from the threshold of distance from the line as Inflection Point 2.

Circle (Upper)

Detects areas at or further away from the threshold of distance from the circle as Inflection Point 2. Specify this if you want to detect a circle from a raised area. Profiles outside the reference circle in the X direction are not detected as detection points.

Circle (Lower)

Detects areas at or further away from the threshold of distance from the circle as Inflection Point 2. Specify this if you want to detect a circle from a depressed area. Profiles outside the reference circle in the X direction are not detected as detection points.

● Refer to the other Measurement Target (Line/Circle)

A measurement target can be referenced as a line or circle. An error occurs if an element other than a line or circle is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement Range (Line/Circle)

Select the method for specifying the measurement range.

● Specify Multiple Ranges (Line/Circle)

If this option is enabled, another measurement range can be specified and approximated lines and circle can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

Correction

If enabled, reduces the noise influence during line or circle detection.

Detection method

Select the method for detecting Inflection Point 2.

- **Search from line/circle**

Searches for profiles from a line or circle and detects points that are at or further away than the threshold. False detections may occur if there is a lot of noise near the line or circle.

- **Search from Opp**

Searches for profiles from the side opposite to the line or circle and detects points that are at or further than the threshold. This prevents false detection when there is a lot of noise near the line or circle. This is effective if the profiles are at a uniform distance from the line or circle.

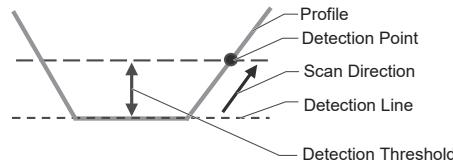
Filter Points

Specifies the number of median filter points to be used when judging that a point is far away from the line or circle. Setting a large value prevents false detections caused by noise, but fluctuations between detection points are greater.

(Example)

Scan direction: Top Right

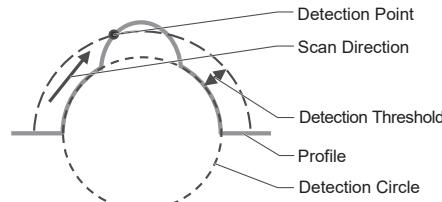
Type: Linear



(Example)

Scan direction: Top Right

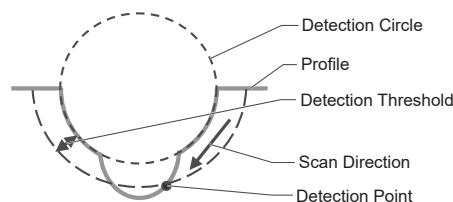
Type: Circle (Upper)



(Example)

Scan direction: Lower Left

Type: Circle (Lower)



■ Two Lines Intersection

Specifies 2 measurement regions and measures the position at which 2 approximated straight lines calculated from the profile within each measurement region intersect.

● Refer to the other Measurement Target (Line 1/Line 2)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement range (Line 1/Line 2)

Specifies the measurement range for detection of approximated lines.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges (Line 1/Line 2)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

- Correction**

If enabled, reduces the noise influence during approximated line detection.

■ Circle/Line Intersection

Specifies a profile calculated from an approximated circle and a profile calculated from an approximated line, draws a line from the center of the circle to intersect the approximated line perpendicularly and measures the position/height of the intersection point.

● Refer to the other Measurement Target (Circle)

A measurement target can be referenced as a circle. An error occurs if a measurement target other than a circle is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement Range (Circle)

Specifies the measurement range for detection of approximated circle.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges (Circle)

If this option is enabled, another measurement range can be specified and approximated circles/lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Refer to the other Measurement Target (Line)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement Range (Line)

Specifies the measurement range for detection of approximated lines.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges (Line)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

- Correction**

If enabled, reduces the noise influence during approximated line and circle detection.

- Intersection type**

Select the point to be calculated as an intersection between circle and line. If there is one intersection point, the contact point between the circle and line is calculated. If there is no intersection point, the intersection point between the approximated line and a perpendicular line from the center of the approximated circle is detected.

- **Midpoint of Left and Right Points**

The middle point of two intersection points is defined as calculated.

- **Left Side Intersection Point**

Of the two points, the left-side intersection point is calculated.

- **Right Side Intersection Point**

Of the two points, the right-side intersection point is calculated.

- **Upper Intersection**

Of the two points, the top-side intersection point is calculated.

- **Lower Intersection**

Of the two points, the bottom-side intersection point is calculated.

█ Profile and Line Intersection

Detects intersections of profiles and lines.

● Measurement Range (Profile)

Specify the profile range for searching for intersections.

● Refer to the other Measurement Target (Line)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement Range (Line)

Specify the measurement range for detection of approximated lines.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement. For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges (Line)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

Correction

If enabled, reduces the noise influence during line detection.

Cross direction

Specify the profile change direction to be detected as an intersection with a line.

- Both Directions

Both rising and falling are the measurement targets.

- Rise

Targets the direction crossing from the bottom of the line to the top.

- Fall

Targets the direction crossing from the top of the line to the bottom.

Scan direction

Specify the direction to search for the intersection point within the measurement range.

Detection label

Out of all intersection point candidates which meet the conditions, specifies the label of detection targets with a number.

█ Center of Circle

Specifies the measurement range and measures the position of the center of an approximated circle detected from the profile in the measurement range.

● Measurement range

Specifies the measurement range for detection of approximated circle.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement.

For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges

If this option is enabled, another measurement range can be specified and approximated circles can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

Correction

If enabled, reduces the noise influence during approximated circle detection.

█ Straight line

Specifies the measurement range and detects an approximated line from the profile in the measurement range.

● Refer to the other Measurement Target (Straight Line)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement range

Specifies the measurement range for detection of approximated lines.

User Specified

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

Refer to Position Measurement (1 point)

Specify a region while referencing a position measured by another profile measurement.

Refer to Position Measurement (2 points)

Specify a region from 2 points measured by another profile measurement. For details, see □ "Measurement Range Settings" (Page 5-37).

● Specify Multiple Ranges

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

Correction

If enabled, reduces the noise influence during approximated line detection.

Parallel Travel range (mm)

It is possible to specify the distance of the parallel translation of detected lines.

Parallel Travel Reference

Specify the reference for the parallel translation. When Parallel Translation Distance is set, parallel translation of the detected line is performed by moving the set parallel translation distance perpendicularly to the detected line.

- Z Reference

Performs parallel translation using the Z direction as a reference.

Performing parallel translation of a line that is around 0° makes it possible to perform parallel translation in the same direction even if the tilt changes.

- X Reference

Performs parallel translation using the X direction as a reference.

Performing parallel translation of a line that is around 90° makes it possible to perform parallel translation in the same direction even if the tilt changes.

■ Straight line passing through a single point

Detects an average line passing through a specified point. The line is parallel to the reference line.
A line at a different angle, such as one perpendicular to the reference line, can be created by setting a tolerance angle.

● Measurement Target (Refer to Point)

Select the measurement target from the following:
Point/Auxiliary Target 1/Auxiliary Target 2/Auxiliary Target 3/Auxiliary Target 4

● Line Type (Straight Line)

Specifies the type of line.

- Line**
Creates an approximate straight line from the profile in the measurement range.
- Horizontal Line**
Creates a horizontal line. The line type cannot be referred to when a horizontal line is specified.

● Refer to the other Measurement Target (Straight Line)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement Range (Straight Line)

Specify the measurement range for detection of approximated lines.

- User Specified**
Specify the left and right edge of the measurement range using numbers. Measurement range will not change.
- Refer to Position Measurement (1 point)**
Specify a region while referencing a position measured by another profile measurement.
- Refer to Position Measurement (2 points)**
Specify a region from 2 points measured by another profile measurement. For details, see □ "Measurement Range Settings" (Page 5-37).

● Multiple Region Specification (Straight Line)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

- Correction**
If enabled, reduces the noise influence during approximated line detection.
- Intersection angle**
An angle intersecting with a reference line can be specified. A line parallel to the reference line can be created by specifying 0 degrees. Perpendicular reference lines can be created by specifying 90 degrees.
- Parallel Travel Range (mm)**
It is possible to specify the distance of the parallel translation of detected lines.
- Parallel Travel Reference**
Specify the reference for the parallel translation. When Parallel Translation Distance is set, parallel translation of the detected line is performed by moving the set parallel translation distance perpendicularly to the detected line.
 - Z Reference**
Performs parallel translation using the Z direction as a reference. Performing parallel translation of a line that is around 0° makes it possible to perform parallel translation in the same direction even if the tilt changes.
 - X Reference**
Performs parallel translation using the X direction as a reference. Performing parallel translation of a line that is around 90° makes it possible to perform parallel translation in the same direction even if the tilt changes.

■ Line Passing Two Points

Detects a line passing through two points. Refer to two different measurement targets as points that the line must pass through.

● Measurement Target (Refer to Point 1/Refer to Point 2)

Select the measurement target from the following:
Point/Auxiliary Target 1/Auxiliary Target 2/Auxiliary Target 3/Auxiliary Target 4

● Options

- Parallel Travel Range (mm)**
It is possible to specify the distance of the parallel translation of detected lines.
- Parallel Travel Reference**
Specify the reference for the parallel translation. When Parallel Translation Distance is set, parallel translation of the detected line is performed by moving the set parallel translation distance perpendicularly to the detected line.
 - Z Reference**
Performs parallel translation using the Z direction as a reference. Performing parallel translation of a line that is around 0° makes it possible to perform parallel translation in the same direction even if the tilt changes.
 - X Reference**
Performs parallel translation using the X direction as a reference. Performing parallel translation of a line that is around 90° makes it possible to perform parallel translation in the same direction even if the tilt changes.

■ Bisector of Two Lines

Detects a line bisecting two lines. Perpendicular bisecting lines can be created by setting a rotation angle.

● Refer to the other Measurement Target (Line 1/Line 2)

A measurement target can be referenced as a line. An error occurs if a measurement target other than a line is selected. During editing, a graphic representing the result for the referenced measurement target is displayed.

● Measurement range (Line 1/Line 2)

Specify the measurement range for detection of approximated lines.

- User Specified**
Specify the left and right edge of the measurement range using numbers. Measurement range will not change.
- Refer to Position Measurement (1 point)**
Specify a region while referencing a position measured by another profile measurement.
- Refer to Position Measurement (2 points)**
Specify a region from 2 points measured by another profile measurement. For details, see □ "Measurement Range Settings" (Page 5-37).

● Multiple Region Specification (Line 1/Line 2)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

● Options

- Correction**
If enabled, reduces the noise influence during approximated line detection.
- Rotation angle**
An angle rotating around the intersection between two lines can be specified. Perpendicular bisecting lines can be created by specifying 90 degrees.
- Parallel Travel Range (mm)**
It is possible to specify the distance of the parallel translation of detected lines.
- Parallel Travel Reference**
Specify the reference for the parallel translation. When Parallel Translation Distance is set, parallel translation of the detected line is performed by moving the set parallel translation distance perpendicularly to the detected line.
 - Z Reference**
Performs parallel translation using the Z direction as a reference. Performing parallel translation of a line that is around 0° makes it possible to perform parallel translation in the same direction even if the tilt changes.
 - X Reference**
Performs parallel translation using the X direction as a reference. Performing parallel translation of a line that is around 90° makes it possible to perform parallel translation in the same direction even if the tilt changes.

Cross-Section Area

Specifies a measurement range and measures the area of regions which are segmented by the zero plane and profile in the measurement range.

Measurement range

Specifies the measurement range for detection of cross-section area.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see  "Measurement Range Settings" (Page 5-37).

Specify Multiple Ranges (Line 1/Line 2)

If this option is enabled, another measurement range can be specified and approximated lines can be detected from those 2 areas. The method for specifying the measurement range is identical to that above.

Distance to Reference Line

Specifies the measurement range, detects a standard model line from the profile in the measurement range, and measures the difference between the profile.

Measurement range

Specifies the measurement range for detection of standard model line.

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see  "Measurement Range Settings" (Page 5-37).

Detection Conditions

Specifies the conditions for detection of the difference between the standard model line.

- Reference Line**

Specifies the standard model line for the profile to be measured.

- Free Curve Line
- Line
- Circle

- Smoothing Range (Common)**

Set if "free curve" is selected for the reference model line.

Set the value to be large when drawing loose free-form lines, and small when drawing steep free-form lines, with regards to the profile within the measurement range.

- Scan direction**

Specifies the direction for detection.

- +/-

Detects convex/concave areas in either +/- direction as differences.

- +

Only detects convex/concave areas in the + direction as differences.

- -

Only detects convex/concave areas in the - direction as differences.

When the standard model line is a circle, [+] indicates the outward direction, and [-] indicates the opposite direction.

- Detection Threshold**

Detects items whose distance from the standard model line exceeds a specified value as faults (unit: mm).

- Lowest Detected Width**

Faults whose fault width is smaller than the specified lower limit are not treated as faults (unit: mm).



If [Distance to Reference Line] is used for position detection, this is calculated as the fault location which is furthest from the model line.

Profile Length

Calculates the distance traversed by the profile in the measurement range.

Measurement range

- User Specified**

Specify the left and right edge of the measurement range using numbers. Measurement range will not change.

- Refer to Position Measurement (1 point)**

Specify a region while referencing a position measured by another profile measurement.

- Refer to Position Measurement (2 points)**

Specify a region from 2 points measured by another profile measurement.

For details, see  "Measurement Range Settings" (Page 5-37).

Options

- Invalid data interpolation**

Interpolates a line between the termination of one valid point and the start of another in the measurement range.

- Smoothing**

Performs moving average processing of profile data in the X direction. Specify the moving average score. To reduce the variation of profile data, increase the setting value.

Auxiliary Target (Point)

Refers to an auxiliary target for a point.

Measurement Target (Refer to Point)

Select an auxiliary target.

Auxiliary Target (Line)

Refers to an auxiliary target for a line.

Measurement Target (Refer to Line)

Select an auxiliary target.

Measurement Range Settings

Set the range which is to be measured.

User Specified

Specifies the left and right edge positions using numbers.
Use when the measurement range does not change.

Left End

Specifies the left edge position of the measurement range.

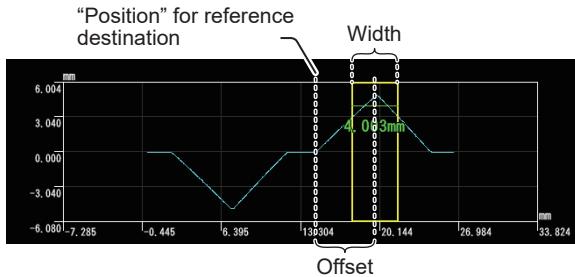
Right End

Specifies the right edge position of the measurement range.

Refer to Position Measurement (1 point)

Specifies a region while referencing a position (position, center position) measured by another profile measurement.

Ref.



Measurement item No.

Specifies the measurement item No. of the position or center position and specifies the center position of the measurement range. Measurement range follows the position measurement results.

Offset

Specify when you want to offset the measurement range position.

Width

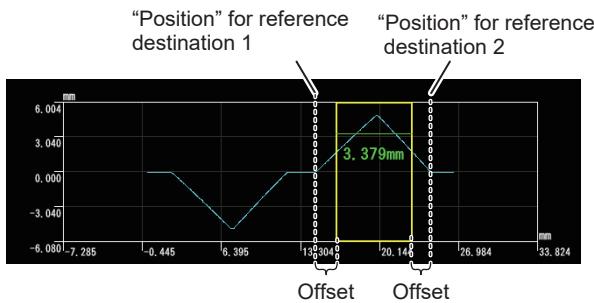
Specify the measurement range width of a referenced position used as a center.

Refer to Position Measurement (2 points)

Specifies 2 points of a referenced position (position, center position) measured by another profile measurement as the left and right edges of the measurement range.

Ref. 1

Specifies the left edge position of the measurement range.



Measurement item No.

Specifies the measurement item No. of the position or center position. Measurement range follows the position measurement results.

Offset

Specify when you want to offset the measurement range position.

Ref. 2

Specifies the right edge position of the measurement range.

Measurement item No.

Specifies the measurement item No. of the position or center position. Measurement range follows the position measurement results.

Offset

Specify when you want to offset the measurement range position.

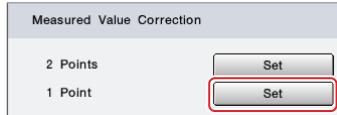
Correcting Measured Values of Profile Measurements

Adjust the measured values to match the actual size.

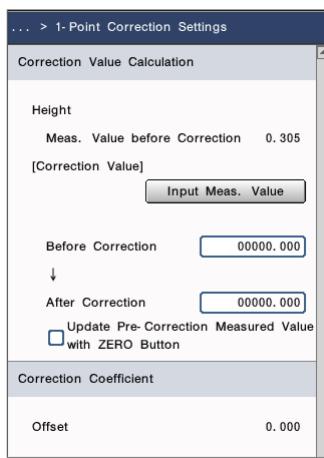
1-Point Correction

1 Perform measurement.

2 Click [Set] under [1-Point].



3 Click [Input Meas. Value], then enter the current measurement values in the [Before Correction] field.



4 Enter the post-correction measurement values in the [After Correction] field.

Offset on the measured value is calculated from the pre-correction and post-correction values.

Point When [Update Pre-Correction Measured Value with ZERO Button] is selected, the [ZERO] button is displayed on the operation screen. Click the [ZERO] button to update the measured value of [Before Correction].

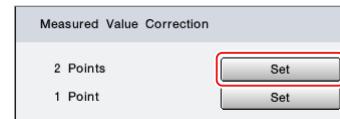
5 Click [OK].

2-Point Correction

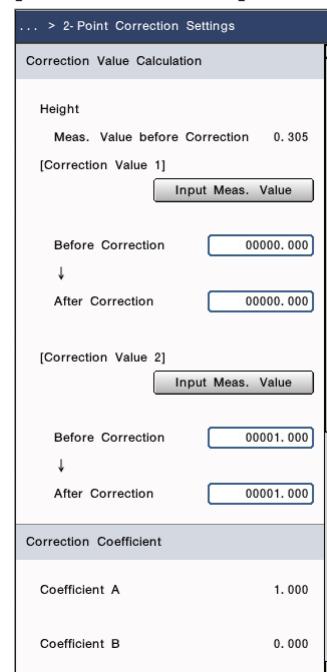
For both measured values, a pre-correction and post-correction value is configured, and correction coefficients A and B are calculated from those results.

1 Perform measurement.

2 Click [Set] under [2-Points].



3 Click [Correction Value 1] - [Input Meas. Value], then enter the current measurement values in the [Before Correction] field of [Correction Value 1].



4 Enter the measurement value post-correction in the [After Correction] field of [Correction Value 1].

5 Perform measurement once more.

6 Click [Correction Value 2] - [Input Meas. Value], then enter the current measurement values in the [Before Correction] field of [Correction Value 2].

7 Enter the measurement value post-correction in the [After Correction] field of [Correction Value 2].

Correction coefficients A and B are calculated from the corrected measured values using [Correction Value 1] and [Correction Value 2].

8 Click [OK].

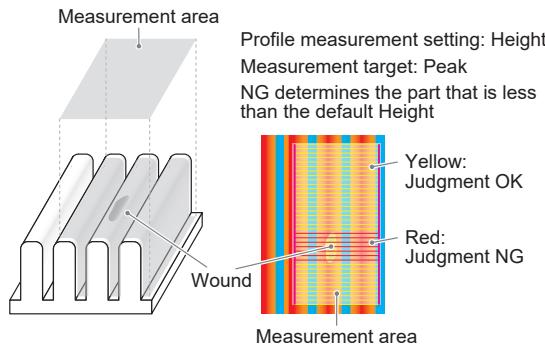
Continuous Profile Measurement

What is [Continuous Profile Measurement]?

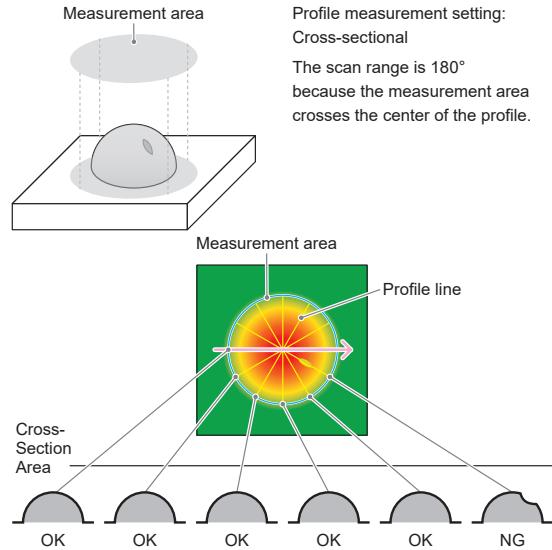
Draws and measures a sequence of numerous profile lines at regular intervals within a specified region of the height image. Allows for various measurements of this profile. The individual profile measurement content which can be applied to these numerous obtained profiles is identical to [Profile Measurement] (Page 5-20).

Measurement Image

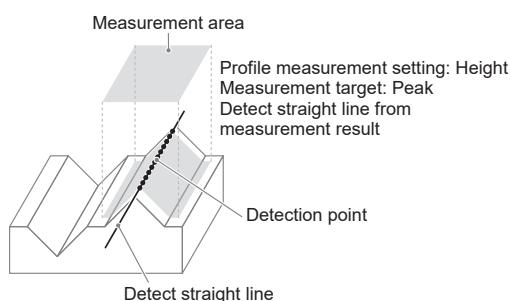
Continuous Profile Measurement in a [Rectangle]/[Rotated Rectangle] Measurement Region



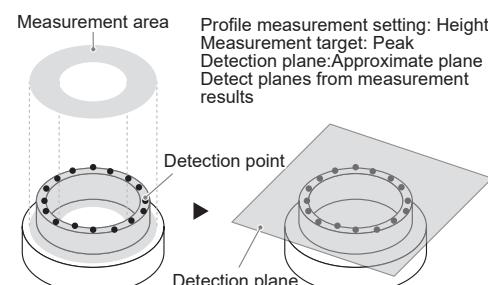
Continuous Profile Measurement in a [Circle] Measurement Region



Line Detection

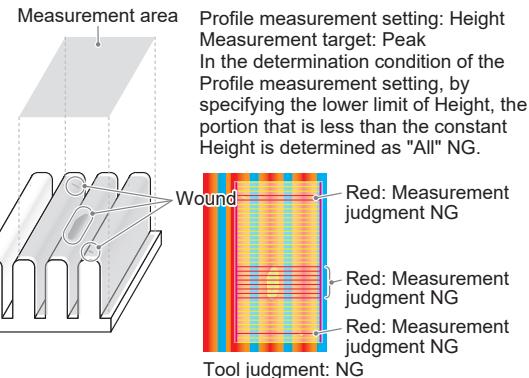


Plane Detection

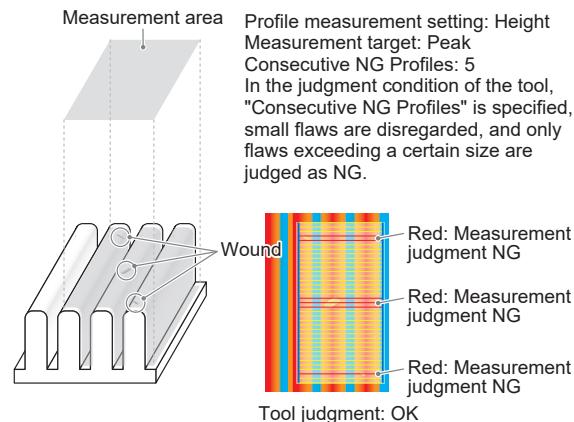


Measurement sample

When Judging with Profile Measurement Results

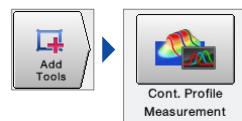


When Judging with Judgment Conditions [Consecutive NG Profiles]



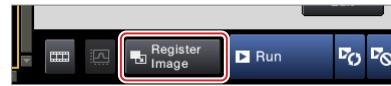
Flow of Settings

1 Add a tool.



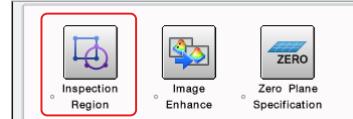
“Adding a tool” (Page 3-16)

2 Register the reference image.



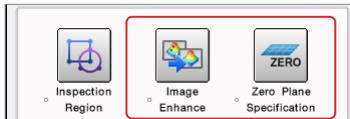
“Register the standard image” (Page 3-15)

3 Set [Inspection Region].



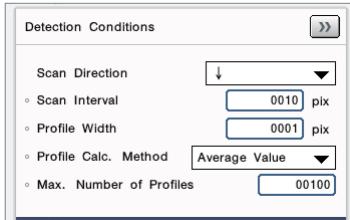
Lay out measurement region to surround the desired measurement area.
“Edit the measurement area” (Page 3-20)

4 Set [Image Enhance] and [Zero Plane Specification].



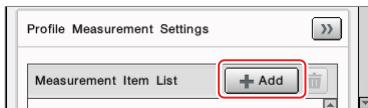
- "Height measurement filters (preprocessing)" (Page 5-10)
- "Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

5 Set [Detection conditions].



- "Detection Conditions (Continuous Profile Measurement)" (Page 5-40)

6 Click [Add] and specify the items and judgment conditions of the profile to be measured.



For details, see "Profile Measurement Types" (Page 5-25).

● Deleting Profile Items

Select the items you would like to delete and click .

● Updating Profile Item Settings

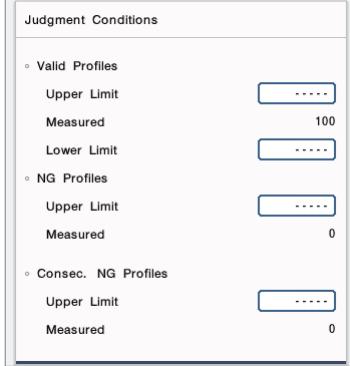
Select the items you would like to update the settings for and click [Edit].

● Copying Profile Items

Select the items you would like to copy and click [Copy].

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



- "Judgment Conditions (Continuous Profile Measurement)" (Page 5-40)

Detection Conditions (Continuous Profile Measurement)

Setting item	Settings
Scan Direction	Selects a scan direction of the profile line.
Scan Interval	Specifies a profile line scan interval (unit: pixels). The smaller the scan interval, the longer the processing time. At the same time, more profiles can be measured within the same region.
Profile Width	Specifies a profile line width (unit: pixels).
Profile Calculation Method	Selects the type of profile to use. <ul style="list-style-type: none"> • Average Value Uses the average of the width direction as the profile. • Maximum Value Uses the maximum value of the width direction as the profile. • Minimum Value Uses the minimum value of the width direction as the profile.
Max. Number of the Profiles	Specifies the maximum number of profiles which can be measured. Set this such that [Max. Profile Count] is larger than [Profile Count]. Also, be aware that the profile count will change along with the measurement region and scan interval.
Display Condition 1 to Display Condition 4	Specifies the type of profile to be displayed when the display conditions have been switched by the view bar. By setting conditions which are frequently used, a profile screen can be made which is suitable for inspection. <ul style="list-style-type: none"> • None Does not display profile. This can be used to reduce resource memory usage. • NG Item Count: Descending Displays the top 4 profiles when sorted by profiles which have the most NG judgments. • Measured Value: Descending Displays the top 4 profiles when sorted by profiles for which the specified measurement item is largest. • Measured Value: Ascending Displays the bottom 4 profiles when sorted by profiles for which the specified measurement item is largest. • Equal Division: Descending Displays profiles from end, when 4 profiles are distributed at regular intervals in the region. • Equal Division: Ascending Displays profiles from start, when 4 profiles are distributed at regular intervals in the region.
Max. Number of Pixels of Display	Specifies a profile display range via pixel count. Setting this be small can reduce resource memory usage. If this is set smaller than the profile to be measured, some portions may not be displayed, so make sure it is larger than the profile.

Judgment Conditions (Continuous Profile Measurement)

Setting item	Settings
Valid Profiles	With a profile in which 1 or more measurement items can be detected being a valid profile, specifies the range judged as OK of those valid profiles with [Upper Limit] and [Lower Limit].
NG Profiles	For profiles judged as NG by individual profile measurements, specifies the range judged as OK by setting [Upper Limit].
Consecutive NG Profiles	For consecutive profiles judged as NG by individual profile measurements, specifies the range judged as OK by setting [Upper Limit].

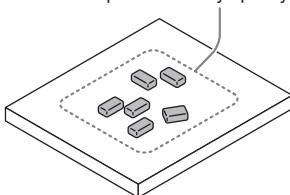
Free Multi-Point Height Measurement

What is [Free Multi-Point Height Measurement]?

Multiple measurement regions can be placed; and the height, area and volume of each region can each be measured.
Multiple regions can be arranged in desired positions.

Measurement Sample

Measures the height of each point of irregularly arranged parts.
A reference plane is set by specifying multiple points on its perimeter.



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Register the reference image.



□ "Register the standard image" (Page 3-15)

3 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

To add a measurement region, click the [Add Inspection Region] button.

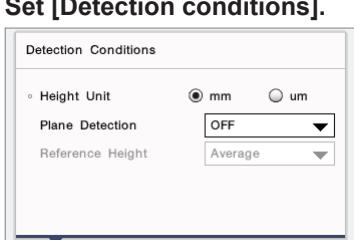
4 Set [Image Enhance] and [Zero Plane Specification].



□ "Height measurement filters (preprocessing)" (Page 5-10)

□ "Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

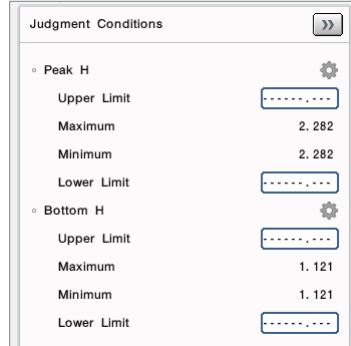
5 Set [Detection conditions].



□ "Detection Conditions (Free Multi-Point Height Measurement)" (Page 5-41)

6 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Free Multi-Point Height Measurement)" (Page 5-41)

Clicking displayed in measurement items allows for correction of individual measurement values.

□ "Correct Individual Measured Values (Measurement Correction)" (Page 5-14)

Detection Conditions (Free Multi-Point Height Measurement)

Setting item	Settings
Height Unit	Select either [mm] or [μm] as the unit for Z and H measurement results. If height unit is set to μm , noise removal and Z-offset units are also set to μm .
Plane Detection	A plane is detected with the specified method from multiple pieces of height data obtained for each measurement region. <ul style="list-style-type: none"> OFF: Does not detect planes. Approximate Plane: Detects a plane according to the least-squares method. Tangential Plane: Detects a tangent plane based on the information group. Detects a tangent plane from multiple pieces of height data.
Reference Height	Specify the reference method of the height data to use in detecting the plane. <ul style="list-style-type: none"> Average: Detects a plane on the basis of all the data within all the measurement regions. Peak: Finds the peak within each measurement region, and then detects a plane on the basis of all these peaks. Bottom: Finds the bottom within each measurement region, and then detects a plane on the basis of all these bottoms.
Plane Calculation Method	Specify this item when calculating an approximate plane with the reference height [Average]. <ul style="list-style-type: none"> High Speed: Calculates the plane by skipping height data within the measurement region. If the plane is not calculated correctly, select [High Accuracy]. High Accuracy: Calculates the plane by using all the height data within the measurement region. Processing takes longer with this option selected.

Judgment Conditions (Free Multi-Point Height Measurement)

Setting item	Settings	Tolerance Units
Peak H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured peak H.	Specified in [Height Unit]
Bottom H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured bottom H.	Specified in [Height Unit]
Average H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured average H.	Specified in [Height Unit]
Peak-to-Peak Height H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured peak-to-peak height H.	Specified in [Height Unit]
Concave Area/Convex Area	Specify the range of the concave/convex area judged as OK by setting [Upper Limit] and [Lower Limit].	mm^2
Concave Volume/Convex Volume	Specify the range of the concave/convex volume judged as OK by setting [Upper Limit] and [Lower Limit].	mm^3

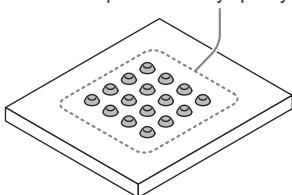
Arranged Multi-Point Height Measurement

What is [Arranged Multi-Point Height Measurement]?

Multiple measurement regions can be placed; and the height, area and volume of each region can each be measured.
The multiple regions can also be arranged in a latticed array form.

Measurement Sample

Measures the height of each point in the 4×4 array region.
A reference plane is set by specifying multiple points on its perimeter.



Flow of Settings

1 Add a tool.



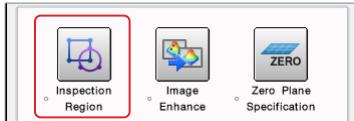
□ "Adding a tool" (Page 3-16)

2 Register the reference image.



□ "Register the standard image" (Page 3-15)

3 Set [Inspection Region].

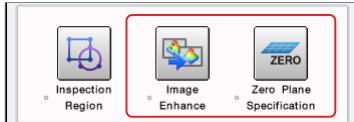


Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

Specify the number of measurement regions by the numbers of rows and columns according to the array of measurement targets.

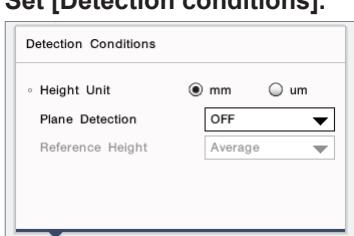
4 Set [Image Enhance] and [Zero Plane Specification].



□ "Height measurement filters (preprocessing)" (Page 5-10)

□ "Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

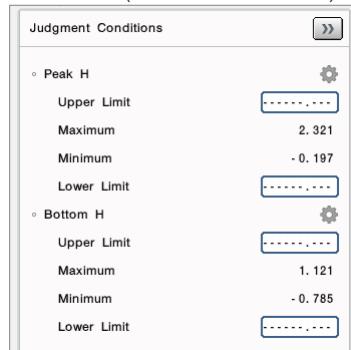
5 Set [Detection conditions].



□ "Detection Conditions (Arranged Multi-Point Height Measurement)" (Page 5-42)

6 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Arranged Multi-Point Height Measurement)" (Page 5-42)

Clicking displayed in measurement items allows for correction of individual measurement values.

□ "Correct Individual Measured Values (Measurement Correction)" (Page 5-14)

Detection Conditions (Arranged Multi-Point Height Measurement)

Setting item	Settings
Height Unit	Select either [mm] or [μm] as the unit for Z and H measurement results. If height unit is set to μm , noise removal and Z-offset units are also set to μm .
Plane Detection	<ul style="list-style-type: none"> OFF: Does not detect planes. Approximate Plane: Detects a plane according to the least-squares method. Tangential Plane: Detects a tangent plane based on the information group. Detects a tangent plane from multiple pieces of height data.
Reference Height	<p>Specify the reference method of the height data to use in detecting the plane.</p> <ul style="list-style-type: none"> Average: Detects a plane on the basis of all the data within all the measurement regions. Peak: Finds the peak within each measurement region, and then detects a plane on the basis of all these peaks. Bottom: Finds the bottom within each measurement region, and then detects a plane on the basis of all these bottoms.
Plane Calculation Method	<p>Specify this item when calculating an approximate plane with the reference height [Average].</p> <ul style="list-style-type: none"> High Speed: Calculates the plane by skipping height data within the measurement region. If the plane is not calculated correctly, select [High Accuracy]. High Accuracy: Calculates the plane by using all the height data within the measurement region. Processing takes longer with this option selected.

Judgment Conditions (Arranged Multi-Point Height Measurement)

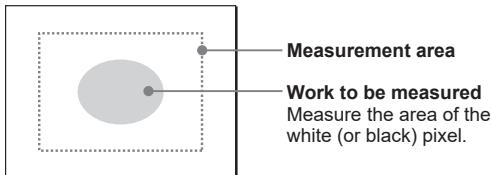
Setting item	Settings	Tolerance Units
Peak H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured peak H.	Specified in [Height Unit]
Bottom H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured bottom H.	Specified in [Height Unit]
Average H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured average H.	Specified in [Height Unit]
Peak-to-Peak Height H	Specify the range judged as OK by setting [Upper Limit] and [Lower Limit] for the measured peak-to-peak height H.	Specified in [Height Unit]
Concave Area/Convex Area	Specify the range of the concave/convex area judged as OK by setting [Upper Limit] and [Lower Limit].	mm^2
Concave Volume/Convex Volume	Specify the range of the concave/convex volume judged as OK by setting [Upper Limit] and [Lower Limit].	mm^3

Area

What is [Area] Measurement?

The taken image is binarized (black and white) and the area of "white" or "black" is measured.

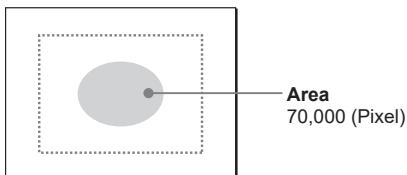
Measurement Image



Measurement sample

When Measured With the Following Conditions:

- Detection color: Black



Flow of Settings

1 Add a tool.



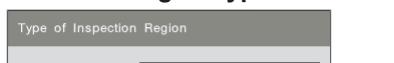
"Adding a tool" (Page 3-16)

2 Select the measurement target image.



"Register the standard image" (Page 3-15)

3 Register the reference image.



"Edit the measurement area" (Page 3-20)

4 Select the region type.



Figure Region

Lay out measurement region to surround the desired measurement area.

"Edit the measurement area" (Page 3-20)

Shape Region

Specifies the shape of a binary image created from a height image as a region.

"Creating a Shape Region" (Page 3-31)

5 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.

"Edit the measurement area" (Page 3-20)

6 Set [Height Extraction] and [Image Enhance].

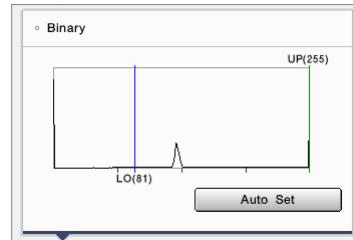
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



"Height Extraction" (Page 5-5)

"Pre-processing filter for contrast images" (Page A-58)

7 Set the threshold for binary.



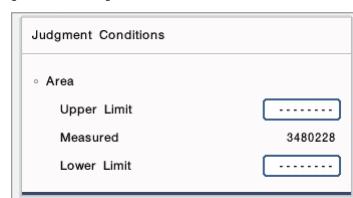
8 Set [Detection Conditions].

For images converted to binary, select whether to measure the [White] or [Black] area.



9 Set [Judgment Conditions].

Specify the range of the area to be judged as OK with [Upper limit] and [Lower limit].



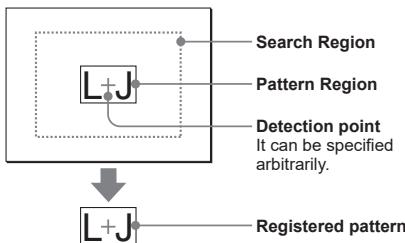
Pattern Search

What is [Pattern Search]?

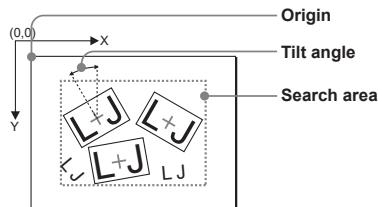
Find the most similar part to the image pattern registered in advance, and output the position, inclination and correlation value of the detected object.

Measurement Image

During pattern registration



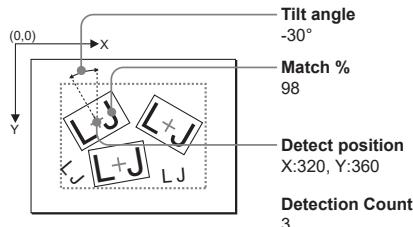
During operation



Measurement sample

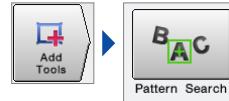
When Measured With the Following Conditions:

- Detection Order: X > Y Ascend
- Judged Label: 0



Flow of Settings

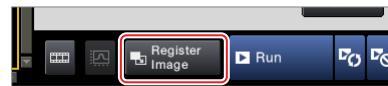
1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

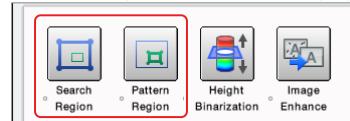
3 Register the reference image.



□ "Register the standard image" (Page 3-15)

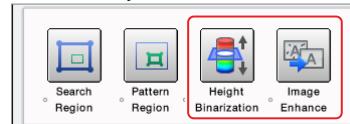
4 Set [Search Region] and [Pattern Region].

Set the detection range (search range) from the model image registered in the pattern region and the model image (pattern region) to detect.



5 Set [Height Binarization] and [Image Enhance].

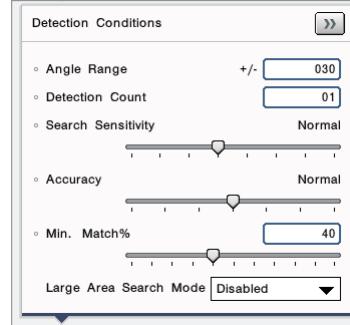
When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



□ "Height Binarization" (Page 5-7)

□ "Pre-processing filter for contrast images" (Page A-58)

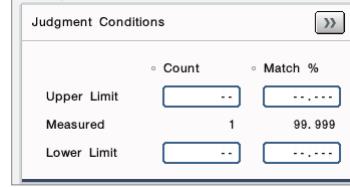
6 Set [Detection Conditions].



□ "Detection Conditions (Pattern Search)" (Page 5-45)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Pattern Search)" (Page 5-45)

Detection Conditions (Pattern Search)

Setting item	Settings
Angle Range	Specify the angle range when the search target is tilted with \pm . The smaller the angle range is, the shorter the processing time.  The smaller the angle range is, the shorter the processing time.
Detection Count	Specify the maximum number of patterns to be detected. Set this option to detect the count and position of multiple identical patterns on the screen.
Search Sensitivity	It is an item related to pattern detection. Increases "search sensitivity" when a miss search occurs (detects a different location than the subject being searched). Increasing "search sensitivity" will improve the stability of the detection, but the processing time will be longer.  Increasing "search sensitivity" will improve the stability of the detection, but the processing time will be longer.
Accuracy	This is an item related to detection accuracy. If you want to increase the detection accuracy, make the "search accuracy" finer. Fining "search accuracy" will improve the stability of the detection, but the processing time will be longer.  Fining "search accuracy" will improve the stability of the detection, but the processing time will be longer.
Min. Match %	"A degree of correlation" is a value indicating how similar to the registered pattern. Patterns with a degree of correlation lower than the "a degree of correlation lower limit" are excluded from measurement candidates, which is useful when for preventing false detection.  Check the variation range of the correlation value of the quality images and set a lower correlation value. When the value is lowered too much, the number of erroneous detections increases.
Large Area Search Mode	Select this option when the pattern region is set to wide. <ul style="list-style-type: none"> Disabled: Wide Search Mode not used. Mode 1: If the region size exceeds a width of 2,432 pixels and/or a height of 2,050 pixels, this mode must be selected. Mode 2: If the region size exceeds a width of 4096 pixels and/or a height of 4096 pixels, this mode must be selected.
Detection Order	Selects how numbers are assigned to numerous detected patterns. <ul style="list-style-type: none"> Y>X: Ascend: Sort by Y coordinate in ascending order. If Y coordinates are close in range, they are sorted by X coordinate in ascending order. X>Y: Ascend: Sort by X coordinate in ascending order. If X coordinates are close in range, they are sorted by Y coordinate in ascending order. X: Ascend: Sort by X coordinate in ascending order. X: Descend: Sort by X coordinate in descending order. Y: Ascend: Sort by Y coordinate in ascending order. Y: Descend: Sort by Y coordinate in descending order. Match%: Ascending: Sort by correlation values in ascending order. Match%: Descend: Sort by correlation values in descending order. Clockwise: Sort the patterns clockwise setting the reference angle as the start angle from the region center. Counterclockwise: Sort the patterns counterclockwise setting the reference angle as the start angle from the region center.
Starting Angle	Specify the angle at which the sorting begins when "Clockwise" or "Counterclockwise" is selected in [Detection Order] setting.
Judged Label	Specifies the pattern for the judged target. Specifies the pattern number (0 to 98) of the pattern to be judged. Only the pattern of numbers specified here is subject to determination.

Judgment Conditions (Pattern Search)

Setting item	Settings
Count	Specify the range of the number of detected items to be judged as OK with "Upper limit" and "Lower limit".
Position	Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Match %	Specify the range of the correlation value to be judged as OK with "Upper limit" or "Lower limit".

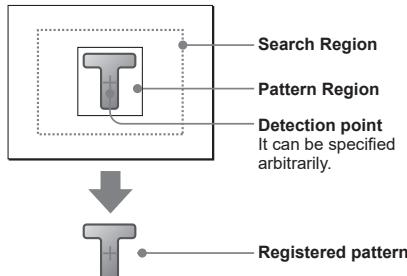
ShapeTrax3A

What is [ShapeTrax3A] Measurement?

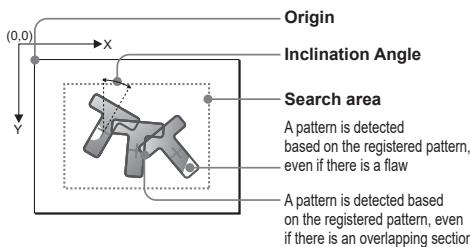
This tool searches for the most similar parts of the input image to already registered pattern outline data, and can measure the pattern's position, tilt angle, and match %.

Measurement Image

During pattern registration



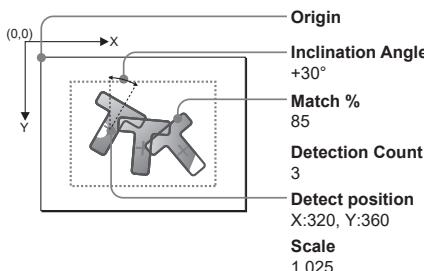
During operation



Measurement sample

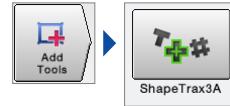
When Measured With the Following Conditions:

- Detection Order: From top-left to bottom
- Judged Label: 0



Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



"Register the standard image" (Page 3-15)

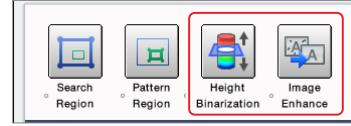
4 Set [Search Region] and [Pattern Region].



Set the detection range (search range) from the model image registered in the pattern region and the model image (pattern region) to detect.

5 Set [Height Binarization] and [Image Enhance].

When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



"Height Binarization" (Page 5-7)

"Pre-processing filter for contrast images" (Page A-58)

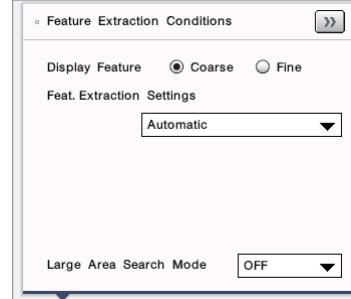
6 Set [Detection Conditions].



"Detection Conditions (ShapeTrax3A)" (Page 5-47)

7 Set [Feature Extraction Conditions].

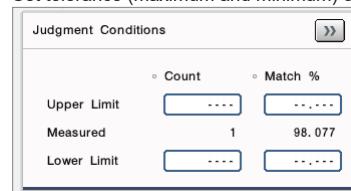
Adjust this such that the appropriate characteristics are extracted, while watching the contrast view.



"Feature Extraction Conditions (ShapeTrax3A)" (Page 5-49)

8 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



"Judgment Conditions (ShapeTrax3A)" (Page 5-49)

Detection Conditions (ShapeTrax3A)

Setting item	Settings
Angle Range	Specify the angle range when the search target is tilted with ±.
Scale	Setting the size of the registered feature to 1.000, set the size fluctuation range of the search object.
Detection Count	Specify the maximum number of patterns to be detected. Set this option to detect the count and position of multiple identical patterns on the screen.
Fine Search Accuracy	Specify fine search precision. <ul style="list-style-type: none"> • Detailed: Increases precision by performing an in-detail fine search. • Fast: Select to prioritize the search speed over precision.
Reverse Detect	Enable to search for the target whose gradation (black and white) is inverted with respect to the registered pattern.
Allowable Distortion	When the edge characteristics of a detection candidate are skewed from the registered pattern due to the angle of view or tilting of the work piece etc., detects as edge characteristic using a fine search if the skewing is within a specified value (pixels).
Min. Match %	"A degree of correlation" is a value indicating how similar to the registered pattern. Patterns with a degree of correlation lower than the "a degree of correlation lower limit" are excluded from measurement candidates, which is useful when for preventing false detection. Check the variation range of the correlation value of the quality images and set a lower correlation value. When the value is lowered too much, the number of erroneous detections increases.
Rotation Direction-Added Search	This is used when you want to calculate the angle of rotation using specific characteristics of circumferential direction for circles, regular polygons, and other work pieces with point symmetry. The total characteristics of the work piece are separately searched, so this is effective when the characteristic point used to determine angle of rotation is small. <ul style="list-style-type: none"> • Rotation Characteristic Region Setting: Specifies the characteristic shape which determines angle of rotation with region. If [Use as Mask] is checked, a region can be specified to exclude from the rotation characteristic area. • Rotation Condition: Setting this option when a correction range has been determined for the rotation direction allows for quick and steady angle alignment. <ul style="list-style-type: none"> • Whole Circumference: Effective for work pieces whose shape is entirely round. • 180° Rotation: Effective when the whole shape is oblong or an ellipse. • Polygon: Effective for work pieces whose shape is entirely polygonal (3 to 16 vertices). • Rotation Center Setting: When the rotation center moves, causing an error in the angle of rotation in the search, allows for correction of the position of the center of rotation for a proper search. <ul style="list-style-type: none"> • Specified Point: Sets the center of rotation by adding a specified X-offset and Y-offset to the center coordinates of the pattern region. • Center of Gravity: Sets the center of rotation to the position of the center of gravity of all registered edge groupings extracted from the base image. • Concentricity Margin Range: When the center of rotation slips out due to the lens angle of view or tilt of the work piece etc., broadens the search range up to a specified value (pixel) to stabilize detection.
Eliminate Overlap	When multiple search results overlap on a detection target, removes from the candidate based on the degree to which the areas of the detection candidates overlap. <ul style="list-style-type: none"> • Elimination Target: When multiple search results overlap on a detection target, specifies the standard for removal from the detection candidates. <ul style="list-style-type: none"> • Other Than Best Match: Of those multiple candidates which overlap, leaves the one with the highest match %. • All: When multiple candidates overlap, removes all of them. • Overlap Area: When multiple search results overlap on a detection target, specifies the degree of overlap in area between detection candidates which will be the standard for removal from the detection candidates.
Select By Feature Pixel Count (Detection Target Selection Conditions)	A function which specifies a region separate from the measurement region, and selects whether to include it in the detection target or not, based on the characteristics within that region. Sets characteristic features which only exist on the front of a work piece (symbols etc.); this is effective for excluding rear-facing items as detection targets, and removing overlap detection by setting around the work piece. Additionally, up to 2 detection target selection conditions can be set at a time. <ul style="list-style-type: none"> • Characteristic Pixel Region Setting: Specifies a region used to find the characteristic pixel count. • Feature Extraction Settings: Sets conditions for the characteristic pixel could measurement target. <ul style="list-style-type: none"> • Link with Current Feature: Use the parameters used in the search, as-is. • Specified Value: Freely change the edge intensity lower limit. This is effective for when the characteristic pixel count conditions are difficult to extract. • Detection Target Retainment Condition: Allows for conditions to be specified on characteristic pixel count to leave in search detection results. <ul style="list-style-type: none"> • Or Few are Retained: Leaves detection results with a characteristic pixel count above a specified value. Good for removing overlap around the work piece, and other times when there are characteristic features. • Or More are Retained: Leaves detection results with a characteristic pixel count lower than a specified value. Good for when there are no characteristic features.
Minimum Settings	<ul style="list-style-type: none"> • Minimum Distance: When search results overlap one detection target, specify the range (number of pixels) from the center of the circumscribed rectangle of the registered feature (fine) to exclude from the detection candidate. Candidates who meet AND criteria for other nearby exclusion settings are excluded. • Minimum Angle: When search results overlap one detection target, specify the range to be excluded from detection candidates by using an angle centered on the detection target angle (reference angle). Candidates who meet AND criteria for other nearby exclusion settings are excluded. • Minimum Scale: When search results overlap with one detection target, specify the range to be excluded from detection candidates by the scale (%) based on the detection target. Candidates who meet AND criteria for other nearby exclusion settings are excluded.

Setting item	Settings
Detection Order	<p>Selects how numbers are assigned to numerous detected patterns.</p> <ul style="list-style-type: none"> • X Ascend: Sort by X coordinate in ascending order. • X Descend: Sort by X coordinate in descending order. • Y Ascend: Sort by Y coordinate in ascending order. • Y Descend: Sort by Y coordinate in descending order. • Match% Ascend: Sort by correlation values in ascending order. • Match% Descend: Sort by correlation values in descending order. • Feature Pixel Count 1/2 Ascend: Sort by edge characteristic pixel count output based on detection target selection conditions in ascending order. • Characteristic Pixel Count 1/2 Descend: Sort by edge characteristic pixel count output based on detection target selection conditions in descending order. • Clockwise: Sort the patterns clockwise setting the reference angle as the start angle from the region center. • Counterclockwise: Sort the patterns counterclockwise setting the reference angle as the start angle from the region center. • From Upper Left (Left to Right): Sort by the Y coordinate of the detected points in ascending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in ascending order. • From Upper Left (Downward): Sort by the X coordinate of the detected points in ascending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in ascending order. • From Upper Right (Right to Left): Sort by the Y coordinate of the detected points in ascending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in descending order. • From Upper Right (Downward): Sort by the X coordinate of the detected points in descending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in ascending order. • From Lower Left (Left to Right): Sort by the Y coordinate of the detected points in descending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in ascending order. • From Lower Left (Upward): Sort by the X coordinate of the detected points in ascending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in descending order. • From Lower Right (Right to Left): Sort by the Y coordinate of the detected points in descending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in descending order. • From Lower Right (Upward): Sort by the X coordinate of the detected points in descending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in descending order.
Starting Angle	Specify the angle at which the sorting begins when [Clockwise] or [Counterclockwise] is selected in [Detection Order].
Grouping Method	<p>Specifies a range to be considered to be the same column or the same row regarding sorting via detection order.</p> <ul style="list-style-type: none"> • Pattern Length (Long Side): The length of the long side of a bounding rectangle around the pattern region is used as the area considered to be the same column or same row. • Pattern Length (XY Individual): When finding the area to be considered the same row, uses the vertical length of a bounding rectangle around the pattern region. Then, when finding the area to be considered the same column, uses the horizontal length of a bounding rectangle around the pattern region. • Specified Value: Specifies a range to be considered to be the same column or the same row in pixels.
Judged Label	Specifies the pattern number (0 to 1999) of the pattern to be judged. Only the pattern of numbers specified here is subject to determination.
Timeout	Set the upper limit for processing time. If the processing time of the tool itself exceeds the set value (0.5 to 60 seconds) due to the state of the input image, the processing of the tool is timed out as an error, and all outputs are set to 0.

Feature Extraction Conditions (ShapeTrax3A)

Setting item	Settings
Display Feature	<p>Specify the characteristics to be displayed in the screen.</p> <ul style="list-style-type: none"> • Coarse: Displays coarse characteristics used by the course search. • Fine: Displays fine characteristics used by the fine search.
Feature Extraction Settings	<p>Specify the strength of edge characteristics used in search.</p> <ul style="list-style-type: none"> • Automatic: Extracts optimal edge characteristics based on the reference image and pattern region. • Automatic (Low Contrast): Select this option when the input image has low contrast and other cases where the search is unstable. • Custom: Sets edge characteristic extraction conditions manually. <ul style="list-style-type: none"> • Lower Edge Intensity.(Registered): Edges with an intensity less than the lower limit for edge intensity (tone change) are excluded from characteristics. • Lower Edge Intensity. (Input): Edges with an intensity less than the lower limit for edge intensity (tone change) are excluded from characteristics.
Search Sensitivity	<p>Changes the reduction rate of the image and characteristics to specify the priority between the search speed and stability.</p> <ul style="list-style-type: none"> • Fast: Select to prioritize the search speed. • Normal: Select this for most situations. • Detailed: Select this when prioritizing search stability. • Custom: Adjust the image and characteristic reduction rate of course searches and fine searches when detection is unstable.
Coarse Search Image Reduction Rate	Specify the compression level of the image used for the reference image and the input image in coarse search. 0 (Shrinkage: Small) to 10 (Shrinkage: Large)
Coarse Search Feature Reduction Rate	Specify the degree of compression of features extracted from the reference image and the input image in coarse search. 0 (Shrinkage: Small) to 10 (Shrinkage: Large)
Fine Search Image Reduction Rate	Specify the compression level of the reference image and the image used for the input image in fine search. 0 (Shrinkage: Small) to 10 (Shrinkage: Large)
Feature Densification	Increase the setting when you want to capture finer characteristics. The higher the settings, the longer the search will take, so choose a setting with an allowable processing speed. Selecting [Auto] will maintain stability while also achieving fast processing.
Large Area Search Mode	When enabled, use the broad search mode. If the search region size or pattern region (including rotation characteristic region) exceeds a width of 2,432 pixels and/or a height of 2,050 pixels, this mode must be selected.
Feature Drawing Tool	<p>When this option is enabled, the feature drawing tool can be used. Draws lines, circles, and other figures, as well as edges which are automatically extracted from the reference image as characteristics. Use this when detection is unstable, causing proper characteristics to not be extracted from the reference image.</p> <ul style="list-style-type: none"> • For details, see □ "Creating feature information from contour information of graphics or images using ShapeTrax3A (feature drawing tool)" (Page 3-24). • Cannot be used simultaneously with the [Eraser Tool].
Eraser Tool	<p>By specifying an arbitrary point on the reference image, detected edges that are within the range can be eliminated as noise components. This is useful for checking each characteristic noise component by switching the course and fine characteristic display.</p> <ul style="list-style-type: none"> • In the [Size] field, Specify the size of the range to remove noise components when specifying any location on the image. • specify whether or not to display the coarse features used for the Coarse search and the fine features used for the Fine search by selecting or deselecting [Coarse] and [Fine] in the [Display Feature] field, respectively. • Cannot be used simultaneously with the [Feature Drawing Tool].

Judgment Conditions (ShapeTrax3A)

Setting item	Settings
Count	Specify the range of the number of detected items to be judged as OK with "Upper limit" and "Lower limit".
Position	Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Match %	Specify the range of the correlation value to be judged as OK with "Upper limit" or "Lower limit".
Scale	For the magnification of the size change relative to the registered pattern of the detected pattern, specify the range to be determined as OK by "Upper limit" and "Lower limit".
Feature Pixel Count	Sets the tolerance for characteristic pixel count within and outside of the pattern output based on detection target selection conditions. This can be set for characteristic pixel count for detection target selection conditions 1 and 2.

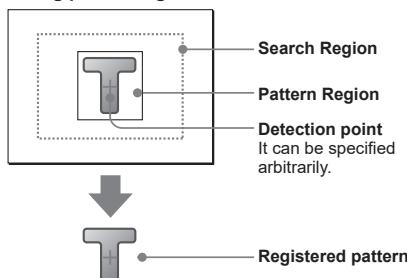
PatternTrax

What is [PatternTrax] Measurement?

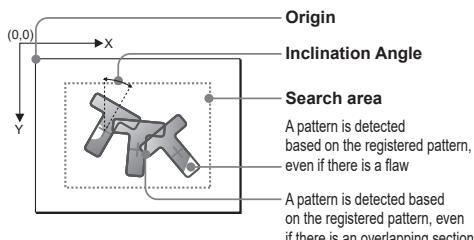
This tool searches for similar parts using tone information that fluctuates around the boundary of image patterns that are pre-registered and outputs the detected target's position, inclination, and match result. It will follow even if there are missing or overlapping measurement objects or changes in surface conditions, in order to search for gradation variation information around the contour.

Measurement Image

During pattern registration



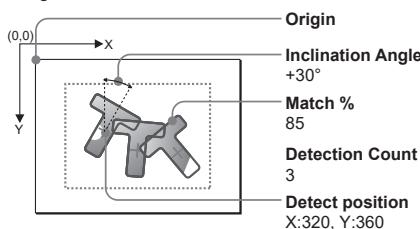
During operation



Measurement sample

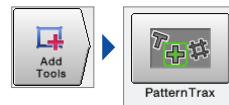
When Measured With the Following Conditions:

- Detection Order: From top-left to bottom
- Judged Label: 0



Flow of Settings

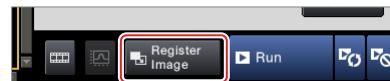
1 Add a tool.



"Adding a tool" (Page 3-16)

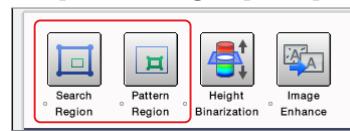
2 Select the measurement target image.

3 Register the reference image.



"Register the standard image" (Page 3-15)

4 Set [Search Region] and [Pattern Region].



Set the detection range (search range) from the model image registered in the pattern region and the model image (pattern region) to detect.

5 Set [Height Binarization] and [Image Enhance].

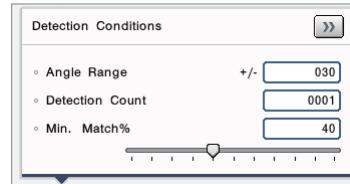
When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



"Height Binarization" (Page 5-7)

"Pre-processing filter for contrast images" (Page A-58)

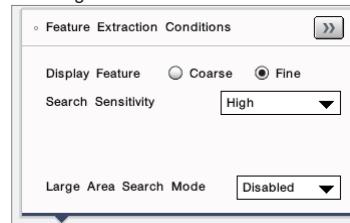
6 Set [Detection Conditions].



"Setting Detection Conditions (PatternTrax)" (Page 5-51)

7 Set [Feature Extraction Conditions].

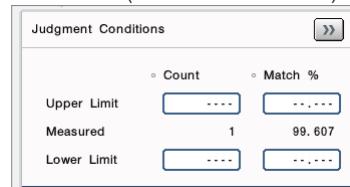
Adjust this such that the appropriate characteristics are extracted, while watching the contrast view.



"Setting Feature Extraction Conditions (PatternTrax)" (Page 5-52)

8 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



"Setting Judgment Conditions (PatternTrax)" (Page 5-52)

Setting Detection Conditions (PatternTrax)

Setting item	Settings
Angle Range	Specify the angle range when the search target is tilted with \pm .
Detection Count	Specify the maximum number of patterns to be detected. Set this option to detect the count and position of multiple identical patterns on the screen.
Detection Region Expansion	If this option is enabled, if the detection point is within the search region, it will also search targets which stick out up to half way of the registered pattern.
Min. Match %	"A degree of correlation" is a value indicating how similar to the registered pattern. Patterns with a degree of correlation lower than the "a degree of correlation lower limit" are excluded from measurement candidates, which is useful when for preventing false detection. Check the variation range of the correlation value of the quality images and set a lower correlation value. When the value is lowered too much, the number of erroneous detections increases.
Detection Order	Selects the identification order of the multiple detected patterns. <ul style="list-style-type: none"> • X Ascend: Sort by X coordinate in ascending order. • X Descend: Sort by X coordinate in descending order. • Y Ascend: Sort by Y coordinate in ascending order. • Y Descend: Sort by Y coordinate in descending order. • Match% Ascend: Sort by correlation values in ascending order. • Match% Descend: Sort by correlation values in descending order. • Clockwise: Sort the patterns clockwise setting the reference angle as the start angle from the region center. • Counterclockwise: Sort the patterns counterclockwise setting the reference angle as the start angle from the region center. • From Upper Left (Left to Right): Sort by the Y coordinate of the detected points in ascending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in ascending order. • From Upper Left (Downward): Sort by the X coordinate of the detected points in ascending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in ascending order. • From Upper Right (Right to Left): Sort by the Y coordinate of the detected points in ascending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in descending order. • From Upper Right (Downward): Sort by the X coordinate of the detected points in descending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in descending order. • From Lower Left (Left to Right): Sort by the Y coordinate of the detected points in descending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in ascending order. • From Lower Left (Upward): Sort by the X coordinate of the detected points in ascending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in descending order. • From Lower Right (Right to Left): Sort by the Y coordinate of the detected points in descending order. Those whose Y coordinates are close in range are treated as being in the same row and are sorted by their X coordinates in descending order. • From Lower Right (Upward): Sort by the X coordinate of the detected points in descending order. Those whose X coordinates are close in range are treated as being in the same column and are sorted by their Y coordinates in ascending order.
Starting Angle	Specify the angle at which the sorting begins when [Clockwise] or [Counterclockwise] is selected in [Detection Order].
Grouping Method	Specifies a range to be considered to be the same column or the same row regarding sorting via detection order. <ul style="list-style-type: none"> • Pattern Length (Long Side): The length of the long side of a bounding rectangle around the pattern region is used as the area considered to be the same column or same row in the XY direction. • Pattern Length (XY Individual): When finding the area to be considered the same row, uses the vertical length of a bounding rectangle around the pattern region. Then, when finding the area to be considered the same column, uses the horizontal length of a bounding rectangle around the pattern region. • Specified Value: Specifies a range to be considered to be the same column or the same row in pixels.
Judged Label	Specifies the pattern number (0 to 1999) of the pattern to be judged. Only the pattern of numbers specified here is subject to determination.
Reverse Detect	Enable to search for the target whose gradation (black and white) is inverted with respect to the registered pattern.
Timeout	Set the upper limit for processing time. If the processing time of the tool itself exceeds the set value (0.5 to 60 seconds) due to the state of the input image, the processing of the tool is timed out as an error, and all outputs are set to 0.
Minimum Distance	When search results overlap one detection target, specify the range (number of pixels) from the center of the circumscribed rectangle of the registered feature (fine) to exclude from the detection candidate. Candidates who meet AND criteria for other nearby exclusion settings are excluded.
Angle Range	When search results overlap one detection target, specify the range to be excluded from detection candidates by using an angle centered on the detection target angle (reference angle). Candidates who meet AND criteria for other nearby exclusion settings are excluded.
Reference Angle	Select the reference angle of the proximity exclusion angle with the detection target angle as 0 degree. When excluding cases such as inversion false detection, it is possible to exclude candidates with angles around 0 degrees and around 180 degrees inverted by selecting "0/180 degrees".

Setting Feature Extraction Conditions (PatternTrax)

Setting item	Settings
Display Feature	Specify the characteristics to be displayed in the screen. <ul style="list-style-type: none"> Coarse: Displays coarse characteristics used by the course search. Fine: Displays fine characteristics used by the fine search.
Search Sensitivity	Changes the reduction rate of an image to specify the priority between the search speed and stability. <ul style="list-style-type: none"> Low: Select to prioritize the search speed. Normal: Select this for most situations. High: Select this when prioritizing search stability. Custom: Adjust the image reduction rate of course searches and fine searches when detection is unstable.
Course Search Image Reduction Rate	Specify the compression level of the image used for the reference image and the input image in coarse search. 0 (Shrinkage: Small) to 16 (Shrinkage: Large)
Fine Search Image Reduction Rate	Specify the compression level of the reference image and the image used for the input image in fine search. 0 (Shrinkage: Small) to 16 (Shrinkage: Large)
Angle Sensitivity	Changes the angle interval width to specify the priority between rotation direction stability and speed. <ul style="list-style-type: none"> Low: Select to prioritize the search speed. Normal: Select this for most situations. High: Select this when prioritizing stability and precision along the circumference. Custom: Specifies the angle interval width with a number.
Angular Step Width	Set the size of the angle step width at the time of search execution as a numerical value. Smaller ones increase rotational stability and accuracy, but increase processing time.
Accuracy	Specify fine search precision. <ul style="list-style-type: none"> Low: Select to prioritize the search speed. Normal: Select this for most situations. High: Select this when prioritizing precision. Very high: Select to give precision the highest priority.
Large Area Search Mode	When enabled, use the broad search mode. This mode must be selected if the area size exceeds a width of 2432 or a height of 2050 pixels.
Optimize	Automatically sets some characteristic extraction conditions such that the registered pattern will be detected. If some unintended characteristics are extracted, remove the check and perform settings manually.
Noise Cut	Ignore gradation fluctuation below the specified gradation.
Gain	Set the gain to emphasize the extracted tone fluctuation. If the gradation variation is small, increase the value.
Feature Extraction Size	Specify the size of gradation variation to be extracted. Increase the value to extract gradual gradation variation.
Deformity Margin	Set the size at which the contour you want to extract changes in proportion to the feature extraction size. If the outline deviates from the registered pattern due to the angle of view or work inclination, etc., increase the value.
Detection Mark	Sets the mark to display on the position that was detected. It does not affect the measured value.
Eraser Tool	When this option is turned on, the eraser tool can be set. By specifying any part of the reference image, it is possible to remove tone fluctuation within the range. <ul style="list-style-type: none"> In the [Size] field, Specify the size of the range to remove noise components when specifying any location on the image. specify whether or not to display the coarse features used for the Coarse search and the fine features used for the Fine search by selecting or deselecting [Coarse] and [Fine] in the [Display Feature] field, respectively.

Setting Judgment Conditions (PatternTrax)

Setting item	Settings
Count	Specify the range of the number of detected items to be judged as OK with "Upper limit" and "Lower limit".
Position	Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Match %	Specify the range of the correlation value to be judged as OK with "Upper limit" or "Lower limit".

Edge Position

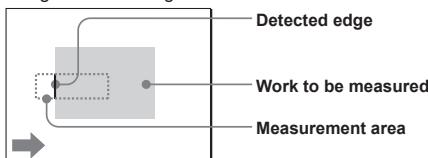
What is [Edge Position] Measurement?

Detects an edge (X or Y direction) in the measurement area and outputs the position.

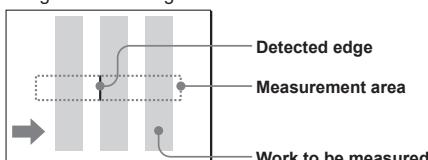
Measurement Image

When the measurement region is a rectangle

- Judged Label: 0
- Scan direction: →
- Edge Direction: Light to dark



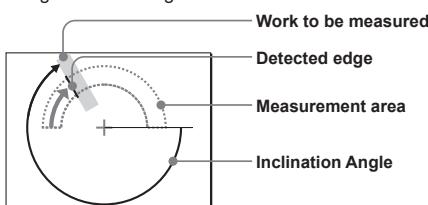
- Judged Label: 1
- Scan direction: →
- Edge Direction: Light to dark



When the measurement region is an arc

When Measured With the Following Conditions:

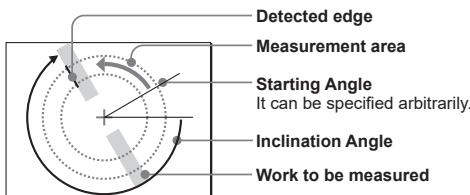
- Judged Label: 0
- Scan direction: (clockwise)
- Edge Direction: Light to dark



When the measurement region is a ring

When Measured With the Following Conditions:

- Judged Label: 0
- Scan direction: (counterclockwise)
- Edge Direction: Dark to light

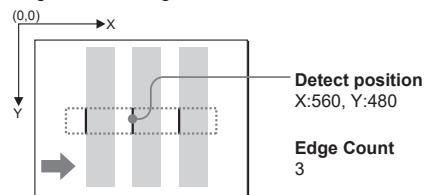


Measurement sample

When the measurement region is a rectangle

When Measured With the Following Conditions:

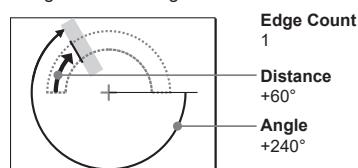
- Judged Label: 1
- Scan direction: →
- Edge Direction: Light to dark



When the measurement region is an arc

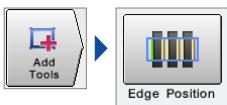
When Measured With the Following Conditions:

- Judged Label: 0
- Scan direction: (clockwise)
- Edge Direction: Light to dark



Flow of Settings

1 Add a tool.



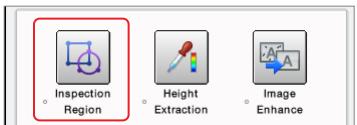
□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.



□ "Register the standard image" (Page 3-15)

3 Register the reference image.



Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

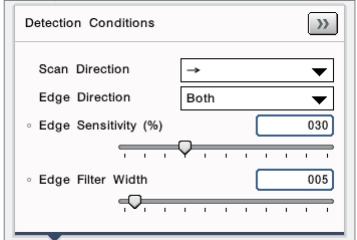
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

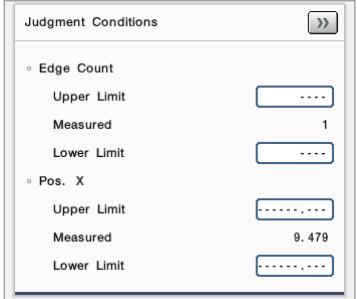
6 Set [Detection Conditions].



□ "Detection Conditions (Edge Position)" (Page 5-54)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Edge Position)" (Page 5-54)

Detection Conditions (Edge Position)

Setting item	Settings
Scan Direction	Specify the direction for scanning for the edge within the measurement region.
Edge Direction	Specify the light level change for edge detection. Select from [Light to Dark], [Dark to Light] or [Both].
Starting Angle	When [Ring] is selected in the measurement area, specify the position to start the edge scan. The setting range is 0° to 359.999°.
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Max. Edge Count	Specify the maximum number of edges to detect. Set when there are multiple edges in the measurement area and you want to detect their number and position.
Judged Label	Specify the edge number to be judged. The edge numbers are numbered from 0 in the detection order according to the Scan direction (if the specified judgment label is not detected, the measurement result of the judgment label will be 0).
Angled Edge Detection	Set "ON" to stabilize the operation of detecting an oblique edge with respect to the measurement area. If "ON" in the normal state, it may affect the measurement accuracy.

Judgment Conditions (Edge Position)

Setting item	Settings
Edge Count	Specify the range of the edge count judged as OK by setting [Upper Limit] and [Lower Limit].
Position	Specify the range of edge position (X or Y) to be judged as OK with [Upper limit] or [Lower limit].
Angle	Specify the range of detection angle to be determined as OK with [Upper limit] and [Lower limit]. The specifiable angular range is 0.000 ° to 360.000 °.

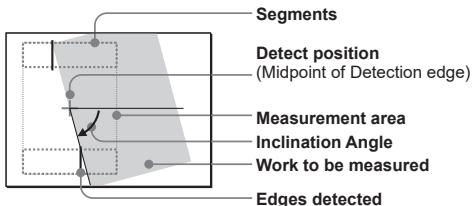
Edge Angle

What is [Edge Angle] Measurement?

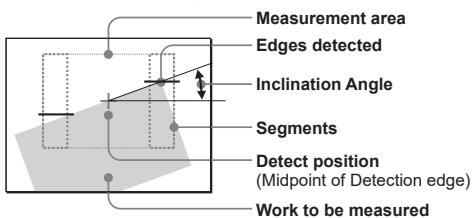
Set two segments in the measurement area, and measure the tilt angle from the edge detected in each segment.

Measurement Image

When the detection angle is [+ 75°]



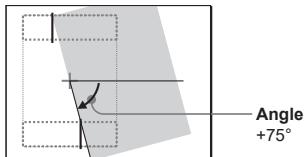
When the detection angle is [- 20°]



Measurement sample

When Measured With the Following Conditions:

- Edge Direction: Both



Flow of Settings

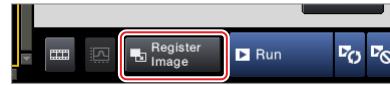
1 Add a tool.



□ "Adding a tool" (Page 3-16)

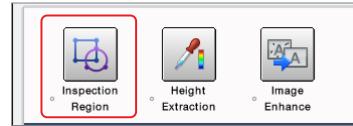
2 Select the measurement target image.

3 Register the reference image.



□ "Register the standard image" (Page 3-15)

4 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

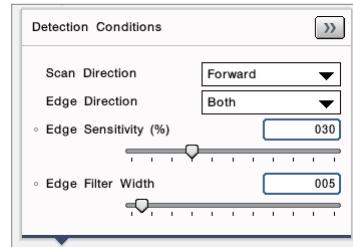
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

6 Set [Detection Conditions].



□ "Detection Conditions (Edge Angle)" (Page 5-56)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Edge Angle)" (Page 5-56)

Detection Conditions (Edge Angle)

Setting item	Settings
Edge Settings	Select "Individual" to specify the edge detection condition for each segment, or "Common" to use a common edge detection condition. Select "Individual" to measure workpieces with different detection states for each segment. Since edge detection conditions can be specified in segment units, edge detection may be stable and accuracy may increase.
Select Edge	Make settings for the setting items in "Detection conditions" with "1st edge" selected, then select "2nd edge" and perform the same setting.
Scan Direction	Specify the direction for scanning for the edge within the measurement region. <ul style="list-style-type: none"> Forward: Detects in the direction of the angle of rotation of a rotated rectangle. Reverse: Detects in the opposite direction of the angle of rotation of a rotated rectangle.
Edge Direction	Specify the light level change for edge detection. Select from "bright->dark", "dark->bright", or "both".
Specified Edge	If multiple edges are detected, specify which edge is to be judged. Edge numbers are assigned in the order specified in the Scan direction. When a negative (minus) number is specified, numbers are assigned from the direction opposite to the Scan direction. If it is not necessary, there is no need to set it.
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Edge Count	Set "ON" to stabilize the operation of detecting an oblique edge with respect to the measurement area. If "ON" in the normal state, it may affect the measurement accuracy.

Judgment Conditions (Edge Angle)

Setting item	Settings
Angle	Specify the range of detection angle to be determined as OK with [Upper limit] and [Lower limit]. The specifiable angular range is -180.000 ° to 180.000 °.
Number of Edges	Specify the range of the edge count judged as OK by setting [Upper Limit] and [Lower Limit]. Of the 1st and 2nd edges, outputs the outputs the one with fewer detected edges.

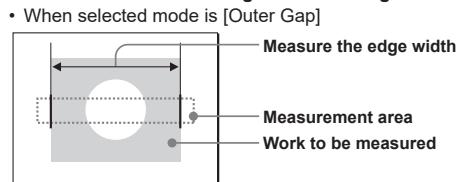
Edge Width

What is [Edge Width] Measurement?

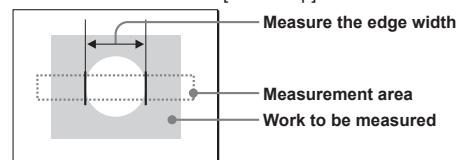
It detects two edges in the measurement area and measures the width between the edges.

Measurement Image

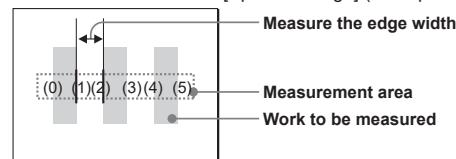
- When the measurement region is a rectangle/rotated rectangle



- When selected mode is [Outer Gap]



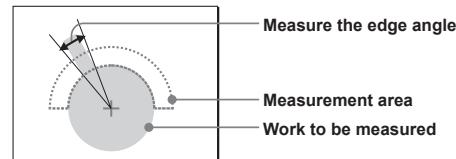
- When selected mode is [Inner Gap]



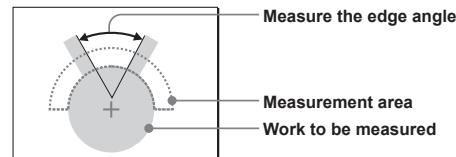
- When selected mode is [Specified Edge] (Example: 1→2)

- When the measurement region is a ring/arc

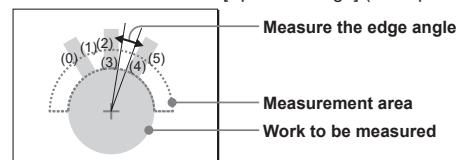
- When selected mode is [Outer Gap]



- When selected mode is [Inner Gap]



- When selected mode is [Specified Edge] (Example: 3→4)

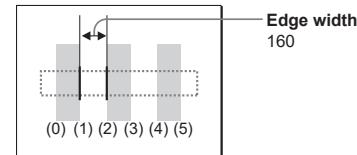


Measurement sample

- When the measurement region is a rectangle

When Measured With the Following Conditions:

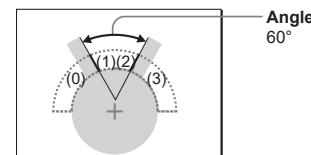
- Select Mode: Specified Edges
- Scan Direction: →
- Edge Direction: Both
- Edge 1: 1
- Edge 2: 2



- When the measurement region is an arc

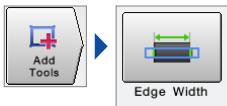
When Measured With the Following Conditions:

- Select Mode: Specified Edges
- Scan Direction: (clockwise)
- Edge Direction: Both
- Edge 1: 1
- Edge 2: 2



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



□ "Register the standard image" (Page 3-15)

4 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

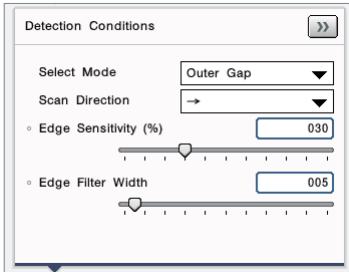
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

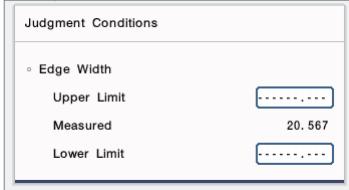
6 Set [Detection Conditions].



□ "Detection Conditions (Edge Width)" (Page 5-58)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Condition (Edge Width)" (Page 5-58)

Detection Conditions (Edge Width)

Setting item	Settings
Select Mode	Selects a type of edge width to measure, either [Outer Gap], [Inner Gap], or [Specified Edges]. <ul style="list-style-type: none"> Outer Gap: Measures the distance between the two outermost edges in the region. Inner Gap: Measures the distance between the two innermost edges in the region. Specified Edges: Measures the distance between the specified edges.
Scan direction	Specify the direction for scanning for the edge within the measurement region.
Edge Direction	Specify the light level change for edge detection. Select from [Light to Dark], [Dark to Light] or [Both].
Starting Angle	When [Ring] is selected in the measurement area, specify the position to start the edge scan. The setting range is 0° to 359.999°.
Edge 1/Edge 2	Specify the start point of the edge width to be measured by "Edge 1" and the end point by "Edge 2".
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Angled Edge Detection	Set "ON" to stabilize the operation of detecting an oblique edge with respect to the measurement area. If "ON" in the normal state, it may affect the measurement accuracy.

Judgment Condition (Edge Width)

Setting item	Settings
Edge Width	Specify the range of edge width to be judged as OK with "Upper limit" and "Lower limit".

Edge Pitch

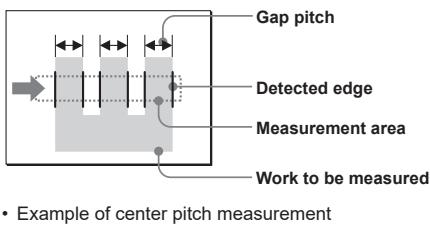
What is [Edge Pitch] Measurement?

Outputs the distance between the odd edge and the even edge of multiple detected edges in the measurement area (gap pitch) and the distance between the centers of the gap pitch (center pitch). If there are multiple pitches, the maximum and minimum values, and the average value can also be measured.

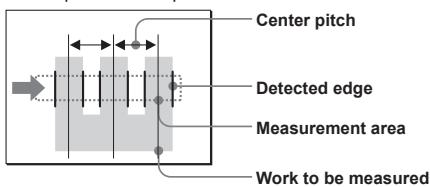
Measurement Image

- When the measurement region is a rectangle

- Example of gap pitch measurement

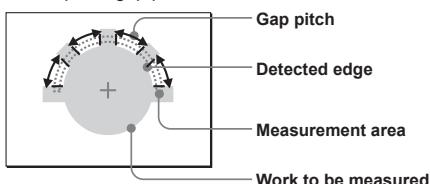


- Example of center pitch measurement

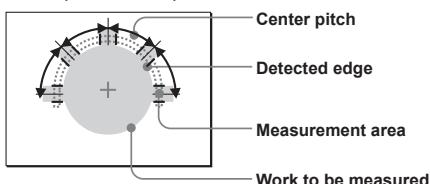


- When the measurement region is a ring/arc

- Example of gap pitch measurement



- Example of center pitch measurement

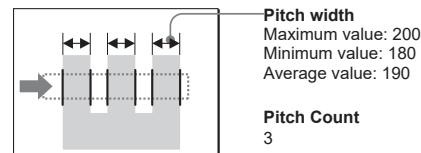


Measurement sample

- When the measurement region is a rectangle

When Measured With the Following Conditions:

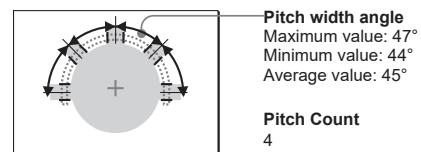
- Select Mode: Gap Pitch
- Scan Direction: →
- Edge Direction: Both



- When the measurement region is a ring/arc

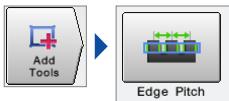
When Measured With the Following Conditions:

- Select Mode: Center Pitch
- Scan Direction: (counterclockwise)
- Edge Direction: Both



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



□ "Register the standard image" (Page 3-15)

4 Set [Inspection Region].

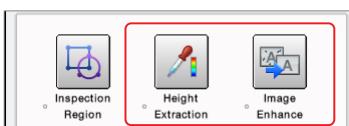


Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

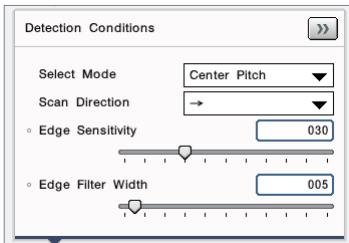
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

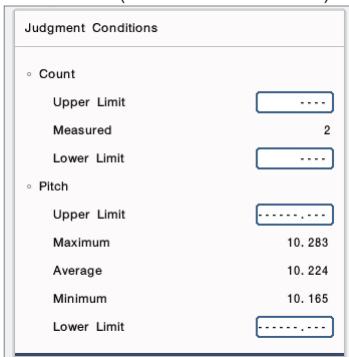
6 Set [Detection Conditions].



□ "Detection Conditions (Edge Pitch)" (Page 5-60)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Edge Pitch)" (Page 5-60)

Detection Conditions (Edge Pitch)

Setting item	Settings
Select Mode	Select a type of edge pitch to measure, either [Center Pitch] or [Gap Pitch]. <ul style="list-style-type: none"> • Center Pitch: Measures the pitch between centers of the gap pitches and finds the maximum, minimum and average values. • Gap Pitch: Measures the maximum, minimum, and average values of the distances between each odd and even nth edge.
Scan Direction	Specify the direction for scanning for the edge within the measurement region.
Edge Direction	Specify the light level change for edge detection. Select from [Light to Dark], [Dark to Light] or [Both].
First edge	Specifies the direction of the tone variation of the first edge to be detected.
Starting Angle	When [Ring] is selected in the measurement area, specify the position to start the edge scan. The setting range is 0° to 359.999°.
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Max. Pitch Count	Set the maximum number of pitches to be measured.
Angled Edge Detection	Set "ON" to stabilize the operation of detecting an oblique edge with respect to the measurement area. If "ON" in the normal state, it may affect the measurement accuracy.

Judgment Conditions (Edge Pitch)

Setting item	Settings
Pitch Count	Specify the range of the number of pitches to be judged as OK with "Upper limit" and "Lower limit".
Pitch	Specify the range of the pitch to be judged as OK with "Upper limit" and "Lower limit".

Edge Pairs

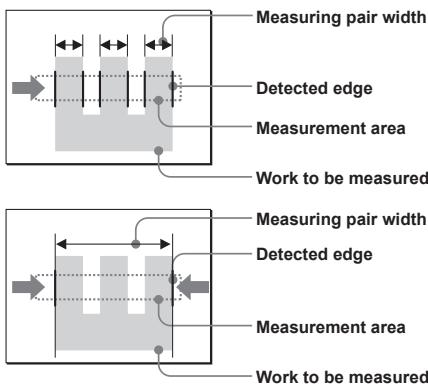
What is [Edge Pairs] Measurement?

Detects two edges (edge pairs) in the measurement area and measures the width between the edges. By setting edge scan conditions and having multiple edge pairs, more optimal detection of the measurement target can be performed.

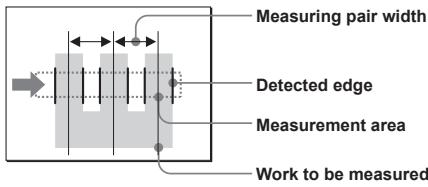
Measurement Image

When the measurement region is a rectangle/rotated rectangle

- Example of pair pitch measurement

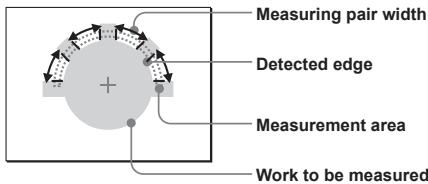


- Example of center pitch measurement

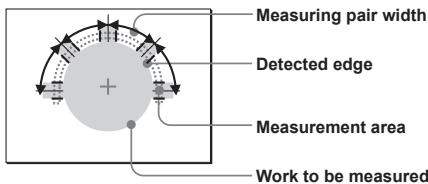


When the measurement region is a ring/arc

- Example of pair pitch measurement



- Example of center pitch measurement

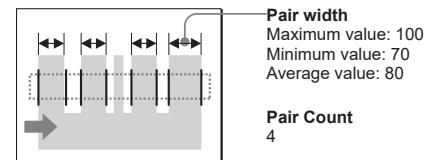


Measurement sample

When the measurement region is a rectangle

Example 1: When an edge pitch is measured under the following conditions

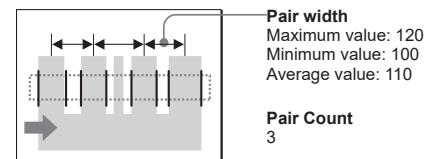
- Select Mode: Pair Pitch
- Scan Direction (1st scan): →
- Scan Direction (2nd scan): →
- Edge Direction (1st scan): Light to dark
- Edge Direction (2nd scan): Dark to light
- Max. Edge Gap: 99,999.999
- Min. Edge Gap: 0050.000



Reference The central pin is below the pair pitch lower limit and is therefore excluded from the search.

Example 2: When a center pitch is measured under the following conditions

- Select Mode: Center Pitch
- Scan Direction (1st scan): →
- Scan Direction (2nd scan): →
- Edge Direction (1st scan): Light to dark
- Edge Direction (2nd scan): Dark to light
- Max. Edge Gap: 99,999.999
- Min. Edge Gap: 0050.000



Reference The central pin is below the pair pitch lower limit and is therefore excluded from the search.

Flow of Settings

1 Add a tool.



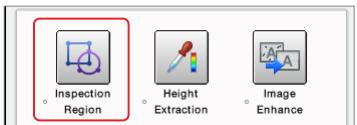
□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.



□ "Register the standard image" (Page 3-15)

3 Register the reference image.

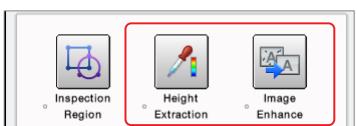


Lay out measurement region to surround the desired measurement area.

□ "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

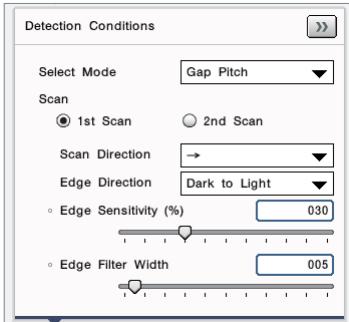
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

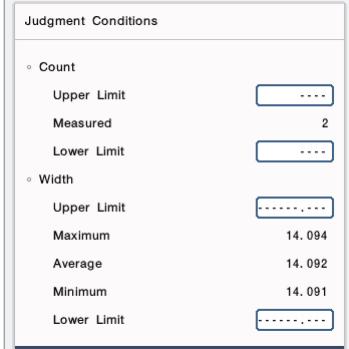
6 Set [Detection Conditions].



□ "Detection Conditions (Edge Pairs)" (Page 5-62)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Condition (Edge Pairs)" (Page 5-62)

Detection Conditions (Edge Pairs)

Setting item	Settings
Select Mode	Select a type of pair edges to measure, either [Gap Pitch] or [Center Pitch]. <ul style="list-style-type: none"> • Gap Pitch: Detects the edge in the specified detection direction and measures the maximum, minimum and average values of the distances from the odd-numbered to even-numbered edge. • Center Pitch: Measures the pitch between centers of the gap pitches and finds the maximum, minimum and average values.
Scan	Select which edge detection condition to set, "1st scan" or "2nd scan".
Scan Direction	Specify the direction for scanning for the edge within the measurement region.
Edge Direction	Specify the light level change for edge detection. Select from [Light to Dark], [Dark to Light] or [Both].
Starting Angle	When [Ring] is selected in the measurement area, specify the position to start the edge scan. The setting range is 0° to 359.999°.
Skip Edges	Specifies the number of edges to skip using the number of edges from the start point of scan.
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Max./Min. Edge Gap	Specify the pitch upper limit value and lower limit value of the pair to be detected. If the pair's pitch is larger than the specified upper limit or smaller than the lower limit, it is not detected as a pair.
Max. Count	Specify the maximum number of pairs to measure.
Judged Label	Select "All" to make judgments by measuring the maximum and minimum values for all pairs. To make a judgment on a specific pair, select "Specified" and then specify the pair number to judge. The pair that is specified here provides the measurement data for judgment in the unit.
Angled Edge Detection	Set "ON" to stabilize the operation of detecting an oblique edge with respect to the measurement area. If "ON" in the normal state, it may affect the measurement accuracy.

Judgment Condition (Edge Pairs)

Setting item	Settings
Pair Count	Specify the range of the number of pairs determined to be OK with "Upper limit" and "Lower limit".
Pair Width	Specify the range of the pair width to be judged as OK with "Upper limit" and "Lower limit".

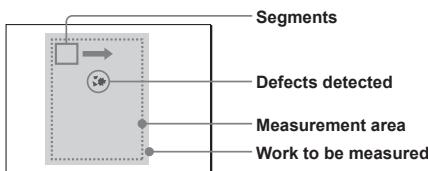
Defect

What is [Defect] Measurement?

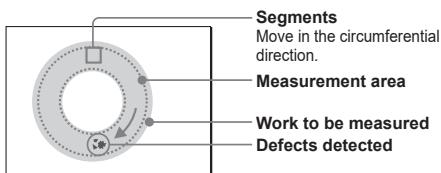
A location where there is a certain level of intensity difference in the measurement area is recognized as a flaw/dirt, and the total amount (size) of the detected flaw/dirt is outputted. Contiguous segments can also be grouped to output the number and location of defects.

Measurement Image

When the Scan Direction is X, Y, or XY



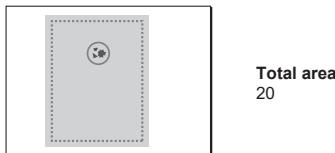
When the Scan Direction is along the circumference



Measurement sample

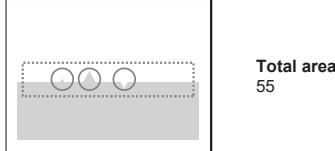
When defect or dirt is detected on the surface of the work piece

- Scan Direction: XY



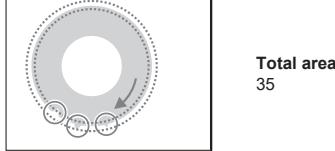
When chipping or burring etc. is detected on the surface of the work piece

- Scan Direction: X



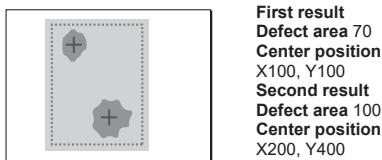
When damage or dirt is detected on the surface of a circular work piece

- Scan Direction: Along circumference



When a damaged or dirty position is detected on the surface of the work piece

- Scan Direction: XY
- Grouping: ON
- Detection Count: 2
- Detection Order: Y > X Ascend



Flow of Settings

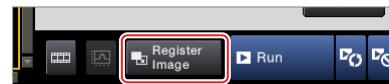
1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

4 Select the region type.

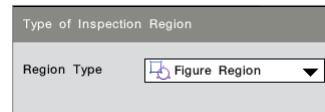


Figure Region

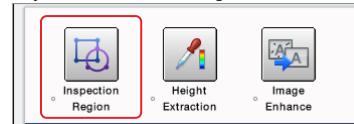
Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

Shape Region

Specifies the shape of a binary image created from a height image as a region.
 "Creating a Shape Region" (Page 3-31)

5 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



6 Set [Height Extraction] and [Image Enhance].

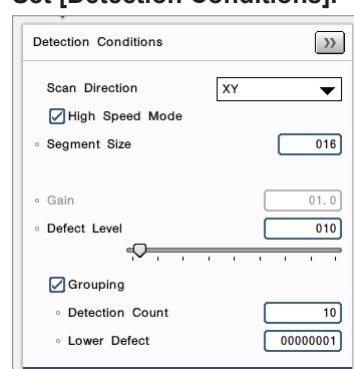
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



"Height Extraction" (Page 5-5)

"Pre-processing filter for contrast images" (Page A-58)

7 Set [Detection Conditions].



"Detection Conditions (Defect)" (Page 5-64)

8 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.

Judgment Conditions	
Total Area	
Upper Limit
Measured	48766
Lower Limit
Groups	
Upper Limit	...
Measured	10
Lower Limit	...
Defect Area	
Upper Limit
Measured	29161
Lower Limit

□ "Judgment Conditions (Defect)" (Page 5-65)

Detection Conditions (Defect)

Setting item	Settings
Scan direction	Select the direction for scanning within the measurement region. <ul style="list-style-type: none"> X: Detects shade difference in the X direction. Select this when canceling backgrounds with a directionality (X direction) for inspection. This is also good for detecting burrs and chipping in the edge face of a work piece. Y: Detects shade difference in the Y direction. Select this when canceling backgrounds with a directionality (Y direction) for inspection. This is also good for detecting burrs and chipping in the edge face of a work piece. XY: Detects shade difference in the X and Y directions. Select this when inspecting a uniform face of the front of a work piece etc. Circumference: Detects circumferential shade difference. Select this when canceling backgrounds with a directionality (circumference direction) for inspection. This is also good for detecting burrs and chipping in the edge face of a work piece. Radius: Detects radial shade difference. Select this when canceling backgrounds with a directionality (radial) for inspection. This is also good for detecting burrs and chipping in the edge face of a work piece.
High Speed Mode	Turning this ON will speed up inspection. When High-Speed Mode is ON, segment size and movement amount can only be set in multiples of 4.
Defect Level	It is a value that defines the "intensity" to be detected as dirt, foreign matter, or defect. Useful for separating detection target and background noise. Adjust so that only the detected objects are displayed while viewing the contrast view.
Individual	Turn on to set segment settings by detection direction. Segments and movement amounts can be set independently for X and Y (in the case of a circumference or arc, the circumference and radial direction, respectively).
Segment Size	Set the size of the segment to scan in the measurement area. The current segment size is displayed in the orange outlined box in the top-left of the screen.
Comparison	To increase the sensitivity to gradual gradient changes, select "Manual" and change the detailed settings. In defect measurements, it may be difficult to detect a slight change, such as an overall discoloration, usually because the difference in concentration between approaching segments is detected as an injury. In such a case, increase the amount of injury by changing the settings of "Element Shift" and "Compare Element" to detect intensity differences at more distant locations.
Element Shift	Specify the amount of movement when calculating the average concentration of a segment. By increasing the size, a wider range of average intensity can be calculated.
Compare Element	Specifies the interval between segments to compare the concentration difference. By enlarging the distance, the more distant segments will be compared.
Gain	Specifies the gain on shade difference for defect detection. Set the gain value high when detecting defects with a low contrast difference.
Grouping	When ON, adjacent injuries can be grouped and treated, and the injury area and the center of gravity can be detected for each group.
Detection Count	Specify the maximum number of injury groups to be detected.
Fill Holes	When the burial is turned on, the group interior will be buried as a detection wound.
Active Border	Exclude groups that exist on the border of the measurement area as targets for detection. Setting to ON removes the background from the inspection region.
Defect Area	The amount of injury larger than the specified upper limit or smaller than the lower limit will not be detected as an injury group.
Roundness	Injury groups whose circularity is greater than the specified upper limit (shape is close to a true circle) or smaller than the lower limit are not detected as injury groups.
Major Axis	Injury groups whose spindle length is greater than the specified upper limit or smaller than the lower limit will not be detected as injury groups.
Axes Ratio (Major/Minor)	Injury groups whose degree of acicular is greater than the specified upper limit (shape is elongated) or smaller than the lower limit are not detected as injury groups.
Equivalent Oval Major Axis	Dor smaller than the lower limit are not detected as injury groups.
Equivalent Oval Aspect Ratio	Injury groups with a larger equivalent oval spindle/secondary axis ratio than the specified upper limit value (the equivalent oval is elongated) or smaller than the lower limit value are not detected as injury groups.
Detection Order	Selects how numbers are assigned to numerous detected groupings. <ul style="list-style-type: none"> Y > X Ascend: Sort by Y coordinate in ascending order. If Y coordinates are close in range, they are sorted by X coordinate in ascending order. X > Y Ascend: Sort by X coordinate in ascending order. If X coordinates are close in range, they are sorted by Y coordinate in ascending order. X Ascend: Sort by X coordinate in ascending order. X Descend: Sort by X coordinate in descending order. Y Ascend: Sort by Y coordinate in ascending order. Y Descend: Sort by Y coordinate in descending order. Area: Ascend: Sort by defect size in ascending order. Area: Descend: Sort by defect size in descending order. Clockwise: Sorts clockwise based on measurement region. Counterclockwise: Sorts counter-clockwise based on measurement region. Out to Center: Sorts from far away to the center of the measurement region. Center to Out: Sorts from the center to far away from the measurement region.
Judged Label	Specify the judgment target from the detected multiple groups.

Judgment Conditions (Defect)

Setting item	Settings
Total Area	Specify the total amount of injury (total of the amount of injury in the measurement area) to be judged as OK with "Upper limit" and "Lower limit".
Groups	Specify the range of the number of groups to be judged as OK with "Upper limit" and "Lower limit".
Defect Area	Specify the amount of injury to be judged as OK with "Upper limit" and "Lower limit".
Center of Gravity	Specify the range of the barycentric position (X/Y) of the injury group specified by the judgment label to judged as OK with "Upper limit" and "Lower limit". <small>[Reference] The positional coordinates (pixel count) of the segment that has the largest defect level can be assigned to the calculation.</small>

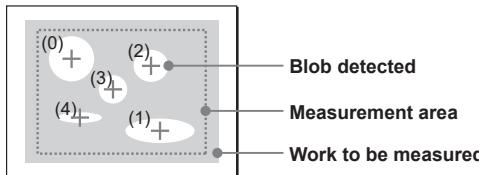
Blob

What is [Blob] Measurement?

A grouping of "white" or "black" of a binarized (black and white) image is called a "blob". This tool can measure feature quantities such as the number and area of blobs, and the center of gravity position.

Measurement Image

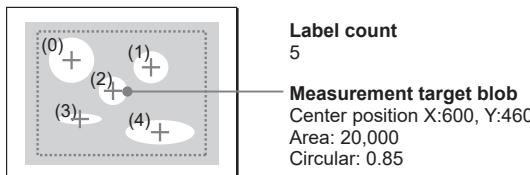
Assigns label numbers to blobs starting with the one with the largest area, and uses these for measurement/detection.



Measurement sample

When Measured With the Following Conditions:

- Detection Order: Y > X Ascend
- Label Selection: 2



Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

4 Select the region type.

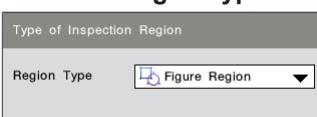


Figure Region

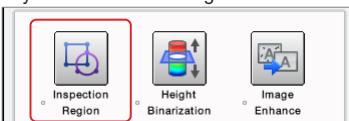
Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

Shape Region

Specifies the shape of a binary image created from a height image as a region.
 "Creating a Shape Region" (Page 3-31)

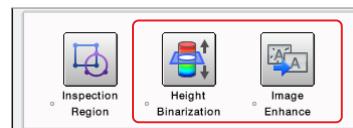
5 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



6 Set [Height Binarization] and [Preprocessing].

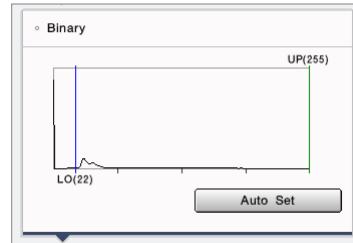
When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



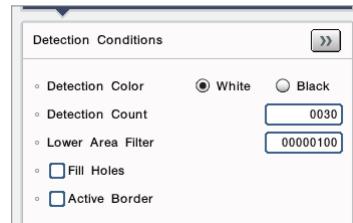
"Height Binarization" (Page 5-7)

"Pre-processing filter for contrast images" (Page A-58)

7 When the measurement target is a grayscale image, set the threshold for binary.



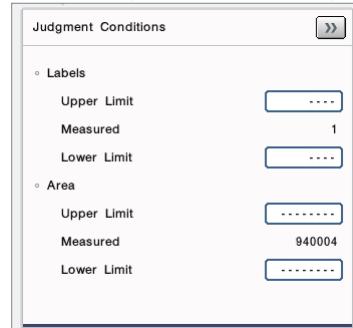
8 Set [Detection Conditions].



"Detection Conditions (Blob)" (Page 5-67)

9 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



"Judgment Conditions (Blob)" (Page 5-67)

Detection Conditions (Blob)

Setting item	Settings
Detection Color	For images converted to binary, select whether to measure the [White] or [Black] area.
Detection Count	Specify the maximum number of blobs to be detected.
Lower Area Filter	Blobs smaller than the specified lower limit will not be detected. Increase the value to count unwanted noise components.
Fill Holes	Fill the inside of the blob with the detection color. When this option is turned on, the inside of the blob is filled and then the area and positional coordinates are calculated.
Active Border	Excludes blobs on the border of the measurement area from measurement. Setting to ON removes the background from the inspection region.
Angle Range	Specify the range of the major angle to be measured. <ul style="list-style-type: none"> • 180°: Measures from -89.999° to 90.000°. • 360°: Measures from -179.999° to 180.000°. • OFF: Always measures with 0 (degrees) without measuring the major angle.
Measure Major/Minor Axes	Check to detect a circumscribed rectangle parallel to the main axis. In addition, measurement results and judgment conditions, "Major Axis", "Minor Axis" and "Axes Ratio (Aspect Ratio)" of filter setting become effective.
Measure Equivalent Oval	If checked, detects equivalent ellipses. In addition, measurement results and judgment conditions, "Equivalent Oval Major Axis", "Equivalent Oval Minor Axis", and "Equivalent Oval Aspect Ratio" of filter setting become effective.
Detection Order	Selects how the multiple detected blobs are numbered. <ul style="list-style-type: none"> • Y > X Ascend: Sort by Y coordinate in ascending order. If Y coordinates are close in range, they are sorted by X coordinate in ascending order. • X > Y Ascend: Sort by X coordinate in ascending order. If X coordinates are close in range, they are sorted by Y coordinate in ascending order. • X Ascend: Sort by X coordinate in ascending order. • X Descend: Sort by X coordinate in descending order. • Y Ascend: Sort by Y coordinate in ascending order. • Y Descend: Sort by Y coordinate in descending order. • Area Ascend: Sort by area in ascending order. • Area Descend: Sort by area in descending order. • Roundness Ascend: Sort by roundness in ascending order. • Roundness Descend: Sort by roundness in descending order. • Clockwise: Sort blobs clockwise beginning from the [Starting Angle]. • Counterclockwise: Sort blobs counterclockwise beginning from the [Starting Angle].
Reference Angle	Specifies the start angle for blob numbering when the detection order is "clockwise" or "counterclockwise".
Judged Label	Specifies the blob to be judged. <ul style="list-style-type: none"> • Specified: Select [Specified] for [Primary Target] and then specify the No. of the blob used in judgment. Only the blob that is specified here becomes the target of judgment. • All: The maximum and minimum values among all the labels are to be judged.
Area	When the area of a cluster is larger than the specified Upper Limit or smaller than the Lower Limit, the cluster is not detected as a blob.
Roundness	If the degree of circularity is larger than the specified upper limit (shape is close to a perfect circle) or smaller than the lower limit, it is not detected as a blob.
Major Axis	If the spindle length is larger than the specified upper limit or smaller than the lower limit, it is not detected as a blob.
Aspect Ratio	If the needleness is greater than the specified upper limit (the shape is elongated) or smaller than the lower limit, it is not detected as a blob.
Equivalent Oval Major Axis	If the equivalent elliptical main axis length is larger than the specified upper limit or smaller than the lower limit, it is not detected as a blob.
Equivalent Oval Aspect Ratio	If the ratio of equivalent elliptical major axis to minor axis is larger than the specified upper limit (equivalent elliptical is thin) or smaller than the lower limit, it is not detected as a blob.

Judgment Conditions (Blob)

Setting item	Settings
Labels	Specify the range of the number of labels judged to be OK with "Upper limit" and "Lower limit".
Center of Gravity	Specify the range of the barycentric position (X/Y) to be judged as OK with "Upper limit" and "Lower limit".
Major Angle	Specify the Rotation range of the Main shaft to be judged as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Area	Specify the range of the area to be judged as OK with "Upper limit" and "Lower limit".
Feret	Specify the range of Feret diameter (X/Y) judged to be OK with "Upper limit" and "Lower limit".
Perimeter	Specify the range of perimeter to be judged as OK with "Upper limit" and "Lower limit".
Roundness	Specifies the allowable roundness range to be judged as OK by setting [Upper Limit] and [Lower Limit]. The "roundness" sets the true circle to 1.000 and approaches 0.000 as it gets farther from the shape of the true circle.
Major Axis	Specify the range of spindle length to be determined as OK with "Upper limit" and "Lower limit".
Minor Axis	Specify the range of minor axis length to be determined as OK with "Upper limit" and "Lower limit".
Axes Ratio (Major/Minor)	Specify the range of needle degree to be judged as OK by "Upper limit" and "Lower limit".
Equivalent Oval Major Axis	Specify the range of equivalent elliptical spindle length to be judged as OK with "Upper limit" and "Lower limit".
Equivalent Oval Minor Axis	Specify the range of equivalent elliptical sub-axis length to be judged as OK with "Upper limit" and "Lower limit".
Equivalent Oval Aspect Ratio	Specify the range of the equivalent elliptic principal axis/minor axis ratio to be judged as OK with "Upper limit" or "Lower limit".

Grayscale Blob

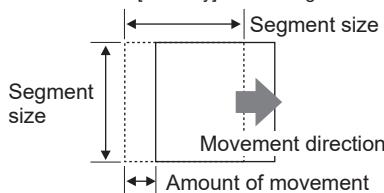
What is [Grayscale Blob] Measurement?

Clusters having a shade difference a certain level above a standard shade level are detected as blobs. Blob count, surface area, center of gravity, volume, light/dark and other information can be measured.

With the shading blob tool, clusters having a shade difference a certain level above a specified standard shade level are called [Blob]. While the Blob Tool deals with [White] or [Black] clusters as [Blob] in images which are converted to binary (black and white), the Shading Blob Tool can use 256 tones of shading data when processing grayscale images. Blob shade and volume (integrated value of shade) can also be measured as characteristics from light/shade data, so damage or dirt can be judged using the blob's darkness. Additionally, because measurement uses the difference from the standard shade level, even if the overall brightness fluctuates, it will not greatly affect the difference. As such, this sort of condition gives added stability to measurements over the Blob Tool which uses binary.

Measurement Image

In shading blob measurement, the measurement segment moves a set amount within the measurement region in the specified detection direction and measures the average shade in each segment. The values measured are treated as the [Intensity] for that segment.



The difference between the shade of each segment and the standard shade level is called the [Intensity Difference] and segment sets whose light/shade level exceeds a set threshold are detected as blobs.

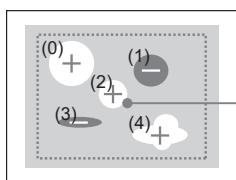


When segment sets which exceed the threshold are in contact on the bright side and dark side, they are detected as one blob. To avoid this, they must be individually detected by specifying the detection target as either [Bright] or [Dark], or the detection threshold must be set high, to prevent contact.

Measurement sample

When Measured With the Following Conditions:

- Detection Order: Y > X Ascend
- Label Selection: 2



Light blob: (0), (2), (4)
Dark blob: (1), (3)

Number of labels: 5

Measurement target blob
Center position X:600, Y:460
Area: 20,000
Circular: 0.85

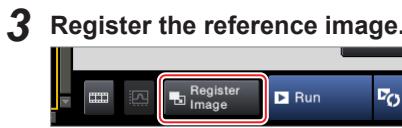
Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.



If there is no reference image, register the reference image.

□ "Register the standard image" (Page 3-15)

3 Register the reference image.

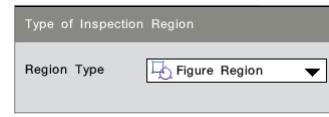


Figure Region

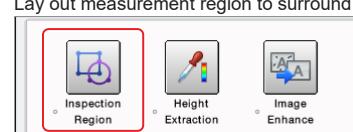
Lay out measurement region to surround the desired measurement area.
□ "Edit the measurement area" (Page 3-20)

Shape Region

Specifies the shape of a binary image created from a height image as a region.
□ "Creating a Shape Region" (Page 3-31)

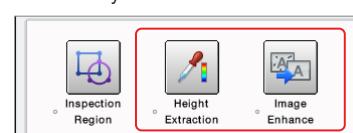
5 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



6 Set [Height Extraction] and [Image Enhance].

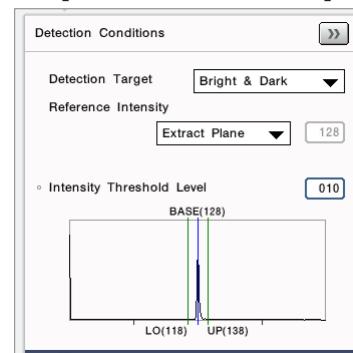
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

7 Set [Detection Conditions].



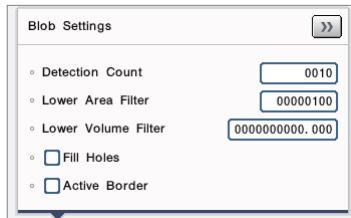
□ "Detection Conditions (Grayscale Blob)" (Page 5-69)

8 Set [Segment Settings].



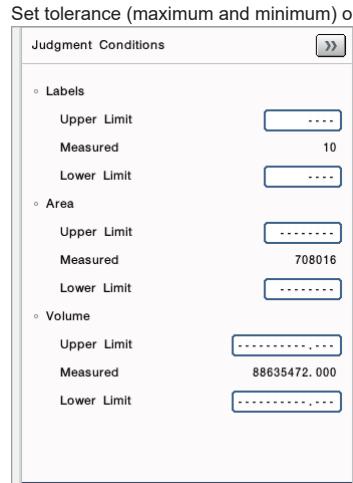
□ "Segment Settings (Grayscale Blob)" (Page 5-69)

9 Set conditions for the blob to be detected.



□ "Blob settings" (Page 5-69)

10 Set [Judgment Conditions].



□ "Judgment Conditions (Grayscale Blob)" (Page 5-70)

Detection Conditions (Grayscale Blob)

Setting item	Settings
Detection target	Select which characteristics to use as the detection target between [Bright] and [Dark]. <ul style="list-style-type: none"> Bright: Of those segments with a shade that is brighter (larger) than the standard shade level, segments whose light/shade level exceeds the threshold are the detection targets. Dark: Of those segments with a shade that is darker (smaller) than the standard shade level, segments whose light/shade level exceeds the threshold are the detection targets. Bright & Dark: Segments whose light/shade level exceeds the threshold are the detection targets. Individual: Sets a detection threshold individually for both light and dark characteristics.
Reference Gray Level	Select a shade level which will be used as a basis for light/shade level. Generally, this is set to be similar to the background shade of the measurement target. <ul style="list-style-type: none"> Average: The average of the shade in the measurement region is used as the standard shade level. Median: The shade located in the middle of the shade distribution is used as the standard shade level. Mode: The most commonly occurring shade in the measurement region is used as the standard shade level. Specified: A specified value is used as the standard shade level. Extract Plane: The shade value equivalent to the height of the extraction plane is used as the standard shade level. Height from the extraction plane is equivalent to the light/shade level.
Detection Threshold Level	Specify the lower limit for light/shade level to be detected as a blob in the range of 0 to 254. Segment clusters whose light/shade level exceeds this threshold will be detected as blobs.
Real Volume Conversion	Outputs volume in actual size by converting the light/shade level (height) and X/Y dimensions to actual size (mm).

Segment Settings (Grayscale Blob)

Setting item	Settings
High Speed Mode	Turning this ON will speed up inspection. When High-Speed Mode is ON, segment size and movement amount can only be set in multiples of 4.
Individual	If this option is enabled, segment size and movement amount can be set individually for both X and Y directions.
Segment size	The larger the value, the greater the effect of noise reduction. However, the detected light/shade levels may change, so adjust the values to be such that the target can be stably detected. The current segment size is displayed in the orange outlined box in the top-left of the screen.
Segment Interval	If [Auto] is selected, a recommended movement amount for the segment size will automatically be set. If [Manual] is selected, the movement amount can be freely specified.
Segment Shift	The larger the value is, the less processing time it will take. However, this will reduce the detection capacity for detailed targets so adjust this value within a range that will make measurement stable. Typically, it is set to a value that is less than the segment size.

Blob settings

Setting item	Settings
Detection Count	Specify the maximum number of blobs to be detected.
Lower Area Filter	Blobs smaller than the specified lower limit will not be detected. Increase the value to count unwanted noise components.
Lower Volume Filter	Does not detect blobs that are smaller than the specified lower limit.
Fill Holes	Fill the inside of the blob with the detection color. When this option is turned on, the inside of the blob is filled and then the area and positional coordinates are calculated.
Active Border	Excludes blobs on the border of the measurement area from measurement. Setting to ON removes the background from the inspection region.
Angle Range	Specify the range of the major angle to be measured. <ul style="list-style-type: none"> 180°: Measures from -89.999° to 90.000°. 360°: Measures from -179.999° to 180.000°. OFF: Always measures with 0 (degrees) without measuring the major angle.
Measure Volume/ Intensity Difference	If this option is enabled, it will measure the volume and light/shade level. Additionally, [Volume], [Average Intensity Difference] and [Maximum Intensity Difference] of measurement result, judgment condition, and filter settings will be enabled.
Measure Major/Minor Axes	Check to detect a circumscribed rectangle parallel to the main axis. In addition, measurement results and judgment conditions, "Major Axis", "Minor Axis" and "Axes Ratio (Aspect Ratio)" of filter setting become effective.

Setting item	Settings
Measure Equivalent Oval	If checked, detects equivalent ellipses. In addition, measurement results and judgment conditions, "Equivalent Oval Major Axis", "Equivalent Oval Minor Axis", and "Equivalent Oval Aspect Ratio" of filter setting become effective.
Detection Order	Selects how the multiple detected blobs are numbered. <ul style="list-style-type: none"> • Y > X Ascend: Sort by Y coordinate in ascending order. If Y coordinates are close in range, they are sorted by X coordinate in ascending order. • X > Y Ascend: Sort by X coordinate in ascending order. If X coordinates are close in range, they are sorted by Y coordinate in ascending order. • X Ascend: Sort by X coordinate in ascending order. • X Descend: Sort by X coordinate in descending order. • Y Ascend: Sort by Y coordinate in ascending order. • Y Descend: Sort by Y coordinate in descending order. • Area Ascend: Sort by area in ascending order. • Area Descend: Sort by area in descending order. • Roundness Ascend: Sort by roundness in ascending order. • Roundness Descend: Sort by roundness in descending order. • Clockwise: Sort blobs clockwise beginning from the [Starting Angle]. • Counterclockwise: Sort blobs counterclockwise beginning from the [Starting Angle]. • Volume Ascend: Sort by volume in ascending order. • Volume Descend: Sort by volume in descending order. • Ave. Intensity Difference: Ascend: Sort by average shade level in ascending order. • Ave. Intensity Difference: Descend: Sort by average shade level in descending order. • Max. Intensity Difference: Ascend: Sort by maximum shade level in ascending order. • Max. Intensity Difference: Descend: Sort by maximum shade level in descending order.
Reference Angle	Specifies the start angle for blob numbering when the detection order is "clockwise" or "counterclockwise".
Judged Label	Specifies the blob to be judged. <ul style="list-style-type: none"> • Specified: Select [Specified] for [Primary Target] and then specify the No. of the blob used in judgment. Only the blob that is specified here becomes the target of judgment. • All: The maximum and minimum values among all the labels are to be judged.
Area	When the area of a cluster is larger than the specified Upper Limit or smaller than the Lower Limit, the cluster is not detected as a blob.
Volume	When the volume of a cluster is larger than the specified Upper Limit or smaller than the Lower Limit, the cluster is not detected as a blob.
Average Intensity Difference	When the average shade level of a cluster is larger than the specified Upper Limit or smaller than the Lower Limit, the cluster is not detected as a blob.
Maximum Intensity Difference	When the maximum shade level of a cluster is larger than the specified Upper Limit or smaller than the Lower Limit, the cluster is not detected as a blob.
Roundness	If the degree of circularity is larger than the specified upper limit (shape is close to a perfect circle) or smaller than the lower limit, it is not detected as a blob.
Major Axis	If the spindle length is larger than the specified upper limit or smaller than the lower limit, it is not detected as a blob.
Axes Ratio	If the needleness is greater than the specified upper limit (the shape is elongated) or smaller than the lower limit, it is not detected as a blob.
Equivalent Oval Major Axis	If the equivalent elliptical main axis length is larger than the specified upper limit or smaller than the lower limit, it is not detected as a blob.
Equivalent Oval Aspect Ratio	If the ratio of equivalent elliptical major axis to minor axis is larger than the specified upper limit (equivalent elliptical is thin) or smaller than the lower limit, it is not detected as a blob.

Judgment Conditions (Grayscale Blob)

Setting item	Settings
Total Area	Specifies the range of the total area judged as OK by setting [Upper Limit] and [Lower Limit].
Labels	Specify the range of the number of labels judged to be OK with "Upper limit" and "Lower limit".
Center of Gravity	Specify the range of the barycentric position (X/Y) to be judged as OK with "Upper limit" and "Lower limit".
Major Axis Angle	Specify the Rotation range of the Main shaft to be judged as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Area	Specify the range of the area to be judged as OK with "Upper limit" and "Lower limit".
Average Intensity Difference	Specifies the range of the shade levels judged as OK by setting the [Upper Limit] and [Lower Limit].
Maximum Intensity Difference	Specifies the range of maximum shade levels judged as OK by setting the [Upper Limit] and [Lower Limit].
Volume	Specifies the range of the volume judged as OK by setting [Upper Limit] and [Lower Limit].
Feret	Specify the range of Feret diameter (X/Y) judged to be OK with "Upper limit" and "Lower limit".
Perimeter	Specify the range of perimeter to be judged as OK with "Upper limit" and "Lower limit".
Roundness	Specifies the allowable roundness range to be judged as OK by setting [Upper Limit] and [Lower Limit]. For [Roundness], a full circle is 1.000, and as the shape moves away from being a full circle, the number approaches 0.000.
Major Axis	Specify the range of spindle length to be determined as OK with "Upper limit" and "Lower limit".
Minor Axis	Specify the range of minor axis length to be determined as OK with "Upper limit" and "Lower limit".
Axes Ratio (Major/Minor)	Specify the range of needle degree to be judged as OK by "Upper limit" and "Lower limit".
Equivalent Oval Major Axis	Specify the range of equivalent elliptical spindle length to be judged as OK with "Upper limit" and "Lower limit".
Equivalent Oval Minor Axis	Specify the range of equivalent elliptical sub-axis length to be judged as OK with "Upper limit" and "Lower limit".
Equivalent Oval Aspect Ratio	Specify the range of the equivalent elliptic principal axis/minor axis ratio to be judged as OK with "Upper limit" or "Lower limit".

Profile Position

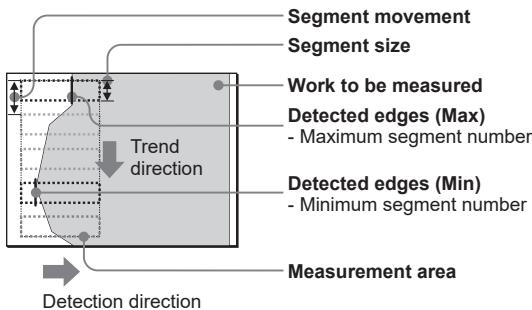
What is [Profile Position] Measurement?

The edges of multiple points in the measurement area are detected, the maximum point (minimum point) among them is detected, and its position is outputted. A circle or straight line from the detected multi-point edge information can also be obtained.

Measurement Image

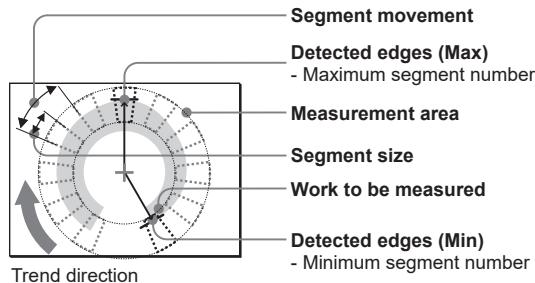
When the measurement region is a rectangle

When the Scan Direction is \rightarrow and the trend direction is \downarrow



When the measurement region is a ring/arc

When the trend direction is clockwise

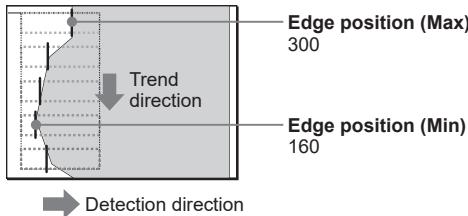


Measurement sample

When the measurement region is a rectangle

When Measured With the Following Conditions:

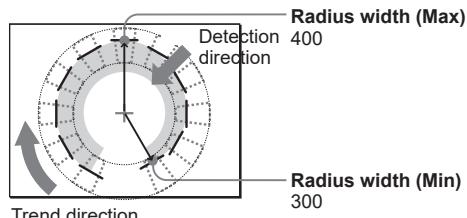
- Trend direction: \downarrow
- Scan Direction: \rightarrow
- Edge Direction: Both



When the measurement region is a ring/arc

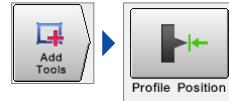
When Measured With the Following Conditions:

- Trend direction: Clockwise
- Scan Direction: Perimeter \rightarrow Center
- Edge Direction: Both



Flow of Settings

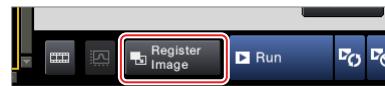
1 Add a tool.



["Adding a tool" \(Page 3-16\)](#)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

["Register the standard image" \(Page 3-15\)](#)

4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



5 Set [Height Extraction] and [Image Enhance].

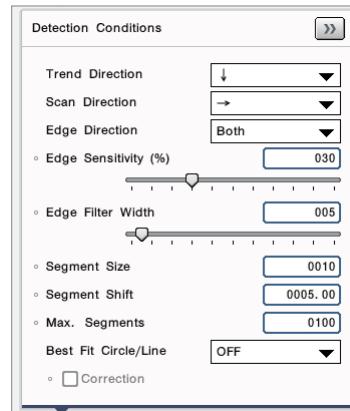
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



["Height Extraction" \(Page 5-5\)](#)

["Pre-processing filter for contrast images" \(Page A-58\)](#)

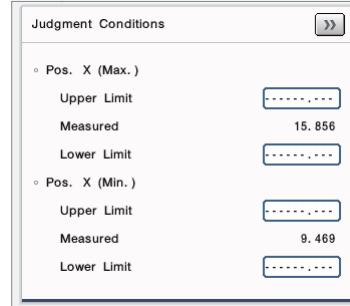
6 Set [Detection Conditions].



["Detection Conditions \(Profile Position\)" \(Page 5-72\)](#)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



["Judgment Conditions \(Profile Position\)" \(Page 5-72\)](#)

Detection Conditions (Profile Position)

Setting item	Settings
Trend Direction	Select the moving direction of the segment to detect the edge. <ul style="list-style-type: none"> Select between [↓] and [→]. If the measurement region is a rotated rectangle, only [↓] is available (from the top side to bottom side) and it will link with the rotation direction of the region. When the measurement region is a ring or arc, only [Clockwise] is available.
Scan Direction	Specify the edge scan direction in the measurement area (segment).
Edge Direction	Specify the light level change for edge detection. Select from [Light to Dark], [Dark to Light] or [Both].
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Segment Size	Specify the size of the segment to detect the edge. When the size is increased, small changes cannot be detected, but they are less susceptible to noise.
Segment Shift	Specifies how much the segment that detects the edge moves in the trend direction. Reducing the amount of movement will increase the processing time, but more points in the same range can be measured.
Starting Offset/ Starting Angle	Specify the amount (angle) to offset the start segment from the start edge of the measurement area. If there is no detected object near the boundary of the measurement area, the leading segment can be optimally positioned without changing the measurement area.
Max. segments	Specifies the maximum number of segments that can be detected. Specify that "Max. segments" is larger than "Segment Count". The "Segment Count" changes in conjunction with the measurement area, segment size, and movement settings.
Judgment Label	Select the segment to be determined from the maximum or minimum, numbered.
Best Fit Circle/Line	Detects a circle or a line from the information of detected multiple edge points.
Correction	Turning this option ON reduces the noise influence during circle or line detection.

Judgment Conditions (Profile Position)

Setting item	Settings
Detection Segments	Specify the range of the number of detected segments to be judged as OK with "Upper limit" and "Lower limit".
Position (Maximum)	Specify the range of the maximum value of the detected position (X- or Y- coordinate) to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rectangle" and the trend direction is → or ↓).
Position (Minimum)	Specify the range of the minimum value of the detected position (X- or Y- coordinate) to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rectangle" and the trend direction is → or ↓).
Position	Specify the range of the position (X- or Y- coordinate) detected as a judgment object segment to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rectangle" and the trend direction is → or ↓).
Distance (Max)	Specify the range of the maximum value of the detected distance to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rotational rectangle").
Distance (Min)	Specify the range of the minimum value of the detected distance to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rotational rectangle").
Distance	Specify the range of the radial width detected as a judgment object segment to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "rotational rectangle").
Radius (Max.)	Specify the range of the maximum value of the detected radial width to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "circumference/arc").
Radius (Min.)	Specify the range of the minimum value of the detected radial width to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "circumference/arc").
Radius	Specify the range of the radial width detected as a judgment object segment to be judged as OK with "Upper limit" and "Lower limit" (when the measurement area is "circumference/arc").
Line Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.
Circle Center	Specify the range of the center of detected circle (X/Y) to be judged as OK with "Upper limit" and "Lower limit".
Circle radius/ diameter	Specify the range of the diameter/radius of the detected circle to be judged as OK with "Upper limit" and "Lower limit".

Profile Width

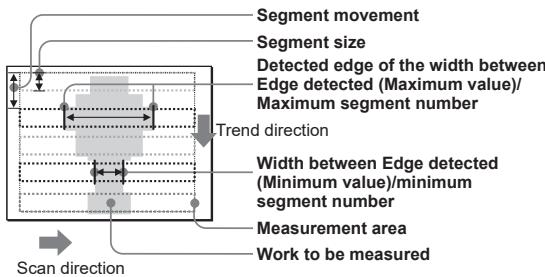
What is [Profile Width] Measurement?

The width between edges is measured at multiple points in the measurement area and outputted. It is convenient because it can measure the maximum width and minimum width within a certain range at one time.

Measurement Image

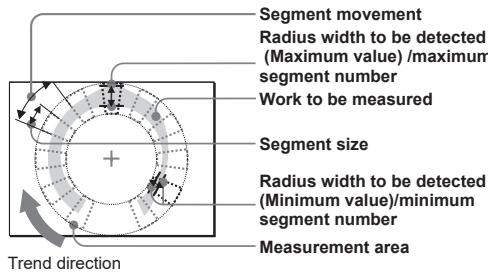
When the measurement region is a rectangle

- When the Scan Direction is [→] and the trend direction is [↓]

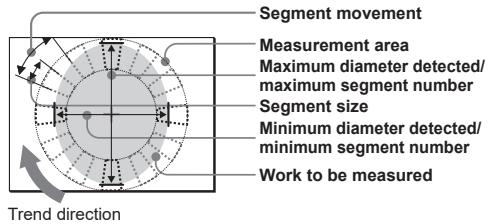


When the measurement region is a ring/arc

- When the trend direction is [Clockwise] and the selected mode is [Outer Gap]



- When the trend direction is [Clockwise] and the selected mode is [Outer Diameter]

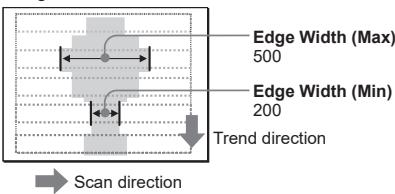


Measurement sample

When the measurement region is a rectangle

When Measured With the Following Conditions:

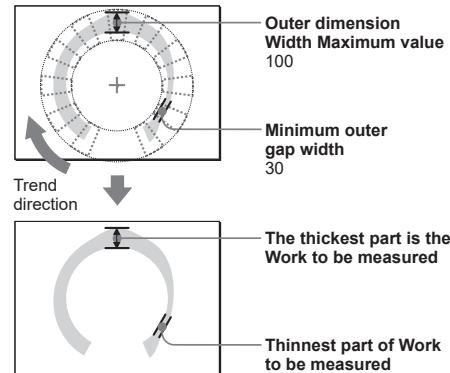
- Select Mode: Outer Gap
- Trend direction: ↓
- Scan Direction: →
- Edge Direction: Both



When the measurement region is a ring/arc

When Measured With the Following Conditions:

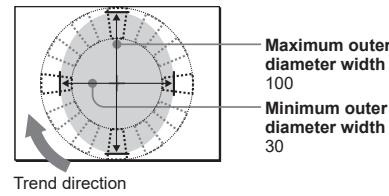
- Select Mode: Outer Gap
- Trend direction: Clockwise
- Scan Direction: Center to perimeter
- Edge Direction: Both



When the measurement region is a ring

When Measured With the Following Conditions:

- Select Mode: Outer Diameter
- Trend direction: Clockwise
- Scan Direction: Center to perimeter
- Edge Direction: Both



Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



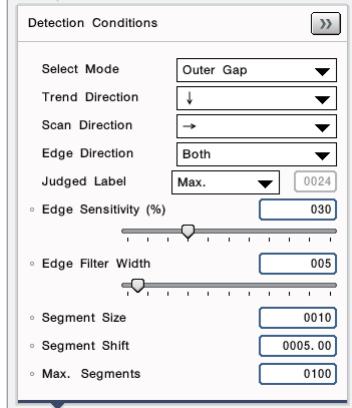
5 Set [Height Extraction] and [Image Enhance].

When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



- "Height Extraction" (Page 5-5)
- "Pre-processing filter for contrast images" (Page A-58)

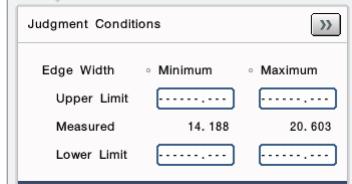
6 Set [Detection Conditions].



- "Detection Conditions (Profile Width)" (Page 5-74)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



- "Judgment Conditions (Profile Width)" (Page 5-74)

Detection Conditions (Profile Width)

Setting item	Settings
Select Mode	<p>Selects a type of edge width to measure, either [Outer Gap], [Inner Gap], [Diameter Outer Gap (Circumference Only)], and [Diameter Inner Gap (Circumference Only)].</p> <ul style="list-style-type: none"> • Outer Gap: Measures the distance between the two outermost edges in the region. • Inner Gap: Measures the distance between the two innermost edges in the region. • Outer Diameter: Measures the outer diameter of the edge detected by two segments opposing in a circle area. • Inner Diameter: Measures the inner diameter of the edge detected by two segments opposing in a circle area.
Trend Direction	<p>Select the moving direction of the segment to detect the edge.</p> <ul style="list-style-type: none"> • Select between [\downarrow] and [\rightarrow]. • If the measurement region is a rotated rectangle, only [\downarrow] is available (from the top side to bottom side) and it will link with the rotation direction of the region. • When the measurement region is a ring or arc, only [Clockwise] is available.
Scan Direction	Specify the edge scan direction in the measurement area (segment).
Edge Direction	Specify the light level change for edge detection. Select from "bright->dark", "dark->bright", or "both".
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.

Setting item	Settings
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Lower Edge Width	Specifies the lower limit of the edge width to be detected as a pair.
Segment Size	Specify the size of the segment to detect the edge. When the size is increased, small changes cannot be detected, but they are less susceptible to noise.
Segment Shift	Specifies how much the segment that detects the edge moves in the trend direction. Reducing the amount of movement will increase the processing time, but more points in the same range can be measured.
Starting Offset/ Starting Angle	Specify the amount (angle) to offset the start segment from the start edge of the measurement area. If there is no detected object near the boundary of the measurement area, the leading segment can be optimally positioned without changing the measurement area.
Max. Segments	Specifies the maximum number of segments that can be detected. Specify that "Max. segments" is larger than "Segment Count". The "Segment Count" changes in conjunction with the measurement area, segment size, and movement settings.
Judged Label	Select the segment to be determined from the maximum or minimum, numbered.
Measure Peak-to-Peak Width	When enabled, peak-to-peak width is detected. The measurement results, "Peak to Peak Width (Maximum)", "Peak to Peak Width (Minimum)", "Show Peak to Peak Width (Maximum)" and "Show Peak to Peak Width (Minimum)" of the determination conditions are also enabled.

Judgment Conditions (Profile Width)

Setting item	Settings
Detection Segments	Specify the range of the number of detected segments to be judged as OK with "Upper limit" and "Lower limit".
Edge Width (Max.)	Specify the range of the maximum value of the detected edge width to be judged as OK with "Upper limit" and "Lower limit".
Edge Width (Min.)	Specify the range of the minimum value of the detected edge width to be judged as OK with "Upper limit" and "Lower limit".
Edge Width	Specify the range of the detected edge width as a judgment object segment to be judged as OK with "Upper limit" and "Lower limit".
Maximum Peak-to-Peak Width	Specify the range of the maximum value of a distance between detected peaks to be judged as OK with "Upper limit" and "Lower limit".
Minimum Peak-to-Peak Width	Specify the range of the minimum value of a distance between detected peaks to be judged as OK with "Upper limit" and "Lower limit".

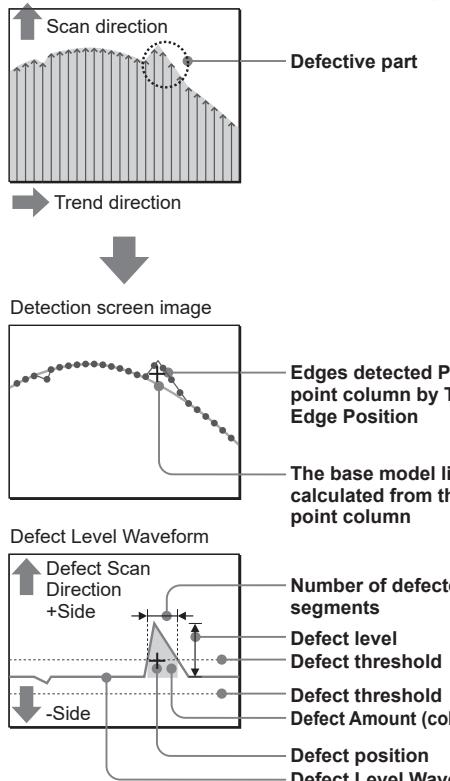
Profile Defect

What is [Profile Defect] Measurement?

A point with large variations is detected as defects (burrs/defects) from reference model lines (straight or circles, ellipses, free curves) of contours calculated from multiple edge information.

Measurement Image

When the standard model line in the measurement region is a curve

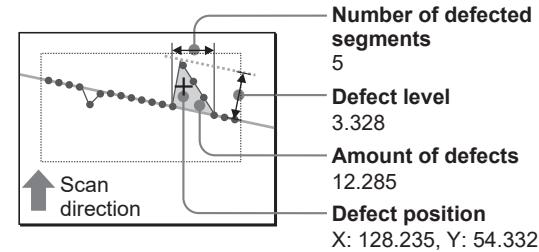


Measurement sample

- When the measurement region is a rectangle and the reference line is a line

When Measured With the Following Conditions:

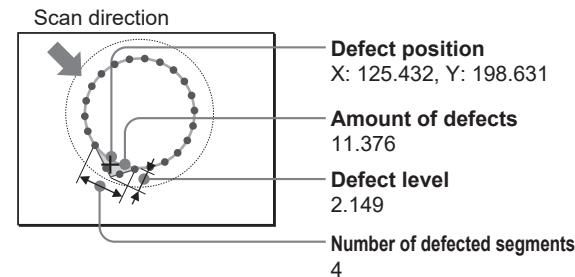
- Reference Line: Line
- Scan Direction: ↑
- Defect Scan Direction: +



- When the reference line is a circle and the measurement region is a circumference

When Measured With the Following Conditions:

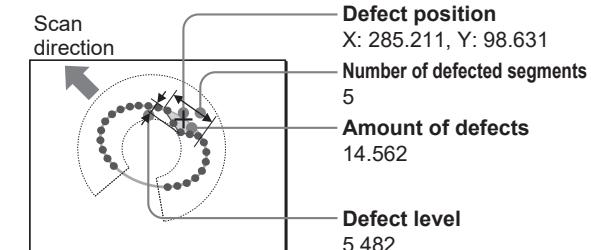
- Reference Line: Circle
- Scan Direction: From perimeter to center
- Defect Scan Direction: +/-



- When the reference line is an oval and the measurement region is an arc

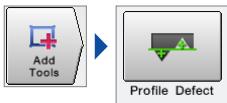
When Measured With the Following Conditions:

- Reference Line: Oval
- Scan Direction: Center to perimeter
- Defect Scan Direction: -



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.

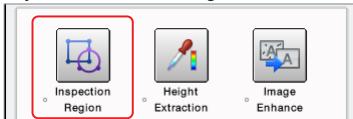


If there is no reference image, register the reference image.

□ "Register the standard image" (Page 3-15)

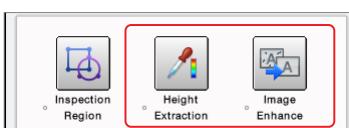
4 Set [Inspection Region].

Layout measurement region to surround the desired measurement area.



5 Set [Height Extraction] and [Image Enhance].

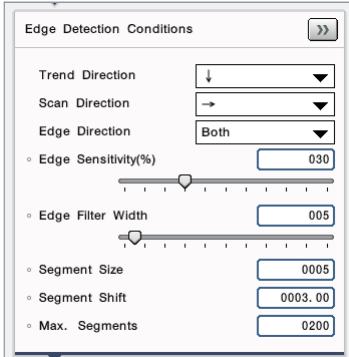
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

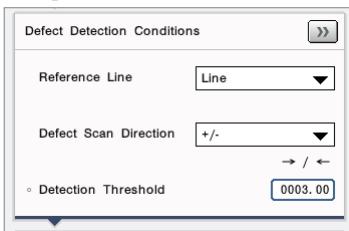
□ "Pre-processing filter for contrast images" (Page A-58)

6 Set [Edge Detection Conditions].



□ "Edge Detection Conditions" (Page 5-76)

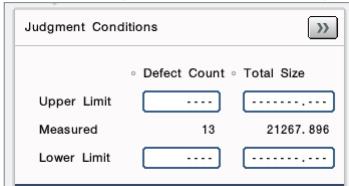
7 Set [Defect Detection Conditions].



□ "Defect Detection Conditions" (Page 5-77)

8 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



□ "Judgment Conditions (Profile Defect)" (Page 5-77)

Edge Detection Conditions

Setting item	Settings
Trend Direction	Select the moving direction of the segment to detect the edge. • Select between [↓] and [→]. • If the measurement region is a rotated rectangle, only [↓] is available (from the top side to bottom side) and it will link with the rotation direction of the region. • When the measurement region is a ring or arc, only [Clockwise] is available.
Scan Direction	Specify the edge scan direction in the measurement area (segment).
Edge Direction	Specify the light level change for edge detection. Select from "bright->dark", "dark->bright", or "both".
Edge Sensitivity	Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.
Edge Filter Width	Edge strength waveform can be averaged. When a noise component causes false edge detections, increasing the filter width can reduce the false detections.
Lower Edge Intensity	Sets the lower limit for recognizing edges. Edges below the lower limit are not detected. It may be possible to exclude noisy edges by adjusting the upper and lower edge intensity values based on the highest edge intensity shown on the left of the edge graph.
Segment Size	Specify the size of the segment to detect the edge. When the size is increased, small changes cannot be detected, but they are less susceptible to noise.
Segment Shift	Specifies how much the segment that detects the edge moves in the trend direction. Reducing the amount of movement will increase the processing time, but more points in the same range can be measured.
Starting Offset/ Starting Angle	Specify the amount (angle) to offset the start segment from the start edge of the measurement area. If there is no detected object near the boundary of the measurement area, the leading segment can be optimally positioned without changing the measurement area.
Max. Segments	Specifies the maximum number of segments that can be detected. Specify that "Max. segments" is larger than "Segment Count". The "Segment Count" changes in conjunction with the measurement area, segment size, and movement settings.
Edge Graph Segment No.	Specify the segment position and edge strength waveform, edge strength numerical value, segment to be displayed on the screen of the edge detection position.

Defect Detection Conditions

Setting item	Settings
Reference Line	Select a standard model line which fits the outline shape of the inspection target from [Line (Rectangle/Rotated Rectangle Region)], [Circle (Circumference/Arc Region)], [Free Curve Line], [Oval (Circumference/Arc Region)]. <ul style="list-style-type: none">• Line: Uses a straight line as the standard model line.• Circle: Uses a circle as the standard model line.• Free Curve Line: Uses a free-form line as the standard model line.• Oval: Uses an oval as the standard model line.
Smoothing Range	Set if "Free Curve Line" is selected for the reference model line. When drawing a loose free curve on the contour of the object to be measured, increase the number. When drawing a sharp free curve, decrease the number.
Defect Scan Direction	Selects defect scan direction from [+], [-], [+/-], and [+/- (Individual)]. <ul style="list-style-type: none">• +: Only detects concave/convex portions in the + direction as faults ([+] is the direction going forwards with respect to the edge detection direction; [-] is the opposite direction).• -: Only detects concave/convex portions in the - direction as faults ([+] is the direction going forwards with respect to the edge detection direction; [-] is the opposite direction).• +/-: Detects concave/convex portions in both the +/- direction as faults ([+] is the direction going forwards with respect to the edge detection direction; [-] is the opposite direction).• +/- (Individual): Detects convex/concave areas in either +/- direction as faults. A level can be specified at which a fault is detected individually for both the + direction and - direction ([+] is the direction going forwards with respect to the edge detection direction; [-] is the opposite direction).
Detection Count	Specify the maximum number of defects to be detected.
Detection Threshold	The distance (number of pixels) from the reference model line is defined and any excess is detected as a defect.
Lower Defect Level Filter	Defects with a defect level smaller than the specified lower limit are not detected as defects.
Lower Defect Width Filter	Defects smaller than the specified lower limit number of defect segments are not detected as defects.
Lower Defect Size Filter	Defects with the amount of defects smaller than the specified lower limit are not detected as defects.
Detection Order	Selects how the multiple detected faults are numbered. <ul style="list-style-type: none">• Segment Ascending: Sort by segment number in ascending order.• Segment Descending: Sort by segment number in descending order.• X Ascend: Sort by X coordinate in ascending order.• X Descend: Sort by X coordinate in descending order.• Y Ascend: Sort by Y coordinate in ascending order.• Y Descend: Sort by Y coordinate in descending order.• Defect Leve Ascending: Sort by fault level in ascending order.• Defect Leve Descending: Sort by fault level in descending order.• Defect Width Ascending: Sort by fault segment count in ascending order.• Defect Width Descending: Sort by fault segment count in descending order.• Defect Size Ascending: Sort by fault in ascending order.• Defect Size Descending: Sort by fault in descending order.
Judged Label	Specifies the fault to be judged. <ul style="list-style-type: none">• Specified: Only the fault with the specified number is the judgment target.• All: Measurement is performed for max./min. on all labels, and all of these are the judgment targets.

Judgment Conditions (Profile Defect)

Setting item	Settings
Detection Segments	Specify the range of the number of detected segments to be judged as OK with "Upper limit" and "Lower limit".
Defect Count	Specify the range of the number of detected injuries to be judged as OK with "Upper limit" and "Lower limit".
Total Size	Specify the range of the total amount of defects to be judged as OK with "Upper limit" and "Lower limit".
Defect Volume	Specify the range of the amount of injury of the injury specified by the judgment label to be judged as OK with "Upper limit" and "Lower limit".
Defect Position	Specify the range of the barycentric position (X/Y) of the injury specified by the judgment label to be judged as OK with "Upper limit" and "Lower limit".

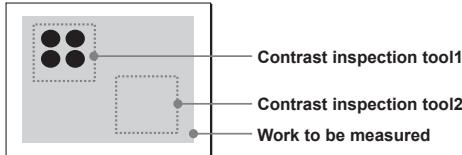
Intensity

What is [Intensity] Measurement?

Measures the average value, maximum value, minimum value, and deviation of the concentration (brightness) in the set measurement area.

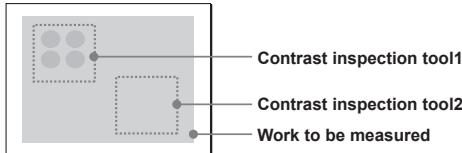
Measurement Image

When the difference between light/dark is great



- Shading inspection tool 1 average shade: 50
- Shading inspection tool 2 average shade: 200
- Shade difference: 150

When the difference between light/dark is slight



- Shading inspection tool 1 average shade: 150
- Shading inspection tool 2 average shade: 200
- Shade difference: 50

Flow of Settings

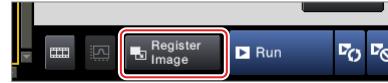
1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

4 Select the region type.

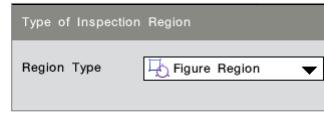


Figure Region

Lay out measurement region to surround the desired measurement area.

"Edit the measurement area" (Page 3-20)

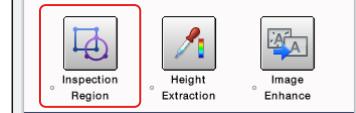
Shape Region

Specifies the shape of a binary image created from a height image as a region.

"Creating a Shape Region" (Page 3-31)

5 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



6 Set [Height Extraction] and [Image Enhance].

When the measurement target is a grayscale image, [Height Extraction] is unnecessary.

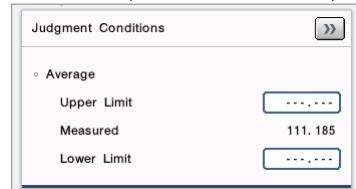


"Height Extraction" (Page 5-5)

"Pre-processing filter for contrast images" (Page A-58)

7 Set [Judgment Conditions].

Set tolerance (maximum and minimum) on measured values.



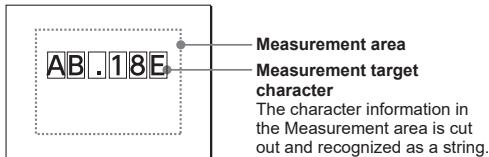
Setting item	Settings
Average	Specify the range of the average concentration to be judged as OK with "Upper limit" and "Lower limit".
Deviation	Specify the range of concentration deviation that is determined to be OK with "Upper limit" and "Lower limit".
Intensity	Specify the range of the intensity (held by each pixel in the measurement area) judged as OK with "Upper limit" and "Lower limit".

OCR2

What is [OCR2] Measurement?

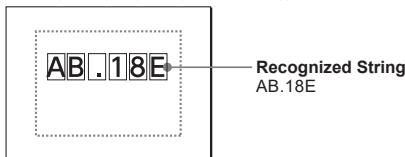
By cutting out text data in the measurement region and comparing with dictionary data, strings in the image can be identified.

Measurement Image



Measurement sample

When Measured With the Following Conditions:
• String Length (String Cut Setting): 6



Flow of Settings

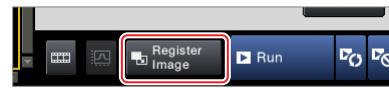
1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



5 Set [Height Extraction] and [Image Enhance].

When the measurement target is a grayscale image, [Height Extraction] is unnecessary.

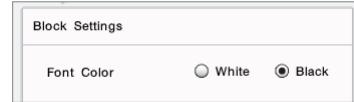


"Height Extraction" (Page 5-5)

"Pre-processing filter for contrast images" (Page A-58)

6 Select font color.

Compare the text and background colors and set which color should be recognized as a character.



- Black: Black portions will be recognized as text.
- White: White portions will be recognized as text.

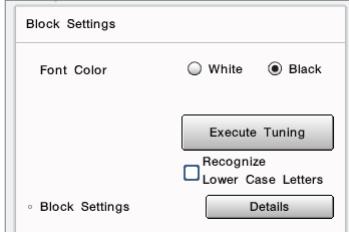
7 If the measurement region is an [Arc], select [String Direction].

Set this cutout direction for strings in the region.



- Clockwise: Cuts out text within the region in a clockwise direction.
- Counterclockwise: Cuts out text within the region in a counter-clockwise direction.

8 Select [Execute Tuning].

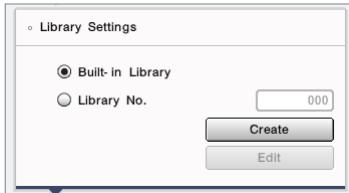


With the settings selected in tuning target, tuning is performed, and cut-out settings are adjusted to ensure that strings are being properly cut out. For the cases where cut-out is not performed properly, select [Details] in block settings and set block conditions.

["Cut-Out Settings \(OCR2\)" \(Page 5-80\)](#)

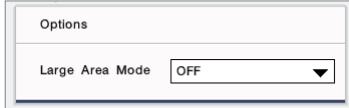
9 Check that characters are being properly recognized.

If the recognized characters are not correct, a library other than the built-in one can be registered, allowing new character patterns to be added, and the reference characters can also be restricted to the built-in library.



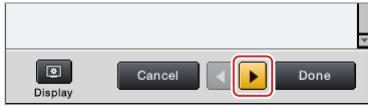
["Library Settings \(OCR2\)" \(Page 5-81\)](#)

10 Configure the [Options] settings.

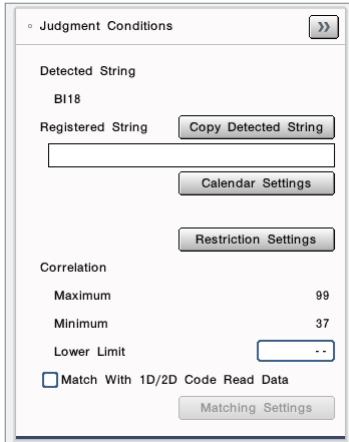


["Options \(OCR2\)" \(Page 5-81\)](#)

11 Click .



12 Set [Judgment Conditions].



Configure tolerance for judgment strings against recognized content and set tolerance (lower limit) on recognized result measurements.

["Judgment Conditions \(OCR2\)" \(Page 5-81\)](#)

When Characters are Incorrectly Recognized

- When character cut-out does not work properly, changing the cut-out method to [Wave Extraction] or [Fixed] will allow for cutting out following the same procedure as [Character Recognition] or  "OCR" (Page 5-86).
- If the recognized characters are not correct, use the dictionary to register an unrecognized character pattern, and the unnecessary characters can also be restricted to the dictionary.

 "Library Settings (OCR2)" (Page 5-81)

Further, reference characters can be limited by character position through the character recognition restriction settings of Judgment Conditions (page 5-81).

Cut-Out Settings (OCR2)

Setting item	Settings
Font Color	Compare the text and background colors and set which color should be recognized as a character. • Black: Black portions will be recognized as text. • White: White portions will be recognized as text.
String Direction	Specifies the read direction for the string when using an arc region. • Clockwise: Cuts out characters in a clockwise direction based on the starting angle from the region center. • Counterclockwise: Cuts out characters in a counter-clockwise direction based on the ending angle from the region center.
Recognize Lower Case Letters	Sets whether to cut out characters while referencing the lower-case character dictionary during tuning. Set this to ON when performing tuning on strings which include lower-case characters.
Block Settings Details	Perform settings on cut-out processing. When printed characters are not being cut out, try the following: • Disable "Border Exclusion" • Decrease the value of "Upper Noise Width" and/or "Upper Noise Height" • Increase the value of "Number of Characters" • For dotted and faint characters, increase the values of [X-Direction Interpolation] and [Y-Direction Interpolation] in [Dotted Character Settings].
Number of Characters	Specify the number of cutout characters from the measurement area.
Follow Zero Suppress	Automatically force [Number of Characters] to conform to judgment string length changes via zero suppression. Set [Number of Characters] to default to maximum string length using zero padding.
Block Mode	Sets the [Block] processing method which splits character data into 1-character units within the measurement region.

Library Settings (OCR2)

■ Registering Characters in Dictionary

If characters cannot be properly recognized with the dictionary currently being used, add characters to be recognized to the dictionary.



- The built-in dictionary cannot be directly edited.
 - Select [Library No.], to specify whether to use that dictionary alongside the built-in one, or to use one over the other.
- "Editing/deleting registered dictionary data" (Page 5-81)

1 Select [Library No.], then input the number of the dictionary to edit (0 to 999).

If the specified dictionary number does not exist, a new one can be created.

2 Click [Edit].

The [Edit] screen appears.



- If [Edit] cannot be selected, [Create] can be chosen to create a new one.

3 Select [Register].

The [Select Register Mode] screen appears.



For details on dictionary editing besides registering new characters, see "Register the character pattern used for character recognition in the library" (Page A-72).

4 Select a dictionary registration method.

● Each

Performs dictionary registration by specifying each character type individually of characters to be cut out.

● Batch

Performs dictionary registration of characters to be cut out with a string all at once.

5 Perform dictionary registration through the selected registration method.

● When "Each" is selected

The [Select Character to Register] screen appears. Using the mouse, or the / keys, select the characters to register from the screen and register them.
Repeat this process until all desired characters have been registered.

● When selecting "Batch"

The "Batch" screen is displayed. Enter the text of the currently cut out character string and register it.

6 When registration is complete, click [Close].

The screen returns to the [Library Settings] screen.

7 Select [Close].

■ Editing/deleting registered dictionary data

Registered dictionary data can be edited/deleted through the following process.

1 Select [Library No.], input the number of the dictionary to (0 to 999), then click [Edit].

The [Edit] screen appears.

2 Perform required operations.

● Enable/Disable

Temporarily enable/disable the selected character pattern.
The invalid character is displayed with , but the data itself is not deleted, so it can be turned back later.

● Delete

Deletes the selected character pattern.

● Delete all

Deletes all character patterns registered in the selected dictionary number.

● Built-In Library Reference Settings

Internal dictionary enable/disable settings for each character type.

● Delete All Built-In Characters

Deletes all built-in dictionary characters contained in the current dictionary file.

3 Select [Close].

Options (OCR2)

Setting item	Settings
Large Area Mode	When enabled, the wide mode is used. This mode must be selected if the area size exceeds a width of 2432 or a height of 2050 pixels with [Block Mode] set to [Recognition Cut-Out] and [Inspection Region] set to [Rectangle]. Enabling this mode increases the amount of resource memory consumption.

Judgment Conditions (OCR2)

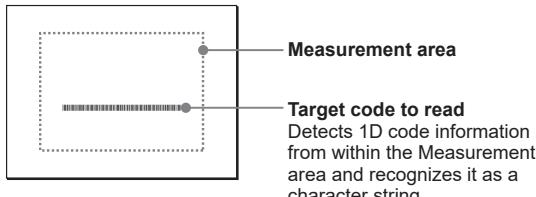
Setting item	Settings
Registered String	Enter the judgment string to be matched with the recognized content. Letters and numbers can be entered as a fixed string.
Calendar Settings	Performs settings for when date tolerance or zero suppression, date encoding, or calculation results are used as a judgment string.
Restriction Settings	Usually character recognition uses all the characters registered in the dictionary, but in situations where only certain characters are recognized and determined, the number of reference characters can also be restricted. Limiting reference characters may improve processing speed or eliminate false positives.
Correlation Lower Limit	"Correlation" is a value that indicates how similar the extracted character is to the dictionary data. For the cutout character below "Correlation Lower Limit", "?" is outputted as unrecognizable, and it is judged to be NG.
Lower Stability	The degree of stability expresses the difference between the recognition degree of the first and second candidates of the recognized character as a numerical value. Specify the lower limit for this minimum stability value. If below this lower limit, "?" is outputted as unrecognizable and it is judged to be NG.
Specified Label	From multiple recognized characters, characters are specified between 0 and 39 as a specification label element in calculation.
Match With 1D/2D Code Read Data	Enabled when comparing the recognized string with the read data of the 1D or 2D code reader tool.
Detected Character Count	Specify the range of the character count judged as OK by setting [Upper Limit] and [Lower Limit].
Follow Zero Suppression	Automatically force the upper limit and lower limit of [Detected Character Count] to conform to judgment string length changes via zero suppression. Set the upper limit and lower limit of [Detected Character Count] to default to maximum string length using zero padding.

1D Code Reader

What is [1D Code Reader] Measurement?

It detects 1D code information in the measurement area and reads the character string contained in the 1D code. The scanned character string can be output to the outside, or the pass/fail judgment can be made by comparing it with the built-in calendar. Also, it can be used for sorting etc.

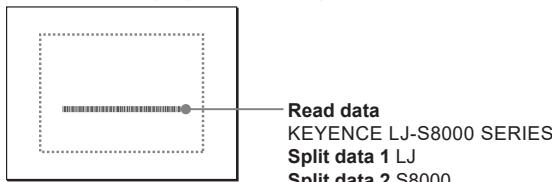
Measurement Image



Measurement sample

When Measured With the Following Conditions:

- Code Type: Code39
- Starting Digit: 1
- Data Length: 100
- Data Splitting: ON
 - Data 1: Starting Digit 9, Data Length 2
 - Data 2: Starting Digit 12, Data Length 5



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.

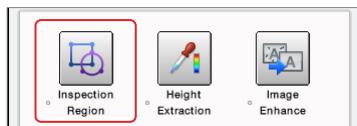


If there is no reference image, register the reference image.

□ "Register the standard image" (Page 3-15)

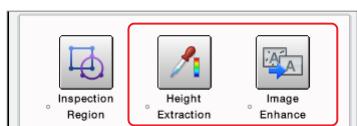
4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



5 Set [Height Extraction] and [Image Enhance].

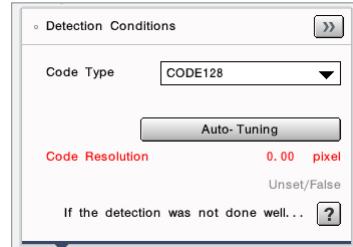
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

□ "Pre-processing filter for contrast images" (Page A-58)

6 Set [Detection Conditions].



□ "Detection Conditions (1D Code Reader)" (Page 5-83)

7 Configure/check the read data.



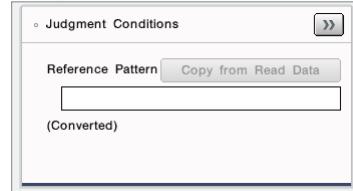
□ "Read Data Settings (1D Code Reader)" (Page 5-83)

8 When performing [Verification], set the judgment conditions after selecting the print quality certification method.



□ "Verification (1D Code Reader)" (Page 5-83)

9 Set [Judgment Conditions].



Measure the image which has the proper read data, then click [Copy From Read Data]; the read string (the string displayed in read data) can now be registered as a reference pattern.

- In the [Reference Pattern] field, Enter a pattern to match the code reading results.

□ "Judgment Conditions (1D Code Reader)" (Page 5-83)

Detection Conditions (1D Code Reader)

Setting item	Settings
Code Type	Select the type of 1D code. Perform auto-tuning to automatically adjust the best settings for code detection.
Read Direction	Specifies the code reading direction.
Code Resolution	Specifies the 1D module width resolution (pixels per 1 module) to read. Setting to a value that is close to the actual read 1D code will allow for more stable detection. Recommended values for standard code resolution (pixel) are 1.5 or more.
Code Detail	Specifies the code type details.
Reference Contrast	Specifies the contrast information to be used when extracting code features. Select from "Highest", "High", "Normal", "Low", and "Lowest". Lowering the value increases the possibility of detecting even weak contrast, but noise may make detection unstable.
Code Color	Selects a code color to detect (code color with respect to the background). <ul style="list-style-type: none"> Both: Can detect black on a white background or white on a black background. However, this takes longer, compared to if [Black (in white background)] or [White (in black background)] are selected. Black (in white background): Can only detect black on a white background. White (in black background): Can only detect white on a black background.
Number of Read Digits	Specify the maximum number of digits of the code to read and the minimum number of digits.
Base Angle	Specify the reference angle at code detection.
Scale Variations	Selects the degree of fluctuation to allow when the code size fluctuates. A smaller allowance will allow for more stable code detection. <ul style="list-style-type: none"> Small: Allow size fluctuations of about $\pm 10\%$ of size. Medium: Allow size fluctuations of about $\pm 20\%$ of size. Large: Allow size fluctuations of about $\pm 30\%$ of size. Unlimited: All size fluctuation which can be read are allowed.
Enable Check Digit	When enabled, checks the check digit (check character) of decoded data.
Check Digit	Specify the inspection method of check digit (check character) of decoded data.
Timeout	Set the upper limit for processing time. If the processing time of the tool itself exceeds the set value (0.01 to 60 seconds) due to the state of the input image, the tool processing will time out as an error.
Large Area Mode	When enabled, the wide mode is used. This mode must be selected if the area size exceeds a width of 2432 or a height of 2050 pixels. After changing to this mode, perform auto-tuning again. Also, review the filter parameters if using a pre-processing filter. This mode cannot be used at the same time as print quality certification (Verification). To enable this mode, set [Verification] to [OFF].

Read Data Settings (1D Code Reader)

Setting item	Settings
Start Digit	Specifies the position of the detected code at which to start reading data.
Read Data Length	Specify the number of characters (Byte unit) data to read from the start position.
Split Data	When enabled, the read data is partially cut out and output as cut out data. Cut data can be matched with patterns.
Output Fixed Length	When enabled, data is output for the number of characters set in the read data length. If the number of read characters is insufficient, it is completed with the character data specified in "Filling Character (1 byte)".
Call Text at Read Error	If enabled, the character data specified in "Text Called" will be output when reading fails.
Output Symbol Identifier	When enabled, a symbol identifier (3 bytes) defined by the ISO / IEC 15424 / JIS X 0530 data carrier identifier (including the symbology identifier) is added to the beginning of the read data.

Verification (1D Code Reader)

Setting item	Settings
Verification	Selects a method for print quality certification.
Overall Symbol Grade Condition	Specify the verification items to be included in the overall grade. The overall grade is the lowest value (grade) of the specified verification items.
Lower Limit	Specify the overall grade to be judged as OK in "Lower limit". The overall grade is the lowest value (grade) of the specified verification items.

Judgment Conditions (1D Code Reader)

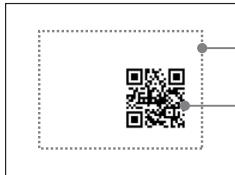
Setting item	Settings
Conditions	To set multiple criteria for matching, select "Multiple".
Condition List	Up to 16 collation conditions can be set. When setting, multiple collation conditions, it is possible to carry out collation that combines multiple arbitrary ranges of read data, and sort by result data of which number collation condition is met. When using it for sorting, disabling "Use in Tool's Judgment" allows collation without affecting the judgment result with non-matching result.
Data Range	Choose the range to match against the matching pattern. When "Split Data" is enabled, extraction range 1 to 8 can be specified to compare against any range of read data.
Reference Pattern	Enter a pattern to match the code reading results.
Conversion Settings	Specify details as necessary for the conditions involved in matching the code reading results.
Read Data Length	Specify the range of read data length to be judged as OK with "Upper limit" and "Lower limit".
Position	Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
Detected Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit".

2D Code Reader

What is [2D Code Reader] Measurement?

It detects 2D code information in the measurement area and reads the character string contained in the 2D code. The scanned character string can be output to the outside, or the pass/fail judgment can be made by comparing it with the built-in calendar. Also, it can be used for sorting etc.

Measurement Image



Measurement area

Target code to read
Detects 2D code information from within the Measurement area and recognizes it as a string.

Measurement sample

When Measured With the Following Conditions:

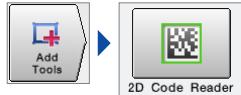
- Code Type: QR
- Starting Digit: 1
- Data Length: 100
- Data Splitting: ON
 - Data 1: Starting Digit 9, Data Length 2
 - Data 2: Starting Digit 12, Data Length 5



Read data
KEYENCE LJ-S8000 SERIES
Split data 1 LJ
Split data 2 S8000

Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

□ "Register the standard image" (Page 3-15)

4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.

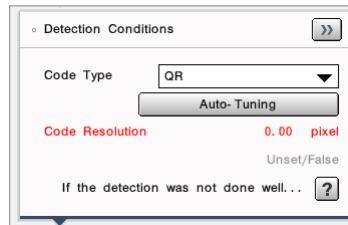


5 Set [Image Enhance].



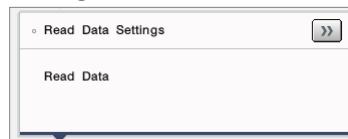
□ "Pre-processing filter for contrast images" (Page A-58)

6 Set [Detection Conditions].



□ "Detection Conditions (2D Code Reader)" (Page 5-85)

7 Configure/check the read data.



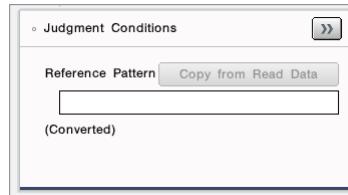
□ "Read Data Settings (2D Code Reader)" (Page 5-85)

8 When performing [Verification], set the judgment conditions after selecting the print quality certification method.



□ "Verification (2D Code Reader)" (Page 5-85)

9 Set [Judgment Conditions].



Measure the image which has the proper read data, then click [Copy From Read Data]; the read string (the string displayed in read data) can now be registered as a reference pattern.

- In the [Reference Pattern] field, Enter a pattern to match the code reading results.

□ "Setting Judgment Conditions (2D Code Reader)" (Page 5-85)

Detection Conditions (2D Code Reader)

Setting item	Settings
Code Type	Select the type of 2D code. Perform auto-tuning to automatically adjust the best settings for code detection. When [Composite Code] is selected, detection conditions must be configured individually for the 2D code and 1D code portions contained in composite symbols.
Code Resolution	Specify the resolution (number of pixels per cell) that is the basis of the 2D code. By setting the 2D code to be actually read and a close value, faster and more stable detection can be performed. Standard code resolution (pixel) of 4.0 or more is recommended.
Reference Contrast	Specifies the contrast information to be used when extracting code features. Select from "Highest", "High", "Normal", "Low", and "Lowest". Lowering the value increases the possibility of detecting even weak contrast, but noise may make detection unstable.
The Number of Cells	Select the number of vertical and horizontal cells of the 2D code to be detected. When "Any", the code can be detected regardless of the number of cells, but processing time will increase.
Code Color	Selects a code color to detect (code color with respect to the background). <ul style="list-style-type: none"> Both: Can detect black on a white background or white on a black background. However, this takes longer, compared to if [Black (in white background)] or [White (in black background)] are selected. Black (in white background): Can only detect black on a white background. White (in black background): Can only detect white on a black background.
Mirrored Reading	The internal processing is switched so that it can correspond to the code which is inverted by the passage direction and the direction of the work and is picked up. <ul style="list-style-type: none"> Both: Can detect normal codes as well as mirrored codes. However, this takes longer, compared to if [Standard Only] or [Mirrored Only] are selected. Standard Only: Can only detect normal codes (cannot detect mirrored codes). Mirrored Only: Can only detect mirrored codes (cannot detect normal codes).
Base Angle	Specify the reference angle at code detection.
Angle range	Specify the code detection range for the reference angle. By limiting the angular range, faster and more stable detection is possible.
Scale Variations	Selects the degree of fluctuation to allow when the code size fluctuates. A smaller allowance will increase processing speed and allow for more stable code detection. <ul style="list-style-type: none"> Small: Allow size fluctuations of about $\pm 10\%$ of size. Medium: Allow size fluctuations of about $\pm 20\%$ of size. Large: Allow size fluctuations of about $\pm 30\%$ of size. Unlimited: All size fluctuation which can be read are allowed.
Timeout	Set the upper limit for processing time. If the processing time of the tool itself exceeds the set value (0.01 to 60 seconds) due to the state of the input image, the tool processing will time out as an error.
Large Area Mode	When enabled, the wide mode is used. This mode must be selected if the area size exceeds a width of 2432 or a height of 2050 pixels. After changing to this mode, perform auto-tuning again. Also, review the filter parameters if using a pre-processing filter. <ul style="list-style-type: none"> This mode cannot be used at the same time as print quality certification (Verification). To enable this mode, set [Verification] to [OFF].

Read Data Settings (2D Code Reader)

Setting item	Settings
Start Digit	Specifies the position of the detected code at which to start reading data.
Read Data Length	Specify the number of characters (Byte unit) data to read from the start position.
Split Data	When enabled, the read data is partially cut out and output as cut out data. Cut data can be matched with patterns.
Output Fixed Length	When enabled, data is output for the number of characters set in the read data length. If the number of read characters is insufficient, it is completed with the character data specified in "Filling Character (1 byte)".
Call Text at Read Error	If enabled, the character data specified in "Text Called" will be output when reading fails.
Output Symbol Identifier	When enabled, a symbol identifier (3 bytes) defined by the ISO / IEC 15424 / JIS X 0530 data carrier identifier (including the symbology identifier) is added to the beginning of the read data.
Expansion Channel Interpretation (ECI)	When enabled, ECI is output as the result of reading code that contains ECI. It does not affect the read operation of code that does not contain ECI.

Verification (2D Code Reader)

Setting item	Settings
Verification	Selects a method for print quality certification.
Overall Symbol Grade Condition	Specify the verification items to be included in the overall grade. The overall grade is the lowest value (grade) of the specified verification items.
Lower Limit	Specify the overall grade to be judged as OK in "Lower limit". The overall grade is the lowest value (grade) of the specified verification items.

Setting Judgment Conditions (2D Code Reader)

Setting item	Settings
Conditions	To set multiple criteria for matching, select "Multiple".
Condition List	Up to 16 collation conditions can be set. When setting, multiple collation conditions, it is possible to carry out collation that combines multiple arbitrary ranges of read data, and sort by result data of which number collation condition is met. When using it for sorting, disabling "Use in Tool's Judgment" allows collation without affecting the judgment result with non-matching result.
Data Range	Choose the range to match against the matching pattern. When "Split Data" is enabled, extraction range 1 to 8 can be specified to compare against any range of read data.
Reference Pattern	Enter a pattern to match the code reading results.
Conversion Settings	Specify details as necessary for the conditions involved in matching the code reading results.
Read Data Length	Specify the range of read data length to be judged as OK with "Upper limit" and "Lower limit".
Position	Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
Detected Angle	Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit".

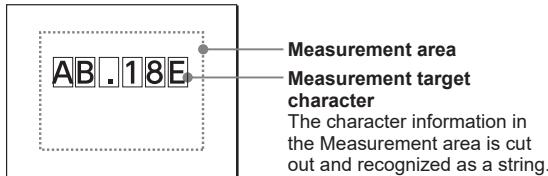
OCR

What is [OCR] Measurement?

By cutting out text data in the measurement region and then comparing with dictionary data, strings in the image can be identified.

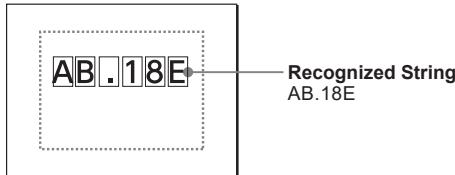
Reference Since the OCR function is included in the OCR2 function, we generally recommend the use of OCR2.

Measurement Image



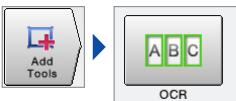
Measurement sample

When Measured With the Following Conditions:
• String Length (String Cut Setting): 6



Flow of Settings

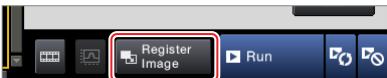
1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

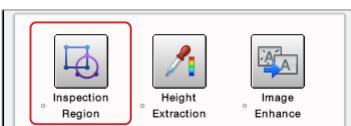
3 Register the reference image.



If there is no reference image, register the reference image.
□ "Register the standard image" (Page 3-15)

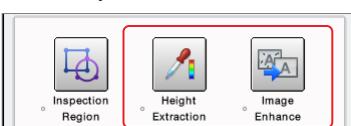
4 Set [Inspection Region].

Lay out measurement region to surround the desired measurement area.



5 Set [Height Extraction] and [Image Enhance].

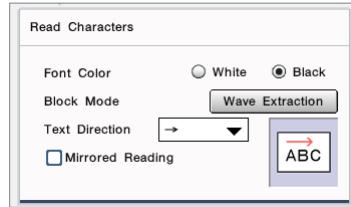
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



□ "Height Extraction" (Page 5-5)

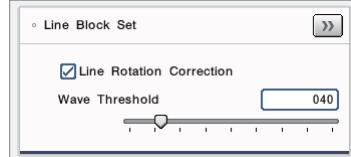
□ "Pre-processing filter for contrast images" (Page A-58)

6 Set [Read Characters], then click



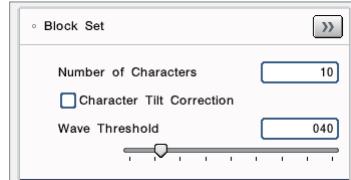
□ "Read Characters (OCR)" (Page 5-87)

7 Set [Line Block Set], then click



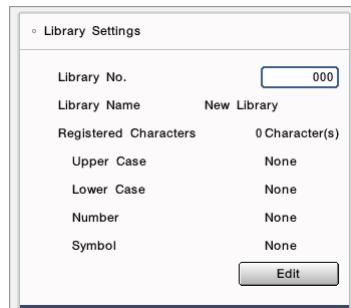
□ "Line Block Set (OCR)" (Page 5-87)

8 Set [Block Set], then click



□ "Block Set (OCR)" (Page 5-87)

9 Set [Library Settings], then click



□ "Library Settings (OCR)" (Page 5-88)

10 Set [Judgment Conditions].



Configure tolerance for judgment strings against recognized content and set tolerance (lower limit) on recognized result measurements.

□ "Judgment Conditions (OCR)" (Page 5-88)

When Characters are Incorrectly Recognized

Instead of steps 6 to 8 above, try the procedure described in □ "When Characters Cannot be Correctly Recognized with Normal Cut-Out Method (Fixed Cut-Out)" (Page 5-89).

Read Characters (OCR)

Setting item	Settings
Font Color	Compare the text and background colors and set which color should be recognized as a character. <ul style="list-style-type: none">• Black: Black portions will be recognized as text.• White: White portions will be recognized as text.
Block Mode	The process of dividing character information in the measurement area into single character units is called "cut out". Proper segmentation requires proper recognition of characters. Select the method of character extraction and set the characters to be extracted one character at a time.
Text Direction	If the text is rotated by 90 ° with respect to the screen horizontal, change the direction of the text.
Mirrored Reading	When checked, the characters which are inverted depending on the passing direction and orientation of workpiece for capturing can be recognized.

Line Block Set (OCR)

Setting item	Settings
Block Target	If the cut-out is not being performed properly due to background noise, sometimes changing the cut-out target will allow cut-out to be performed.
Line Rotation Correction	Check if the cut out line is inclined to the measurement area and the height of the line fluctuates.
Wave Threshold	Specify the lower threshold of the projected waveform as waveform strength. Lowering the threshold increases the sensitivity of the incision, but may increase noise.
Smoothing Filter	Apply the inflation treatment to the projected waveform for a specified number of times to make the shape of the waveform smooth. This improves the situation where the character is composed of dots, etc. and the separation is more than necessary, but may reduce the sensitivity of detection for a slight line spacing.
Upper Row Height (Region Ratio)	Specify the upper limit of the height of the line to be cut out as a percentage of the measurement area width. If the line spacing is narrow and two lines have been erroneously detected as one line, etc., it can be forcibly cut into two lines.
Upper Noise Intensity	Specify the upper limit of the intensity of the projection waveform to be treated as noise information in the projection waveform by the difference from the projection waveform threshold. Excludes noise information with a Strength less than the upper limit from the extraction target.
Upper Noise Width	Specify the maximum width in pixels of the projected waveform to be treated as noise information in the projected waveform. Exclude noise information with a width less than the upper limit from the extraction target.

Block Set (OCR)

Setting item	Settings
Block Target	If the character cut-out is not being performed properly due to background noise, this may be effective.
Number of Characters	Specify the number of cutout characters from the measurement area.
Character Tilt Correction	If the cut out character is deformed diagonally, set "Skew correction" to ON. When set to ON, correction is performed on the slope.
Fitting	Fine-tune the size of the cutout area determined by the projection waveform with the size of the actual character. Reduces the impact on recognition when text size changes.
Fitting (When Block Mode is [Fixed])	Choose whether to have the cut area reflect the actual character size. When it turns ON, the actual character size can be reflected in the clipping area, and the influence on the recognition degree when the character size changes is reduced.
Noise Cancellation on the Border	When performing fitting processing within the fixed extraction or projection extraction (ratio specification) extraction area, noise on the boundary of the extraction area that causes a malfunction is excluded from the process.
Wave Threshold	Specify the lower threshold value of the projection waveform to be used for clipping by the waveform strength. Lowering the threshold increases the sensitivity of the incision, but may increase noise.
Smoothing Filter	Apply the inflation treatment to the projected waveform for a specified number of times to make the shape of the waveform smooth. This improves the situation where the character is composed of dots, etc. and the separation is more than necessary, but may reduce the sensitivity of detection for a slight line spacing.
Upper Line Height (Text Ratio)	Specifies the upper limit of the character width to be cut out as a percentage of the character height. If the space between characters is narrow and two characters have been misdetected as one character, the characters can be forcibly separated.
Upper Noise Intensity	Specify the upper limit of the intensity of the projection waveform to be treated as noise information in the projection waveform by the difference from the projection waveform threshold. Excludes noise information with a Strength less than the upper limit from the extraction target.
Upper Noise Width	Specify the maximum width in pixels of the projected waveform to be treated as noise information in the projected waveform. Exclude noise information with a width less than the upper limit from the extraction target.

Library Settings (OCR)

■ Registering Characters in Dictionary

1 Click [Edit].

The [Edit] screen appears.

2 Select the registered dictionary file with [Library No.] (0 to 999).

To update the list format, update [View Mode].

● Character

A list of registered characters is displayed in a matrix.

● Registered

Registration state of all character types is shown in a list.
To change the dictionary's title, enter any title in the [Library Name] field (up to 30 full-width characters, or 60 half-width characters).

3 Select [Register].

The [Select Register] screen appears.

4 Select a dictionary registration method.

The following 2 dictionary registration methods can be chosen:

● Each

Performs dictionary registration by specifying each character individually of characters to be cut out.

● Batch

Performs dictionary registration of characters to be cut out with a string all at once.

5 Perform dictionary registration through the selected registration method.

● When "Each" is selected

If the cut-out characters are selected from the screen, the [Select Register Strings] screen appears. Once the characters to be registered have been selected, register them. Repeat this process until all desired characters have been registered.

● When selecting "Batch"

The "Batch" screen is displayed. Enter the text of the currently cut out character string and register it.

6 When registration is complete, click [Close].

Return to the [Edit Dictionary] screen.

7 Select [Close].

■ Edit/delete registered dictionary data

Registered dictionary data can be edited/deleted through the following process.

1 Click [Edit] on the [Library Settings] screen.

The [Edit] screen appears.

2 Perform required operations.

Enable/Disable

Temporarily enable/disable the selected character pattern.
The invalid character is displayed with ×, but the data itself is not deleted, so it can be turned back later.

Delete

Deletes the selected character pattern.

Delete all

Deletes all character patterns registered in the selected dictionary number.

3 Select [Close].

Judgment Conditions (OCR)

Setting item	Settings
Registered String	Enter the judgment string to be matched with the recognized content. Up to 20 characters or symbols can be entered as a fixed string.
Conversion Settings	If a date or calculation result is used as a judgment string, specifies how those strings will be expanded. Specifies date offset or error tolerance, date encryption settings, calculation result expansion digits, base, and whether zero suppression is enabled. This item can only be configured when date or calculation result is selected under judgment string.
Restriction Settings	Usually character recognition uses all the characters registered in the dictionary, but in situations where only certain characters are recognized and determined, the number of reference characters can also be restricted. Limiting reference characters may improve processing speed or eliminate false positives.
Correlation Lower Limit	"A degree of recognition" is a value that indicates how similar the extracted character is to the dictionary data. For the cutout character below "Recognition Lower Limit", "?" is outputted as unrecognizable, and it is judged to be NG.
Lower Stability	The degree of stability expresses the difference between the recognition degree of the first and second candidates of the recognized character as a numerical value. Specify the lower limit for this minimum stability value. If below this lower limit, "?" is outputted as unrecognizable and it is judged to be NG.
Lower Intensity Deviation	Specify the lower limit of concentration deviation that is judged blank (SPACE) in the cutout area. If the noise component of the underground to be inspected is recognized as a character, raise the lower limit to correspond. Conversely, if a space is recognized because the contrast between the letter and the background is low, the lower limit may be recognized as a letter.
Specified Label	From multiple recognized characters, characters are specified between 0 and 19 as a specification label element in calculation.
Match With 1D/2D Code Read Data	When comparing the recognized string to the read data of [1D Code Reader] or [2D Code Reader] or [2D Code Reader] (Page 5-82), [2D Code Reader] or [2D Code Reader] (Page 5-84) tools, places a check in [Match with 1D/2D Code Read Data].

When Characters

Cannot be Correctly Recognized with Normal Cut-Out Method (Fixed Cut-Out)

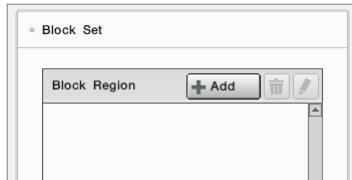
- 1 Click [Read Characters] in the [Primary Settings] screen.**

The [Block Mode] screen appears.

- 2 Click [Fixed], then click [OK].**

- 3 Click .**

- 4 Add a character cut-out region.**



Click [Add], then click the top left and bottom right corners of an area that will enclose the character (repeat this operation as needed for each character).

- 5 Check the [Fitting] box to enable fitting.**

- 6 Click .**

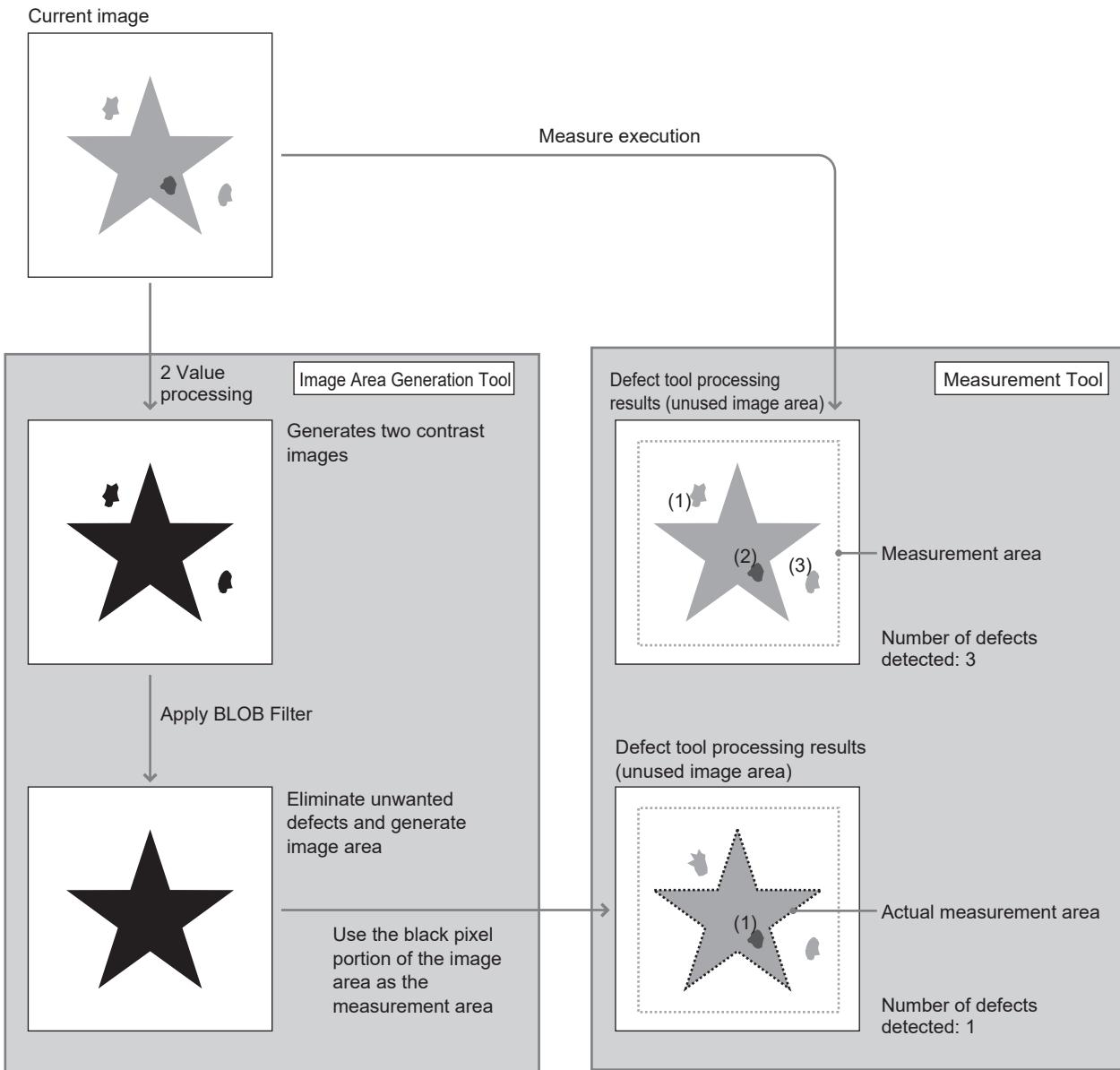
From this point, proceed as per the explanation in  "Flow of Settings" (Page 5-86).

Image Region Generator

What is the [Image Region Generator] tool?

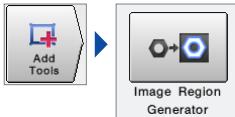
It generates a free-form measurement region. This measurement region can be used in the desired measurement tool. This function is useful when a measurement region for complicated shapes is needed.

● Example



Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.

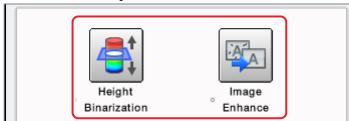


If there is no reference image, register the reference image.

"Register the standard image" (Page 3-15)

4 Set [Height Binarization] and [Image Enhance].

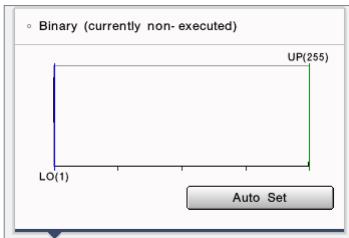
When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



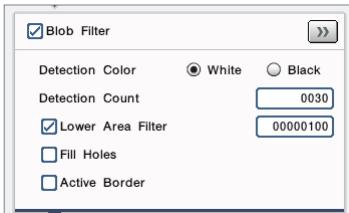
"Height Binarization" (Page 5-7)

"Pre-processing filter for contrast images" (Page A-58)

5 Set the threshold for binary.



6 To apply the blob filter, change the settings after checking the [Blob Filter] box.



"Blob" (Page 5-66)

7 To perform shrink processing of the white pixels and black pixels, check the [Shrink White Pixels Process] and [Shrink Black Pixels Process] boxes.

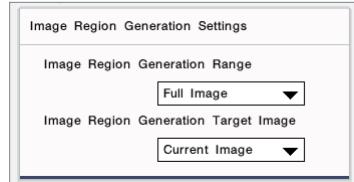


Setting item	Settings
Shrink White Pixels	Enable this to shrink white pixels and remove white pixel noise.
Shrink Black Pixels	Enable this to shrink black pixels and remove black pixel noise.

Reference The [Shrink White Pixels] process is a shrink filter, while the [Shrink Black Pixels] process is an expand filter. For details on each filter, see "Pre-processing filter list".

"Pre-processing filter for contrast images" (Page A-58)

8 Configure [Image Region Generation Settings].



● Image Region Generation Range

Select a generation range for the image region.

Full image

The entire image is the range for image region generation.

Rectangle

The image region generation range can be specified. The region is generated from the specified range.

● Image Region Generation Target Image

Select the target image for application of the generated image region.

Current image

Applies the image region to the current image and displays it.

Reference image

Applies the image region to the reference image and displays it.

9 Specify the generated image region as a measurement region for another measurement tool.

On the [Measurement Region] screen that is displayed by clicking [Measurement Region] in the measurement tool, check the [Use Image Region] box and specify the image region generator tool number that will serve as the reference for the region shape.

The detection color (white or black) can be specified, and the shape can also be previewed for checking.

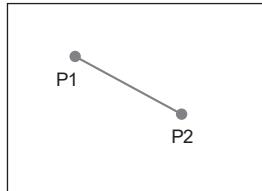
Line Display

This tool displays a line (line connecting 2 points, horizontal line, or vertical line).

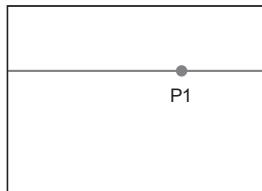
There are two manners for specifying a point: Specifying it with a fixed point, and by referencing a detection position of another tool which is already specified.

● Image of display

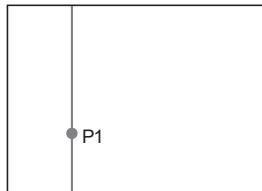
○ Point-to-Point (line segment)



○ Horizontal Line

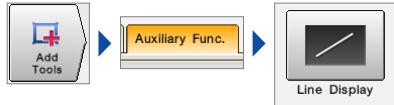


○ Vertical Line



Flow of Settings

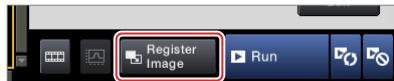
1 Add a tool.



↳ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

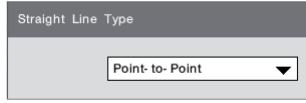
3 Register the reference image.



If there is no reference image, register the reference image.

↳ "Register the standard image" (Page 3-15)

4 Select [Straight Line Type].



5 Draw a line.

Draw a line connecting two points

1 Select [Point-to-Point] in the in [Straight Line Type] field.

2 Either click directly on the desired coordinate, or click the point (green point) detected by another tool to select the 1st point for the line.

To redo point 1, click [Undo].

3 This tool displays a line (line connecting 2 points, horizontal line, or vertical line).

A line is drawn between the 2 selected points.

Draw a horizontal or vertical line

1 Select either [Horizontal] (if drawing a horizontal line) or [Vertical] (if drawing a vertical line] in the [Straight Line Type] field.

2 Either click directly on the desired coordinate, or click the point (green point) detected by another tool.

A horizontal or vertical line passing through the selected point is drawn.

Correcting a drawn line

■ Correcting the point which the line passes through

Use either of the methods below to correct the point.

- Click [Reset] for [Point 1] or [Point 2] and then either click directly on the desired coordinate, or click the point (green point) detected by another tool.
- Click on the coordinates and enter the coordinates directly. Click on the [Point 1] or [Point 2] coordinates and enter the coordinates directly.

■ Changing the line thickness or color displayed in Run mode

1 Click [Display].

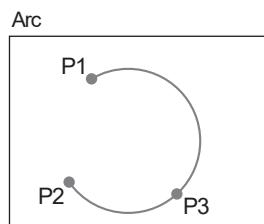
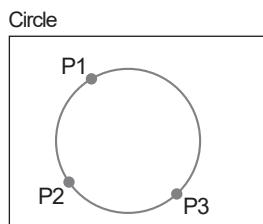
The [Display] screen appears.

2 Change the [Line Thickness] or [Color] field settings as necessary.

Circle Display

Shows a circle or an arc.

Image of display



Flow of Settings

1 Add a tool.



□ "Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.

□ "Register the standard image" (Page 3-15)

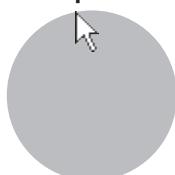
4 Select [Circle Type].

5 Draw a circle.

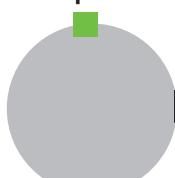
Drawing a circle

1 In the [Circle Type] field, click [Circle].

2 Click point 1 on the edge of the circle.

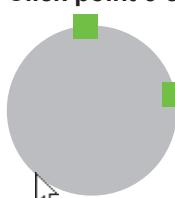


3 Click point 2 on the edge of the circle.



To redo either point 1 or point 2, click [Undo].

4 Click point 3 on the edge of the circle.

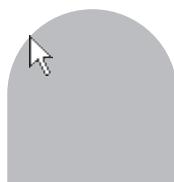


A circle that passes through the 3 selected points is drawn.

Drawing an arc

1 In the [Circle Type] field, click [Arc].

2 Click the start point on the arc.

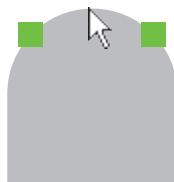


3 Click the end point on the arc.



To reset the starting point and end point of the arc, click [Undo].

4 Click the center point on the arc.



An arc that passes through the 3 selected points is drawn.

Correcting a Drawn Circle/Arc

Correcting a Circle/Arc

Click on the [Center] or [Radius] coordinates in the case of [Circle], or on [Center], [Radius], [Starting Angle], or [Ending Angle] fields in the case of [Arc] and enter the coordinates directly.

Changing the Circle/Arc Thickness or Color Displayed in Run mode

1 Click [Display Options].

The [Display Options] screen appears.

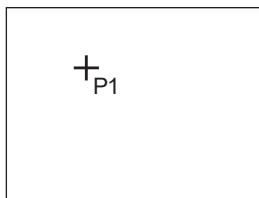
2 Change the [Line Thickness] or [Color] field settings as necessary.

Point Display

Shows a point (rotating cross).

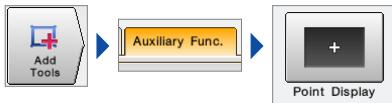
● Image of display

Horizontal



Drawing a point

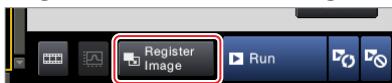
1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

4 Click directly on the desired coordinate.

A cross is drawn with the center at the selected point.

Correcting a drawn point

■ Correcting the point position

- 1 Click on the [Center] coordinates and enter the coordinates directly.
- 2 Click [Rotation Angle] and enter the rotation angle for the cross.
- 3 Click [Width] and select the cross size.

■ Changing the point thickness or color displayed in Run mode

- 1 Click [Display Options].
The [Display Options] screen appears.
- 2 Change the [Line Thickness] or [Color] field settings as necessary.

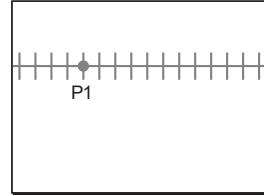
Scale Display

This tool displays scales.

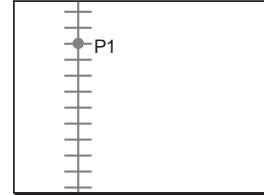
There are two manners for specifying a point: Specifying it with a fixed point, and by referencing a detection position of another tool which is already specified.

● Image of display

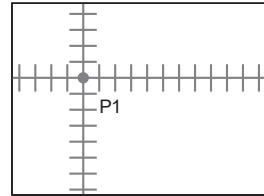
○ Horizontal



○ Vertical



○ Horizontal/Vertical



Drawing a scale

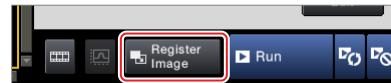
1 Add a tool.



"Adding a tool" (Page 3-16)

2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

4 Select [Straight Line Type].

- 5 Either click directly on the desired coordinate, or click the point (green point) detected by another tool.

A scale passing through the selected point is drawn.

Correcting a drawn scale

■ Correcting the scale position or scale span

- 1 Click on the [Position] field coordinates and enter the coordinates directly.
- 2 Click the [Large Scale Span] field and select the interval for the large scale tick marks.
- 3 Click the [Small Scale Span] field and select the interval for the small scale tick marks.

■ Changing the scale color displayed in Run mode

- 1 Click [Display Options].
The [Display Options] screen appears.
- 2 Change the settings in the [Color] field as required.

Calculation

Calculation

The calculation tool is used for processing multiple functions in as a calculation string with the results being used directly as the output of the calculation unit or for populating user specified variables. As the results of multiple operational expressions can be substituted into another operational expression, it is possible to handle complex judgments based on various judgment results and measurement values.

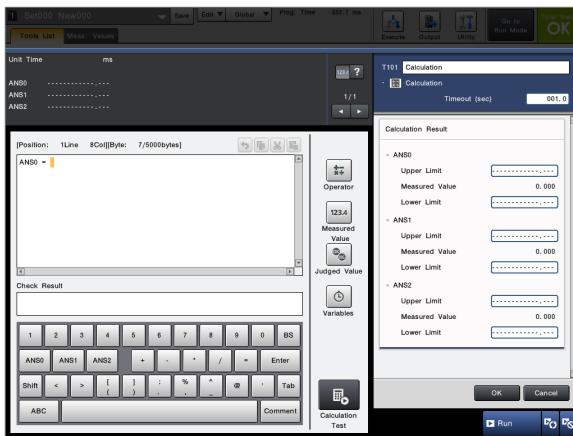
Flow of Settings

1 Add a tool.



"Adding a tool" (Page 3-16)

2 Set the calculation details.



Click the following buttons to enter functions other than values: [Operator], [Measured Value], [Judged Value], or [Variables].

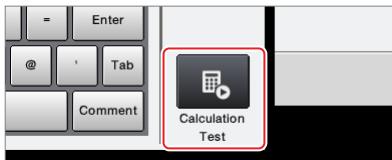
For more information about functions, refer to "Operation Notations" (Page A-2).

3 Set the calculation results.

Input of the value in any of calculation results [ANS0], [ANS1] or [ANS2] can be used as the calculation result.

- (Example) $\text{ANS0} = \text{T100.RSLT.N [0]} : \text{MS}$
- Judgment tolerance can be set for the calculation result.

4 Execute Calculation Test to check if there is a calculation error.



5 Set [Judgment Conditions].

Set the tolerance (upper limit and lower limit) for [ANS0], [ANS1] and [ANS2].

Position Adjustment Settings

Position Adjustment with Pattern Match (Profile)

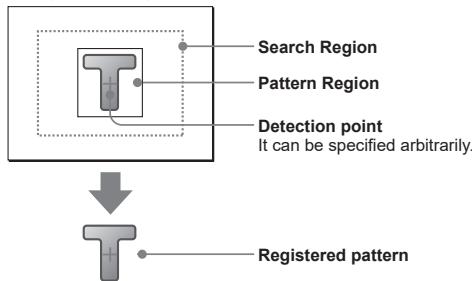
What is [Position Adjustment with Pattern Match (Profile)]?

Finds the most similar part to the previously registered contour information and outputs the position and inclination of the detected object. This position correction tool references the configured position correction's edge as reference for the positional adjustment.

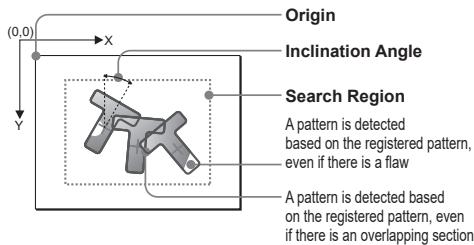
For details on the advanced settings (settings displayed with ) , see the reference tool  "ShapeTrax3A" (Page 5-46).

Measurement Image

During pattern registration



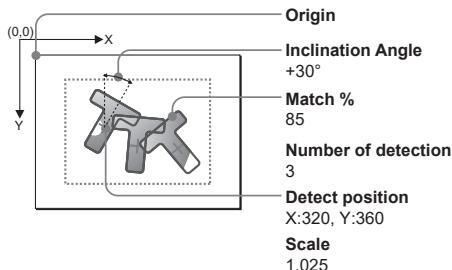
During operation



Measurement sample

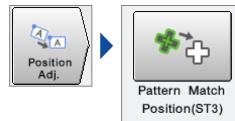
When Measured With the Following Conditions:

- Detection Order: From top-left to bottom
- Judged Label: 0

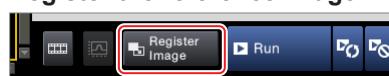


Flow of Settings

1 Add a tool.

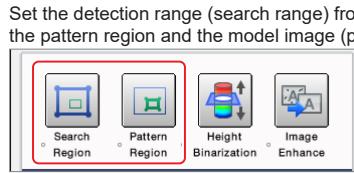


2 Select the measurement target image.



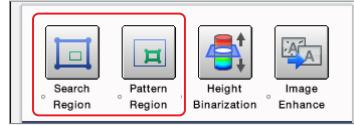
If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

3 Register the reference image.



4 Set [Search Region] and [Pattern Region].

Set the detection range (search range) from the model image registered in the pattern region and the model image (pattern region) to detect.



5 Set [Height Binarization] and [Image Enhance].

When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



 "Height Binarization" (Page 5-7)

 "Pre-processing filter for contrast images" (Page A-58)

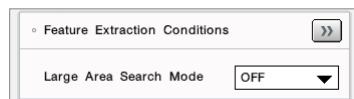
6 Set angle range.

Specify the angle range when the search target is tilted with \pm .



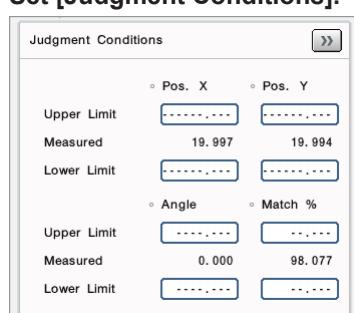
 "Detection Conditions (ShapeTrax3A)" (Page 5-47)

7 Set characteristic extraction conditions.



 "Detection Conditions (ShapeTrax3A)" (Page 5-47)

8 Set [Judgment Conditions].



Set tolerance (maximum and minimum) on measured values.

- In the [Position] field, Specify the range of X coordinate/Y coordinate to be determined as OK with "Upper limit" or "Lower limit".
- In the [Angle] field, Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000° to 180.000° .
- In the [Match %] field, Specify the range of the correlation value to be judged as OK with "Upper limit" or "Lower limit".

After settings are completed

The added tool is registered as [Reference] tool, and it can be used as a reference for the Position Correction of other tools.
For details on the position correction, see □ "Position Correction Settings" (Page 3-34).

When Expected Measurement Results Cannot be Obtained

Statuses	Remedy
Registered characteristic and input characteristic not visible.	Select [Fine] under [Display Feature] in [Feature Extraction Conditions].
Some of the targets cannot be located.	Decrease [Min. Match %].
A target with a different size cannot be located.	Change the upper/lower limit in [Scale Range].
Processing time is slow.	<ul style="list-style-type: none"> • Select [Fast] in [Fine Search Accuracy]. • Narrow the search region.
There are unnecessary characteristics in registered characteristics and the search is not stable.	Delete unnecessary characteristics with the eraser tool, and edit characteristics with the feature drawing tool.
A target with inverted light/shade cannot be located.	Check [Reverse Detect].
Search is sometimes not possible due to view angle or tilt of the work piece etc.	Increase [Allowable Distortion].
Only the detection angle is unstable with rotational symmetry work.	Change the settings with [Rotation Direction-Added Search] so that the rotation direction can be detected.
An overlapped target cannot be detected.	Reduce the [Minimum Distance] and [Angle Range] in [Minimum Settings] (surrounding removal distance and angle range are an AND condition).
I do not want to detect an overlapped target.	Select [All] as the removal target in [Eliminate Overlap].
I want to additionally specify whether to include in or exclude from the detection target based on characteristics around the pattern.	Change the settings for specifying the region for referencing characteristics or detection target etc. in [Characteristic Pixel Count Selection].
There are too few characteristics with the input characteristics and the search is not stable.	Select [Detailed] under [Search Sensitivity] in [Feature Extraction Conditions].

- There are unnecessary characteristics in registered characteristics and the search is not stable.
 - Delete unnecessary characteristics with the eraser tool, and edit characteristics with the feature drawing tool.
- Registered characteristic and input characteristic not visible.
 - Select [Fine] under [Feature Characteristics] in [Feature Extraction Conditions].

Position Adjustment with Edge

What is [Position Adjustment with Edge]

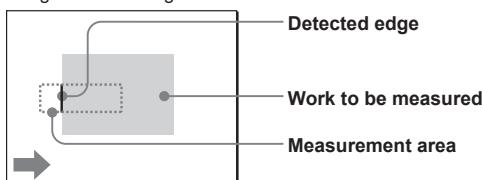
Detects an edge (X or Y direction) in the measurement area and outputs the position. Corrects the positional error of the correction destination tool according to the change in the position of the edge detected by this tool that is the source of positional error correction.

For details on the advanced settings (settings displayed with ) see the reference tool  "Edge Position" (Page 5-53).

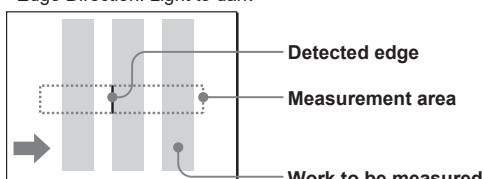
Measurement Image

When the measurement region is a rectangle

- Judged Label: 0
- Scan Direction: →
- Edge Direction: Light to dark



- Judged Label: 1
- Scan Direction: →
- Edge Direction: Light to dark

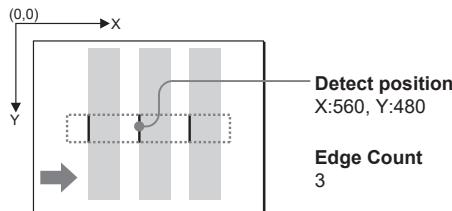


Measurement sample

When the measurement region is a rectangle

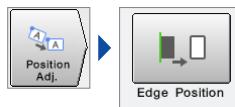
When Measured With the Following Conditions:

- Judged Label: 1
- Scan Direction: →
- Edge Direction: Light to dark



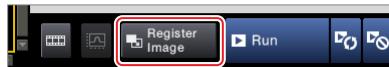
Flow of Settings

1 Add a tool.



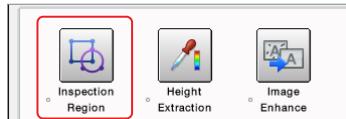
2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

4 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

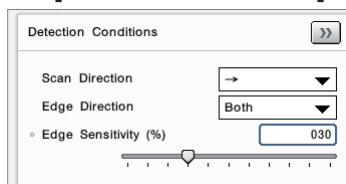
5 Set [Height Extraction] and [Image Enhance].

When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



 "Height Extraction" (Page 5-5)
 "Pre-processing filter for contrast images" (Page A-58)

6 Set [Detection Conditions].



Scan Direction

Specify the direction to scan the edge in the measurement area.
Choose from →, ←, ↓, ↑.

Edge Direction

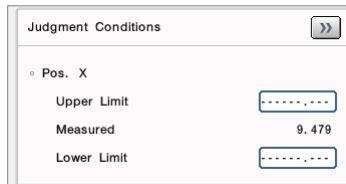
Specify the light level change for edge detection.
Select from "bright->dark", "dark->bright", or "both".

Edge Sensitivity

Sets the percentage of waveform peak to be recognized as an edge when the largest change in gradation is 100%. Peaks of waveforms below this edge sensitivity are not recognized as edges, which is useful for ignoring noise.

 "What is an edge?" (Page A-66)

7 Set [Judgment Conditions].



Set tolerance (maximum and minimum) on measured values.

Position

Specify the range of edge position (X or Y) to be judged as OK with "Upper limit" or "Lower limit".

■ After settings are completed

The added tool is registered as [Reference] tool, and it can be used as a reference for the Position Correction of other tools.
For details on the position correction, see □ "Position Correction Settings" (Page 3-34).

When Expected Measurement Results Cannot be Obtained

Statuses	Remedy
Edge intensity waveform is not displayed	Select display after filter
To detect an edge on the right, not on the left	Set scan direction to [\leftarrow] (with a rectangle etc., [\uparrow], [\downarrow], [\rightarrow], and [\leftarrow] can be selected).
I only want to detect only edges that become dark	Select [Light to Dark] in edge direction.
Instead of the desired edge, a dark edge in the measurement region is detected erroneously.	Reduce edge sensitivity while viewing the edge sensitivity graph.
I want to detect curved edges, but it goes inward.	Reduce the edge filter width while viewing the detected edge position.
Weak noise is detected erroneously.	While viewing the edge graph, increase [Lower Edge Intensity] or [Edge Sensitivity].
Angled edge detection position is not stable.	Check the [Angled Edge Detection] box or increase [Edge Filter Width].

- Instead of the desired edge, a dark edge in the measurement region is detected erroneously.
→ Reduce edge sensitivity while viewing the edge intensity waveform.
- I want to detect curved edges, but it goes inward.
→ Reduce the edge filter width while viewing the detected edge position.

Position Adjustment with Line Position and Angle

What is [Position Adjustment with Line Position and Angle] Measurement?

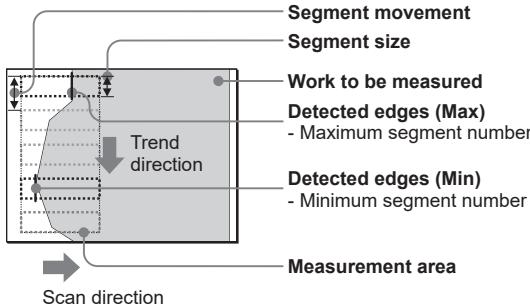
Edges are detected at multiple points in the measurement area, and straight lines are obtained from the edge information of the detected multiple points. The position correction of the correction destination tool is performed according to the variation of the position and inclination of the straight line obtained by this tool that is the origin of position error correction.

For details on the advanced settings (settings displayed with ) see the reference tool  "Profile Position" (Page 5-71).

Measurement Image

When the measurement region is a rectangle

When the Scan Direction is  and the trend direction is 



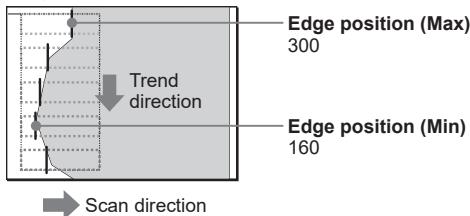
Scan direction

Measurement sample

When the measurement region is a rectangle

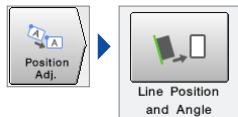
When Measured With the Following Conditions:

- Trend direction: 
- Scan Direction:
- Edge Direction: Both

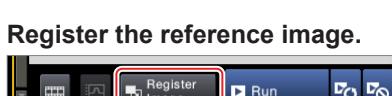


Flow of Settings

1 Add a tool.

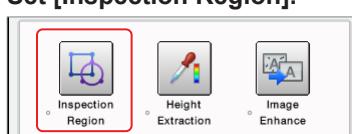


2 Select the measurement target image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

3 Register the reference image.



Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

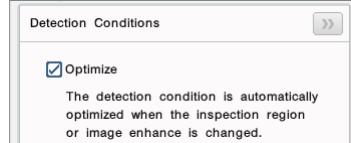
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



 "Height Extraction" (Page 5-5)

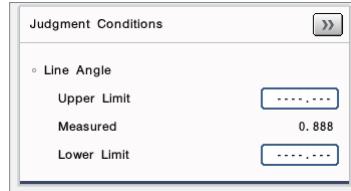
 "Pre-processing filter for contrast images" (Page A-58)

6 If the line is not detected, remove check from [Optimize] and adjust the set value.



For details on the setting values, see  "Detection Conditions (Profile Position)" (Page 5-72).

7 Set [Judgment Conditions].



Set tolerance (maximum and minimum) on measured values.

○ Line Angle

Specify the range of detection angle to be determined as OK with "Upper limit" and "Lower limit". The specifiable angular range is -180.000 ° to 180.000 °.

After settings are completed

The added tool is registered as [Reference] tool, and it can be used as a reference for the Position Correction of other tools.

For details on the position correction, see  "Position Correction Settings" (Page 3-34).

When Expected Measurement Results Cannot be Obtained

Statuses	Remedy
The desired line is not detected.	Remove the check from [Optimize] and set the Scan Direction and edge direction.
Instead of the desired edge, a dark edge in the measurement region is detected erroneously.	Reduce edge sensitivity while viewing the edge sensitivity graph.

The desired line is not detected.

→ Remove the check from [Optimize] and set the Scan Direction and edge direction.

4 Set [Inspection Region].



Position Adjustment at Center of Circle

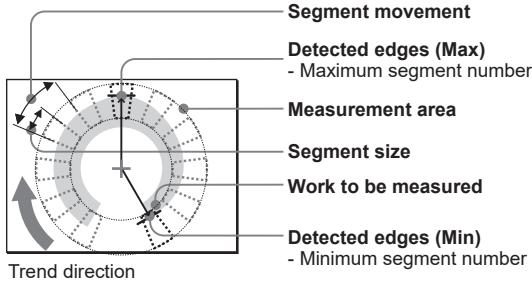
What is [Position Adjustment at Center of Circle] Measurement?

Edges are detected at multiple points in the measurement area, and a circle is determined from the edge information of the detected multiple points. This tool is applied as a position correction reference for another tool (target) where the position adjustment is performed according to the deviation from the center position of the detected circle.

For details on the advanced settings (settings displayed with ) see the reference tool  "Profile Position" (Page 5-71).

Measurement Image

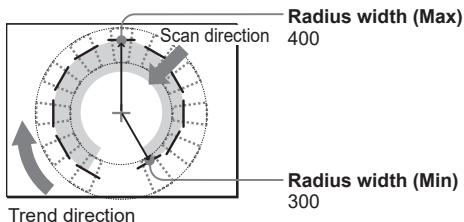
When the measurement region is a ring/arc
When the trend direction is clockwise



Measurement sample

When the measurement region is a ring/arc
When Measured With the Following Conditions:

- Trend direction: Clockwise
- Scan Direction: Perimeter → Center
- Edge Direction: Both



Flow of Settings

1 Add a tool.



2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

4 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

5 Set [Height Extraction] and [Image Enhance].

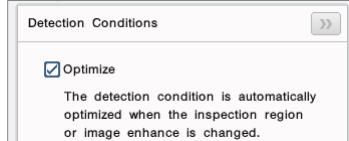
When the measurement target is a grayscale image, [Height Extraction] is unnecessary.



 "Height Extraction" (Page 5-5)

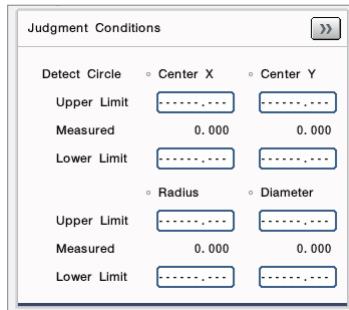
 "Pre-processing filter for contrast images" (Page A-58)

6 If the circle is not detected, remove the check from [Optimize] and adjust the set values.



For details on the setting values, see  "Detection Conditions (Profile Position)" (Page 5-72).

7 Set [Judgment Conditions].



Set tolerance (maximum and minimum) on measured values.

Detection Circle Center

Specify the range of the center of detected circle (X/Y) to be judged as OK with "Upper limit" and "Lower limit".

Detected Circle Radius/Diameter

Specify the range of the diameter/radius of the detected circle to be judged as OK with "Upper limit" and "Lower limit".

After settings are completed

The added tool is registered as [Reference] tool, and it can be used as a reference for the Position Correction of other tools.

For details on the position correction, see  "Position Correction Settings" (Page 3-34).

When Expected Measurement Results Cannot be Obtained

Statuses	Remedy
The desired circle is not detected.	Remove the check from [Optimize] and set the Scan Direction and edge direction.
Instead of the desired edge, a dark edge in the measurement region is detected erroneously.	Reduce edge sensitivity while viewing the edge sensitivity graph.

Position Adjustment with Gravity Center of Cluster

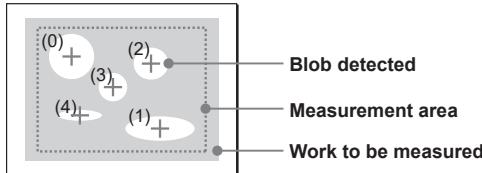
What is [Position Adjustment with Gravity Center of Cluster] Measurement?

Detects a block of extracted color and outputs its center of gravity position. This tool is applied as a position correction reference for another tool (target) where position adjustment is performed according to the positional gap from the detected cluster's gravity center.

For details on the advanced settings (settings displayed with ) , see the reference tool  "Blob" (Page 5-66).

Measurement Image

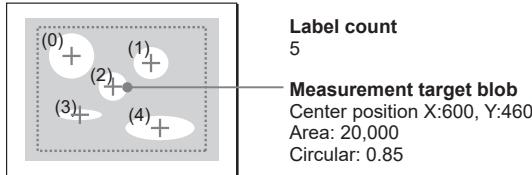
Assigns label numbers to blobs starting with the one with the largest area, and uses these for measurement/detection.



Measurement sample

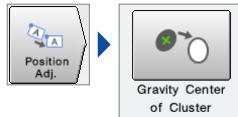
When Measured With the Following Conditions:

- Detection Order: Y > X Ascend
- Label Selection: 2



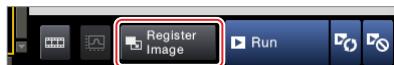
Flow of Settings

1 Add a tool.



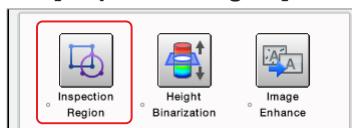
2 Select the measurement target image.

3 Register the reference image.



If there is no reference image, register the reference image.
 "Register the standard image" (Page 3-15)

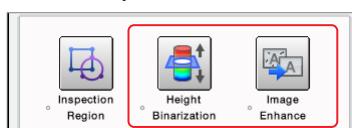
4 Set [Inspection Region].



Lay out measurement region to surround the desired measurement area.
 "Edit the measurement area" (Page 3-20)

5 Set [Height Binarization] and [Image Enhance].

When the measurement target is a grayscale image, [Height Binarization] is unnecessary.



 "Height Extraction" (Page 5-5)
 "Pre-processing filter for contrast images" (Page A-58)

6 Set the conditions for binary conversion.

7 Set [Detection Conditions].



Detection Color

For images converted to binary, select whether to measure the [White] or [Black] area.

Lower Area Filter

Blobs smaller than the specified lower limit will not be detected. Increase the value to count unwanted noise components.

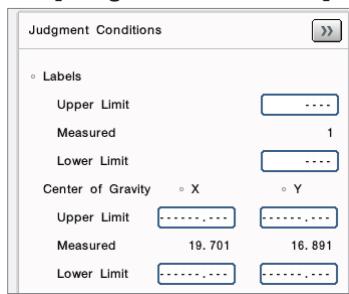
Fill Holes

Fill the inside of the blob with the detection color. When this option is turned on, the inside of the blob is filled and then the area and positional coordinates are calculated.

Active Border

Excludes blobs on the border of the measurement area from measurement. Setting to ON removes the background from the inspection region.

8 Set [Judgment Conditions].



Set tolerance (maximum and minimum) on measured values.

- In the [Labels] field, Specify the range of the number of labels judged to be OK with "Upper limit" and "Lower limit".
- In the [Center of Gravity] field, Specify the range of the barycentric position (X/Y) to be judged as OK with "Upper limit" and "Lower limit".

After settings are completed

The added tool is registered as [Reference] tool, and it can be used as a reference for the Position Correction of other tools.

For details on the position correction, see  "Position Correction Settings" (Page 3-34).

When Expected Measurement Results Cannot be Obtained

Statuses	Remedy
The blue point is not the detection target.	Select black under detection color.
31 or more blobs cannot be detected.	Increase [Detection Count] to the number required.
A small target cannot be located.	Reduce [Lower Area Filter].
Detect a target with the same area filter for which the center is not extracted.	Check the [Fill Holes] box.
I do not want to detect a target that goes over the measurement region.	Check the [Active Border] box.
To locate only round targets	Set the roundness filter.
To locate only long and thin targets	Set the aspect ratio filter.
Judge based on the number of targets	Set the upper/lower limits of labels for the judgment condition.

Chapter 6 Execute Condition/Output Settings

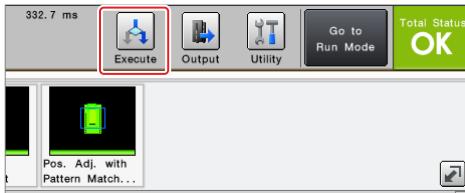
Execute Condition.....	6-2
Overview of Output Settings	6-4

Execute Condition

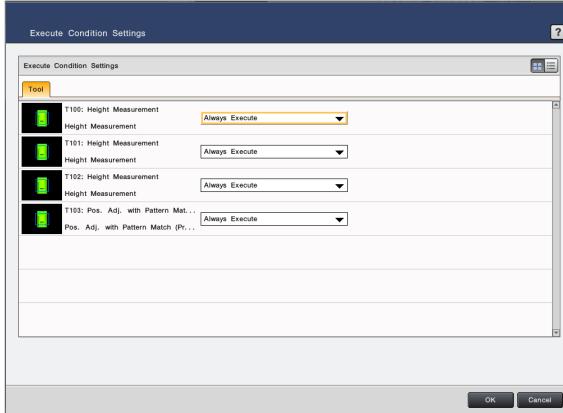
On the [Execute Condition Settings] screen, execution/non-execution of each tool can be changed. It is useful for switching inspection process of an individual program.

Displaying [Execute Condition Settings] Screen

1 Click [Execute] in Setup mode.



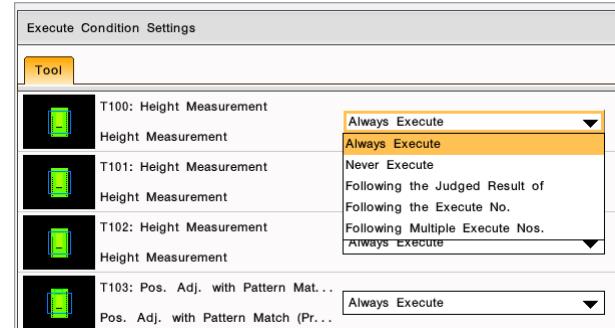
The [Execute Condition Settings] screen appears.



Setting execute conditions (Execute Condition Settings)

Execution/non-execution of each tool can be changed. It is useful for switching inspection process of an individual program.

1 Set execute conditions are for each tool.



● Always Execute

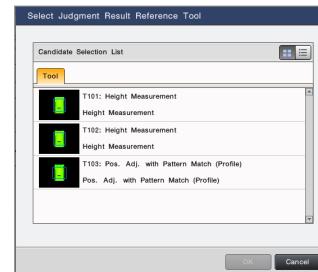
Always applies the inspection tool.

● Never Execute

Never applies the inspection tool. This is used to make non-execution temporarily in order to confirm the operation of other tools.

● Following the Judged Result of

Changes between execution and non-execution depending on the OK/NG result of other tools. After selecting this, click the empty field to the right and specify the target tool on the [Select Judgment Result Reference Tool] screen.



● Following the Execute No.

Only when the set Execute No. matches the [Currently Valid Execute No.] will the target tool be executed.

● Following Multiple Execute Nos.

Multiple Execute Nos. can be specified for executing the target tool. Click the Specify Execute No. field on the right of the execute condition and check the box of the execute number of the tool condition to be executed on the [Select Execute Nos.] screen.

● Do not execute the tool when its condition reference tool is not executed

If this option is checked, the execution target tool will not be executed if its condition reference tool is not executed in cases where: (1) the execution target tool is referencing the judgment result of another tool or (2) the execution target tool is referencing a tool whose execution/non-execution is based on the judgment result of another tool.

2 After completing the setting, click [OK].

Changing the Execute No.

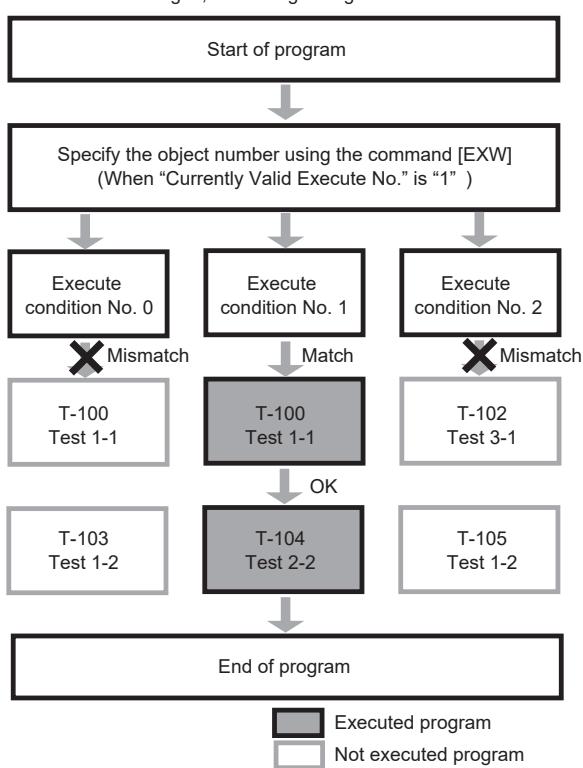
If [Following the Execute No.] or [Following Multiple Execute Nos.] is selected, the [Currently Valid Execute No.] field is displayed in the lower part of the [Execute Condition Settings] screen. When the execute No. is set here, only the tool where the execute No. is set performs measurement.

The [Currently Valid Execute No.] can be rewritten externally by using the EXW command (page XX-XX).

Main application of execute conditions (Example)

External instruction to change the type is given to change the inspection immediately (as per Execute No.).

During inspection, when the [Currently Valid Execute No.] is changed to the number of the next object type with the EXW command, execution/non-execution is changed for the arrival of the object. Since only execute conditions are changed, the setting change time can be reduced.



Overview of Output Settings

The judgment result or measured values of the unit can be output from the parallel I/O connector of the unit or an Ethernet or other communication port. Images can be output to an SD card or USB HDD.

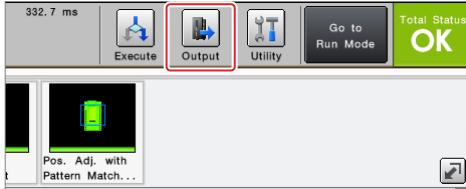
Item	Description	Ref.
Judgment Settings	Set [Total Status] and [Partial Judgment].	6-5
OR Terminal	Set the output method for when the total status value is output from the OR terminal.	6-5
OUT Terminal	Set the output item for I/O output of "Total Status values", "Tool Judgment values", "In-Tool Judgment values", "Partial Judgment values" and "Group Judgment values".	6-6
RS-232C (Non-Procedural)	Set the items for output of results with RS-232C non-procedural communications.	6-7
Ethernet (Non-Procedural)	Set the items for output of results with non-procedural communications from an Ethernet interface.	6-8
SD card 2	Set the items for output of results to the SD card inserted in the SD2 slot.	6-9
USB HDD	Set the items for output of results to the USB HDD connected to the controller.	6-10
PC Program	Set the items for output of results to a PC application (LJ-H1X) from an Ethernet interface.	6-11
PLC-Link	Set the items for output of results with PLC-Link (RS-232C) or PLC-Link (Ethernet).	6-12
EtherNet/IP	Set the items for output of results with EtherNet/IP.	6-13
EtherNet/IP Unit	Set the items for output of results with EtherNet/IP unit.	6-13
PROFINET	Set the items for output of results with PROFINET.	6-14
PROFINET Unit	Set the items for output of results with PROFINET unit.	6-14
EtherCAT Unit	Set the items for output of results with EtherCAT unit.	6-16
FTP	Set the items for output of results to the FTP server.	6-18
Image Output	Change the settings for output of the image used for measurement via the Ethernet interface to an external device or for saving it on SD card 2 or USB HDD.	6-19



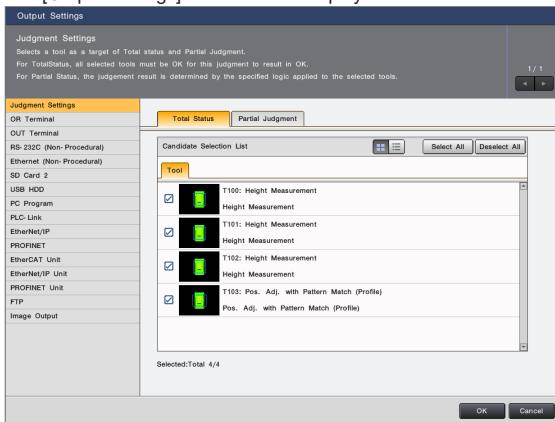
- Data can be output only in Run mode.
- The SD card 1 cannot be specified as the data output destination.

Displaying [Output Settings] Screen

1 Click [Output] in Setup mode.



The [Output Settings] screen will be displayed.



Judgment Settings

Selects the tool as a target of the total status and partial judgment.

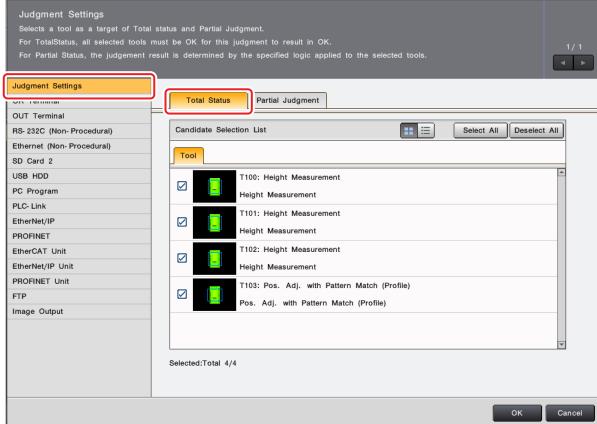
Total Status

The value of the logical add (OR) for the tool judgment.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [Judgment Settings] > [Total Status].



3 Specify the tool as a target of total status.

4 After completing the setting, click [OK].

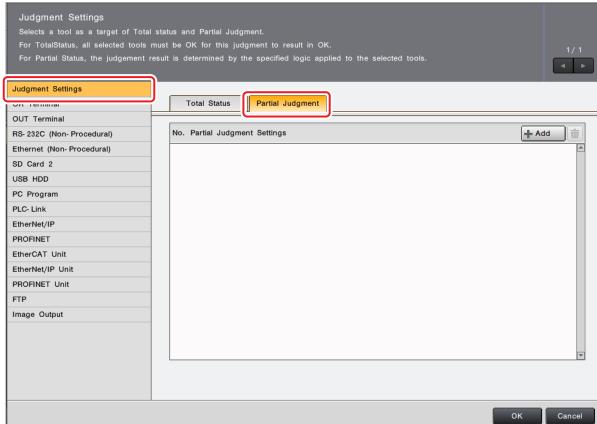
Partial Judgment

The value of the logical add (OR) or logical multiply (AND) of the judged value for the selected tool or judged group.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [Judgment Settings], and then select the [Partial Judgment] tab.



3 Click [Add].

The partial judgment group is added.

4 Click [Judgment Settings] and specify the tool for judgment and the partial judgment.

5 Select [Condition Logic].

● OR

If there is even one NG in the items specified in [Judgment Settings], judges as NG.

● AND

Only when all items specified in [Judgment Settings] are NG, judges as NG.

6 After completing the setting, click [OK].

OR Terminal

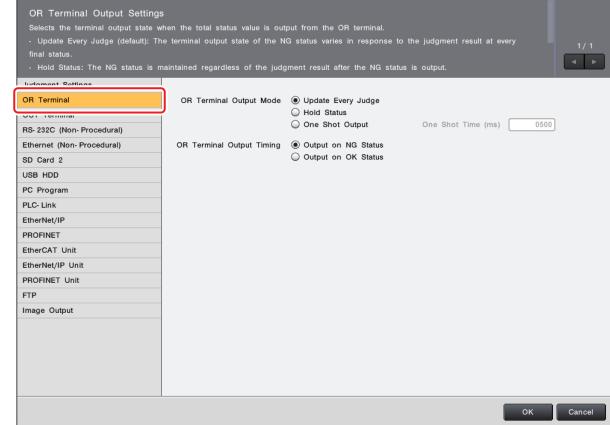
This unit's OR terminal's output method can be changed.

Reference For more information about the output from the OR terminal, refer to □ "Terminal Block Interface" (Page 9-44).

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [OR Terminal].



3 Set [OR Terminal Output Mode].

● Update Every Judge

Outputs for each total status in synchronization with STO.
The timing of STO can be set via □ "External Terminal" (Page 8-2).

● Hold Status

Once NG judgment is output, NG status is held regardless of subsequent judgment results. To cancel this, it is necessary to reset the unit (it is canceled also when moving from Run mode to Setup mode).

● One Shot Output

If an NG occurs, the OR terminal is ON only for the duration set in [One Shot Time] and it is then OFF.

4 Set [OR Terminal Output Timing].

● Output on NG Status

Outputs when judged as NG.

● Output on OK Status

Outputs when judged as OK.

5 After completing the setting, click [OK].

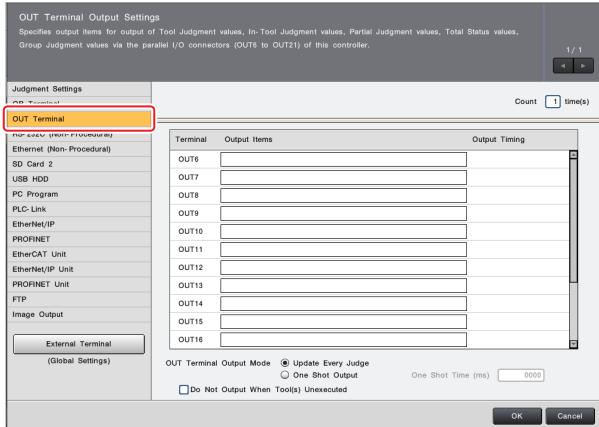
OUT Terminal

Sets the output items of "Total Judgment values", "Tool Judgment values", "In-Tool Judgment values", "Partial Judgment values" and "Group Judgment values" which are output from the unit's parallel I/O interface.

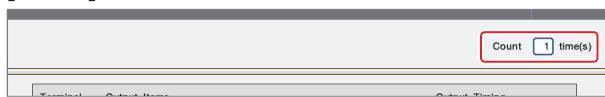
1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [OUT Terminal].



3 Specify the number of outputs from 1 to 8 in [Count].



Output Times tabs are displayed matching the specified number of outputs.

4 Set [OUT Terminal Output Mode].



● Update Every Judge

Outputs for each judgment in synchronization with STO.
The timing of STO can be set via □ "External Terminal" (Page 8-2).

● One Shot Output

If an NG occurs, the OUT terminal is ON only for the duration set in [One Shot Time] and it is then OFF.

Reference The "OUT Terminal Output Mode" setting is only enabled when Output Times is set to 1.

5 Select the Output Times tab to configure the required output items.

6 Click [Output Items] of the desired output terminal for change of allocation.

The [Output Item Settings] screen appears.

7 Select the output item.

If multiple judgments or tools are allocated in [Partial Judgment], [Tool Judgment] or [In-Tool Judgment], the logical addition (OR) for each judgment value is output.

● Tool Judgment

Outputs the desired tool judgment results.

● In-Tool Judgment

Output any tool inside judgment result.

● Partial Judgment

Outputs the desired partial judgment results.

● Total Status

Outputs the total status result.

● Group settings

● None

Output is not performed.

8 Select [Output Timing].

● On NG Status

Outputs when the judgment result is NG.

● On OK Status

Outputs when the judgment result is OK.

9 Check [Do Not Output When Tool(s) Unexecuted] if output is not to be executed when the measurement specified in Step 4 is not executed.

When a check is placed, output is not done when a tool is skipped due to the execute condition or it is not executed due to settings errors. Check this option if [On OK Status] was selected in Step 7 and the OUT terminal must not become ON when the specified measurement is not executed.

10 After completing the setting, click [OK].

RS-232C (Non-Procedural)

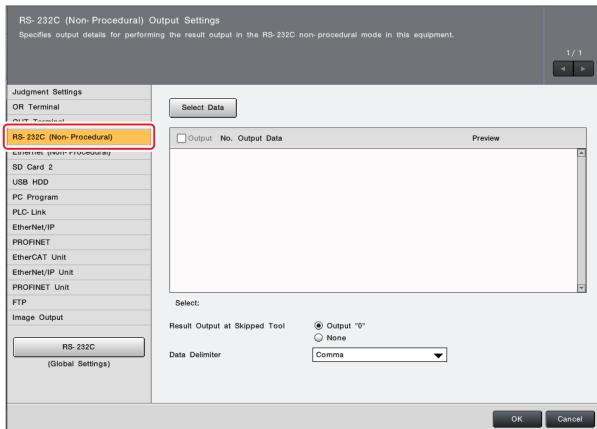
Output details such as measured value, judgment result, number of measurement, etc. are specified for output in RS-232C non-procedural communication of this unit. The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [RS-232C (Non-Procedural)].

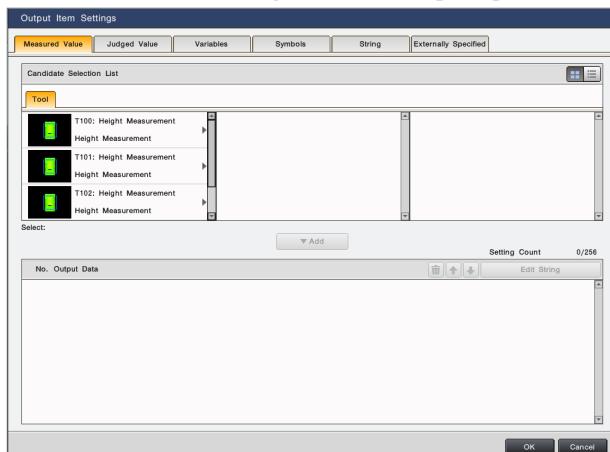


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

Symbols

Click the [Symbols] tab and select the item for output.

String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.

- If a delimiter is required, add the string item for output of the delimiter.

Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 To change the output format, click the of the output item to be changed and change the setting on the [Output Format Settings] screen.

Check [Customize Format] and specify the number of output digits and the use or non-use of the plus sign and the zero suppression process. When [Batch Format Change] is checked, the same setting can be reflected to the other output items as well.

8 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

9 In [Data Delimiter], select the delimiter character to place between output data.

10 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stop output for each output item

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

Ethernet (Non-Procedural)

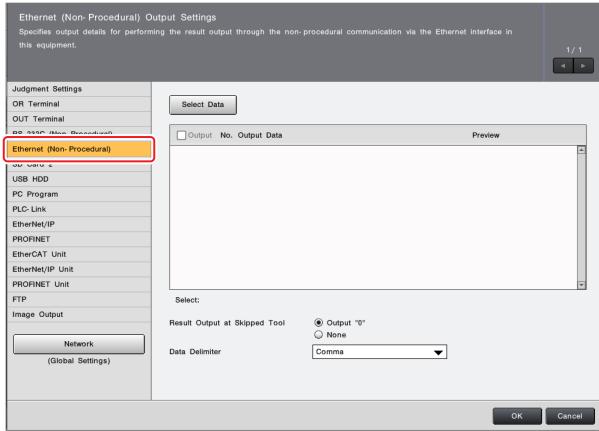
Output details such as measured value, judgment result, number of measurement, etc. are specified for output in Ethernet interface non-procedural communication of this unit. The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [Ethernet (Non-Procedural)].

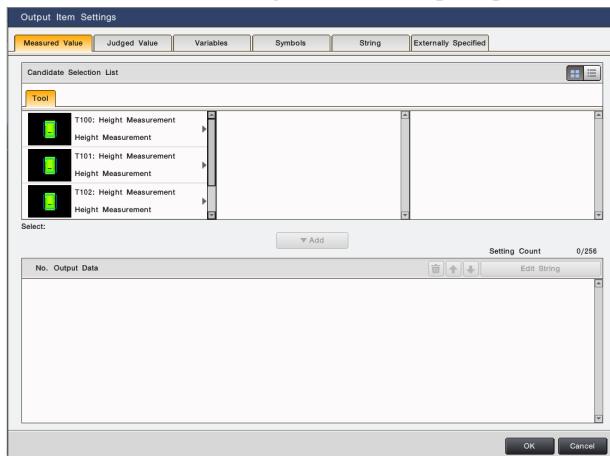


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time:

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

Symbols

Click the [Symbols] tab and select the item for output.

String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.
- If a delimiter is required, add the string item for output of the delimiter.

Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

If there are other desired items for output, repeat step 4.

After completing the setting, click [OK].

To change the output format, click the or of the output item to be changed and change the setting on the [Output Format Settings] screen.

Check [Customize Format] and specify the number of output digits and the use or non-use of the plus sign and the zero suppression process. When [Batch Format Change] is checked, the same setting can be reflected to the other output items as well.

In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

In [Data Delimiter], select the delimiter character to place between output data.

After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stop output for each output item

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

SD Card 2

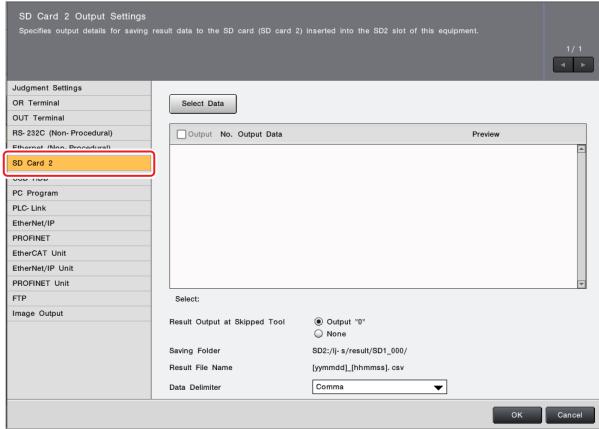
Output details such as measured value, judgment result, number of measurement, etc. are specified for saving on the SD card (SD card 2) inserted in the SD2 slot. The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [SD Card 2].

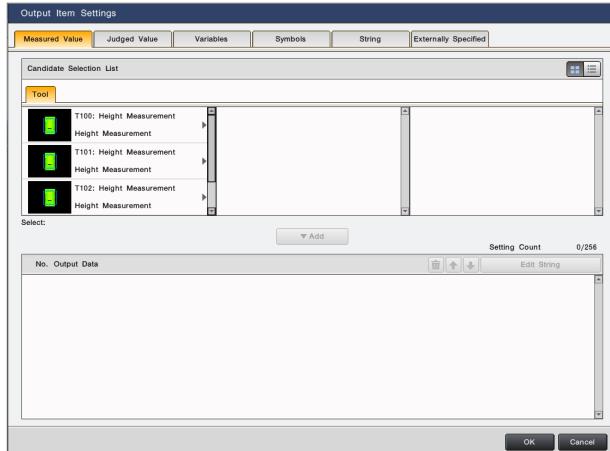


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

Symbols

Click the [Symbols] tab and select the item for output.

String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.
- If a delimiter is required, add the string item for output of the delimiter.

Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

If there are other desired items for output, repeat step 4.

After completing the setting, click [OK].

To change the output format, click the of the output item to be changed and change the setting on the [Output Format Settings] screen.

Check [Customize Format] and specify the number of output digits and the use or non-use of the plus sign and the zero suppression process. When [Batch Format Change] is checked, the same setting can be reflected to the other output items as well.

In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stop output for each output item

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

USB HDD

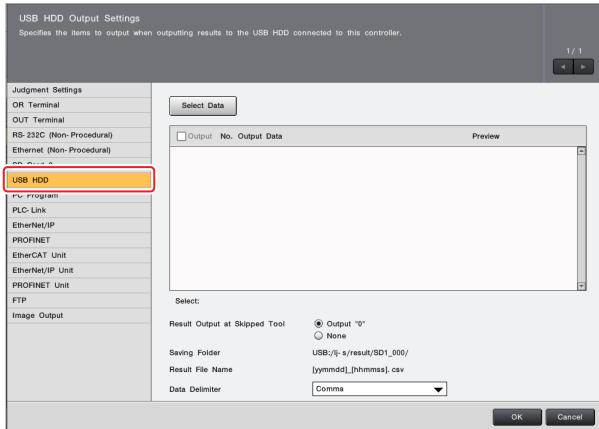
Output details such as measured value, judgment result, number of measurement, etc. are specified for saving on the USB HDD. The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [USB HDD].

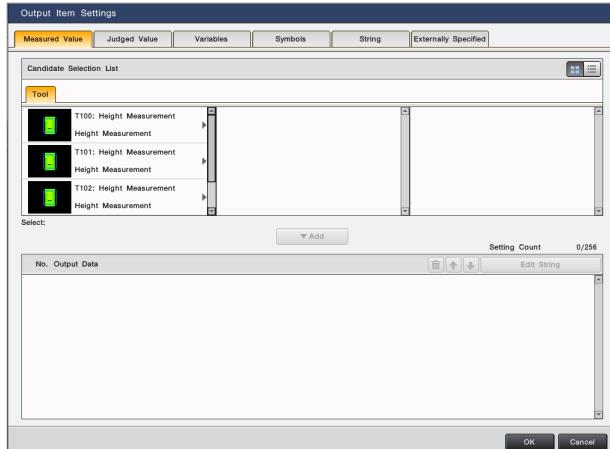


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

Symbols

Click the [Symbols] tab and select the item for output.

String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.

- If a delimiter is required, add the string item for output of the delimiter.

Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 To change the output format, click the □ of the output item to be changed and change the setting on the [Output Format Settings] screen.

Check [Customize Format] and specify the number of output digits and the use or non-use of the plus sign and the zero suppression process. When [Batch Format Change] is checked, the same setting can be reflected to the other output items as well.

8 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

9 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stop output for each output item

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

PC Program

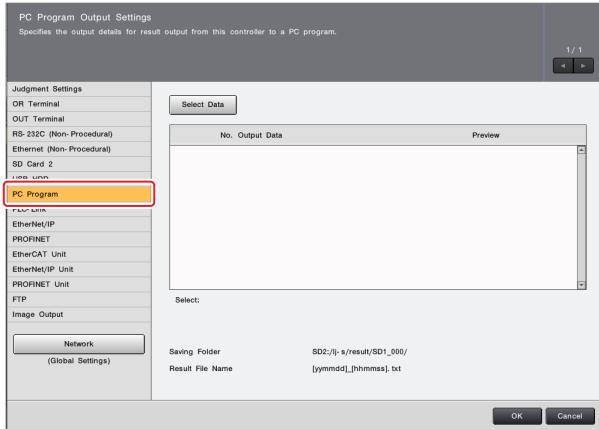
Output details such as measured value, judgment result, number of measurement, etc. are specified for output to the PC program (LJ-S Series Terminal-Software) from this unit's Ethernet interface. The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [PC Program].

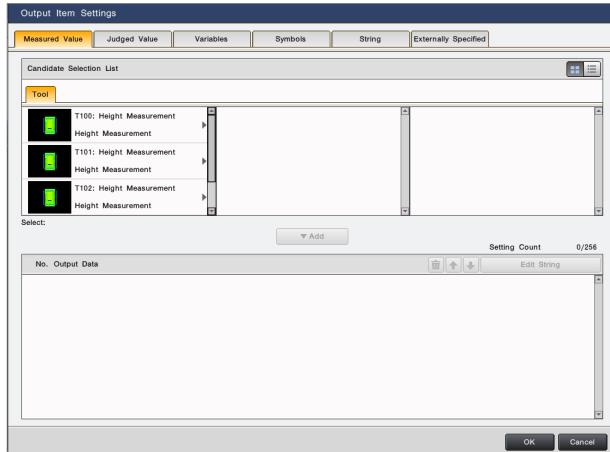


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

● Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

● Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

● Variables

Click the [Variables] tab and select the item for output.

○ Total count

Outputs the number of measurement in a 10-digit number.

○ OK Count

Outputs the OK count in a 10-digit number.

○ NG Count

Outputs the NG count in a 10-digit number.

○ Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

○ Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

○ Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

○ Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

○ Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

○ Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

○ Program No.

Outputs the current program No.

● Symbol

Click the [Symbols] tab and select the item for output.

● String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.
- If a delimiter is required, add the string item for output of the delimiter.

● Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

PLC-Link

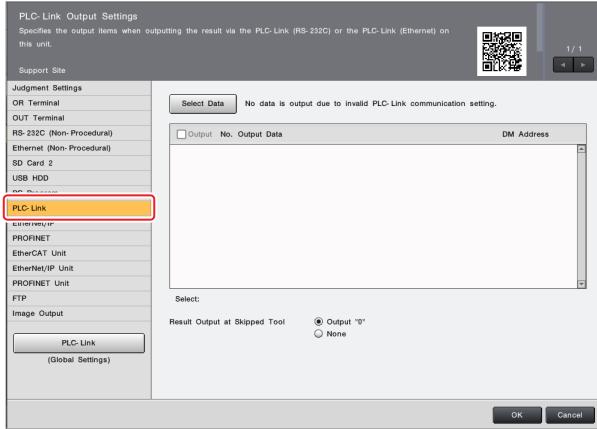
Output details such as measured value, judgment result, number of measurement, etc. are specified for output to PLC-Link (RS-232C) or PLC-Link (Ethernet). The data to be output and the output order can be specified in accordance with the environment of the system.

Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [PLC-Link].

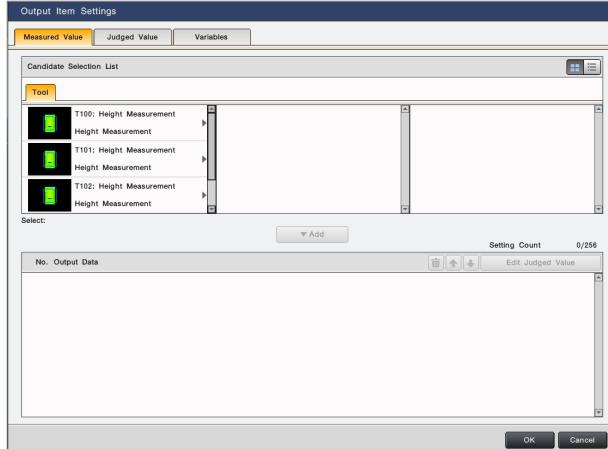


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

● Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

● Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

● Variables

Click the [Variables] tab and select the item for output.

○ Total count

Outputs the number of measurement in a 10-digit number.

○ OK Count

Outputs the OK count in a 10-digit number.

○ NG Count

Outputs the NG count in a 10-digit number.

○ Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

○ Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

○ Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

○ Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

○ Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

○ Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

○ Program No.

Outputs the current program No.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

● Output "0"

When the specified tool is not executed, output "0".

● None

Outputs nothing.

8 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stopping output

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

EtherNet/IP, EtherNet/IP Unit

Output details such as measured value, judgment result, measurement count, etc. are specified for output via EtherNet/IP communication from the Ethernet port or from a connected EtherNet/IP unit (CB-NEP20E: option). The data to be output and the output order can be specified in accordance with the environment of the system.

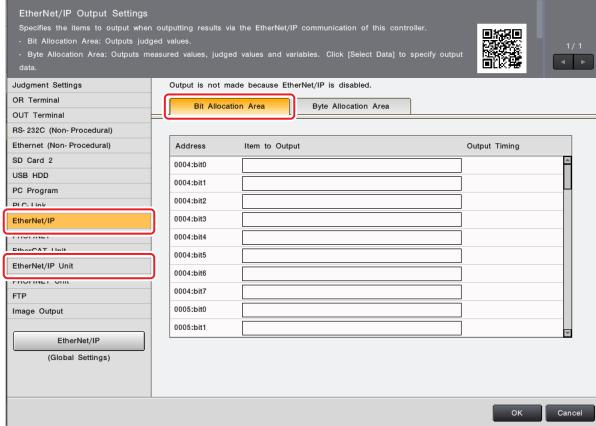
Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

Setting the bit allocation area output items

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [EtherNet/IP] or [EtherNet/IP Unit] > [Bit Allocation Area].



The default is set to no output of data.

3 Click the [Item to Output] field of the address for change of allocation.

The [Output Item Settings] screen appears.

4 Select the output item.

If multiple judgments or tools are allocated in [Partial Judgment] or [Tool Judgment], the logical addition (OR) for each judgment value is output.

Tool Judgment

Outputs the desired tool judgment results.

Partial Judgment

Outputs the desired results of □ "Partial Judgment" (Page 6-5).

Total Status

Outputs the total status result.

Group settings

None

Output is not performed.

5 Select [Output Timing].

On NG Status

Outputs when the judgment result is NG.

On OK Status

Outputs when the judgment result is OK.

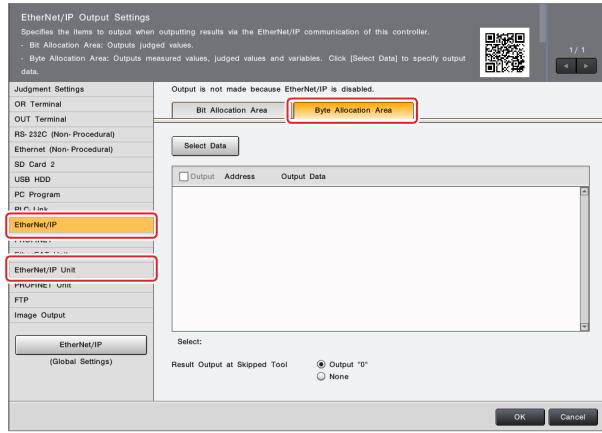
6 After completing the setting, click [OK].

Setting the byte allocation area output items

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [EtherNet/IP] or [EtherNet/IP Unit] > [Byte Allocation Area].

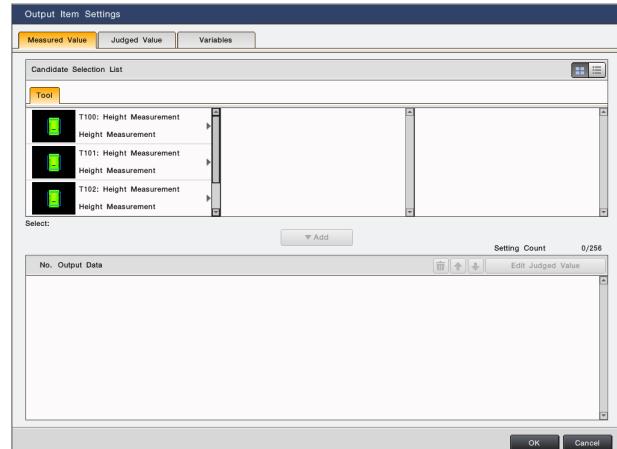


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

8 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stopping output

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

PROFINET, PROFINET Unit

Output details, such as measured value, judgment result, and measurement count, are specified for output via PROFINET communication from the controller's Ethernet port or from a connected PROFINET unit (CB-NEP20EA: option). Output details and output sequence can be specified according to the environment in which the system is used.

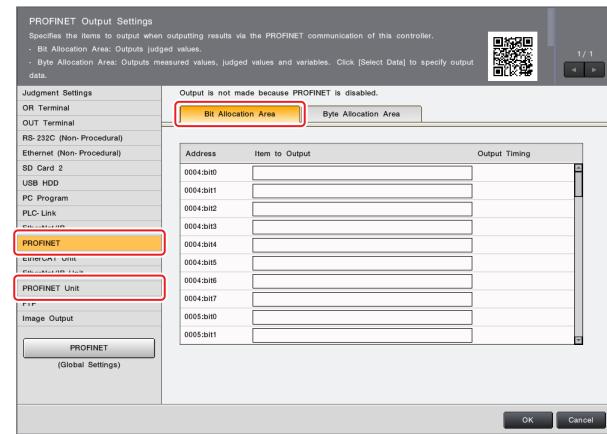
If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

Setting the bit allocation area output items

1 Displays [Output Setting] screen

"Displaying [Output Settings] Screen" (Page 6-4)

2 Select [PROFINET] or [PROFINET Unit] > [Bit Allocation Area].



The default is set to no output of data.

3 Click the [Item to Output] field of the address for change of allocation.

The [Output Item Settings] screen appears.

4 Select the output item.

If multiple judgments or tools are allocated in [Partial Judgment] or [Tool Judgment], the logical addition (OR) for each judgment value is output.

Tool Judgment

Outputs the desired tool judgment results.

Partial Judgment

Outputs the desired results of "Partial Judgment" (Page 6-5).

Total Status

Outputs the total status result.

Group settings

None

Output is not performed.

5 Select [Output Timing].

On NG Status

Outputs when the judgment result is NG.

On OK Status

Outputs when the judgment result is OK.

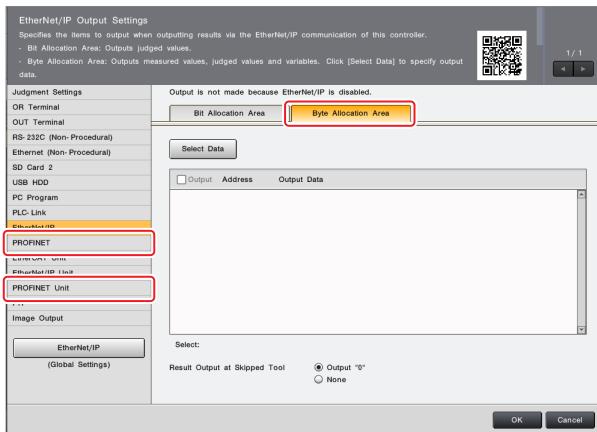
6 After completing the setting, click [OK].

Setting the byte allocation area output items

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [PROFINET] or [PROFINET Unit] > [Byte Allocation Area].

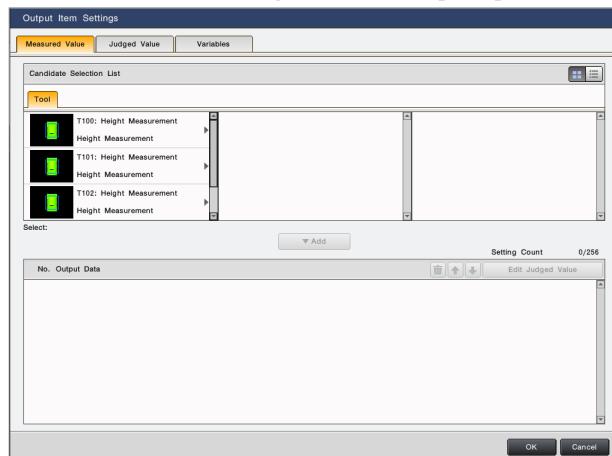


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

Program No.

Outputs the current program No.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

Output "0"

When the specified tool is not executed, output "0".

None

Outputs nothing.

8 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stopping output

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

EtherCAT Unit

Output details such as measured value, judgment result, measurement count, etc. are specified for output via EtherCAT communication from a connected EtherCAT unit (CB-NEC20E: option). The data to be output and the output order can be specified in accordance with the environment of the system.

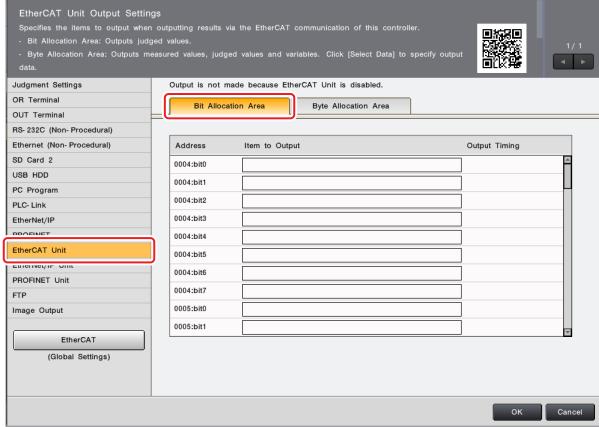
Reference If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.

Setting the bit allocation area output items

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [EtherCAT Unit] > [Bit Allocation Area].



The default is set to no output of data.

3 Click the [Item to Output] field of the address for change of allocation.

The [Output Item Settings] screen appears.

4 Select the output item.

If multiple judgments or tools are allocated in [Partial Judgment] or [Tool Judgment], the logical addition (OR) for each judgment value is output.

● Tool Judgment

Outputs the desired tool judgment results.

● Partial Judgment

Outputs the desired results of □ "Partial Judgment" (Page 6-5).

● Total Status

Outputs the total status result.

● Group settings

● None

Output is not performed.

5 Select [Output Timing].

● On NG Status

Outputs when the judgment result is NG.

● On OK Status

Outputs when the judgment result is OK.

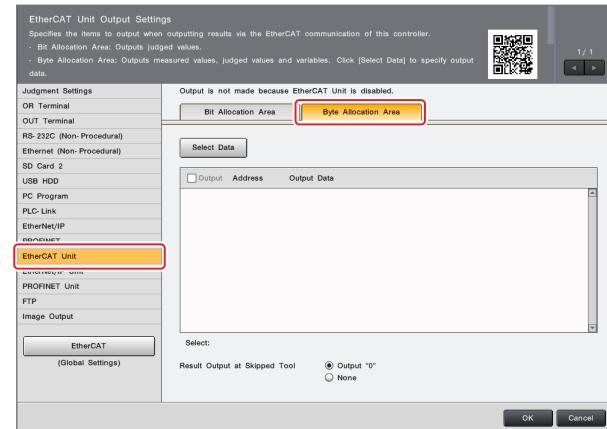
6 After completing the setting, click [OK].

Setting the byte allocation area output items

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [EtherCAT Unit] > [Byte Allocation Area].

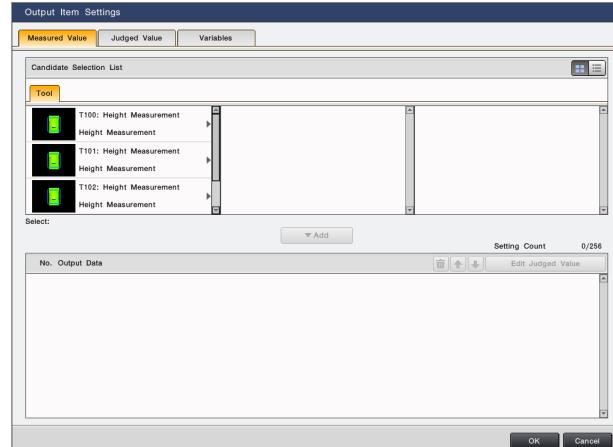


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

5 Select the item for output and click [Add].

Added items are shown on the list and items are output in the order from the top.

● Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

● Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

● Variables

Click the [Variables] tab and select the item for output.

○ Total count

Outputs the number of measurement in a 10-digit number.

○ OK Count

Outputs the OK count in a 10-digit number.

○ NG Count

Outputs the NG count in a 10-digit number.

○ Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

○ Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

○ Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

○ Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

○ Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

○ Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

○ Program No.

Outputs the current program No.

6 If there are other desired items for output, repeat step 4.

7 After completing the setting, click [OK].

8 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 5 is skipped by the execute condition (Page 6-2) or when no execution occurs due to a setting error.

● Output "0"

When the specified tool is executed, outputs "0".

● None

Nothing is output.

9 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stopping output

Uncheck the [Output] box in the output data display.

FTP

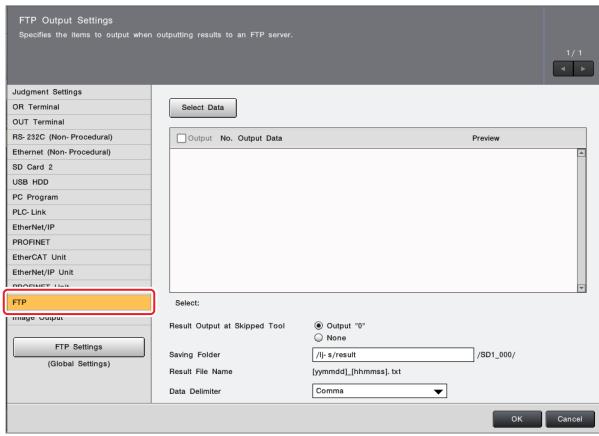
Output details such as measured value, judgment result, number of measurement, etc. are specified for output to the FTP server. The data to be output and the output order can be specified in accordance with the environment of the system.

- Reference** If an overflow occurs from the output buffer of the controller, output of some measurement data (measured value, judgment values, etc.) may be omitted.
- "FTP Client Settings (Master)" (Page 8-4) If SFTP is enabled in the FTP client settings, the SFTP icon will be displayed below the output items list. Only ASCII characters can be used for the output destination folder and file names with SFTP.

1 Displays [Output Setting] screen

□ "Displaying [Output Settings] Screen" (Page 6-4)

2 Select [FTP].

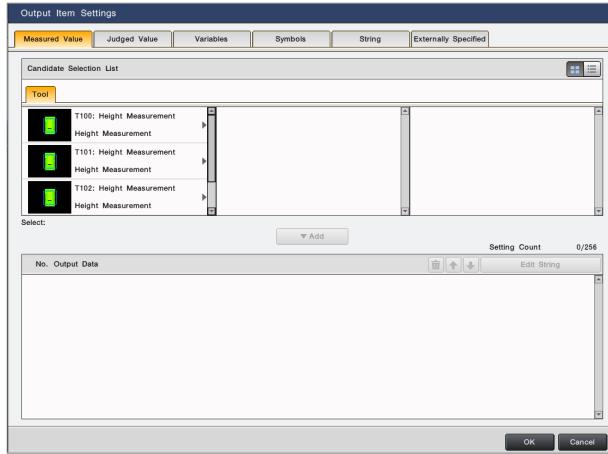


The default is set to no output of data.

3 Click [Select Data].

The [Output Item Settings] screen appears.

4 Select the item for output and click [Add].



Added items are shown on the list and items are output in the order from the top.

Measured value

Click the [Measured Value] tab, select the desired tool for output and the measured value, and click [Add].

Judged Value

Click the [Judged Value] tab and select the judgment value for output (0: OK, 1: NG).

Variables

Click the [Variables] tab and select the item for output.

Total count

Outputs the number of measurement in a 10-digit number.

OK Count

Outputs the OK count in a 10-digit number.

NG Count

Outputs the NG count in a 10-digit number.

○ Program Time

The measurement time is output in the form of integer 7 digits + decimal number 1 digit (Unit: ms).

○ Interval time

Outputs the trigger interval in 7 integers + 1 decimal digit (Unit: ms).

○ Date & Time

The measurement date and time is output for date and time in 2 digits for each (YYMMDDHHMMSS).

○ Scaling Coefficient

Outputs the scaling correction factor (X direction, Y direction, length direction).

○ Execute No.

Outputs the execute No. at the time of measurement in a 2-digit number.

○ Program SD card No.

Outputs the SD card No. (1, 2) where the current program is saved.

○ Program No.

Outputs the current program No.

● Symbols

Click the [Symbols] tab and select the item for output.

● String

Click the [String] tab, then click [Add] and input the desired string for output.

- A delimiter (,) is not output after the output of symbols and character strings.
- If a delimiter is required, add the string item for output of the delimiter.

● Externally Specified String

When [Externally Specified String 0] to [Externally Specified String 9] is specified, the string entered in the text box (up to 64 characters in terms of half-size characters) will be initially set. The externally specified string can be updated with the STW command from an external device.

5 If there are other desired items for output, repeat step 4.

6 After completing the setting, click [OK].

7 To change the output format, click the ▶▶ of the output item to be changed and change the setting on the [Output Format Settings] screen.

Check [Customize Format] and specify the number of output digits and the use or non-use of the plus sign and the zero suppression process. When [Batch Format Change] is checked, the same setting can be reflected to the other output items as well.

8 In [Result Output at Skipped Tool], select the action for when the measurement specified in Step 4 is skipped by the execute condition or when no execution occurs due to a setting error.

● Output "0"

When the specified tool is not executed, output "0".

● None

Outputs nothing.

9 In [Saving Folder], set the FTP server output destination folder.

10 After completing the setting, click [OK].

Changing the output sequence

After selecting the output item for change of sequence in the output data display, click or .

Deleting items canceling output

After selecting the output item for discontinuing output in the output data display, click .

Temporarily stopping output

Uncheck the boxes to the left of the output items to temporarily stop output for in the output data display.

Image Output

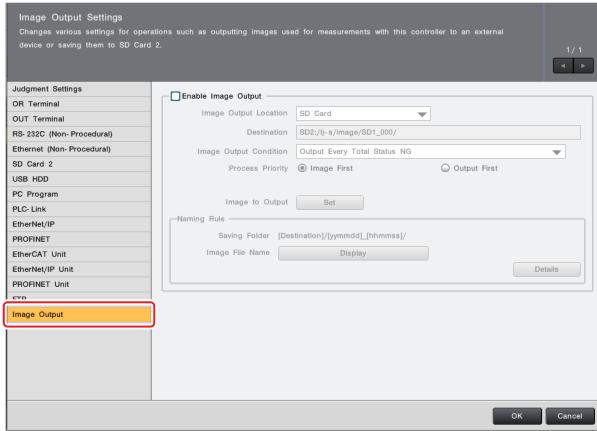
Change the settings for output of the image used for measurement via the Ethernet interface to an external device or for saving it on SD card 2, USB HDD, or FTP.

- Reference If a large number of files is present at the destination folder, it may take additional time to save.
If [FTP] is selected for the image output location and "SFTP" (Page 8-4) is enabled, only ASCII characters can be used for the folder and file names.

1 Displays [Output Setting] screen

"Displaying [Output Settings] Screen" (Page 6-4)

2 Select [Image Output].



3 To output an image, check [Enable Image Output] and change output settings.

● Image Output Location

Select the image output destination. When FTP is selected, specify the output destination folder as well.

● Image Output Condition

Select the image output timing.

● Process Priority

Select whether to prioritize image processing or output processing when the memory in the controller that is used for image output is full.

○ Image First

Since measurement processing is prioritized, there may be some omission in the image output.

○ Output First

Since image output is prioritized, image processing is resumed after image output is completed.

● Image to Output

Specify the type of image to output.

○ Height image

Only the height image will be output.

○ Grayscale

Only the grayscale image will be output.

○ Height Image/Grayscale Image

The height and grayscale images will be output.

● Naming Rule

Click [Details] to display the [Details] screen. The file saving folder and output file name settings for image output can be changed.

○ New Folder Rule

Specifies the method to split the folders for image output.

• None

Save all images in the designated folder without folder division.

• Date

Create a new folder "YYMMDD" for each output to the designated folder and save the image from that date in that folder. When the date changes, a new folder is created and the image saving location is changed.

• No. Images (initial configuration value)

Create a new folder "YYMMDD_HHMMSS" in the designated folder for each save and save the image from that date and time in that folder. When the number of files stored in the folder exceeds the specified value, a new folder is created and the destination of the image is changed accordingly.

● Automatically delete old folders (only during SD card output)

If this option is checked, it will be automatically deleted from old folders when it exceeds the specified upper limit of the number of folders held. Specify the upper limit of folders held using the "number of folders held" (initial value: 10).



If "automatically delete old filters (only during SD card output)" is checked, the output time is delayed when deleting a folder.

○ File Naming Rule

Selects the rule for naming image files.

• Auto (initial configuration value)

Names the file "[Date at time of image output]_HHMMSS_{Number of measurements}_IMG_{Total judgment}.{File format}"
(* Height image= HEIGHT, grayscale image = INTENSITY)
The file name will be as (example: 120601_092309_000000001_IMG_HEIGHT_OK.bmp).

• Sequential

Names the file "serial No._character string_IMG_Judgment.File format"
(* Height image= HEIGHT, grayscale image = INTENSITY)
The file name will be as (example: 001_output_IMG_HEIGHT_NG.bmp).
Specify the maximum sequential number in the [Sequence Limit] field.
If the maximum sequential number is exceeded, the sequence returns to 0. Therefore, older images may be overwritten when folder splitting is set to [None] or [Date], or when the number of images specified in [No. Images] is larger than the maximum sequential number.
Specify the [Fixed Name] field or the [Externally Specified String 0] to [Externally Specified String 9] fields for the [String].
When the [Fixed Name] is specified, the file name is set to the character string entered in the text box (max. 32-byte characters).
When [Externally Specified String 0] to [Externally Specified String 9] are specified, the file name is initially set to the character strings entered in the text boxes (max. 64-byte characters). The externally specified string can be updated with the STW command from an external device.

• Custom

Click [Edit File Name] to display the [Edit File Name] screen where [Measured Value], [Judged Value], [Variables], [Date & Time], [String], [Externally Specified String], and [Image-specific Information] can be used to edit the format of the output file name.

○ File Format

Select the image save format.

• BMP

Save files as bitmap files.

• BMP (1/2 Resolution)

Vertical and horizontal reduce the number of pixels to 1/2 in each direction and save it in a bitmap format.

• BMP (1/4 Resolution)

Vertical and horizontal reduce the number of pixels to 1/4 in each direction and save it in a bitmap format.

• BMP (1/8 Resolution)

Vertical and horizontal reduce the number of pixels to 1/8 in each direction and save it in a bitmap format.

• JPG

Saves the images in JPEG format.

• PNG (initial configuration value)

Saves the images in PNG format.



Images are compressed with the [JPEG] and [PNG] formats, so output may take longer compared to the BMP format.

For JPEG format images, the measurement results may differ from those of images registered with the BMP or PNG format due to image degradation attributable to compression.

Due to image degradation attributable to compression, correct height data cannot be obtained if a [JPEG] format height image is specified (this degradation does not happen with the [PNG] format because its compression is lossless). Use the [BMP] or [PNG] save format with height images.



When [No. Images] is selected in [New Folder Rule], the output folder is created at the time of the first image output after:

- The controller is turned on.
- The controller is reset.
- When programs are changed
- When image output settings are changed
- When settings to clear the archived image are changed
- When changed with the OW command

4 After completing the setting, click [OK].

Chapter 7 Utility

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Overview of Utility

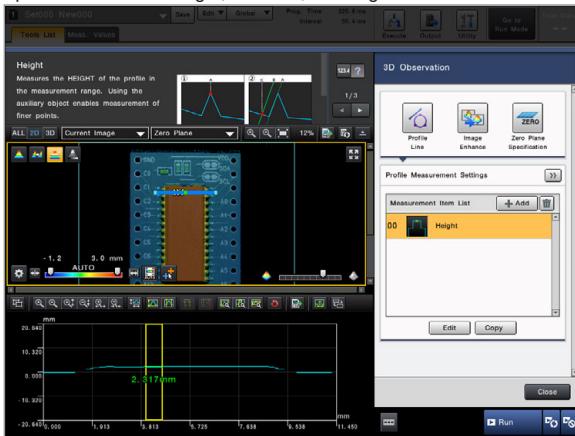
Click [Utility] on the menu bar to display the [Utility] screen.



	<p>This function supports the confirmation of the 3D-shape of the object to be observed using the height image. "3D Observation" (Page 7-3)</p>		<p>Check the communication status of PROFINET. The communication status of data that is input/output by PROFINET of the controller can be checked during run mode and setup mode. When [Enable PROFINET] is checked in [Global] → [Communications & I/O] → [PROFINET], it is displayed in the utility. "PROFINET Memory Monitor" (Page 7-17)</p>
	<p>Adjust according to the navigation. It can eliminate over-detection and improve yield rate. "Adjustment Navigation" (Page 7-4)</p>		<p>Check the communication status of EtherCAT. The communication status of data that is input/output by EtherCAT of the controller can be checked during run mode and setup mode. When [Enable EtherCAT] is checked in [Global] → [Communications & I/O] → [EtherCAT], it is displayed in the utility. "EtherCAT Memory Monitor" (Page 7-18)</p>
	<p>Share judgment conditions between tools. Can share decision criteria by creating groups. "Share Judgment Condition" (Page 7-6)</p>		<p>Can calculate the image processing results on a pixel-by-pixel basis. It is possible to handle measured values calculated to actual values via the screen display, judgment, calculation, external input/output, etc. "Scaling Correction" (Page 7-19)</p>
	<p>Can check the display of the timing chart format. By verifying the collected trace logs, the points where the timing of external control and measurement execution can be efficiently identified as out of sync. "Trace Logs" (Page 7-7)</p>		<p>Analyzes the operation result. All measurement results during operation are recorded in the memory of the controller. The statistical results can be checked/saved during operation in Run and Setup modes. "Statistics" (Page 7-25)</p>
	<p>Check the connection status of input/output signals. The connection status of signals input and output via the I/O connector (parallel I/O interface and terminal block interface) of this machine can be checked during run mode and setup mode. "I/O Monitor" (Page 7-13)</p>		<p>The measurement result can be verified through editing the settings of the tool together with the archived image. All of the archived images saved in main unit's memory can be tested with the current program settings, and then the tools adjusted based on the results. "Batch Test" (Page 7-28)</p>
	<p>Check communication status of RS-232C (non-procedural communication). The communication status of signals input and output via the RS-232C connector of the controller can be checked during Run mode and setup mode. "RS-232C Monitor" (Page 7-13)</p>		<p>Change the save settings of archived images. The captured image during operation can be saved in the image buffer memory of the controller and read out later. You can also re-measure with the read image and check the measurement value. "Archived Image Settings" (Page 7-28)</p>
	<p>Check the communication status of Ethernet (non-procedural communication). The communication status of signals input and output via the Ethernet connector of the controller can be checked during Run mode and setup mode. "Ethernet Monitor" (Page 7-14)</p>		<p>Configure the image strip settings. In addition to the images (archived images) recorded in the controller, the images saved in the SD card or USB HDD or FTP server can be displayed on the image strip to specify them for re-test. "Image Strip Settings" (Page 7-29)</p>
	<p>Check the communication status of PLC-Link. The communication status of data that is input/output by PLC-Link communications can be checked during run mode and setup mode. When the communication mode is set to [PLC-Link] in [Global] → [Communications & I/O] → [PLC-Link], it is displayed in the utility. "PLC-Link Memory Monitor" (Page 7-15)</p>		<p>Protect settings from a third party. To protect tool settings from a third party, viewing and editing of tool settings can be locked. To prevent diversion of inspection settings, the controller that can use the inspection settings can be limited. "Security Settings" (Page 7-30)</p>
	<p>Check the communication status of EtherNet/IP. The communication status of data that is input/output by EtherNet/IP of the controller can be checked during run mode and setup mode. When [Enable EtherNet/IP] is checked in [Global] → [Communications & I/O] → [EtherNet/IP], it is displayed in the utility. "EtherNet/IP Memory Monitor" (Page 7-16)</p>		<p>Manages the files in the SD card and USB HDD. From the [Manage Files] screen, the files saved in the SD card and USB HDD can be managed, and the SD card and USB HDD can be verified/formatted. "Manage Files" (Page 7-32)</p>
	<p>Do the removal process for the SD card 2 and USB HDD. "Remove External Media" (Page 7-35)</p>		<p>Manuals and references are published on the internet. A QR code is provided to easily access each web site. "Support Site" (Page 7-36)</p>

3D Observation

Select [3D Observation] from the utility to display the profile of the position of the measurement line specified on the image or specify the measurement range on the profile to measure height, distance, and angle.



Applying filter in the image (preprocessing)

Filters can be applied in the image.

"Height measurement filters (preprocessing)" (Page 5-10)

Specify the zero plane (zero plane specification)

Any surface that is different from the reference plane can be set as the basis for a 3D measurement.

"Specifying the Measurement Reference Plane (Zero Plane Specification)" (Page 5-9)

Measuring height, distance, and angle by specifying a profile line (profile line)

Specify a profile line on the image. Measures the height, distance, and angle of the profile line relative to the profile at which the profile line is located.

1 In the [3D Observation] screen, select [Profile Line].



2 Select the profile line specification method.

● Profile Line

Specify 2 Points.

Specifies a start and end point in the image, and takes a profile line.

Horizontal Line

Draw a straight profile line in the X direction on the image.

Vertical Line

Draw a straight profile line in the Y direction on the image.

Circle

Draw a profile line in a circumferential direction on the image.

● Profile Width

Specify a profile line width. For example, if 3 is specified, an average profile from 3 measurement lines is obtained.

● Profile Calculation Method

Select the profile calculation method to be used.

Average Value

The profile line is the average of the profiles obtained from multiple measurement lines.

Maximum Value

The profile line is maximum profile that can be obtained from multiple measurement lines.

Minimum Value

The profile line is minimum profile that can be obtained from multiple measurement lines.

● Profile Shape Correction

Rotation + Projection

Even if the zero plane tilts in the direction of the cross section or perpendicular to it, there will be no shape distortion. Profile is rotated within the cross section, then a vertical cross section is projected onto the zero plane.

Rotation Only

Even if the zero plane tilts in the direction of the cross section, there will be no shape distortion. Profile is rotated within the cross section based on its tilt. Used for measurement with a cross section parallel to the Z-axis.

None

The zero plane's height is subtracted to calculate the profile. If the zero plane tilts, there will be shape distortion.

● Valid Pixel Border Processing

Select how to process the profile at the boundary between valid and invalid pixels. Affects only the edge and inflection point measurements.

Extend Upward

Connect the upper limit and valid pixels.

Extend Downward

Connect the lower limit and valid pixels.

None

Do not connect the profile in the border area. This will mean that edges and inflection points are not detected.

3 Click [OK].

4 Click the [Add] of the [Measured Item List].

The [Profile Measurement Type] screen appears.

5 Select a profile measurement type to add and then select [Add].

"Profile measurement tool/Continuous profile measurement tool" (Page 5-3)

6 Specify details for each measurement type and then click [Complete].

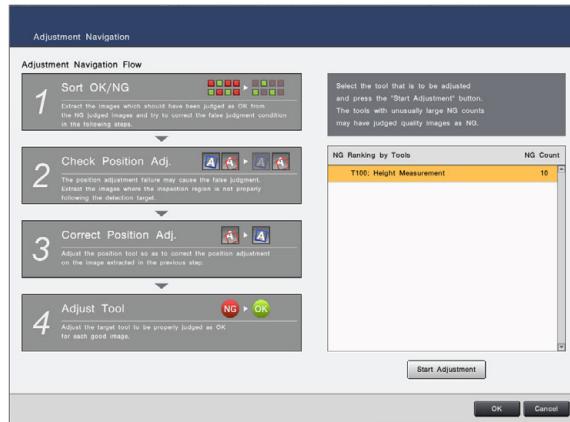
Adjustment Navigation

By using a archived NG image, the setting of a tool that would incorrectly judge the good part as NG can be adjusted.

- 1** Leave a history of NG images in Run mode.
- 2** Click [Utility] > [Tool Adjustment Navigation].



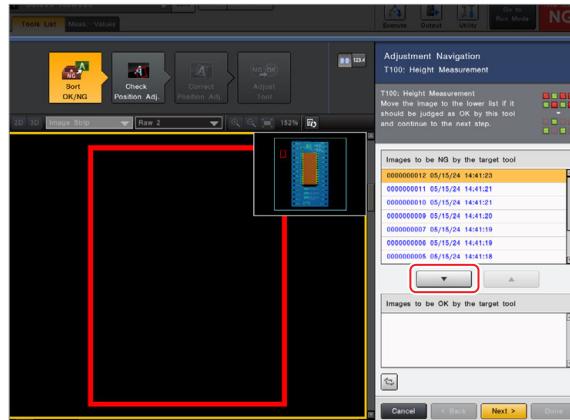
The analysis is performed for the archived image, and the tool that was NG is displayed in the [NG Ranking by Tools] column on the right side of the screen.



- 3** Select the tool to be adjusted, and then click [Start Adjustment].

The [Sort OK/NG] screen is displayed, and the image that is judged to be NG with the selected tool is displayed in the [Image to be NG by the Target Tool] column.

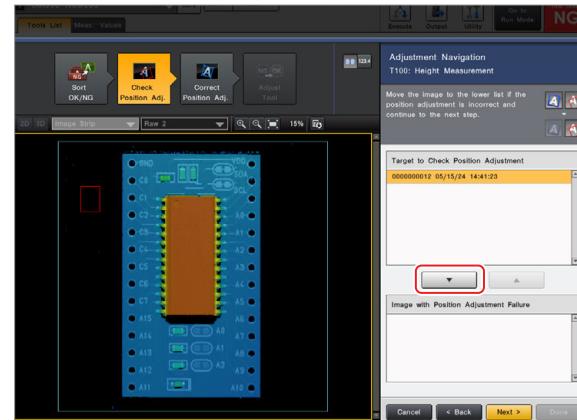
- 4** In the [Image to be NG by the Target Tool] column, select the image that should be OK, and then click [▼] to move to the [Image to be OK by the target tool] column.



- 5** Click [Next].

The [Check Position Adj.] screen is displayed, and the image selected in Step 4 is displayed in the [Target to Check Position Adjustment] column. For tools that do not have Position Correction setup, go to step 11.

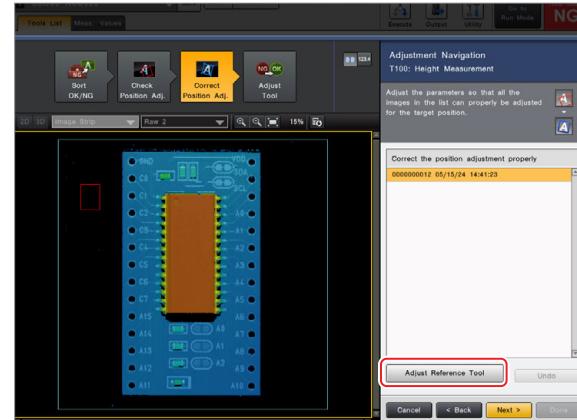
- 6** In the [Target to Check Position Adjustment], select an image that has not been corrected, and then click [▼] to move to the [Image with Position Adjustment Failure] column.



- 7** Click [Next].

The [Position Correction] screen is displayed, and the image selected in Step 6 is displayed in the [Correct Position Adj.] column.

- 8** Select the image that needs to be adjusted for misalignment correction, and then click [Adjust Reference Tool].



The Position Correction source tool correction screen appears.

- When more than one Position Correction source tool exists

The [Select Tool for Position] screen appears.

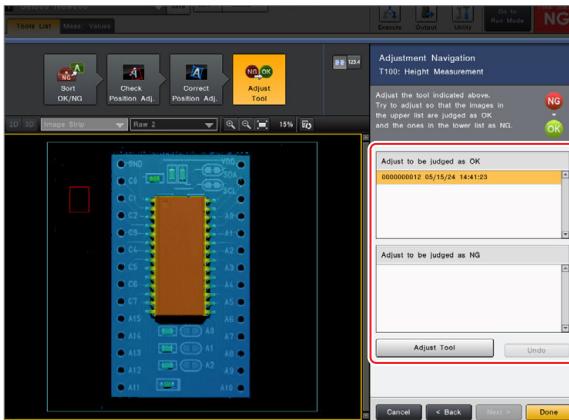
From the [Tool List for Position Adjustment Reference] column, select the Position Correction source tool that cannot be measured correctly, and click [Adjust Tool].

- 9** Correct the setting value of the Position Correction source tool so that it can be measured correctly.

- 10** When all the images have been correctly position adjusted, click [Next].

The [Adjust Tool] screen is displayed.

- 11** Adjust the setting value of the tool so that the image in the [Adjust to be judged as OK] column is judged as OK, and the image in the [Adjust to be judged as NG] column is judged as NG.



Which tool to edit can be specified if the tool is a dimensions and geometric shape tool with reference to another tool.

- 12** Click [Complete] when all the image corrections are done and [No images to be adjusted remain.] is displayed.

Continue to make corrections to other tools as needed.

Share Judgment Condition

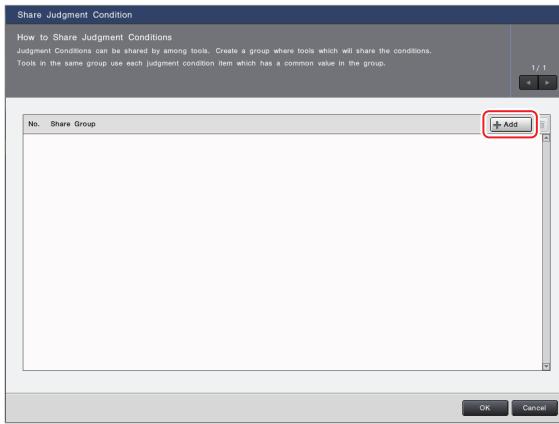
Shared judgment conditions can be used for multiple tools. When the same judgment conditions are used, it is not necessary to specify the judgment conditions for each tool, helping to reduce the amount of setup work.

A maximum of 100 groups of shared judgment conditions can be registered.

1 Click [Utility] > [Share Judgment Condition].

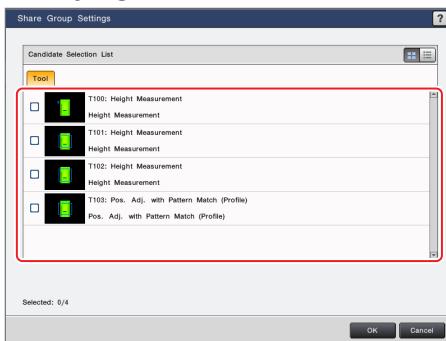


2 Click [Add].



The [Share Group Settings] screen appears.

3 Check the boxes of the tools that will share the same judgment conditions.



Judgment conditions can be shared only by tools that contain the same judgment conditions.

● If more than one tool already has a judgement condition

If the judgment conditions are different between the selected tools, the [Judgment Condition Overwriting Confirmation] screen appears. Check the box of the tool with the judgment conditions that will be kept, then click [OK].

The judgment conditions of the checked tool are kept, and the judgment conditions of the other tools are overwritten.

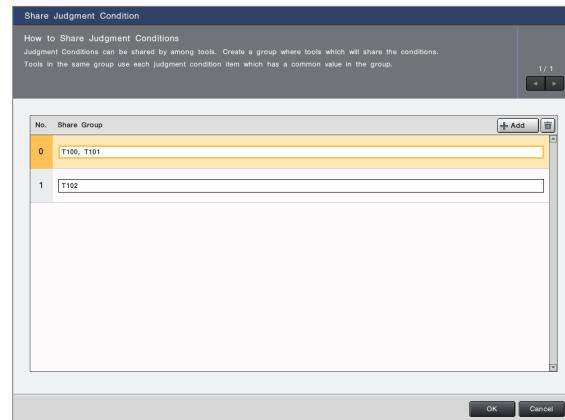
4 Click [OK].

The judgment conditions are now shared among the tools selected in Step 3.

5 Click [OK].

Cancelling judgment condition sharing

1 On the [Share Judgment Condition] screen, click the group to cancel judgment condition sharing for to select it.



2 Click [] at the top right corner of the screen.

3 Click [OK].

Sharing of judgment conditions is canceled.

Editing judgment condition sharing

New tools can be added or removed from the judgment conditions.

1 In the [Share Judgment Condition] screen, click the input column of the share target to be edited.

The [Share Group Settings] screen appears.

2 Change the share settings.

- Check the box of the tools to add.
- Uncheck the boxes of tools to remove from sharing.

3 Click [OK].

4 Click [OK].

Trace Logs

The status changes (ON/OFF) of the controller terminals, the commands from connected devices, and the execution status of each tool can be checked on the [Trace Log] screen with a timing chart display. By verifying the trace log collected on the production line, it is possible to efficiently identify the point where the timing deviation of flow execution and external control occurs and where the processing time is bottlenecked. Data transmitted in communications with an external device can be collected to check what data was transmitted and when.

- Point** In a controller that is collecting trace logs, processing time occurs for each event logged. Because of that, if there is a large number of objects to be collected in 1 measurement, the measurement time of the controller during the collection may vary. If the measurement time variation is a problem, use only the minimum required collection targets.

● Trace Logs Recording Targets

The trace log records the running state of the connected controller in units called "events" immediately after the start of the collection. An event is a change point for each collection target, such as the following:

- Terminal ON/OFF (1 event at ON, 1 event at OFF)
- Program settings and tool beginning/completion (1 event when beginning, 1 event when completing)
- Accepting/completing a command (1 event when accepting, 1 event when completing)

● Trace Logs Recording Amount

The maximum number of collected events in the trace log is 15000. When the total number of events for all items to be collected reaches the maximum number after the start of collection, the collection continues by overwriting the old event records.

Collecting Trace Logs

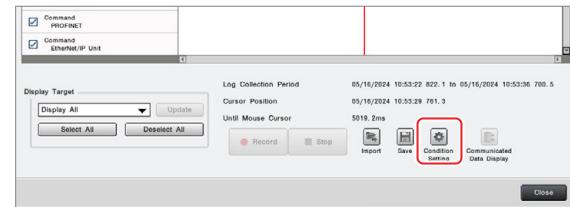
Trace logs are collected from the controller

1 Click [Utility] > [Trace Log].



- Point** If trace logging has been executed in the past, trace logs that have been collected previously are displayed on the [Trace Log] screen. Previously collected trace logs are cleared when collection is started anew.

2 Click [Condition Setting] and specify the logging condition as necessary.



For details on trace log collection condition setting, see ["Collecting Trace Logs" \(Page 7-7\)](#).

- Reference** Limiting the logging targets to the bare essentials can reduce the impact on controller measurement time.

3 Click the [Go to Run mode] button to switch the controller to Run mode.

- Point** Trace logging cannot be started in Setup mode.

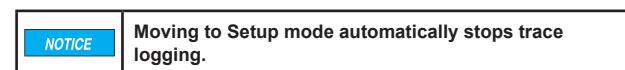
4 Click [Record].

Trace log collection will start in accordance with the logging condition.

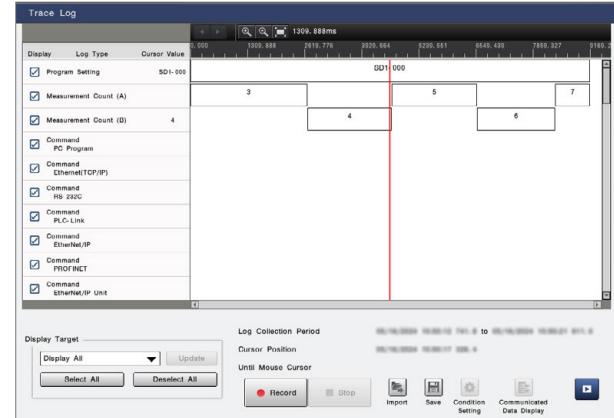
- Reference** This is available only on the operation screen.

5 Execute the inspection.

6 Click [Stop].



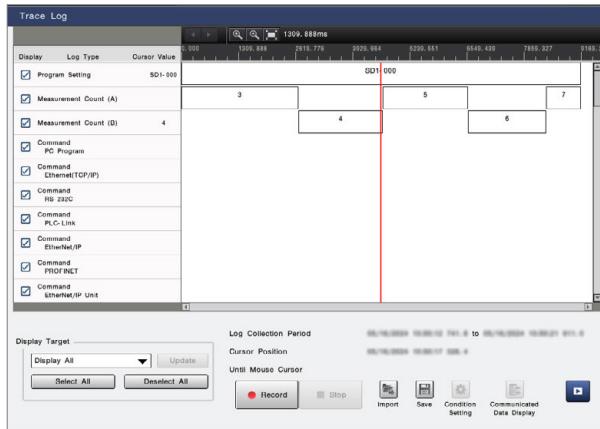
The collected trace logs are displayed on the [Trace Log] screen.



For more details on how to look at the screen, see ["Viewing Trace Logs" \(Page 7-8\)](#).

Viewing Trace Logs

The collected trace logs are displayed on the [Trace Log] screen.



Timing chart

Displays trace logs in the timing chart format.

Cursor Position

After the timing chart are displayed, the cursor (red line) can be moved by clicking the timing chart. The value of the cursor position is displayed under [Cursor Value] in the list of log types.

Communication data collection position

A blue line is displayed on the position where communications data was collected.

Program

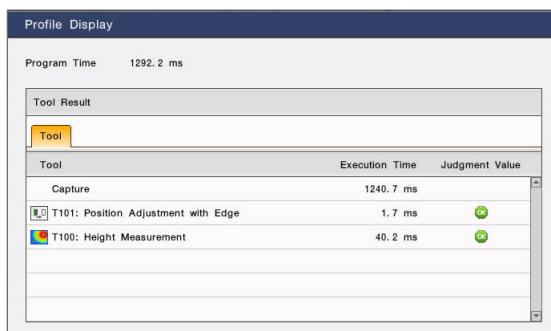
Displayed in a rectangle. The number in the rectangle is the program setting number.

Measurement Count

Displayed in a rectangle. The number in the rectangle is the measurement count.

A measurement count for which total status is NG is displayed with a red frame.

Right-clicking [Measurement Count] and selecting [Profile Display] displays the judgment value and execution time of each tool.



The execution time and judgment value for the tools added can be checked.

Command

Displayed in a rectangle. The characters in the rectangle are the command name. Commands that resulted in an error are displayed in a yellow frame.

The statuses of external terminals, PLC-Link, EtherNet/IP, PROFINET, EtherCAT:

Displayed as an ON or OFF waveform (timing chart).



- Placing the cursor over the program setting, measurement count, or commands displays information on the timing chart. The information displayed according to the cursor position varies depending on the type of trace log.
- The scroll bar of the timing chart can be moved using the mouse wheel.

Jump

Jump to events from the current cursor position on the timing chart.

Moves to the previous event.

Moves to the next event.

Scale

Enlarge or reduce the scale of the timing chart in the horizontal direction (time axis).

Enlarges/reduces the scale.

Adjusts the scale so that the entire trace log is displayed.

The scale of the timing chart in the horizontal direction (time axis) can also enlarged or reduced by moving the mouse wheel over the timing chart.

List of Log Types

The trace logs to be collected are displayed in a list.

Select the check box under [Display] for the log type to display. To refresh the trace log display, click [Update] in the [Display Target] field.

The value for the position where the cursor (red line) is on the timing chart is displayed under [Cursor Value].



- The information for the cursor value varies depending on the type of trace log.
- The selection state of the log type is cleared when the power is turned off.

Display Target

Select the display target and click [Update] to refresh the trace log display.

Display All

Displays the trace log of all log types.

Selected Targets Only

Displays only the trace log of the log types that have their [Display] check box selected in the list of log types.

Click [Select All] or [Deselect All] to select or clear all the [Display] check boxes in the list of log types at the same time.

Log Collection Period

Displays the period (YYMMDD HHMMSS msec.) which indicates when the trace logs displayed on the [Trace Log] screen were collected.

Cursor Position

Displays the time (YYMMDD HHMMSS msec.) of the position of the cursor that is displayed when the timing chart is clicked.

Until Mouse Cursor

Displays the relative time from the cursor position (red line) to the mouse cursor position.

Record

Starts collecting trace logs.

Stop

Ends the collection of trace logs.

Import

Loads and displays the binary data file of the trace log.

"Saving and Importing Trace Logs" (Page 7-12)

Save

Saves the data of the displayed trace log file.

"Saving and Importing Trace Logs" (Page 7-12)

Condition Setting

The [Trace Logging Condition Setting] screen appears.

"Collecting Trace Logs" (Page 7-7)

The collection condition for trace logs can only be set in Setup mode.

Communicated Data Display

Displays the collected communication data.

For details, see "Checking the Communication Data" (Page 7-10).

This can only be displayed when collecting communication data.
Whether or not to collect communication data is set through "Setting the Collection Condition for Trace Logs" (Page 7-9).

Trigger

A trigger is issued with each click.

This button is only displayed when the [Trace Log] screen is displayed in Run mode.

Setting the Collection Condition for Trace Logs

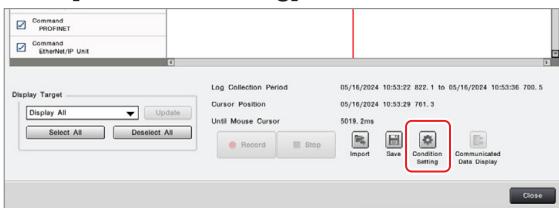
Set whether to collect communication data (command parameters, command results, flag details, and so on) transmitted in communications with an external device when collecting trace logs.

Point The collection condition for trace logs can only be set in Setup mode.

1 Click [Utility] > [Trace Log].



2 Click [Condition Setting].



The [Trace Logging Condition Setting] screen appears.

3 Select the [Collect Communicated Data] check box to also collect communication data when collecting trace logs.



4 After completing the setting, click the [OK] button.

Point The setting state of the collection condition is saved in the global settings data (env.dat).

Checking the Communication Data

The communication data collected can be checked.

The displayed value is the value of the communication data at the current cursor position (red line).

"PLC-Link" (Page 7-10)

"EtherNet/IP, EtherNet/IP unit, PROFINET, PROFINET unit, EtherCAT" (Page 7-11)



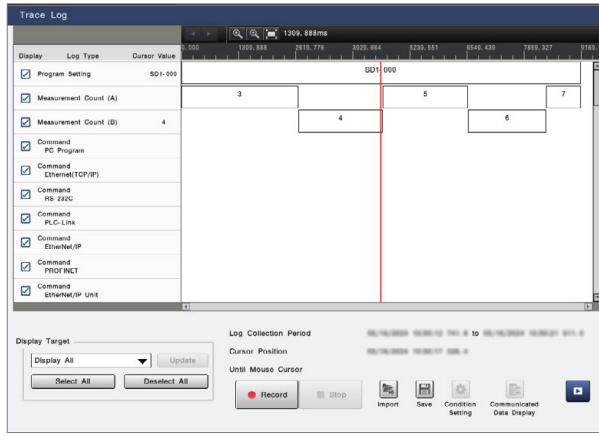
This can only be displayed when collecting communication data.
Whether or not to collect communication data is set through "Setting the Collection Condition for Trace Logs" (Page 7-9).

PLC-Link

1 Click [Utility] > [Trace Log].



2 Click the point to check the communication data of on the timing chart.



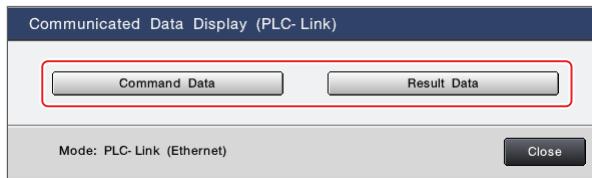
3 Click [Communicated Data Display].

The [Communicated Data Display (PLC-Link)] screen appears.



The state at the time of logging is displayed for [Mode].

4 Click [Command Data] or [Result Data] according to the item to be checked.



5 Check the communication data.

● Command Data List Screen

PLC-Link Command Data List		
Data Display Method: Decimal (signed)		
Input Data		
Address	Value	Descriptions
00100	00000000	Command No.
00102	00000000	Command Parameter 1
00104	00000000	Command Parameter 2
00106	00000000	Command Parameter 3
00108	00000000	Command Parameter 4
00110	00000000	Command Parameter 5
00112	00000000	Command Parameter 6
00114	00000000	Command Parameter 7
00116	00000000	Command Parameter 8
00118	00000000	Command Parameter 9
00120	00000000	Command Parameter 10
00122	00000000	Command Parameter 11
00124	00000000	Command Parameter 12
00126	00000000	Command Parameter 13
Command Parameter Display Count:		0016
Command Result Display Count:		0025
Output Data		
Address	Value	Descriptions
00003	00000000	Command Complete
00200	00000000	Command Result 1
00202	00000000	Command Result 2
00204	00000000	Command Result 3
00206	00000000	Command Result 4
00208	00000000	Command Result 5
00210	00000000	Command Result 6
00212	00000000	Command Result 7
00214	00000000	Command Result 8
00216	00000000	Command Result 9
00218	00000000	Command Result 10
00220	00000000	Command Result 11
00222	00000000	Command Result 12
00224	00000000	Command Result 13
Command Result Display Count:		0025
Mode: PLC-Link (Ethernet)		
<input type="button" value="Close"/>		

- Use the down arrow (▼) on the top right corner of the screen to select the format of the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).
 - Command Parameter Display Count: To change the number of command parameters displayed.
 - Command Result Display Count: To change the number of command results displayed.
-
- The maximum number of command parameters that can be displayed is 49.
 - The maximum number of command results that can be displayed is 50.

● Result Data List Screen

PLC-Link Result Data List		
Data Display Method: Decimal (signed)		
Result Data		
Address	Value	Descriptions
00000	00000000	Result Output Complete
00001	00000000	Result Output Control
00500	00000000	Result Data 1
00502	00000000	Result Data 2
00504	00000000	Result Data 3
00506	00000000	Result Data 4
00508	00000000	Result Data 5
00510	00000000	Result Data 6
00512	00000000	Result Data 7
00514	00000000	Result Data 8
00516	00000000	Result Data 9
00518	00000000	Result Data 10
00520	00000000	Result Data 11
00522	00000000	Result Data 12
Result Data Display Count:		0100
Mode: PLC-Link (Ethernet)		
<input type="button" value="Close"/>		

- Use the down arrow (▼) on the top right corner of the screen to select the format of the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).
- Result Data Display Count: To change the number of items of results data displayed.



The maximum number of items of results data that can be displayed is 200.

6 Click [Close].

7 Click [Close].

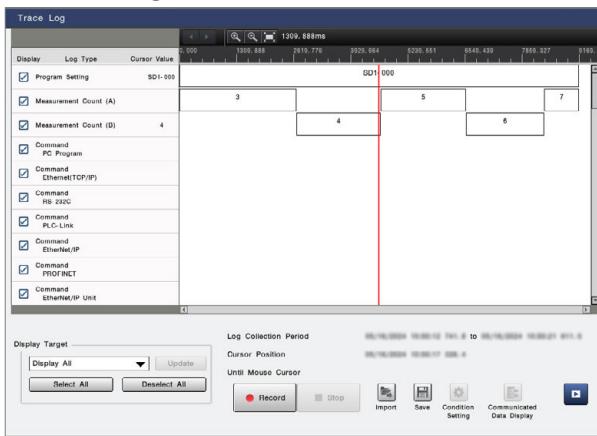
EtherNet/IP, EtherNet/IP unit, PROFINET, PROFINET unit, EtherCAT

This section explains the EtherNet/IP trace log as an example.

1 Click [Utility] > [Trace Log].



2 Click the point to check the communication data of on the timing chart.

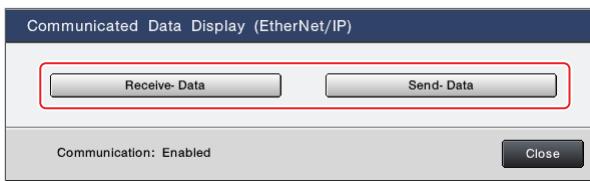


3 Click [Communicated Data Display].

The [Communicated Data Display (EtherNet/IP)] screen appears.

Reference The state at the time of logging is displayed for [Communication Settings].

4 Click [Receive-Data] or [Send-Data] according to the item to be checked.



5 Check the communication data.

● Controller receive-data list screen

EtherNet/IP Receive-Data List		
Bit Allocation Area		
Address	Value	Descriptions
0000:bit0	<input type="checkbox"/>	Command Request Flag
0000:bit1	<input type="checkbox"/>	(Reserved)
0000:bit2	<input type="checkbox"/>	(Reserved)
0000:bit3	<input type="checkbox"/>	Result ACK Flag
0000:bit4	<input type="checkbox"/>	Error Reset Request Flag
0000:bit5	<input type="checkbox"/>	(Reserved)
0000:bit6	<input type="checkbox"/>	(Reserved)
0000:bit7	<input type="checkbox"/>	(Reserved)
0001:bit0	<input type="checkbox"/>	TRG
0001:bit1	<input type="checkbox"/>	(Reserved)
0001:bit2	<input type="checkbox"/>	(Reserved)
0001:bit3	<input type="checkbox"/>	(Reserved)
0001:bit4	<input type="checkbox"/>	(Reserved)
0001:bit5	<input type="checkbox"/>	(Reserved)
0001:bit6	<input type="checkbox"/>	(Reserved)
0001:bit7	<input type="checkbox"/>	(Reserved)
0002:bit0	<input type="checkbox"/>	Command Parameter1
0002:bit1	<input type="checkbox"/>	Command Parameter2
0002:bit2	<input type="checkbox"/>	Command Parameter3
0002:bit3	<input type="checkbox"/>	Command Parameter4
0002:bit4	<input type="checkbox"/>	Command Parameter5
0002:bit5	<input type="checkbox"/>	Command Parameter6
0002:bit6	<input type="checkbox"/>	Command Parameter7
0002:bit7	<input type="checkbox"/>	Command Parameter8
0003:bit0	<input type="checkbox"/>	Command Parameter9
0003:bit1	<input type="checkbox"/>	Command Parameter10
0003:bit2	<input type="checkbox"/>	Command Parameter11
0003:bit3	<input type="checkbox"/>	Command Parameter12
0003:bit4	<input type="checkbox"/>	Command Parameter13

Byte Allocation Area		
Address	Value	Descriptions
0012	<input type="checkbox"/>	ExecCondNo
0014	<input type="checkbox"/>	(Reserved)
0016	<input type="checkbox"/>	Command Number
0020	<input type="checkbox"/>	0000000001
0024	<input type="checkbox"/>	0000000012
0028	<input type="checkbox"/>	0000000000
0032	<input type="checkbox"/>	0000000000
0036	<input type="checkbox"/>	0000000000
0040	<input type="checkbox"/>	0000000000
0044	<input type="checkbox"/>	0000000000
0048	<input type="checkbox"/>	0000000000
0052	<input type="checkbox"/>	0000000000
0056	<input type="checkbox"/>	0000000000
0060	<input type="checkbox"/>	0000000000
0064	<input type="checkbox"/>	0000000000
0068	<input type="checkbox"/>	0000000000

Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

Reference 496 bytes of data are displayed in the receive-data list.

● Controller send-data list screen

EtherNet/IP Send-Data List		
Bit Allocation Area		
Address	Value	Descriptions
0000:bit0	<input type="checkbox"/>	Command Complete Flag
0000:bit1	<input type="checkbox"/>	Command Error Flag
0000:bit2	<input checked="" type="checkbox"/>	Command Ready Flag
0000:bit3	<input type="checkbox"/>	Result Ready Flag
0000:bit4	<input type="checkbox"/>	Result OR Flag
0000:bit5	<input type="checkbox"/>	(Reserved)
0000:bit6	<input type="checkbox"/>	(Reserved)
0000:bit7	<input type="checkbox"/>	(Reserved)
0001:bit0	<input checked="" type="checkbox"/>	READY
0001:bit1	<input type="checkbox"/>	TRG_ack
0001:bit2	<input type="checkbox"/>	(Reserved)
0001:bit3	<input type="checkbox"/>	BUSY
0001:bit4	<input type="checkbox"/>	ERROR
0001:bit5	<input type="checkbox"/>	(Reserved)
0001:bit6	<input checked="" type="checkbox"/>	RUN
0001:bit7	<input type="checkbox"/>	(Reserved)
0002:bit0	<input type="checkbox"/>	Error Code
0002:bit1	<input type="checkbox"/>	(Reserved)
0002:bit2	<input type="checkbox"/> Total Count
0002:bit3	<input type="checkbox"/>	0000000000
0002:bit4	<input type="checkbox"/>	Command Result
0002:bit5	<input type="checkbox"/>	0000000000
0002:bit6	<input type="checkbox"/>	Command Data1
0002:bit7	<input type="checkbox"/>	0000000000
0003:bit0	<input type="checkbox"/>	Command Data2
0003:bit1	<input type="checkbox"/>	0000000000
0003:bit2	<input type="checkbox"/>	Command Data3
0003:bit3	<input type="checkbox"/>	0000000000
0003:bit4	<input type="checkbox"/>	Command Data4
0003:bit5	<input type="checkbox"/>	0000000000
0003:bit6	<input type="checkbox"/>	Command Data5
0003:bit7	<input type="checkbox"/>	0000000000
0004:bit0	<input type="checkbox"/>	Command Data6
0004:bit1	<input type="checkbox"/>	0000000000
0004:bit2	<input type="checkbox"/>	Result Data1
0004:bit3	<input type="checkbox"/>	0000000000
0004:bit4	<input type="checkbox"/>	Result Data2
0004:bit5	<input type="checkbox"/>	0000000000
0004:bit6	<input type="checkbox"/>	Result Data3
0004:bit7	<input type="checkbox"/>	0000000000
0005:bit0	<input type="checkbox"/>	Result Data4
0005:bit1	<input type="checkbox"/>	0000000000
0005:bit2	<input type="checkbox"/>	Result Data5
0005:bit3	<input type="checkbox"/>	0000000000
0005:bit4	<input type="checkbox"/>	Result Data6
0005:bit5	<input type="checkbox"/>	0000000000
0005:bit6	<input type="checkbox"/>	Result Data7
0005:bit7	<input type="checkbox"/>	0000000000

Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

Reference 496 bytes of data are displayed in the send-data list.

6 Click [Close].

7 Click [Close].

Saving and Importing Trace Logs

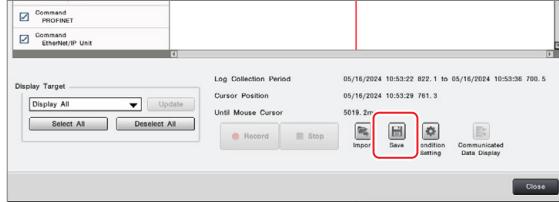
The collected trace logs can be saved to and loaded from an SD card.

Point Trace logs can be saved and loaded in both Setup mode and Run mode.

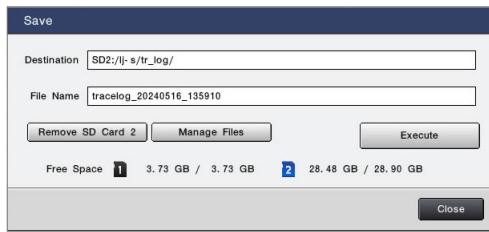
Saving Collected Trace Logs

Save the data of the displayed trace log to an SD card.

1 On the [Trace Log] screen, click [Save].



2 Specify [Destination] and [File Name], and then click [Execute].



Once the trace log has been saved, a notification message appears.

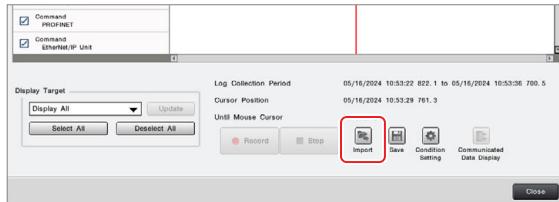
3 Click [Close].

Reference Saved trace log files can also be opened with the Simulation-Software. When opening with the Simulation-Software, the trace log file that has been saved with this procedure, places the file directly under the SD2 path of the selected workspace and then execute the importing process of the trace log.

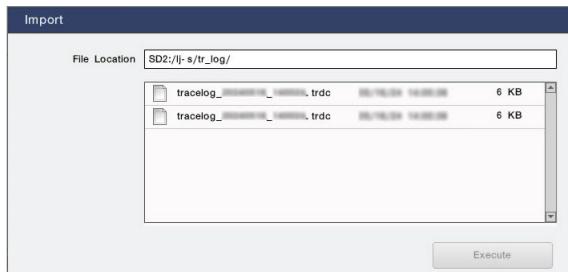
Importing Saved Trace Logs

Load and display trace log files saved in an SD card.

1 On the [Trace Log] screen, click [Import].



2 Specify the trace log file to load and click [Execute].



The trace log file is loaded and displayed on the [Trace Log] screen.

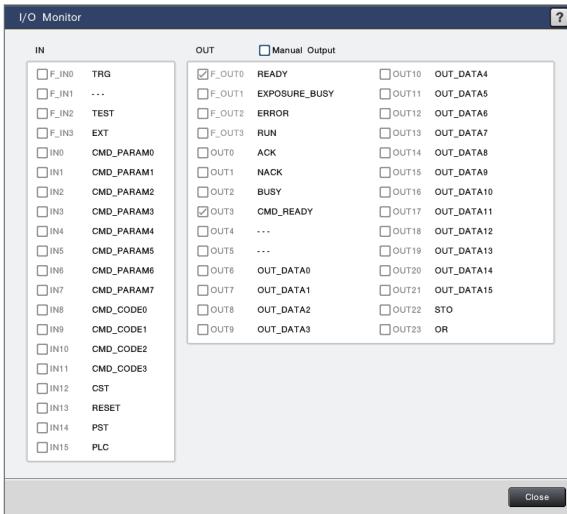
I/O Monitor

The connection status of signals input and output via the I/O connector (parallel I/O interface and terminal block interface) of this machine can be checked during run mode and setup mode. When proper signal transmission between the connected devices fails, this feature is very useful as the connection status of the terminal in this machine can be verified while the controller and external equipment are connected.

1 Click [Utility] > [I/O Monitor].



2 Verify the connections.



In [IN] on the left of the screen, input terminal is displayed. In [OUT] on the right of the screen, output terminal is displayed.

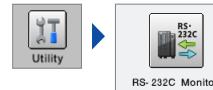
- The status display of each terminal is updated in real time in response to input and output signals, and the check mark is enabled for ON (short circuit) terminal.
- To turn ON a specific output terminal, check [Perform Forced Output] and then enable the check mark for the required terminal (only in setting mode).

3 Click [Close].

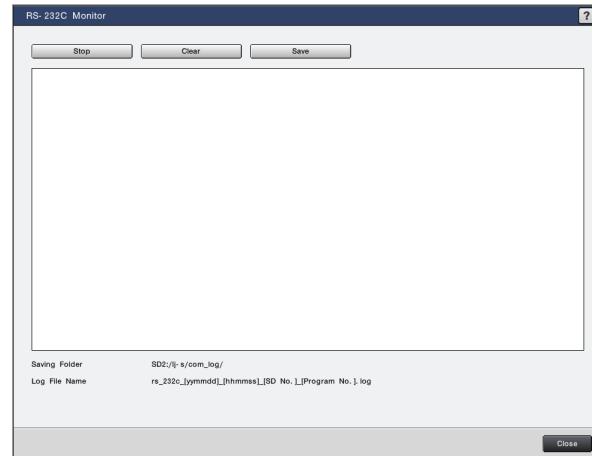
RS-232C Monitor

The communication status of signals input and output via the RS-232C connector of the controller can be checked during Run mode and setup mode. When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected. The latest communication log for 10 KB can also be saved.

1 Click [Utility] > [RS-232C Monitor].



2 Verify the communication status.



The current communication status is updated in real time in response to input and output commands.

- "<" appears at the beginning of the data outputted from the controller, and ">" appears at the beginning of the data inputted to the controller.
- Characters other than ASCII code are displayed in hexadecimal.

3 Perform the following operations , as needed.

- Temporarily stop updating the screen display

Select [Stop].

- Clear communication log

Select [Clear].

- Save the communication log on the SD card

The file name "rs_232c_{YYMMDD}_{HHMMSS}_{SD card number}_{Inspection setting number}.log" is saved to "lj-s/com_log" of SD card 2 when [Save] is selected.

4 Click [Close].

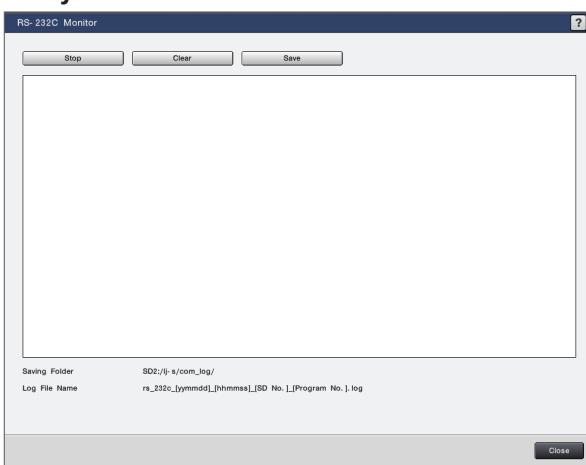
Ethernet Monitor

The communication status of signals input and output via the Ethernet connector of the controller can be checked during Run mode and setup mode. When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected. The latest communication log for 10 KB can also be saved.

1 Click [Utility] > [Ethernet Monitor].



2 Verify the communication status.



The current communication status is updated in real time in response to input and output commands.

- "<" appears at the beginning of the data outputted from the controller, and ">" appears at the beginning of the data inputted to the controller.
- Characters other than ASCII code are displayed in hexadecimal.

3 Perform the following operations , as needed.

- Temporarily stop updating the screen display
Select [Stop].
- Clear communication log
Select [Clear].
- Save the communication log on the SD card
The file name "Ethernet_YYMMDD_HHMMSS_{SD card number}_{Inspection setting number}.log" is saved to "j-s/com_log" of SD card 2 when [Save] is selected.

4 Click [Close].

PLC-Link Memory Monitor

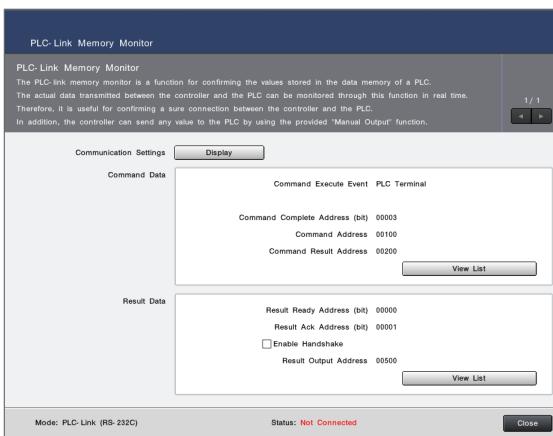
This monitor is used to check the communication status of the input/output signals of PLC-Link of the controller. When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected.

- Reference**
- Use of the PLC-link memory monitor is available only when the PLC-link is enabled.
 - When the PLC-link is not connected, monitoring is not possible. Use the monitor after establishing the PLC-link connection.

1 Click [Utility] > [PLC-Link Memory Monitor].

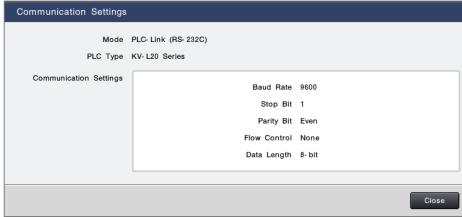


2 Click [View List] in the [Command Data] field or [Result Data] field according to the item to be checked.

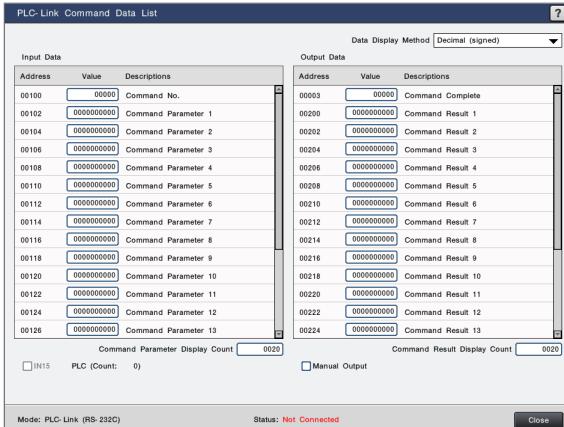


3 Verify the communication status.

Communication Settings

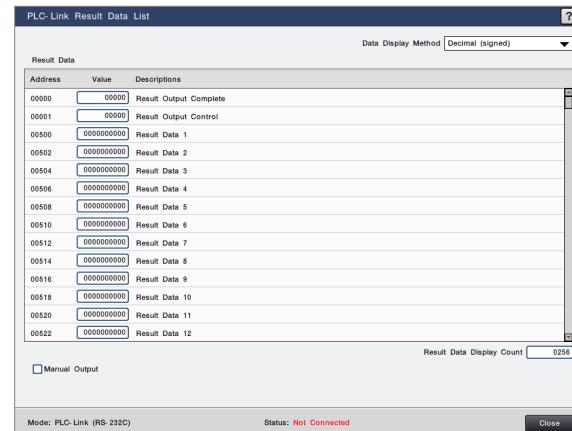


Command Data List Screen



- Use the down arrow (▼) on the top right corner of the screen to select the format of the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).
- Command Parameter Display Count: To change the number of command parameters displayed.
- Command Result Display Count: To change the number of command results displayed.
- Perform Forced Output: Check this box to manually change the value for the selected address and confirm the change on the PLC side.

Result Data List Screen



- Use the down arrow (▼) on the top right corner of the screen to select the format of the value to monitor from Hexadecimal, Decimal (unsigned), or Decimal (signed).
- Result Data Display Count: To change the number of items of results data displayed.
- Perform Forced Output: Check this box to manually change the value for the selected address and confirm the change on the PLC side.

4 Click [Close].

5 Click [Close].

EtherNet/IP Memory Monitor

This monitor is used to check the communication status of the input/output signals during EtherNet/IP communication using the Ethernet port of the controller or an EtherNet/IP unit (CB-NEP20E: option). When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected.

Reference

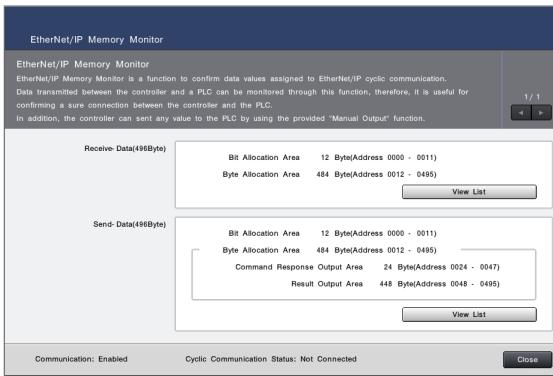
- Use of the EtherNet/IP memory monitor is available only when EtherNet/IP [Enable/Disable] (□ "Enable/Disable" (Page 8-8)) is set to [Enable] or [Enable unit].
- When EtherNet/IP communication is not connected, monitoring is not possible.

Use the monitor after establishing this connection.

1 Click [Utility] > [EtherNet/IP Memory Monitor].

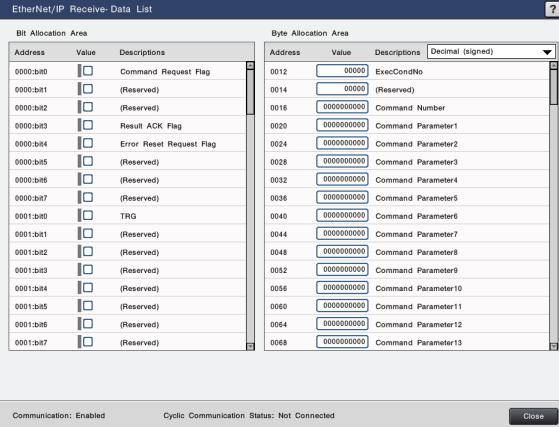


2 Click [View List] of either [Receive-Data] or [Send-Data] according to the items to be checked.



3 Verify the communication status.

● Receive-Data List screen



Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

● Send-Data List screen

Bit Allocation Area			Byte Allocation Area		
Address	Value	Descriptions	Address	Value	Descriptions
0000:b10	<input type="checkbox"/>	Command Complete Flag	0012	00000	Error Code
0000:b11	<input type="checkbox"/>	Command Error Flag	0014	00000	(Reserved)
0000:b12	<input checked="" type="checkbox"/>	Command Ready Flag	0016	0000000012	Total Count
0000:b14	<input type="checkbox"/>	Result Ready Flag	0020	0000000000	Command Result
0000:b15	<input type="checkbox"/>	Result OR Flag	0024	0000000000	Command Data1
0000:b16	<input type="checkbox"/>	(Reserved)	0028	0000000000	Command Data2
0000:b17	<input type="checkbox"/>	(Reserved)	0032	0000000000	Command Data3
0001:b10	<input checked="" type="checkbox"/>	READY	0036	0000000000	Command Data4
0001:b11	<input type="checkbox"/>	TRG_ack	0040	0000000000	Command Data5
0001:b12	<input type="checkbox"/>	EXPOSURE_BUSY	0044	0000000000	Command Data6
0001:b13	<input type="checkbox"/>	BUSY	0048	0000000000	Result Data1
0001:b14	<input type="checkbox"/>	ERROR	0052	0000000000	Result Data2
0001:b15	<input type="checkbox"/>	(Reserved)	0056	0000000000	Result Data3
0001:b16	<input type="checkbox"/>	RUN	0060	0000000000	Result Data4
0001:b17	<input type="checkbox"/>	(Reserved)	0064	0000000000	Result Data5
			0068	0000000000	Result Data6

Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

Manual Output

Check this box to manually change the value for the selected address and confirm the change on the PLC side.

4 Click [Close].

5 Click [Close].

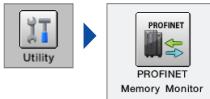
PROFINET Memory Monitor

This monitor is used to check the communication status of the input/output signals during PROFINET communication using the Ethernet port of the controller or PROFINET unit (CB-NEP20EA: option). When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected.

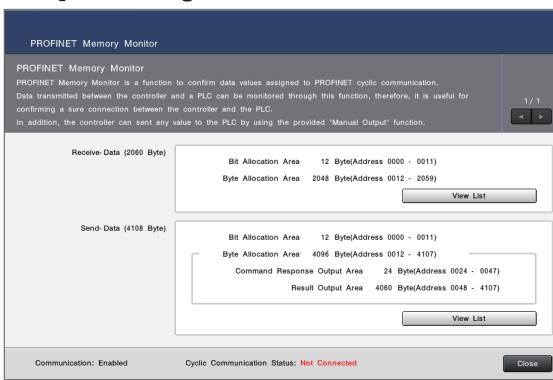
Reference

- Use of the PROFINET memory monitor is available only when PROFINET "Enable/Disable" (Page 8-9) is set to [Enable PROFINET] or [Enable PROFINET unit].
- When PROFINET communication is not connected, monitoring is not possible. Use the monitor after establishing this connection.

1 Click [Utility] > [PROFINET Memory Monitor].

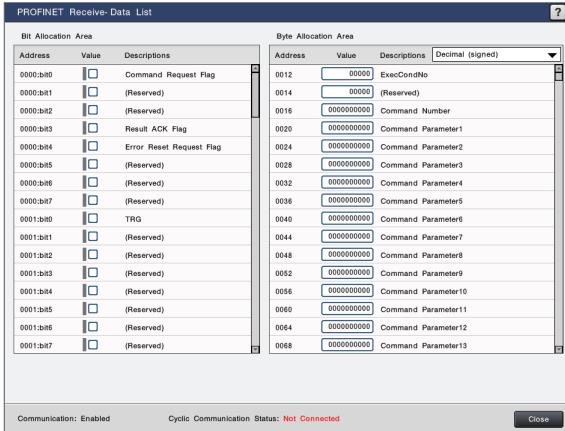


2 Click [View List] of either [Receive-Data] or [Send-Data] according to the items to be checked.



3 Verify the communication status.

● Receive-Data List screen



Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

● Send-Data List screen

PROFINET Send-Data List		
Bit Allocation Area		
Address	Value	Descriptions
0000:b10	<input type="checkbox"/>	Command Complete Flag
0000:b11	<input type="checkbox"/>	Command Error Flag
0000:b12	<input checked="" type="checkbox"/>	Command Ready Flag
0000:b14	<input type="checkbox"/>	Result Ready Flag
0000:b16	<input type="checkbox"/>	Result OR Flag
0000:b17	<input type="checkbox"/>	(Reserved)
0000:b18	<input type="checkbox"/>	(Reserved)
0000:b19	<input type="checkbox"/>	(Reserved)
0000:b20	<input type="checkbox"/>	(Reserved)
0001:b10	<input checked="" type="checkbox"/>	READY
0001:b11	<input type="checkbox"/>	TRG_ack
0001:b12	<input type="checkbox"/>	EXPOSURE_BUSY
0001:b13	<input type="checkbox"/>	BUSY
0001:b14	<input type="checkbox"/>	ERROR
0001:b15	<input type="checkbox"/>	(Reserved)
0001:b16	<input type="checkbox"/>	RUN
0001:b17	<input type="checkbox"/>	(Reserved)

Byte Allocation Area		
Address	Value	Descriptions
0012	00000	Error Code
0014	00000	(Reserved)
0016	000000012	Total Count
0020	000000000	Command Result
0024	000000000	Command Data1
0028	000000000	Command Data2
0032	000000000	Command Data3
0036	000000000	Command Data4
0040	000000000	Command Data5
0044	000000000	Command Data6
0048	000000000	Result Data1
0052	000000000	Result Data2
0056	000000000	Result Data3
0060	000000000	Result Data4
0064	000000000	Result Data5
0068	000000000	Result Data6

Manual Output

Communication: Enabled Cyclic Communication Status: Not Connected Close

Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

Manual Output

Check this box to manually change the value for the selected address and confirm the change on the PLC side.

4 Click [Close].

5 Click [Close].

EtherCAT Memory Monitor

This monitor is used to check the communication status of the input/output signals during EtherCAT communication using an EtherCAT unit (CB-NEC20E: option). When proper data transmission between the connected devices fails, this feature is very useful as the communication content can be verified while the controller and external equipment are connected.

Reference

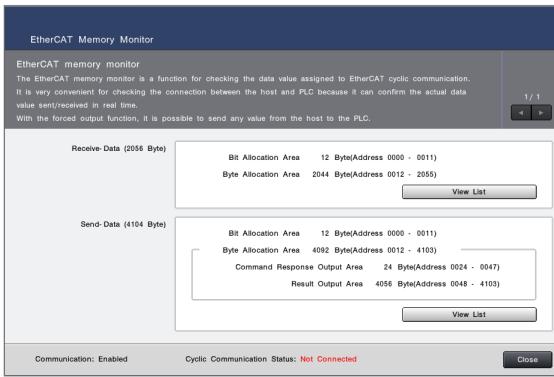
- Use of the EtherCAT memory monitor is available only when the [Enable EtherCAT] setting (□ "Enable EtherCAT" (Page 8-10)) is enabled.
- When EtherCAT communication is not connected, monitoring is not possible.

Use the monitor after establishing this connection.

1 Click [Utility] > [EtherCAT Memory Monitor].

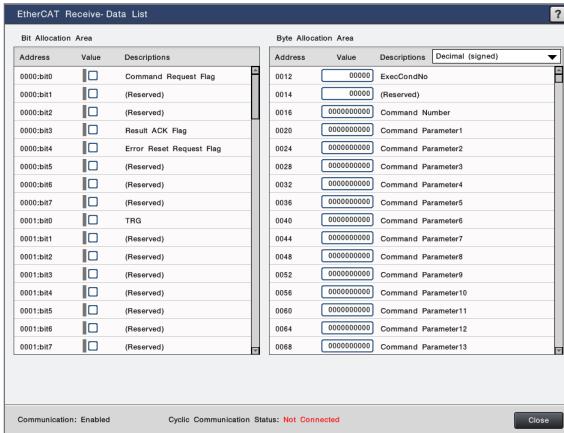


2 Click [View List] of either [Receive-Data] or [Send-Data] according to the items to be checked.



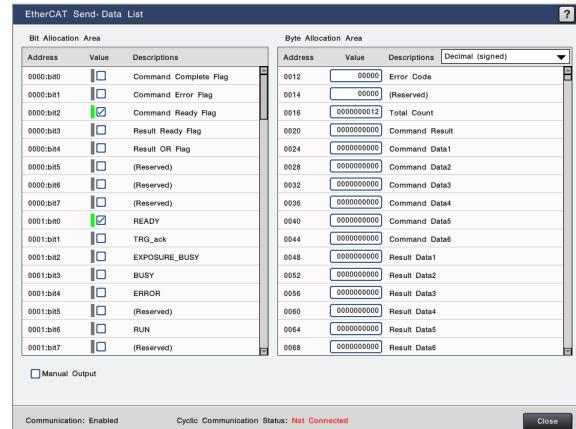
3 Verify the communication status.

● Receive-Data List screen



Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

● Send-Data List screen



Select ▼ at the top right of the byte allocation area to select hexadecimal display, decimal display (unsigned), or decimal display (signed) for the monitor values.

○ Manual Output

Check this box to manually change the value for the selected address and confirm the change on the PLC side.

4 Click [Close].

5 Click [Close].

Scaling Correction

Specify a scaling correction value to handle measurements that have been converted into actual size values by displaying the screen, determining, calculating, external input/output, etc.

Convert measurements by multiplying them by a constant factor

If the correction factor is already known, change the setting so that the measured value is multiplied by a constant factor.

 The initial value is set according to the connected head.

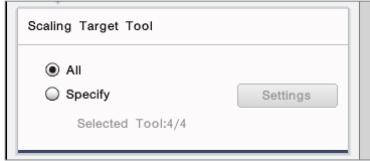
1 Click [Utility] > [Scaling].



2 In the [Scaling Coefficient] [Coefficient] column, specify the correction factor coefficient (how many pixels are converted to 1) directly, and then select the unit.



3 Specify [Scaling Target Tool].



All

Specifies all tools for scaling correction.

Specify

Click [Settings] and specify the tool scaling correction.

4 After completing the setting, click [OK].

Specify the desired physical size based on the actual measurement

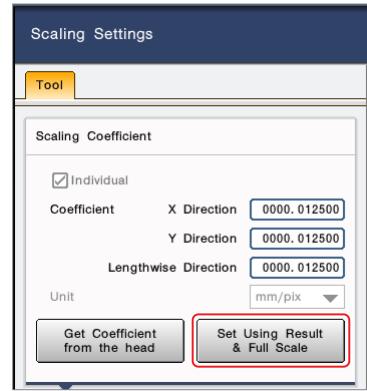
The correction factor is obtained from the measurement result of the workpiece width or pitch interval whose actual size value is known. It is convenient to use a ruler or other tool to determine the length when the target's length is unknown.

1 Click [Utility] > [Scaling].



2 What is known of the actual value will be imaged.

3 In the [Coefficient] column, click [Set Using Result & Full Scale].



4 Click the tab to convert (X Direction/Y Direction/Lengthwise Direction), if [Individual] are enabled.

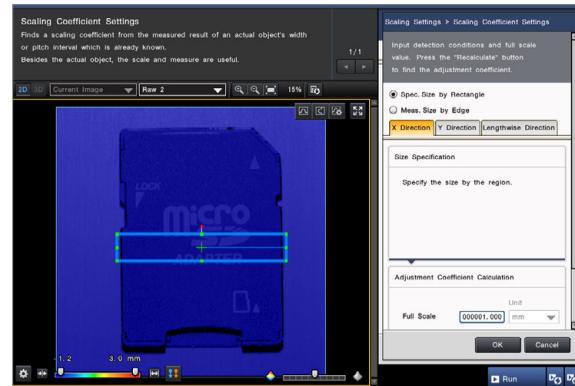
5 Configure the following settings:

When selecting [Spec. Size by Rectangle]

Specify the area which you can see the actual size of the captured workpiece with the size of the area.

(Example)

Specify the width of a SD card, which is already known to be 192 mm, with rectangle size



● When selecting [Meas. Size by Edge]

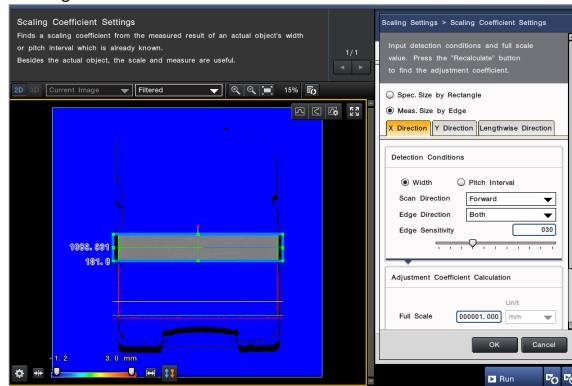
Measure the width or pitch interval of something for which the actual dimensions are known.

Measured values are displayed under [Measured] in the [Adjustment Coefficient Calculation] field.

For more information about the edge measuring method, refer to □ "What is an edge?" (Page A-66).

(Example)

Specify the width of a SD card, which is already known to be 192 mm, with rectangle size



- 6** Specify the specified/measured width or pitch interval dimensions and units in the [Adjustment Coefficient Calculation] column, then click [Recalculate].

The scaling coefficient is automatically calculated.

- 7** If [Individual] is enabled, click the tabs for the other conversions (X Direction/Y Direction/Lengthwise Direction) and repeat steps 5 through 6.
- 8** After completing all conversion settings, select [OK].
- 9** In the [Scaling Target Tool] field, specify the tools to apply scaling.
 - All: Specifies all tools for scaling correction.
 - Specify: Click [Settings] and specify the tool scaling correction.
- 10** After completing the setting, click [OK].

Operation Screen Setting

Multiple customized screen displays can be made according to the environments. Appropriate displays can be used for different applications or user accounts.

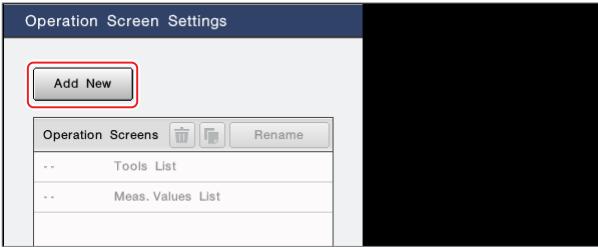
Adding new operation screen

To display the customized operation screen, first an operation screen must be added.

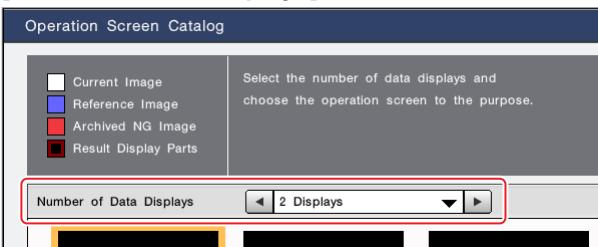
1 Click [Utility] > [Operation Screens].



2 Click [Add New].

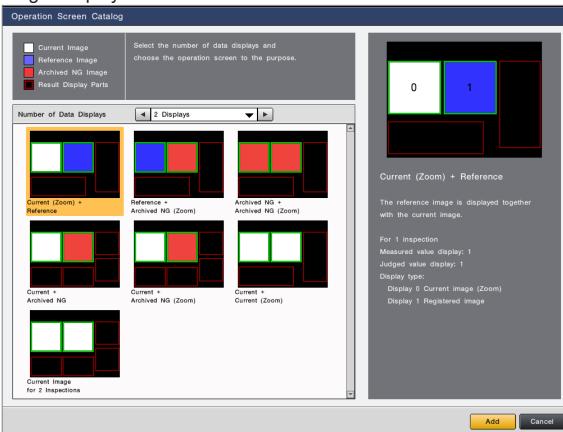


3 Select the number of data screens to display in [Number of Data Displays].



4 Select the base template for desired operation screen and click [Add].

As an example here, the [Current Image 1] of "Number of Data Displays: Single Display" is selected.



5 The template selected in Step 4 is added as the operation screen and the screen returns to the [Operation Screen Settings] screen.

Measured values or judgment values can be added on the added operation screen or the display details of the data screen can be changed.
□ "Editing an operation screen" (Page 7-22)

6 Click [Save] to save the settings data of the operation screen.

7 Click [Exit].

Manage the operation screen settings

Copy and add operation screen

Select the operation screen to copy in the [Operation Screen Settings] screen, and then click .

Delete an operation screen

1 Select the operation screen to delete in the [Operation Screen Settings] screen, and then click .

2 Click [OK].

Change the name of the operation screen.

1 Select the operation screen to change the name of in the [Operation Screen Settings] screen, and then click [Rename].

2 Enter the new name, then click [OK].

Verifying display content of the operation screen (preview)

1 Select the operation screen to verify the display contents of in the [Operation Screen Settings] screen, and then click [Preview].

The operation screen is displayed in full screen view.
After confirmation, click [Preview] again.

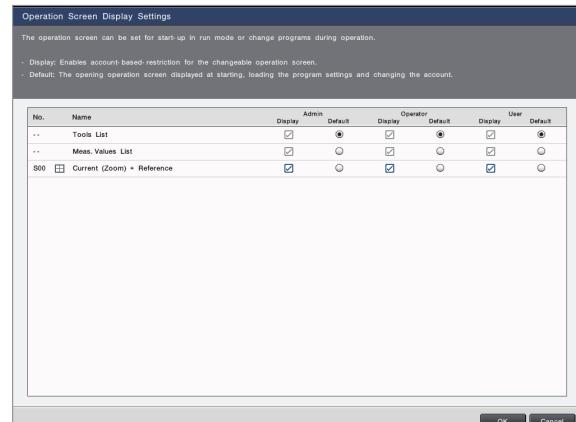
Limiting operation screen which can be used for each user account

1 Click [Display Options] on the [Operation Screen Settings] screen.

The [Operation Screen Display Settings] screen appears.

The measurement list can be displayed by default.

2 Select the operation screens and the default which can be used for each account.



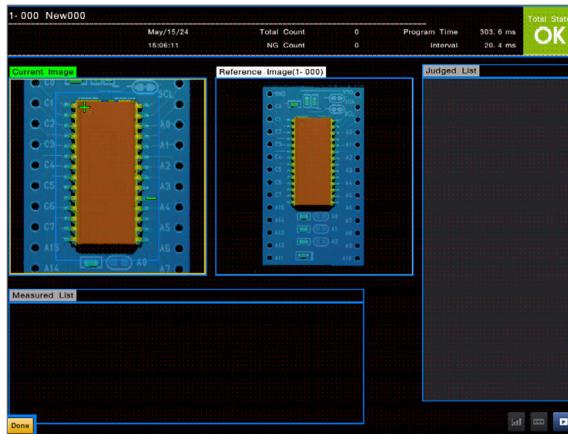
- Display: Check on the operation screens which can be used.
- Default: Select the operation screen type which is displayed as default at start-up of this machine or at change of the user account.

3 Click [OK].

To start the device in the Run Mode and with the specified screen when the power is supplied, use the □ "Startup Mode Settings" (Page 8-16) to select the mode.

Editing an operation screen

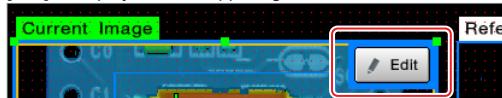
The operation screen can be edited in the [Operation Screen Settings] screen by clicking [Edit].



Editing part details

1 Click the part to edit.

[Edit] is displayed in the upper right.



2 Click [Edit].

The selected parts' settings screen appears.

- "Editing display content at the common area" (Page 7-22)
- "Editing display content of the data screen" (Page 7-22)
- "Editing display content of the measured value" (Page 7-23)
- "Editing display content of the judgment value" (Page 7-23)
- "Editing display content of the string" (Page 7-24)

3 Edit the part, then click [OK].

4 When editing of the operation screen is complete, click [Settings Complete].

The screen returns to the [Operation Screen Settings] screen.

Editing display content at the common area

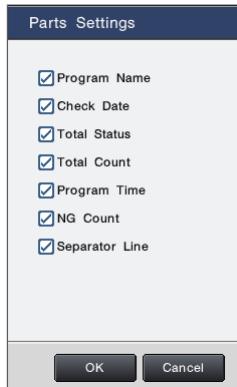
Display content at the common area at the upper part of the screen can be edited.

1 Click the common area and click [Edit].



The [Parts Settings] screen appears.

2 Uncheck items not to be displayed.



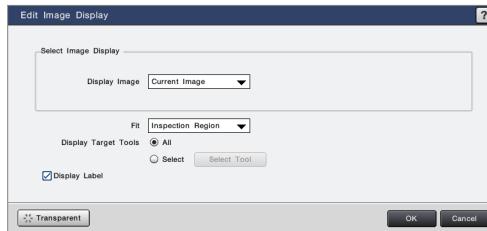
3 After completing the setting, click [OK].

Editing display content of the data screen

1 Select the desired data screen for editing the display content of, and click [Edit].



2 Change the settings.



Reference Click [Transparent] to check the area hidden by the [Edit Image Display] screen in transparent mode. To return to the original display, click [Transparent] again.

● Display Image

Select the image type to display.

○ Current Image

Displays the image captured most recently.

○ Reference Image

Displays the standard image corresponding to the tool selected.

○ Archived NG Image

Displays the archived image in the event of an NG judgment.

○ Archived image

Displays the archived image.

○ Target Generation

Specify the generation to be displayed for the NG archived image or the archived image. Depending on the type of head of cameras connected, and the contents of the program settings, the range of the generation that can be set is different. This setting item is only displayed when NG archived images or archived images are selected as the displayed images.

○ Display NG Tool

When NG has occurred in the tool specified in [Display Target Tool], the tool that NG has occurred in is displayed. This setting item is only displayed when NG archived images are selected as the displayed images.

● Fit

Selects automatic zoom-in/out (fit display) suitable for the display image size.

○ Display Size

Displays in fit according to the screen size.

○ Inspection Region

Displays in fit according to the measurement region of selected tool.

○ Detect Position

For the tool that measures the position, displays in fit so that the detection position may be at the center. For other tools, displays in fit so that the inspection region position may be at the center.

● Display Target Tools

Select the tool for display target.

○ All

Specifies all tools for display.

○ Select

Specifies only specific tools for display. Click [Select Tool] to display the [Select Tool] screen. Check the tool for display and click [OK].

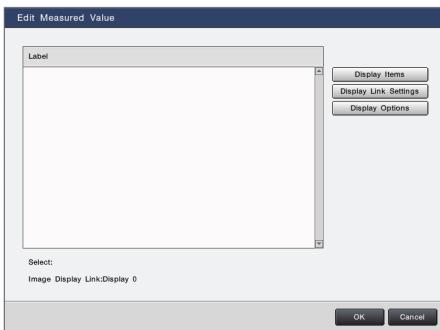
● Display Label

The labels linked to the data status will be displayed at the top of the total judgment. If the [NG Archived Image] is selected in [Display Image], the updated date will be displayed at the bottom of the data screen.

3 After completing the setting, click [OK].

■ Editing display content of the measured value

- 1 Select the desired measured value for editing the display content of, and click [Edit].**
- 2 Change the settings.**



● Display Items

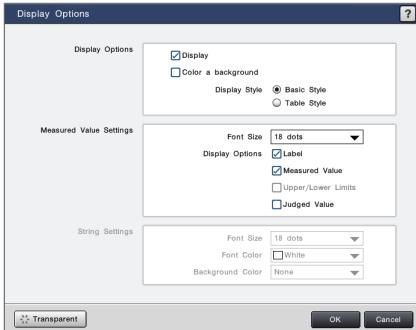
Click to display the [Select Display Item] screen. After selecting the measured value Variables or String for display, click [Add].

● Display Link Settings

When multiple data screens are placed on the operation screen, select which data screen's measured value is to be displayed. Click to display the [Display Link Settings] data screen. In [Display Link], select the target screen.

● Display Options

Since when clicking the [Display Options] screen is displayed, and set the display method of the measured value.



○ Display Options

- **Display**
Check for display of the measurement value on the operation screens.
- **Color a background**
Check for coloring the background.
- **Display Style**
Select the style from [Basic Style] and [Table Style].

○ Measured Value Setting

- **Font Size**
Select the display size of the measured value.
- **Label**
Check for display of the label of measured value.
- **Measured Value**
Check for display of the measured value.
- **Upper/Lower limits**
Check for display of upper/lower limits (valid when [Table Style] is selected).
- **Judged Value**
Check for display of judgment value (OK/NG).

○ [String Settings] (valid when [Basic Style] is selected)

- **Font Size**
Select the display size of the string.
- **Font Color**
Select the display color of the string.
- **Background Color**
Select the background color of the string.

3 After completing the setting, click [OK].

■ Editing display content of the judgment value

- 1 Select the desired judgment value for editing the display content of, and click [Edit].**
- 2 Change the settings.**



● Display Items

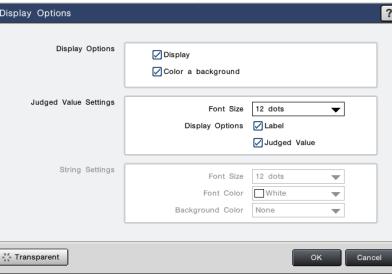
Click to display the [Select Display Item] screen. After selecting the measured value for display, click [Add].

● Display Link Settings

When multiple data screens are placed on the operation screen, select which data screen's judgment value is to be displayed. Click to display the [Display Link Settings] data screen. In [Display Link], select the target screen.

● Display Options

Since when clicking [Display Options] the screen is displayed, set the display method of the judgment value.



○ Display Options

- **Display**
Check for display of the judgment value on the operation screens.
- **Color a background**
Check for coloring the background.

○ Judged Value Settings

- **Font Size**
Select the display size of the judgment value.
- **Label**
Check for display of the label of judgment value.
- **Judged Value**
Check for display of judgment value (OK/NG).

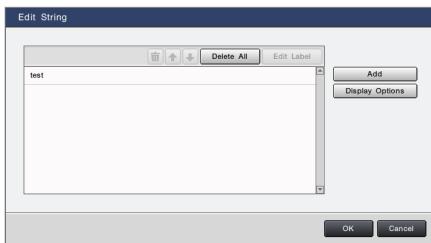
○ String Settings

- **Font Size**
Select the display size of the string.
- **Font Color**
Select the display color of the string.
- **Background Color**
Select the background color of the string.

3 After completing the setting, click [OK].

■ Editing display content of the string

- 1 Select the desired string for editing the display content of, and click [Edit].**
- 2 Change the settings.**

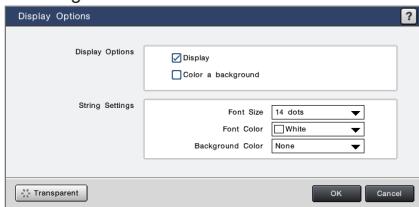


● Add

Click to add a string for display on the operation screen. The [String] screen appears. Enter the string for display.

● Display Options

Select the desired string for change of display on the [Edit String] screen and click. The [Display Options] screen appears. Set the display method of the string.



○ Display Options

- **Display**
Check for display of the character string on the operation screens.
- **Color a background**
Check for coloring the background.

○ String Settings

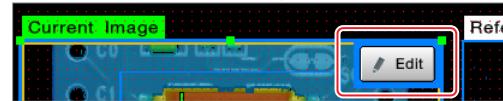
- **Font Size**
Select the display size of the string.
- **Font Color**
Select the display color of the string.
- **Background Color**
Select the background color of the string.

3 After completing the setting, click [OK].

Moving parts

- 1 Click the part to move.**

[Edit] is displayed in the upper right.



- 2 Drag from within the frame of the displayed part to moving the part.**

Drag the handle of the outer frame to change the size.

- 3 After completing the move, click [Done].**

The screen returns to the [Operation Screen Settings] screen.

Placing a new part that was added.

- 1 Right-click any position on the screen.**

The context menu appears.

- 2 Select [Add].**

The selected part is added onto the operation screen, and the settings screen for the selected part is displayed.

- 3 Edit part details.**

- 4 According to the displayed contents, drag the handle of the outer frame of the part to change the size.**

- 5 After adding the part and changing settings, click [Done].**

The screen returns to the [Operation Screen Settings] screen.

Deleting parts

- 1 Right-click the desired part for deletion and select [Delete] from the context menu.**

- 2 After deletion is complete, click [Done].**

The screen returns to the [Operation Screen Settings] screen.

Statistics

When measurement results are set as statistical targets in advance, the results can be recorded in the memory of the main unit during operation, and the statistical results can be checked and saved. In operation mode, the statistics and graphs are updated in real time and the upper and lower tolerances can be changed, so it is convenient to check the optimal tolerances from the statistics and understand the status of the inspection process during operation in the test run before introduction.

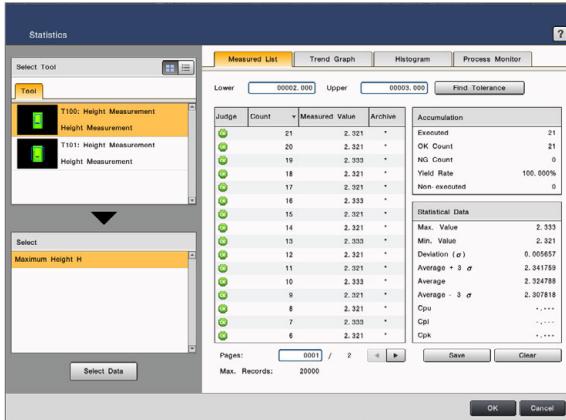
Setting the measurement items for statistics

Specify the measurement item of the tool subject to statistics (only in the setting mode). The measurement items of the tools with the tolerance already set are automatically added to the statistics.

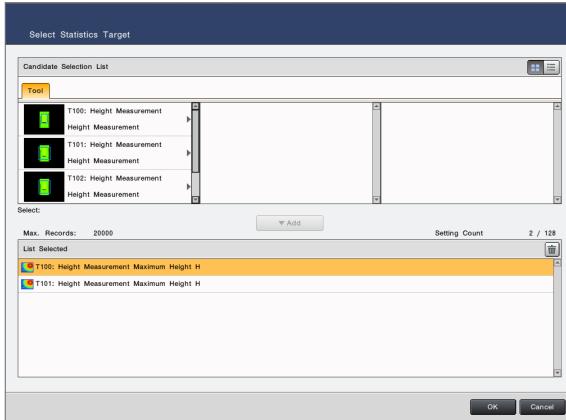
1 Click [Utility] > [Statistics].



2 Click [Select Data] at the lower left of the screen.



3 Select the item for statistics and click [Add].



If there are other desired items for addition, repeat this step.

● Deleting measurement items from statistics target

To delete some or all of the measurement items displayed on the setting screen of the Select Data.
In [List Selected] of the [Select Statistics Target] screen, select the data to be excluded from the statistics target and click .

4 After completing the setting, click [OK].

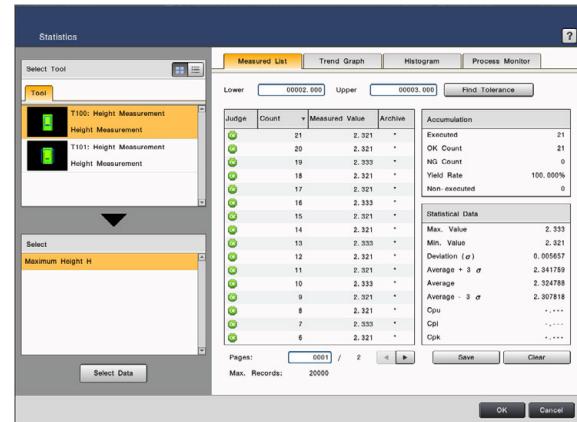
Displaying statistics (Meas.Values List)

The statistical results of items specified as the target for the statistics can be checked numerically. In addition to checking the statistics such as OK/NG judgment number and deviation for each item, process capability index (Cpu, Cpl, Cpk), measurement values and judgment results can also be saved to the SD card 2. In addition, it is also possible to analyze the cause of NG by matching the image data recorded in the image archives.

1 Click [Utility] > [Statistics].



2 Click the [Measured List] tab.



3 In [Select Tool] and [Select] on the left of the screen, select the tool and the measured value to check.

The specified statistical values displayed.

● Checking the measured value of each item

Move the cursor to the [Measured List] tab.
If an NG occurs at the time of measurement, an NG icon appears at the left side of number of measurement. If the item is OK or no limit is set, an OK icon appears.

● Displaying images during measurement

Double-click the number of measurement displayed with [*] to display the image saved at the time of the measurement.

● Adjusting the Tolerance

To adjust the tolerance, directly change the [Upper Limit] or [Lower Limit] value, then click [OK].
The judgment record changes according to the changed lower and upper limits. Make adjustments while observing changes such as yield, etc.
By clicking on [Find Tolerance], the result of adding to/subtracting from the average value by multiplying the deviation value of the measurement item by an arbitrary scale factor can be automatically set as the upper/lower limits of the tolerance.



 Items whose limits are to be adjusted in Run mode must be registered beforehand in the Custom Menu with the [Permit Change Judgment Conditions in Run mode] option enabled.

● Save the recorded measurement results on the SD card 2 (Export)

If you select [Save] while the SD card 2 is inserted in this unit, you can save the currently recorded measurement results, judgment results, and measurement item names as text data.
The measurement item name and measurement results (number of measurement/statistical target/individual judgment) are saved in a csv text file as "{save date}_{save time}_{SD card number}_{inspection setting number}_dat.csv" to "lj-s/stat" of SD card 2.

4 After checking is complete, click [OK].

Displaying measured values along the time axis (Trend Graph)

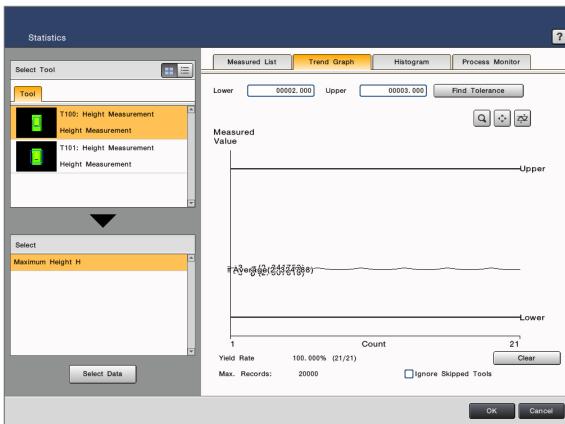
Measured values can be displayed along the time axis (Trend Graph). This function is useful for checking how data is changing over the course of time or several inspections during Run mode.

In Run mode, variation of the graph and the yield rate which are updated in real time can be checked, and in the setting mode, the upper and lower tolerance limits can be changed to match the observed data range. The graph also displays whether the image data was recorded in the image archives and allows for images to be viewed directly.

1 Click [Utility] > [Statistics].



2 Click the [Trend Graph] tab.



- 3** In [Select Tool] and [Select Measured Value] on the left of the screen, select the tool and the measured value to check.

● Adjusting the Tolerance

To adjust the tolerance, directly change the [Upper] or [Lower] value, then click [OK].

Tolerances can also be adjusted by dragging the upper or bottom bar up and down.

At the time of change, the judgment result and the yield change in conjunction with the upper and lower limit values. Make adjustments while observing changes such as yield, etc.

Items whose limits are to be adjusted in Run mode must be registered beforehand in the Custom Menu with the [Permit to Change Judgment Conditions in Run mode] option enabled.

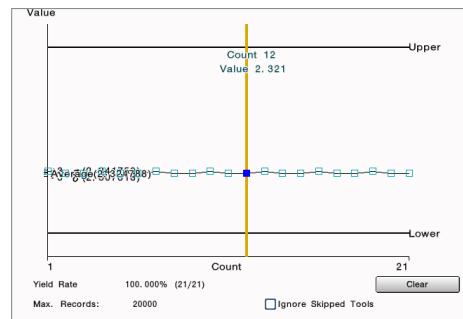
● Zoom in/out the trend graph display

During Run mode, click [Stop] to stop updating the graph and zoom in/out of the graph for an enlarged/reduced view.

- Click at any place to display the upper/lower/left/right buttons. The image can be zoomed in/out with the zoom cursor position serving as the center.
- While keeping zoom-in/out, the display area can be moved to a desired place.
- Returns the Y-axis direction to the initial automatic adjustment state.

● Check measured values on the trend graph

Click any point on the graph to display the cursor at the position. The number of measurement and the measured value at the cursor position are displayed.



● Check the image saved on the trend graph

With respect to the measurement result for which the image is saved in the image archives, " is displayed on the trend graph when the cursor bar is displayed,

By clicking on the displayed area of □, the image saved at the time of the measurement gets displayed.

4 After checking is complete, click [OK].

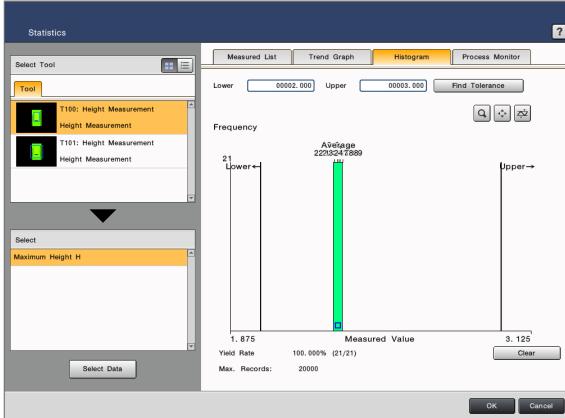
Displaying the distribution of measured values (Histogram)

This can be used to display the distribution of values as a histogram. This function allows the user to visually grasp the overall dispersion of measured values, so it is useful when adjusting tolerance level. In Run mode, variation of the graph and the yield rate which are updated in real time can be checked, and in the setting mode, the upper and lower tolerance limits can be changed to match the observed data range. The graph also displays whether the image data was recorded in the image archives and allows for images to be viewed directly.

1 Click [Utility] > [Statistics].



2 Click the [Histogram] tab.



3 In [Select Tool] and [Select] on the left of the screen, select the tool and the measured value to check.

Adjusting the Tolerance

To adjust the tolerance, directly change the [Upper] or [Lower] value, then click [OK].

Tolerances can also be adjusted by dragging the upper or lower bars left and right.

At the time of change, the judgment result and the yield change in conjunction with the upper and lower limit values. Make adjustments while observing changes such as yield, etc.



Items whose limits are to be adjusted in Run mode must be registered beforehand in the Custom Menu with the [Permit to Change Judgment Conditions in Run mode] option enabled.

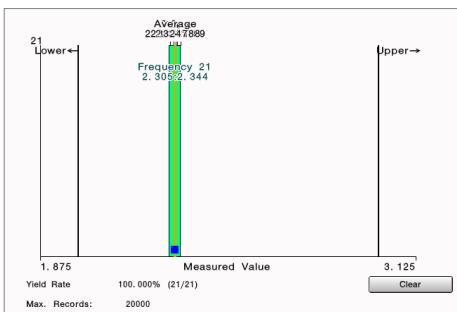
Zooming IN/OUT of the displayed image

During Run mode, click [Stop] to stop updating the graph and zoom in/out of the graph for an enlarged/reduced view.

- Click at any place to display the upper/lower/left/right buttons. The image can be zoomed in/out with the zoom cursor position serving as the center.
- While keeping zoom-in/out, the display area can be moved to a desired place.
- Returns the Y-axis direction to the initial automatic adjustment state.

Check the measured value on the histogram

Click any point on the graph to display the cursor at the position. The record count and the measured value range at the cursor position are displayed.



Check the image saved on the histogram

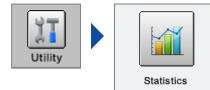
With respect to the measurement result for which the image is saved in the image archives, " is displayed on the histogram when the cursor bar is selected. By clicking on the displayed area of " , the image saved at the time of the measurement will be displayed in test mode.

4 After checking is complete, click [OK].

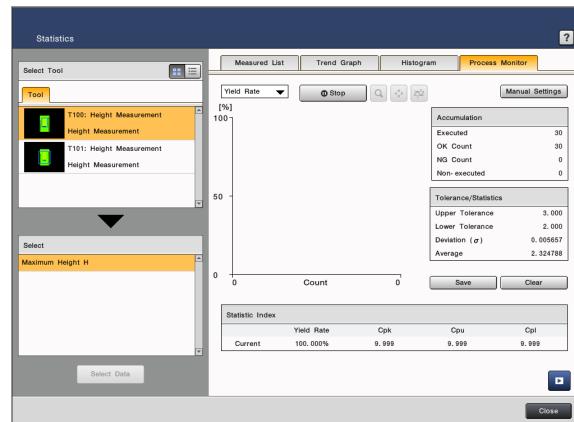
Evaluating quantitative process capability (Process Monitor)

The current values of yield rate and process capability index or change with time can be monitored. It is useful to analyze the inspection process in statistical perspective without being subject to the influence of the judgment results of each object.

1 Click [Utility] > [Statistics].



2 Click the [Process Monitor] tab.



3 In [Select Tool] and [Select] on the left of the screen, select the tool and the measured value to check.

Statistic Index

In the menu at the upper part of the graph, select the desired item for display.

- Yield Rate
Displays the quality ratio of the inspection process.
- Cpk
Displays the process capability index which is one of the indexes used to evaluate the process capability of a process quantitatively. The smaller value between Cpu and Cpl is used.
- Cpu
Displays the process capability index only for the upper limit standard.
- Cpl
Displays the process capability index only for the lower limit standard.

Changing the plot interval of graph display

Click [Manual Settings]. On the [Manual Settings] screen, adjust the plot interval of graph display.

- You can adjust the plot interval of the graph display only when using the process monitor in setting mode.

Zooming IN/OUT of the graph display of the process monitor

During Run mode, click [Stop] to stop updating the graph and zoom in/out of the graph for an enlarged/reduced view.

- Click at any place to display the upper/lower/left/right buttons. The image can be zoomed in/out with the zoom cursor position serving as the center.
- While keeping zoom-in/out, the display area can be moved to a desired place.
- Returns the Y-axis direction to the initial automatic adjustment state.

Save the recorded measurement results on the SD card 2 (Export)

If you select [Save] while the SD card 2 is inserted in this unit, you can save the currently recorded measurement results, judgment results, and measurement item names as text data.

The measurement results (number of measurement in plotting/Yield/Cpk/Cpu/Cpl) are saved in a csv text file as "{save date}_{save time}_{SD card number}_{inspection setting number}_stat.csv" to "lj-s/stat" of SD card 2.

4 After checking is complete, click [OK].

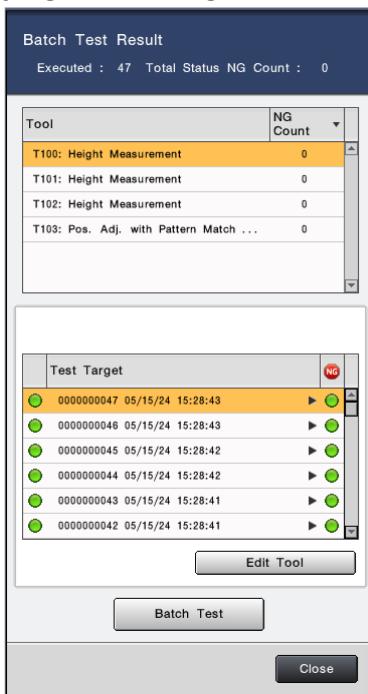
Batch Test

Since the tool setting values based on the past archived image (images on the image strip) are adjusted, they can be re-tested in batch. Here is an example of adjusting the tool judged NG to be OK.

- 1 In Run mode, you can leave a archive of the image, and then switch to the setting mode.**
- 2 Click [Utility] > [Batch Test].**



- 3 In [Tool], select the target tool for adjustment and in [Test Target], select the image which has been judged NG during measurement.**



- 4 Click [Edit Tool].**

The edit screen of the target tool appears.

- 5 Adjust the setting values of OK and judgment.**

- 6 When the adjustment is finished, click [Batch Test] to confirm that there is no effect other than the adjusted image.**

Archived Image Settings

The captured image during operation can be saved in the image buffer memory of the controller and read out later. You can also re-measure with the read image and check the measurement value. This is useful when you want to check the image at a later time when NG occurs while operating.

Reference Since the archived image is saved in the image buffer memory of this machine, the saved image will be erased in the following cases. When you want to preserve the saved image, save it to SD card 2, USB HDD, FTP server.

- When this machine is turned off
- When the RESET operation is performed
- When program settings are changed
- When the model, or number of head to be connected is changed
- When the image condition of the connected head is changed
- When the storage condition of the archived image setting is changed
- When the settings related to the NG archived image on the operation screen settings is changed

- 1 Click [Utility] > [Archived Image Settings].**



- 2 Configure the archived image settings.**



● Archive Condition

Select the storage condition of the archived image.

Auto (initial configuration value)

Records all captured images. Since the NG archived image is recorded in another area in the memory, the NG archived image is not overwritten as long as the number of NG times does not exceed a certain number.

Latest

Records all captured images. In order to record the OK archived image and the NG archived image in the same region in the memory without distinction, more recent archived images compared to [Automatic] can be accumulated.

Total status NG

Total judgment will save only the measurement image of NG.

● Memory Distribution

Click [Set] in [Memory Distribution] to specify whether to allocate the memory in the main unit in favor of archive accumulation or image output.

Give Priority to Archiving

Memory is prioritized so that more archived images can be left.

Give Priority to Image Output

Use memory as a buffer for image output.

Give Same Priority to Archiving and Image Output

Use memory equally for archive accumulation and image output.

Reference Depending on the settings, whether you select [Give Priority to Archiving] or [Give Priority to Image Output], the number of archive accumulations may not change.

- 3 After completing the setting, click [OK].**

● Number of images that can be saved

The number of images you can be saved depends on the settings and the combination of the connected head and the number of pixels in the Y direction.

Reference The accumulated archived image in the image strip can be checked (Max. 1024 times) or specified as an archived image in the operation screen setting (Max. 300 times). Over that can be used as a buffer for image output.

Image Strip Settings

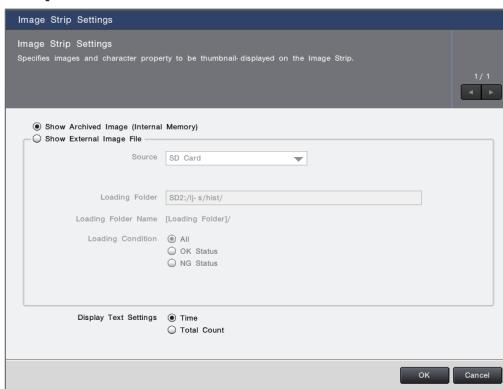
In addition to the images (archived images) recorded in the controller, images saved in the SD card or USB HDD or FTP server can be displayed on the image strip to specify them for re-test.

Reference For information about image strip operations, refer to ["Check Past Image in the Image Strip" \(Page 3-12\)](#).

1 Click [Utility] > [Image Strip Setting].



2 Specify the image to be displayed in the image strip.



● Show Archived Image (Internal Memory) (initial setting)

Displays the images stored in the controller (archived images) on the image strip.

● Show External Image File

Displays images saved in the SD card or USB HDD or FTP server on the image strip. Specify also the device and read source folder. If [OK Status] is selected as the Loading Condition, only OK images can be displayed. If [NG Status] is selected, only NG images can be displayed.

Point If [FTP] is selected as the source and ["SFTP" \(Page 8-4\)](#) is enabled, only ASCII characters can be used for the folder and file names.

Reference The file names ("YYMMDD_HHMMSS_{number of measurement}_{image name}_{total judgment}.bmp/jpg/png" or "{serial number}_{specified character string}_{image name}_{total judgment}.bmp/jpg/png") of image files loaded as external files must conform to the following image output file naming rules.
Example
240615_123456_000000001_IMG_HEIGHT_OK.bmp

3 In the [Display Text Settings], select the text to display as an explanation for the images below the image strip image from [Time] (measurement time) or [Total Count].

4 After completing the setting, click [OK].

Security Settings

To protect tool settings from a third party, viewing and editing of tool settings can be locked. To prevent diversion of inspection settings, the controller that can use the inspection settings can be limited.

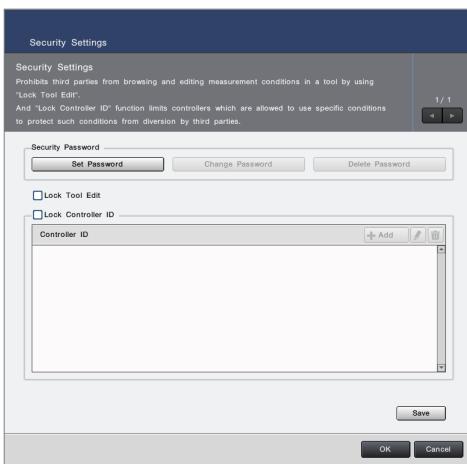
Security password

To enable the security function, a password must be set. This password used exclusively for the security function is required when editing or other operation of the security function. Note that the password cannot be changed again if you forget it. (Password can be set for each inspection setting).

- 1 Click [Utility] > [Security Settings].



- 2 Click [Password Settings] in the [Security Password] field, and set a password with 4 to 32 characters.



Enter a password to be registered in the [Password] and re-enter it in the [Password (Confirm)] for confirmation, and then click [OK].

- 3 If you do not want to add tools or edit from the toolbar, check [Lock Tool Edit].

The following items are prohibited by Lock Tool Edit.

- Addition of a new tool
- Editing (excluding items registered in the custom menu), deleting, copying, pasting and specified tool ID pasting of a tool
- Adjustment Navigation
- Batch Test

- 4 The current settings in controllers other than the registered controller ID cannot be used if the check box of [Lock Controller ID] is enabled.

The controller ID can be checked on the □ "System Information" (Page 8-18).



If the controller ID is different, the settings cannot be loaded.
Input of the security password allows for loading of settings.
In this case, the ID of the controller which loaded the settings is automatically registered.

- 5 After completing the setting, click [OK].

Change the registered password

- 1 Click [Change Password] in the [Security Password] field.

The [Change Security Password] screen appears.

- 2 Enter the currently used password in the [Old Password] and then enter a new password in the [New Password] and [New Password (Confirm)], and then click [OK].

Delete the registered password

- 1 Click [Delete Password] in the [Security Password] field.

The [Delete Security Password] screen appears.

- 2 Enter the password in the [Password], and then click [OK].

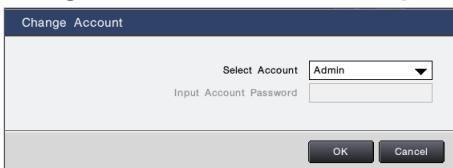
Change Account

Change the user account operating the controller
For details on user accounts that can be used on this device, see □ "Set Account" (Page 8-17).

- 1 Click [Utility] > [Change Account].



- 2 In [Select Account], select the desired account to change to and enter the account password.



- 3 Click [OK].

This changes the account.

Manage Files

From the [Manage Files] screen, files saved in the SD card or USB HDD can be managed, and the SD card or USB HDD can be verified/formatted.

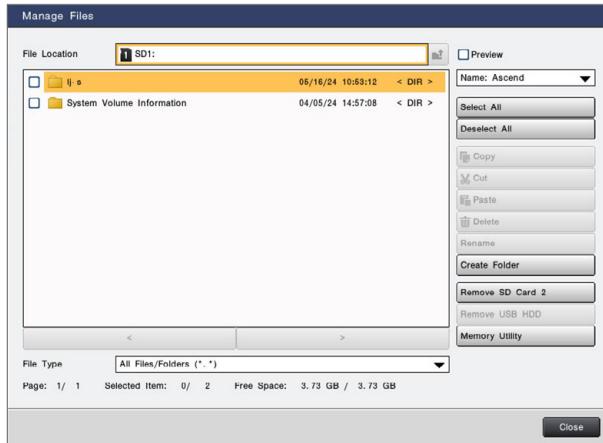
Point You cannot manage files on an FTP server with [Manage Files].

Displaying the [Manage Files] screen

1 Click [Utility] > [Manage Files].



The [Manage Files] screen appears.



2 Select [Close] to finish managing files.

Check files stored on SD card or USB HDD

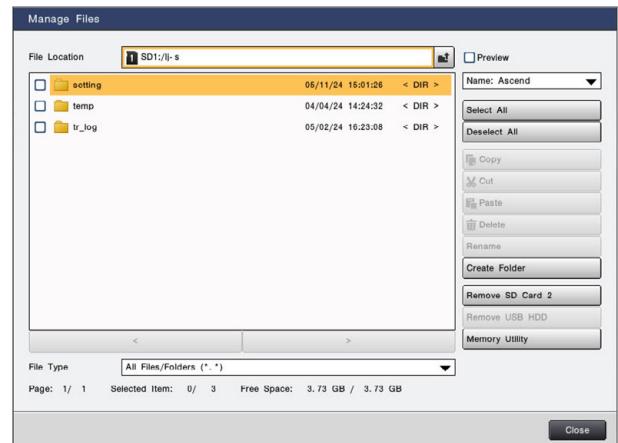
1 From the [Manage Files] screen, select the [File Location].

Considering SD card 1 as SD1, SD card 2 as SD2, and USB HDD as USB, the icons are displayed representing SD card 1, SD card 2, and USB HDD.



2 Click with the mouse over the drive or folder for which you want to check the contents.

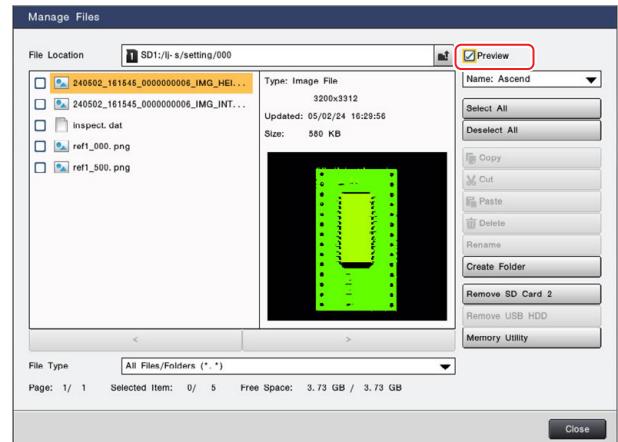
A list of files and folders contained in the folder is displayed.



To display the sub folder of a drive or folder, click [+] on the left of the drive or file location or folder icon.

Switch the display method of list display

Check [Preview] at the upper right of the screen if you want to display the contents of the image file,



Display order

The order for displaying the list of files and folders can be switched between ascending and descending order based on file name, last saved time, or file size.

To change the display order, select the desired display order from the menu on the right side of the screen.

Managing folders and files

Folders and files in the SD card or USB HDD can be managed just in the same way as folders and files on a computer.

Copying folders and files

To replicate folders and files follow this procedure.

- 1 Select the folders or files to be copied and enable the check mark in the list display screen.**
- 2 Select [Copy].**
A confirmation message appears.
- 3 Click [Close].**
- 4 In [File Location], select the duplicated folder or the location where you want to save the files.**
- 5 Select [Paste].**
A confirmation message appears.
- 6 Click [OK].**
The folders or files selected in step 1 are copied and added to the list display screen.

Moving folders and files

To move folders and files follow this procedure.

- 1 Select the folders or files to be moved and enable the check mark in the list display screen.**
- 2 Select [Cut].**
A confirmation message appears.
- 3 Click [Close].**
- 4 In [File Location], select the duplicated folder or the location where you want to save the files.**
- 5 Select [Paste].**
A confirmation message appears.
- 6 Click [OK].**
The folders or files selected in step 1 are moved.

Deleting folders and files

- 1 Select the folders or files to be deleted and enable the check mark in the list display screen.**
- 2 Select [Delete].**
A confirmation message appears.
- 3 Click [OK].**
- 4 Click [Close].**

Renaming folders and files

- 1 Select one folder or file to be renamed and enable the check mark in the list display screen.**
- 2 Click [Rename].**
The [Rename] screen appears.
- 3 Change the name of the folder or file and click [OK].**
 - "Entering Text" (Page 3-9)
A confirmation message appears.
- 4 Click [Close].**

Creating new folders

- 1 From the [File Location], select the location to create the folder.**
- 2 Click [Create Folder].**
The [Create Folder] screen appears.
- 3 Enter the folder name, then click [OK].**
 - "Entering Text" (Page 3-9)
A confirmation message appears.
- 4 Click [Close].**

Perform SD card 2 removal processing (Remove SD Card 2)

Choose [Remove SD Card 2] operation, then press the SD card in the SD2 slot inward to release and remove the card.



- Take the following steps to protect the SD card and the data it contains.
- When removing SD card 1, make sure to turn off the controller first.
- If you remove the SD card using a procedure other than that specified, or if power is turned off when the card is being accessed, any writing task will stop resulting in a possible loss of data or damage to the SD card.

1 From the [Manage Files] screen, select [Remove SD Card 2].

A confirmation message appears.

2 Click [OK].

The LED indicator turns off, indicating that SD card 2 can now be removed.

3 Press the SD card in the SD2 slot inward to release and remove the SD card.

Perform USB HDD removal processing (Remove USB HDD)

Remove the USB cable and the USB HDD after executing [Remove USB HDD].



- Be sure to follow the procedure to protect the USB HDD and the data it contains.
- If you remove the USB HDD using a procedure other than that specified, or if the power is turned off while the USB HDD is being accessed, the file saving operation will stop resulting in a possible loss of data or damage to the USB HDD.

1 In the [Manage Files] screen, select [Remove USB HDD].

A confirmation message appears.

2 Click [OK].

USB HDD can be removed.

3 Remove the USB cable and remove the USB HDD.

Checking and formatting SD cards and USB HDD (Memory Utility)

Formatting the SD cards and USB HDD (Format)



- When the memory is formatted, all data stored on the card will be lost. Formatting erases all of the data on the memory, and data cannot be restored. Copy the data from the memory onto an SD card or a computer before formatting the memory.
- When using a USB HDD on the controller, be sure to use the USB HDD formatted on the controller. If you use a USB HDD that has not been formatted on the controller, the data in the USB HDD may be damaged.

1 From the [Manage Files] screen select [Memory Utility].

The [Memory Utility] screen appears.



2 Select [Format] of SD card or USB HDD to be formatted.

A confirmation message appears.

3 Click [OK].

After formatting, a confirmation screen appears.

4 Click [Close].

Checking the SD card

If an error occurs within an SD card it may cause additional problems such as the inability to load files or the loss of files. If these types of problems occur, the Check function can be used to resolve such errors.

1 From the [Manage Files] screen select [Memory Utility].

The [Memory Utility] screen appears.

2 Select [Check] of the SD card to be verified.

A confirmation message appears.

3 Click [OK].

After the check is complete, the "Check is complete" confirmation message appears.

4 Click [Close].

Remove External Media

Removing SD Card 2

Choose [Remove SD Card 2] operation, then press the SD card in the SD2 slot inward to release and remove the card.



- Take the following steps to protect the SD card and the data it contains.
- When removing SD card 1, make sure to turn off the controller first.
- If you remove the SD card using a procedure other than that specified, or if power is turned off when the card is being accessed, any writing task will stop resulting in a possible loss of data or damage to the SD card.

1 Click [Utility] > [Remove External Media].



2 Select [SD Card 2].



3 Click [OK].

The LED indicator turns off, indicating that SD card 2 can now be removed.

4 When the confirmation screen appears to notify that it is ready for removal, select [OK] to close the confirmation screen.

5 Click [Close].

6 Press the SD card in the SD2 slot inward to release and remove the SD card.

Removing USB HDD

Remove the USB cable and the USB HDD after executing [Remove USB HDD].



- Be sure to follow the procedure to protect the USB HDD and the data it contains.
- If you remove the USB HDD using a procedure other than that specified, or if the power is turned off while the USB HDD is being accessed, the file saving operation will stop resulting in a possible loss of data or damage to the USB HDD.

1 Click [Utility] > [Remove External Media].



2 Remove [USB HDD].



3 Click [OK].

4 When the confirmation screen appears to notify that it is ready for removal, click [OK] to close the confirmation screen.

USB HDD can be removed.

5 Click [Close].

6 Remove the USB cable and remove the USB HDD.

Support Site

The PLC connection guide for the LJ-S8000 Series and references including video manuals are published on the internet.
To access the web site, read the QR code with a smartphone or tablet terminal or directly enter the URL.

● URL/QR code of the support site

Top page of the support site
www.keyence.com/support_ljs8000



PLC Connection Guide/Communications
www.keyence.com/communication_ljs8000



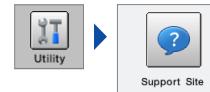
Video manual
www.keyence.com/video_ljs8000



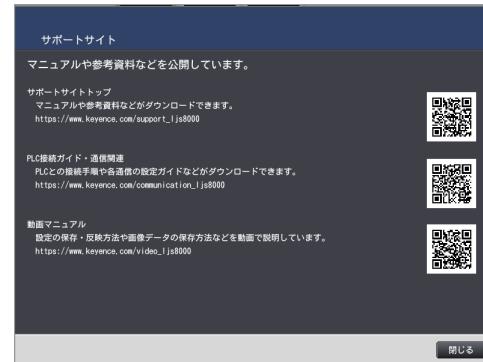
Accessing from mobile devices

You can read the QR code to access the site that directs you to a language selection page and then to a page in the selected language.

1 Click [Utility] > [Support Site].

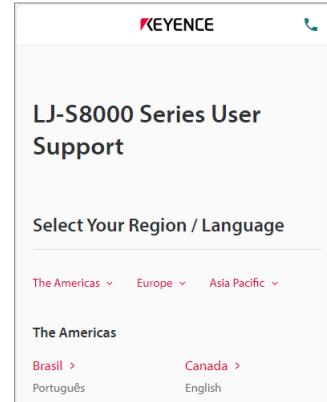


2 Read the QR code with a mobile device and select a language to display.

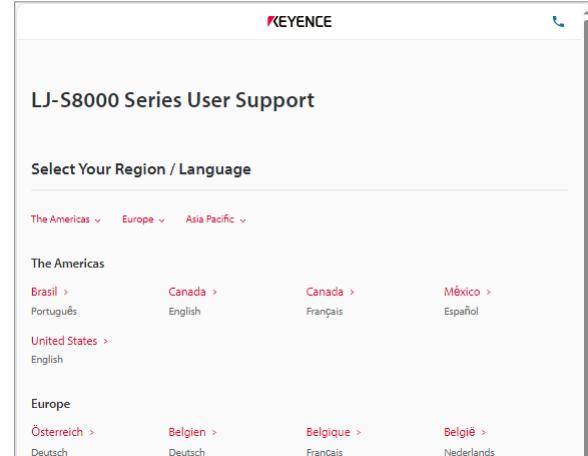


* Some devices can read the QR code with the standard camera app.

● In the case of a smartphone:



● In the case of a tablet:



3 You can access the page.

Chapter 8 Global Settings

External Input/Output Settings.....	8-2
System Settings.....	8-12

External Input/Output Settings

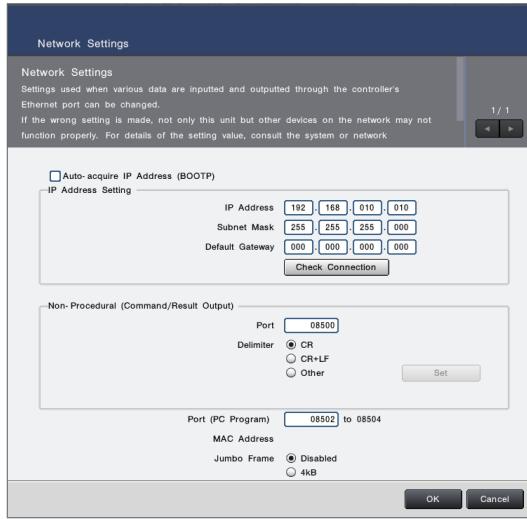
Network

You can change the settings for inputting and outputting various data on the Ethernet port of this unit. If you make a mistake, not only this unit but also the devices on the network may not operate properly. Consult your system administrator or network administrator about setting values.

Reference For details on input/output of signals from/to external devices, refer also to **“Chapter 9 Communication control” (Page 9-1).**

1 Select [Global] > [Communications & I/O] > [Network].

2 Change the settings as necessary.



● IP Address Setting

Set network configuration information (IP address and subnet mask, default gateway). To specify an IP address for this device, enter the IP address (initial configuration value: 192.168.10.10), the subnet mask (initial configuration value: 255.255.255.0) and the default gateway (initial configuration value: 0.0.0.0).

● Automatically Acquire IP Address (BOOTP)

Network setting information (IP address and subnet mask, default gateway) is acquired from the BOOTP server at controller startup (default setting: disabled). The received network information is reflected in the Global settings. When receiving the information from the BOOTP server fails at the next activation, the stored configuration is used for activation.

Reference Click on [Check Connection] and enter the IP address of the connection destination you wish to check to confirm if data transmission is possible with that connection destination.

● Non-Procedural (Command/Result Output)

○ Port number

Enter the port number to use when communicating without procedure (command/result output) (initial configuration value: 8500).

○ Delimiter

Select the delimiter of the Ethernet communication from among [CR] (initial configuration value), [CR+LF] and [Other]. When [Other] is selected, the delimiter can be specified for each function set of command and result outputs.

● Port (PC Program)

Inputs the first number of the three ports to use with the communication with the PC program (Default: 8502). The PC program uses three consecutive port numbers from the input value.

● Jumbo Frame

When using jumbo frames, select the frame size to use (4 kB; initial configuration value: disabled).

Point When using jumbo frames, they must be supported by all devices on the network.

3 After completing the setting, click [OK].

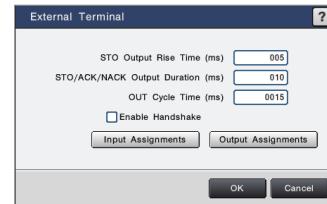
External Terminal

You can change the settings for inputting/outputting data with the external terminal (parallel I/O connector, terminal block) of this device.

Reference Please refer to **“Control/Data Output via I/O Terminals” (Page 9-43)** for more information on external terminals.

1 Select [Global] > [Communications & I/O] > [External Terminal].

2 Change the settings as necessary.



● STO Output Rise Time (ms)

Set the time required from finishing output data settings to STO startup from 1 to 999 (ms) (initial configuration value: 5 ms).

● STO/ACK/NACK Output Duration (ms)

Set the time required from starting up STO to shutting down STO from 5 to 999 (ms) (initial configuration value: 10 ms).

● OUT Output Switching Frequency (ms)

Set the time required from starting up STO to starting up the next STO from 2 to 1000 (ms) (initial configuration value: 15ms).

● Enable Handshake

Check this option to enable handshake for communication through the input/output terminals.

Reference You can only enable [Enable Handshake] if a PST has been assigned with input terminal assignment. Also, timeout is disabled as long as the handshake is enabled. For details, refer to **“With handshake” (Page 9-61)**.

● Input Assignments

Right click to display the [Input Assignments] screen. Choose the signal to be assigned to the terminal and click [OK].

Click “Filter Length Settings” to specify the signal filter length for the input terminal as 40 to 153600 ns (initial configuration value: 40000 ns) for F_IN* and 40 to 81264600 ns (initial configuration value: 40000 ns) for IN*.

● Output Assignments

Click to display the [Output Assignments] screen. Choose the signal and output format to be assigned to the terminal and click [OK].

○ Normally Open

Normal output method.

○ Normally Closed

All output terminals invert from Normally Open to allow output.

3 After completing the setting, click [OK].

Terminals that allow signal assignment modification

The input and output terminals for which the assigned signal can be changed from [Input Assignments] and [Output Assignments] are as follows.

● Input terminals

Terminal name	Initial Assignment	Assignable Signal
F_IN2	TEST	TEST
F_IN3	EXT	EXT
IN6	CMD_PARAM6	CMD_PARAM6, TEST, EXT
IN7	CMD_PARAM7	CMD_PARAM7, TEST, EXT
IN14	PST	PST, TEST, EXT
IN15	PLC	PLC, TEST, EXT

● Output terminal

Terminal name	Initial Assignment	Assignable Signal
F_OUT0	READY	READY
F_OUT1	EXPOSURE_BUSY	EXPOSURE_BUSY
F_OUT2	ERROR	ERROR
F_OUT3	RUN	RUN
OUT0	ACK	ACK, RUN, ERROR
OUT1	NACK	NACK, RUN, ERROR
OUT4	---	READY, RUN, ERROR
OUT5	---	RUN, ERROR, EXPOSURE_BUSY
OUT18	OUT_DATA12	OUT_DATA12, RUN, ERROR, OUTPUT_IMG_BUSY, OUTPUT_IMG_STATUS
OUT19	OUT_DATA13	OUT_DATA13, RUN, ERROR, OUTPUT_IMG_BUSY, OUTPUT_IMG_STATUS
OUT20	OUT_DATA14	OUT_DATA14, RUN, ERROR, OUTPUT_IMG_BUSY, OUTPUT_IMG_STATUS
OUT21	OUT_DATA15	OUT_DATA15, RUN, ERROR, OUTPUT_IMG_BUSY, OUTPUT_IMG_STATUS

RS-232C

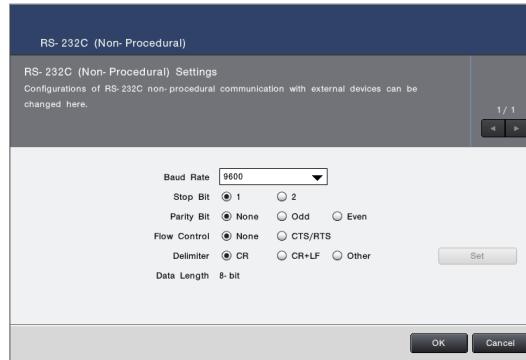
Use the following procedures to communicate with external devices in the RS-232C non-procedural mode.

Reference

- For details on input/output of signals from/to external devices, refer also to "Chapter 9 Communication control" (Page 9-1).
- Settings cannot be applied if PLC-Link (RS-232C) is enabled.

1 Select [Global] > [Communications & I/O] > [RS-232C].

2 Change the settings as necessary.



● Baud Rate

Select the baud rate from 9600 (initial configuration value) or from 19200, 38400, 57600, 115200, 230400 (bps).

● Stop Bit

Select [1] (initial value) or [2] for the stop bit.

● Parity Bit

Select the parity bit from [None] (initial configuration value) or [Odd]/[Even].

● Flow Control

Select the flow control from [None] (initial configuration value) or [CTS/RTS].

● Delimiter

Choose from [CR] (initial configuration value), [CR+LF] or [Other]. When [Other] is selected, the delimiter can be specified for each function set of command and result outputs.

● Data Length

Displays the data length for specified data transmission.

3 After completing the setting, click [OK].

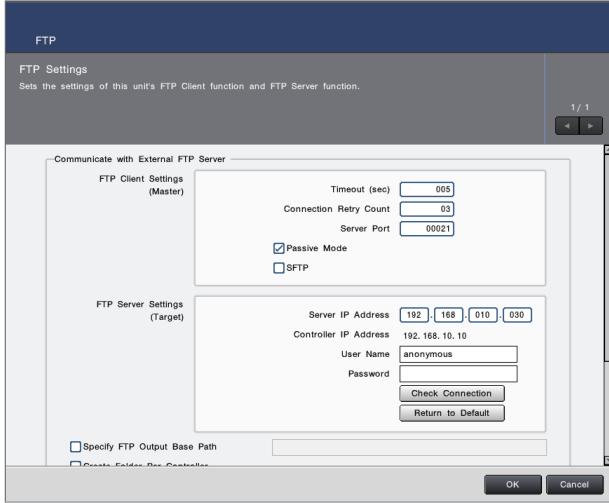
FTP

Various settings for operating the device as an FTP client or an FTP server can be changed (FTP: file transfer protocol).

Point If [FTP] is selected as the source and SFTP transfer is enabled, only ASCII characters can be used for the folder and file names.

1 Select [Global] > [Communications & I/O] > [FTP].

2 Change the settings as necessary.



● FTP Client Settings (Master)

The FTP function of this device can be used to access an FTP server (a hard disk drive compatible with a network having a PC or FTP server function) from an Ethernet interface.

○ Timeout (sec)

Enter the timeout time (s) for a response from the FTP server when outputting data (initial configuration value: 5 s).

○ Connection Retry Count

Enter the number of retries when a login error to the FTP server has occurred (initial configuration value: 1 time).

○ Server Port

Enter the control port number on the FTP server side (initial configuration value: 21. 22 when SFTP is in use).

○ Passive Mode

Check the box to use the FTP in passive mode (initial configuration value: Enabled (passive mode)).

○ SFTP

Select this check box to use SSH File Transfer Protocol (SFTP) (initial configuration value: Cleared).

Point When using SFTP, it is recommended that the controller's FTP server function be disabled to strengthen security.

● FTP Server Settings (Target)

○ Server IP Address

Specify the IP address of the FTP server.
(initial configuration value: 192.168.10.30)

○ Controller IP Address

The IP address of this device will be displayed.

○ Username

Enter the user name for logging into the FTP server.

○ Password

Enter the password for logging into the FTP server.

Point

- The FTP command "APPE" is used to output data to the FTP server on this controller. If your FTP server does not support the "APPE" command, data cannot be outputted.
- If there is a firewall on the FTP server or on the network path to the FTP server, it may fail to connect. If this is the case, you will need to take measures such as disabling the firewall. Please check with your network administrator or PC manufacturer for details.
- The FTP server function can be used at the same as the FTP client function. However, when using SFTP with the FTP client function, it is recommended that the FTP server function be disabled to strengthen security.

Reference

- Click on [Check Connection] and enter the IP address of the connection destination you wish to check to confirm if data transmission is possible with that connection destination.
- Click on [Return to Default] to restore the FTP server (connection destination) settings to their initial configuration values.

● Specify FTP Output Base Path

Ticking this box will allow you to specify the base path for the FTP output. Note that the base path specified here will be applied to all FTP outputs including result and image outputs.

● Create Folder Per Controller

If you tick this box, a folder with the controller's IP address as its name will be created and output via FTP is done. This option is useful as it allows you to separate the data when outputting data from multiple controllers to the same FTP server.

● Access Controller SD Cards

The device will operate as an FTP server. The SD card of the device can be accessed from an external FTP client through an Ethernet. Available users are [admin] (Administrator), [operator] (Operator) and [anonymous] ([operator] and [anonymous] are read-only users). The password is the same as that used for [Set Account].

○ Enable FTP Server

Check this box to use the device as an FTP server. The controller must be rebooted to enable changes to "Enabling FTP Server Function".

○ Allow Anonymous User

Check this box to enable access by anonymous users (initial configuration value: enabled). When the server is accessed by an anonymous user, files and folders on the terminal cannot be operated and files cannot be sent to the terminal (files may be acquired).

○ Listen Port

Enter the port number open to the FTP client (initial configuration value: 21). The controller must be rebooted to enable changes to [Listen Port].

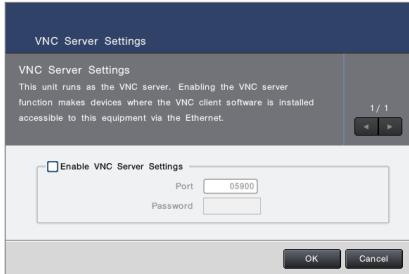
3 After completing the setting, click [OK].

VNC

This unit operates as a VNC server. By enabling the VNC server function, devices equipped with VNC client software can remotely access this machine via Ethernet.

1 Select [Global] > [Communications & I/O] > [VNC].

2 Change the settings as necessary.



● Enable VNC Server Settings

Check the box to use the VNC server function.

○ Port

Specify the communication port number used by the VNC server function. (initial configuration value: 5900)

○ Password

Enter the password used to access the VNC server.

3 After completing the setting, click [OK].

Tested VNC clients

We test connections with the following VNC clients.
(As of April 2024)

● PC software

- UltraVNC_1.2.2.3

● Touch panel displays (Supports Monitor screen display only.)

- KEYENCE VT3-XXX, VT5-XXX
- Digital Electronics Corporation GP-XXX series

PLC-Link

PLC-Link is a communication mode that directly inputs and outputs data memory of PLC (Programmable Logic Controller) in RS-232C interface or Ethernet interface of this unit. In addition to outputting measurement result data, you can also execute commands.

Reference

Please refer to ["Control/Data Output via the PLC-Link"](#) (Page 9-25) for more information on PLC-Link. EtherNet/IP, PROFINET and EtherCAT cannot be used in conjunction with PLC-Link. When using the RS-232C port, nonprocedural RS-232C communication cannot be used in conjunction with PLC-Link.

PLC-Link via RS-232C

Follow the steps below to enable PLC and PLC-Link via RS-232C. For more information about the data address, refer to ["Common Settings for PLC-Link"](#) (Page 8-7).

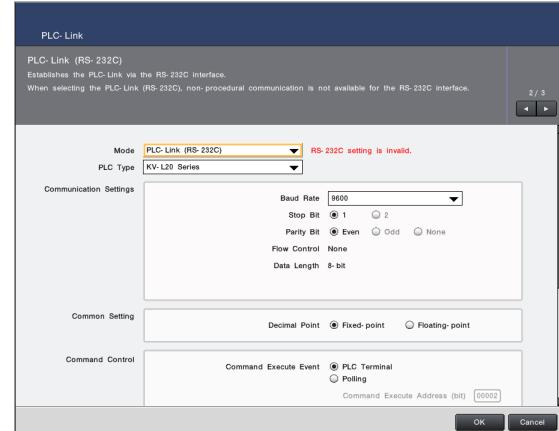
1 Select [Global] > [Communications & I/O] > [PLC Link].

2 Select [PLC-Link (RS-232C)] in [Mode], and then select the name of the series to be connected from [PLC Type].



The settings for the selected PLC type appear.

3 Change the settings as necessary.



Now, items specific to PLC-Link via RS-232C will be described. For details on PLC-Link common settings, refer to ["Common Settings for PLC-Link"](#) (Page 8-7).

● Communication Settings

○ Baud Rate

Select the baud rate for the RS-232C interface from 9600 (initial configuration value) or from 19200, 38400, 57600, 115200 and 230400 (bps).

○ Stop Bit

Select [1] (initial value) or [2] for the stop bit.

○ Parity Bit

Select [Even] (initial value), [Odd], or [None] for the parity bit.

○ Flow Control

Types of flow control will be displayed.

○ Data Length

Displays the data length for specified data transmission.

Reference Settings will be restricted as shown below depending on the selected PLC type.

	Baud Rate	Stop Bit	Parity Bit	Flow Control
KV-L20 Series	(Unlimited)	"1" Fixed	"Odd" Fixed	"None" Fixed
MELSEC AnN Series	(Unlimited)	(Unlimited)	(Unlimited)	"CTS/RTS" Fixed
MELSEC Q/L/iQ-R/iQ-F Series	(Unlimited)	(Unlimited)	(Unlimited)	"CTS/RTS" Fixed
MELSEC FX Series	"38400" "19200" "9600" only	(Unlimited)	(Unlimited)	"CTS/RTS" Fixed
SYSMAC C Series	"19200" "9600" only	(Unlimited)	(Unlimited)	"None" Fixed
SYSMAC CJ/CS1/CP1 Series	(Unlimited)	(Unlimited)	(Unlimited)	"None" Fixed
YASKAWA MP Series	(Unlimited)	(Unlimited)	(Unlimited)	"None" Fixed

4 After completing the setting, click [OK].

PLC-Link via Ethernet

Follow the steps below to enable PLC and PLC-Link via Ethernet. For more information about the data address, refer to "Common Settings for PLC-Link" (Page 8-7).

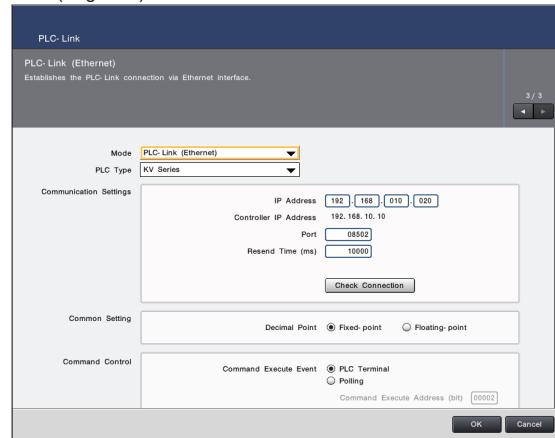
- Select [Global] > [Communications & I/O] > [PLC Link].
- Select [PLC-Link (Ethernet)] in [Mode], and then select the name of the series to be connected from [PLC Type].



The settings for the selected PLC type appear.

- Change the settings as necessary.

Now, items specific to PLC-Link via Ethernet will be described. For details on PLC-Link common settings, refer to "Common Settings for PLC-Link" (Page 8-7).



● IP Address

Specify the IP address of the communication destination unit (initial configuration value: 192.168.10.20). Make sure that the specified IP address is unique and different from the IP addresses for other devices.

● Controller IP Address

The IP address of this device will be displayed (initial configuration value: 192.168.10.10).

● Port

Enter the port number used for PLC-Link (initial configuration value: 8502 (KV series), 5000 (MELSEC Q/L/iQ-R/iQ-F), 9600 (SYSMAC CJ/CS1/CP1), 1024 (YASKAWA MP)). Specify the communication destination port for this device from 1025 to 4999 or 5010 to 65535 if connecting to a built-in MELSEC Q/L/iQ-R/iQ-F Ethernet port.

● Resend Time (ms)

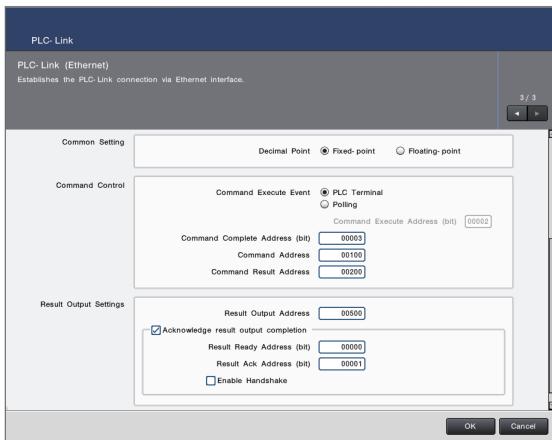
Sets the retry intervals (ms) at a transmission error (Default: 10000ms).

● NODE No. (when selecting SYSMAC)

Enter the node number used to identify the controller. Note that the node number must be unique for each device connecting to the identical network (Default: 001).

- After completing the setting, click [OK].

Common Settings for PLC-Link



Result Output Settings

Measurement Result Output Address

Specify the header address of the data memory where the measurement results are stored (default: 00500). The data memory to use is 2 words for each item. However for characters, 2 words for each character (1 byte).

Acknowledge result output completion

If enabled, 1 will be written to the data memory specified in [Result Ready Address (bit)] when the measurement result output is completed. If disabled, care must be taken for the data reception timing, but the time to write 1 to [Result Ready Address (bit)] can be shortened.

Result Ready Address (bit)

Specify the address of the data memory for the unit to notify the PLC that the measurement result data has been written (initial configuration value: 00000). The used data memory is 1 word. The unit writes 1 when the data output for one measurement has been completed successfully.

Result Ack Address (bit)

Notify that the measurement result data stored in the data memory specified by the measurement result output address has been confirmed by the PLC, and specify the data memory address to be used when requesting the writing of the next measurement result data from this machine (initial configuration value: 00001). The used data memory is 1 word. When the PLC writes 1 to the Result Output Control Address (bit), the machine writes the Result Output Completion Address (bit) back to 0. Also, write 0 when writing the next measurement result to this unit.

Enable Handshake

The Handshake keeps this controller from loading its measurement result output data to the memory until it acknowledges that the PLC has received the last output data. If enabled, this device will write 1 to a result output completion address (bit) when measurement result output is complete. Upon reception of this, the PLC checks the result output area and writes 1 to the Result Ack Address (bit). The device will detect this and write 0 to the result output completion address (bit). If the PLC requests that the next measurement results are written, the device will write 0 to the result output control address (bit).

Common Setting

Decimal Point

Select the data expression method when outputting result data.

Fixed-point (default)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data. (address m: lower 16 bit, address m+1: higher 16 bit).

Floating-point

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

Command Control

Command Execute Event

Select the method of executing the command when issuing the command using PLC-Link.

PLC Terminal (initial configuration value)

Executes a command at a rising edge of the PLC terminal.

Polling

Monitor (poll) the value of the data memory specified in the [Command Execute Address (bit)] and execute the command when the value of the data memory at this address changes from 0 to 1.

Command Execute Address

Used when [Command Execute Event] is [Polling] (initial setting: 00002). The used data memory is 1 word. The command is executed when the value of this address data memory changes from 0 to 1.

Command Complete Address

Specify the address of the data memory that notifies that writing to [Command Result Address] is completed after the command execution is completed (initial setting: 00003). The used data memory is 1 word.

Command Address

Specify the head address of data memory that stores command codes and parameters executed by this device (initial configuration value: 00100).



The command code and parameter are specified by 2 words each.

Command Result Address

Specify the heading address of the data memory where the machine stores the command execution result (default: 00200). If command execution fails, an error code is stored.

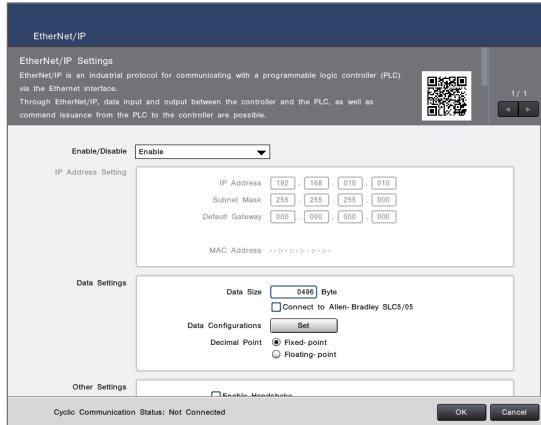
EtherNet/IP

EtherNet/IP is an industrial protocol for communicating with a programmable logic controller (PLC) via the Ethernet interface. Through EtherNet/IP, data can be input/output between PLC and this machine, and commands can be issued from PLC to this machine.

Reference For details on communication/control using EtherNet/IP, also refer to ["Overview of Control and Data Output by EtherNet/IP"](#) (Page 9-66).

1 Select [Global] > [Communications & I/O] > [EtherNet/IP].

2 Change the settings as necessary.



● Enable/Disable

Select whether to communicate via the controller's Ethernet port or via an EtherNet/IP unit.

○ Disable

EtherNet/IP communication is not performed.

○ Enable

Select this option to communicate via the controller's Ethernet port.

○ Enable Unit

Select this option to communicate via an EtherNet/IP unit connected to the controller.

Reference PLC-Link, PROFINET, and EtherCAT cannot be used in conjunction with EtherNet/IP.

● IP address

Enter the IP address of the PROFINET unit (initial configuration value: 192.168.10.20).

● Subnet Mask

Enter the subnet mask of the EtherNet/IP unit (initial configuration value: 255.255.255.0).

● Default Gateway

Enter the IP address of the default gateway of the EtherNet/IP unit (initial configuration value: 0.0.0.0).

● Enable DHCP

Select this check box to automatically assign the IP address, subnet mask, and default gateway (only settable when the EtherNet/IP unit is enabled). Initial configuration value: disabled).

● MAC Address

- If you select [Enable] in [Enable/Disable], the MAC address of the Ethernet port is displayed.
- If you select [Enable unit] in [Enable/Disable], the MAC address of the EtherNet/IP unit is displayed.

● Data Size

Specifies the data size of Assembly Object in the cyclic communication and the message communication (Default: 496 byte). For the cyclic communication, a connecting PLC is given priority to specify data size. Therefore, the data size specified here may differ from that in actual processing. Use a PLC compatible with Large Forward Open in order to transact data exceeding 496 byte.

● Connect to Allen-Bradley SLC5/05

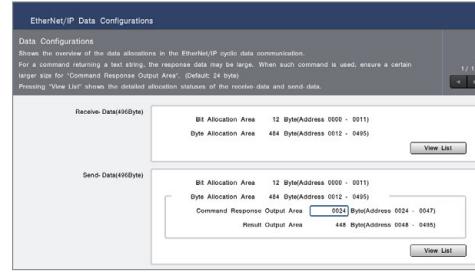
Checking the box limits the data size settable up to 248 byte. PLCs specified here do not support the cyclic communication, therefore, the data size of Assembly Object in the message communication should be changed according to the specifications of the PLCs.

Reference

- Although there is no problem if the cyclic communication data size set at the controller is not the same as the cyclic communication data size on the PLC side, it is recommended that the same value as the PLC data size be set so that the allocated data can be sent and received correctly.
- The value set here is used as the data size when accessing assembly object input data (instance 100, attribute 3) and output data (instance 101 [if using the unit's Ethernet port] / 150 [if using the communication expansion unit], attribute 3) during message communication.

● Data Configurations

Click [Set] to display an overview of data assignment in EtherNet/IP cyclic communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for [Command Response Output Area]. (initial configuration value: 24 byte) Click [View List] shows the detailed allocation statuses of the receive-data and send-data.



○ Receive-data

Displays an overview of the allocations for data received by the controller from the PLC.

○ Send-data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

● Decimal Point

Select the decimal point notation of result data output and decimal-related commands.

○ Fixed-point (initial configuration value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

E.g.: "1.234" is output as "1234".

○ Floating-Point

The data is handled as 32-bit single-precision floating decimal point data.

Reference

For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

● Enable Handshake

The Handshake keeps this controller from loading its measurement result output data to the memory until it acknowledges that the PLC has received the last output data. If enabled, the controller turns on the "Result ready flag" after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on the "Result ack flag". The controller detects this and turns off the "Result ready flag". The PLC turns off the "Result ack flag" to request the controller to load the next output data.

● Create EDS File

Outputs an EDS file and icon that include information related to the controller EtherNet/IP functions. The naming rules for these files are as shown below.

○ Controller:

- Keyence_3010_0101.eds
- LJ-S_Series.ico

○ Communication expansion unit (CB-NEP20E)

- Keyence_3011_0101.eds
- LJ-S-CB-NEP.ico

Reference

- The file output path is SD2:/lj-s/EDS on the controller and SD2/lj-s/EDS_EX on the communication expansion unit.
- Since the EDS file does not contain the information that was set or changed in the controller global settings, the created EDS file will always contain the same information.

3 After completing the setting, click [OK].

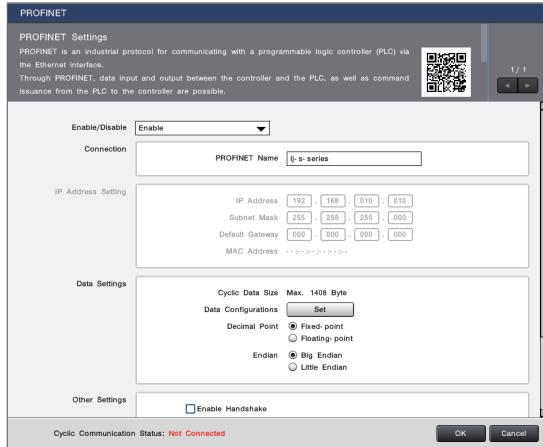
PROFINET

PROFINET is an industrial protocol for communicating with a programmable logic controller (PLC) via the Ethernet interface. Through PROFINET, data input and output between the controller and the PLC, as well as command issuance from the PLC to the controller are possible.

Reference For details about communication/control using PROFINET, also refer to "Overview of control and data output by PROFINET" (Page 9-90).

1 Select [Global] > [Communications & I/O] > [PROFINET].

2 Change the settings as necessary.



● Enable/Disable

Select whether to communicate via the controller's Ethernet port or via a PROFINET unit.

○ Disable PROFINET

PROFINET communication is not performed.

○ Enable PROFINET

Select this option to communicate via the controller's Ethernet port.

○ Enable PROFINET unit

Select this option to communicate via a PROFINET unit connected to the controller.

Reference PLC-Link, EtherNet/IP, and EtherCAT cannot be used in conjunction with PROFINET.

● PROFINET Name

Specifies a unique name of this controller so that the connecting PLC can identify the controller in PROFINET network. Unless a proper name is specified, the PLC cannot find the controller and cannot ensure PROFINET communication. A name to be specified here must be identical to that given to this controller when the PLC configures its PROFINET specifications.

● IP Address

Enter the IP address of the PROFINET unit.
(initial configuration value: 192.168.10.20)

● Subnet mask

Enter the subnet mask of the PROFINET unit.
(initial configuration value: 255.255.255.0)

● Default gateway

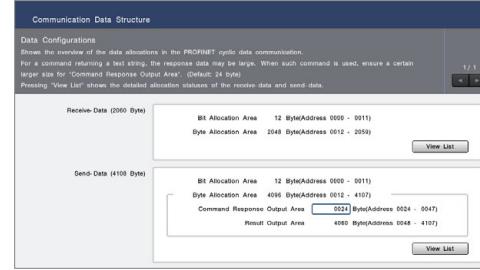
Enter the IP address of the default gateway of the PROFINET unit (initial configuration value: 0.0.0.0).

● MAC Address

- If you select [Enable] in [Enable/Disable], the MAC address of the Ethernet port is displayed.
- If you select [Enable PROFINET unit] in [Enable/Disable], the MAC address of the PROFINET unit is displayed.

● Data Configurations

Left-click [Set] to display an overview of data allocations in Shows the overview of the data allocations in the PROFINET cyclic data communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for [Command Response Output Area]. (initial configuration value: 24 byte) Pressing [View List] shows the detailed allocation statuses of the receive-data and send-data.



○ Receive-data

Displays an overview of the allocations for data received by the controller from the PLC.

○ Send-data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

● Decimal Point

Select the decimal point notation of result data output and decimal-related commands.

○ Fixed-point (initial configuration value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

○ Floating-Point

The data is handled as 32-bit single-precision floating decimal point data.

Reference For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

● Endian

Endian is a method of arranging multi-byte data in the PLC data memory. Select a correct endian according to the type of PLC (default: big endian). The endians for typical PLC are as shown below.

- Siemens: Big endian
- Omron: Little endian

● Enable Handshake

The Handshake keeps this controller from loading its measurement result output data to the memory until it acknowledges that the PLC has received the last output data. If enabled, the controller turns on the "Result ready flag" after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on the "Result ack flag". The controller detects this and turns off the "Result ready flag". The PLC turns off the "Result ack flag" to request the controller to load the next output data.

● Issue Alarm Manually

Checking [Issue Alarm Manually] box will issue an alarm under PROFINET protocol through an alarm CR function. Click the wheel button of the mouse to actually issue the alarm.

● Create GSDML File

Outputs a GSDML file and icon that include information related to the controller PROFINET functions. The naming rules for these files are as shown below.

○ Controller:

- GSDML-V2.43-Keyence-LJ-S_Series-20240322.xml
- GSDML-01FD-0BBE-LJ-S_Series.bmp

○ Communication expansion unit (CB-NPN20EA)

- GSDML-V2.34-Keyence-LJ-X8K-CB-NPN20E-20200305.xml
- GSDML-01FD-LJ-X8K-CB-NPN20E.bmp

Reference The file output path is SD2:/lj-s/GSDML on the controller and SD2:/lj-s/GSDML_EX on the communication expansion unit.
Because the GSDML file does not contain the information that was set or changed in the controller global settings, the created GSDML file will always contain the same information.

3 After completing the setting, click [OK].

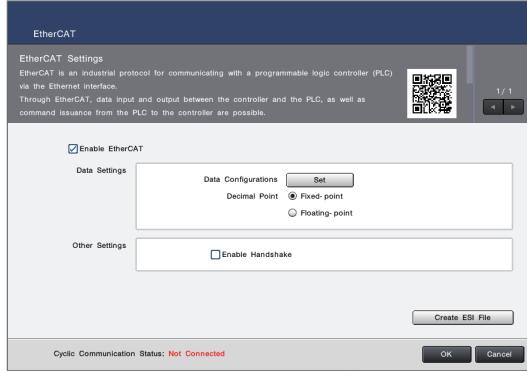
EtherCAT Unit

EtherCAT is an industrial protocol for communicating with a programmable logic controller (PLC) via the Ethernet interface. Through EtherCAT, data can be input/output between PLC and this machine, and commands can be issued from PLC to this machine.

Reference For details about communication/control using EtherCAT, also refer to [“Overview of Control/Data Output Using EtherCAT” \(Page 9-102\)](#).

1 Select [Global] > [Communications & I/O] > [EtherCAT Unit].

2 Change the settings as necessary.



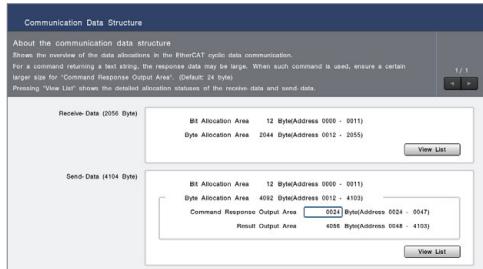
● Enable EtherCAT

Select whether to use EtherCAT. Check this box to enable.

Reference When PLC-Link, EtherNet/IP, or PROFINET is enabled, EtherCAT cannot be used. Disable these other protocols.

● Data Configurations

Click [Set] to display an overview of data allocations in the EtherCAT cyclic data communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for [Command Response Output Area]. (initial configuration value: 24 byte) Pressing [View List] shows the detailed allocation statuses of the receive-data and send-data.



○ Receive-data

Displays an overview of the allocations for data received by the controller from the PLC.

○ Send-data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

● Decimal Point

Select the data notation of result data output and data that handles decimal points with command control.

○ Fixed-Point (initial configuration value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

○ Floating-Point

The data is handled as 32-bit single-precision floating decimal point data.

Reference For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

● Enable Handshake

The Handshake keeps this controller from loading its measurement result output data to the memory until it acknowledges that the PLC has received the last output data.

If enabled, the controller turns on the “Result ready flag” after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on the “Result ack flag”. The controller detects this and turns off the “Result ready flag”. The PLC turns off the “Result ack flag” to request the controller to load the next output data.

● Create ESI File

Outputs an ESI file that includes information related to the controller's EtherCAT function. The naming rules for the file are as follows.

- File Output Path: SD2:/lj-S/ESI
- ESI File Name: Keyence_LJ-S_CB-NEC_Series.xml

Reference Because the ESI file does not contain the information that was set or changed in the controller global settings, the created ESI file will always contain the same information.

3 After completing the setting, click [OK].

SNTP

The Simple Network Time Protocol (SNTP) is a communication protocol for synchronizing the times of devices connected on the network. Enabling SNTP using the controller installed on a network that can communicate with the SNTP server will allow you to connect to the SNTP server to acquire the correct time and periodically synchronize the time of the controller.

1 Select [Global] > [Communications & I/O] > [SNTP].

2 Change the settings as necessary.



● Enable SNTP

Choose whether to connect to the SNTP and synchronize times. Check this box to enable.

● SNTP Server Settings (Connection Destination)

Server IP Address: Specify the IP address of the SNTP server (initial configuration value: 192.168.10.40).

Click on [Check Connection] and enter the IP address of the connection destination you wish to check to confirm if data transmission is possible with that connection destination.

● Time Zone

Select the timezone of the time acquired from the SNTP server (initial configuration value: 14: GMT).

Main Timezones	
• 4:GMT -8:00	Pacific Time Zone
• 6:GMT -6:00	Central Standard Time, Mexico City, Central America
• 9:GMT -4:00	Atlantic Standard Time
• 11:GMT -3:00	Brasilia
• 12:GMT -2:00	Mid-Atlantic
• 14:GMT	London, Coordinated Universal Time
• 15:GMT +1:00	Berlin, Brussels, Rome, Paris, Bern
• 16:GMT +2:00	Athens, Jerusalem
• 17:GMT +3:00	Kuwait
• 19:GMT +4:00	Moscow
• 22:GMT +5:30	New Delhi
• 26:GMT +7:00	Bangkok
• 27:GMT +8:00	Kuala Lumpur, Singapore, Taipei, Beijing
• 28:GMT +9:00	Japan, Seoul
• 30:GMT +10:00	Canberra, Sydney

● Update Cycle (min.)

Set the cycle at which to acquire time from the SNTP server (initial configuration value: 1).

3 After completing the setting, click [OK].

If an error occurs when attempting to synchronize time with the server, an error message will be displayed at the bottom left of the screen. This error message will continue to be displayed until the correct synchronization at the next update cycle or the SNTP is reconfigured.

System Settings

Controller Name

Enter a controller name.

The set name will be displayed in "System Information" (Page 8-18).

1 Select [Global] > [System Settings] > [Controller Name].

2 Enter the name of the controller.



The name of the controller must not be longer than 32 characters. Only alphabet characters may be used.

3 Click [OK].

Choose the standard save format of the standard image (Reference Image File Type)

Specify the initial save format of the standard image. The standard image registration by the command is always performed in the save format specified here.

Specifying "JPG" as the save format has the following advantages and disadvantages. Please choose the save format to match the purpose of use.

- Advantage:
You can save more standard images or inspection settings on the SD card because the file size is compressed.
- Disadvantage:
 - The measurement result where the BMP format (uncompressed) standard image is performed as standard may differ because the image information taken undergoes compression.
 - It may take more time to change the inspection settings compared to when using a BMP format standard image because a compressed image is unpacked when changing the inspection settings.
 - The file size of the image and the number of savable images may vary because the compression rate varies depending on the content of the image.
 - Due to image degradation attributable to compression, correct height data cannot be obtained if a [JPEG] height image is specified (this degradation does not happen with the [PNG] format because its compression is lossless). Use the [BMP] or [PNG] save format with height images.

1 Select [Global] > [System Settings] > [Reference Image File Type].

2 Change the settings as necessary.



- PNG (initial configuration value): Saves the images in PNG format.
- BMP: Bitmap format
- JPG: JPEG format

3 Click [OK].

Point

"3D Observation" (Page 7-3) The format for saving images displayed in the VIEW bar for 3D Observation () can be selected from PNG, BMP or CSV.

Image Capture Settings

Change the save destination, naming rules and file type for image files that are saved when saving the screen of the device displayed on the external monitor as an image (screen capture). A screen capture can be taken from the common context menu by holding the right button down for around 1 second on the screen. The folder for output can be specified because the FTP can be specified via a command.

Division rules, naming rules and file type of the image files saved via screen capture can be changed.

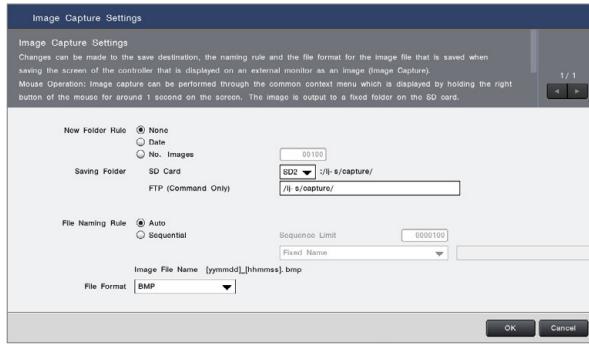


When using a command to save a screen capture to the FTP with SFTP transfer, only ASCII characters can be used for the folder and file names.

"FTP" (Page 8-4)

1 Select [Global] > [System Settings] > [Image Capture Settings].

2 Change the settings as necessary.



● New Folder Rule

This option specifies how to split a folder for saved captured images.

None (initial configuration value)

Save all screen capture images in the designated folder without folder division.

Date

Create a new folder "YYMMDD" for each output to the designated folder and save the screen capture from that date in that folder. When the date changes, a new folder is created and the screen capture saving location is changed.

No. Images

Create a new folder "YYMMDD_HHMMSS" in the designated folder for each save and save the screen capture from that date and time in that folder. When the number of files stored in the folder exceeds the specified value, a new folder is created and the destination of the captured data is changed accordingly.



If [No. Images] is selected, the output folder is created upon the first screen capture after the following times.

- The controller is turned on.
- Any of the image capture settings is changed.

● Saving Folder

SD card

Saved in SD1 or SD2: /j-s/capture/.

FTP

You can specify the FTP output folder using the communication command as it allows you to select an FTP server as the file save destination.



- The FTP command "APPE" is used to output data to the FTP server on this controller. If your FTP server does not support the "APPE" command, data cannot be outputted.
- If there is a firewall on the FTP server or on the network path to the FTP server, it may fail to connect. If this is the case, you will need to take measures such as disabling the firewall. Please check with your network administrator or PC manufacturer for details.

● File Naming Rule

Select naming rules for files on screen capture.

Auto (initial configuration value)

Will have the file name "[Date and time at time of screen capture].[save type]".

Sequential

Will have the file name "[Sequential]_[String].[Save Format]". Specify the maximum sequential number in the [Sequence Limit] field. Since the serial number returns to 0 when it exceeds the maximum serial number, the old output data file may be overwritten when folder division is set to [None] [Date], or the specified number of [No. Images] is larger than the maximum serial number.

Specify the [Fixed Name] field or the [Externally Specified String] field for the [String].

When the [Fixed Name] is specified, the file name is set to the character string entered in the text box (max. 64-byte characters).

When the [Externally Specified String] is specified, the file name is initially set to the character string entered in the text box (max. 64-byte characters). The external fixed name can be updated with the STW command from an external device.

● File Format

Select save format for files on screen capture.

- BMP (initial configuration value): Save files as bitmap files.
- JPG: Save files as JPEG files.
- PNG: PNG format

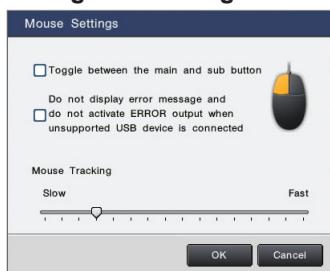
3 After completing the setting, click [OK].

Mouse Settings

Change the mouse pointer speed and the functions of the left and right buttons.

1 Select [Global] > [System Settings] > [Mouse Settings].

2 Change the settings as necessary.



● Toggle between the main and sub button

Checking this box allows the right/left button function of the mouse to be toggled.

● Do not display error message and do not activate ERROR output when unsupported USB device is connected

When this check box is selected, there is no error message displayed or ERROR output when an unsupported USB device is connected.

● Mouse Tracking

Set the migration speed of the mouse pointer.

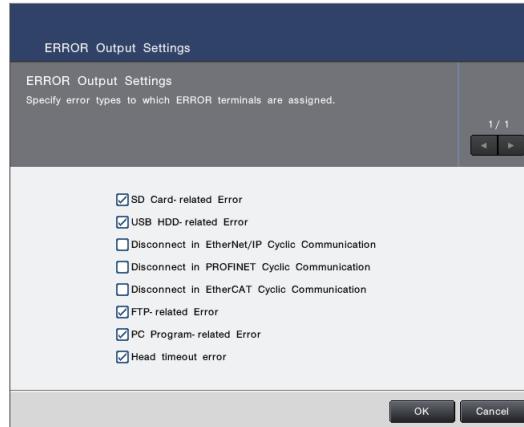
3 After completing the setting, click [OK].

ERROR Output Settings

Items associated with ERROR terminal output can be specified.

1 Select [Global] > [System Settings] > [ERROR Output Settings].

2 Check the error to be output from the ERROR output terminal.



The error is not output when the box is unchecked.

● SD Card-related Error

If an error related to the SD card has occurred, the ERROR output terminal is turned ON (initial configuration value: enabled).

● USB HDD-related Error

If an error related to the USB HDD has occurred or an unsupported USB device has been connected, the ERROR output terminal is turned ON (initial configuration value: enabled). When the check box for [Do not display error message and do not activate ERROR output when unsupported USB device is connected] is selected in [Mouse Settings], the ERROR output terminal is turned ON when an unsupported USB device is connected.

● Disconnect in EtherNet/IP Cyclic Communication

When shutting off EtherNet/IP cyclic communication, the ERROR output terminal is turned ON (initial configuration value: disabled).

● Disconnect in PROFINET Cyclic Communication

When shutting off PROFINET cyclic communication, the ERROR output terminal is turned ON (initial configuration value: disabled).

● Disconnect in EtherCAT Cyclic Communication

When shutting off EtherCAT cyclic communication, the ERROR output terminal is turned ON (initial configuration value: disabled).

● FTP-related Error

If an error related to FTP has occurred, the ERROR output terminal is turned ON (initial configuration value: enabled).

● PC Program-related Error

If an error related to the PC application has occurred, the ERROR output terminal is turned ON (initial configuration value: enabled).

● Head timeout error

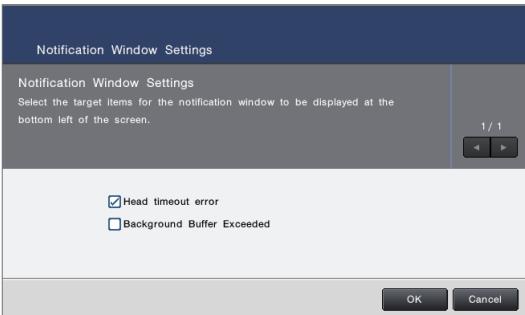
Turns on the ERROR output terminal when a timeout occurs for internal head processing (default: Enable).

3 After completing the setting, click [OK].

Notification Window Settings

1 Select [Global] > [System Settings] > [Notification Window Settings].

2 Change the settings as necessary.



● Head timeout error

Displays a notification window when a timeout occurs for internal head processing.

● Background Buffer Exceeded

Displays a notification window when the front imaging number has been reached.

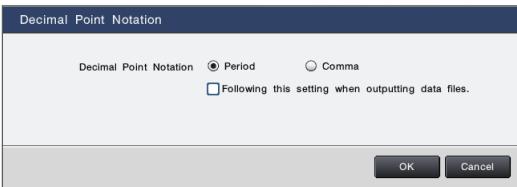
3 Click [OK].

Decimal Point Notation

How to display decimal points in numerical boxes and when displaying results can be specified.

1 Select [Global] > [System Settings] > [Decimal Point Notation].

2 Change the settings as necessary.



● Period (initial configuration value)

Display decimals after periods.

● Comma

Display decimals after commas.

3 Click [OK].

Change the display settings common between the tools (Tool Common Display Settings)

You can set the display settings for the region lines, zero planes, icons on the image display and the Display Tool List button as common display settings among different tools.

1 Select [Global] > [System Settings] > [Tool Common Display Settings].

2 Change the settings as necessary.



● Region Line Display

○ Line Thickness (pt)

You can change the thickness of the area line (initial value: 6 pt).

● Zero Plane Display

○ Without 3D Shape Correction

Generates the Zero Screen Display image by subtracting the height of the Zero Screen. The 3D shape displays with the Zero Screen slanting.

○ With 3D Shape Correction (initial configuration value)

Even if the zero plane tilts in the direction of the cross section, there will be no 3D shape distortion.

● Icon Display on the Data Display

○ Always Display (initial configuration value)

Always display icons on the data screen where there is focus.

○ Never Display

Do not display icons.

○ Display During Mouseover

Display icons only when the mouse is on the data screen.

● Display Tool List Button Display

○ Always Show (initial configuration value)

The Display Tool List button will always be displayed.

○ Display During Mouseover

The Display Tool List button will be displayed only when the mouse is on the toolbar.

3 Click [OK].

Startup Mode Settings

Select the Run mode when turning on this device among Configuration Mode and Run mode.

1 Select [Global] > [Startup Mode Settings].

2 Change the settings as necessary.



● Run Mode

Startup the device in Run mode when the device is turned on.

● Configuration Mode (initial configuration value)

Startup the device in Configuration Mode when the device is turned on.

● Startup Hiding Menu Bar

When this box is checked, the controller starts wherein the menu bar will be in hidden state when operation screens S00 - S09 are selected.

3 After completing the setting, click [OK].

Set Account

Change settings such as passwords and authority for the accounts of administrators, operators and visitors prepared as accounts for this device.

Administrator

Can use all functions of this device. To restrict the permission for data setting and system operation, change this option to the operator or user account.

Operator

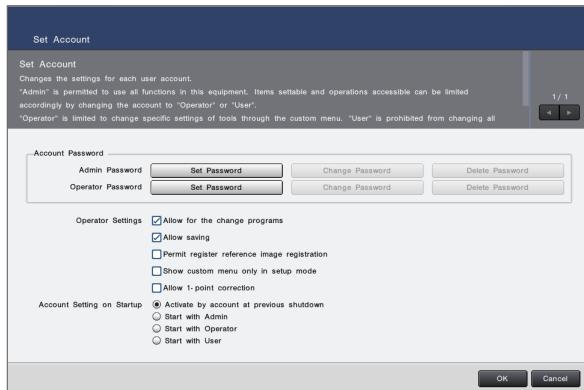
Limited to setting only some items.

User

Cannot change any settings.

1 Select [Global] > [Set Account].

2 Change the settings as necessary.



● Account Password

□ "Protect from Incorrect Operation" (Page 8-17)

● Operator settings

Check the operations to allow.

Activate by account at previous shutdown

Check this box to allow the operator to change programs.

Allow saving

Check this box to allow the operator to change and save the settings.

Permit register reference image registration

Check this to allow standard image to be registered.

"Operator" accounts can also use this standard image registration button.

Show custom menu only in setup mode

Check this box to always display the custom menu with "Operator" account when Setup mode is entered.

Allow 1-point correction

Check this box to allow 1-point correction.

● Account Setting on Startup

Select the account to be used upon startup.

Account at Last Shutdown (initial configuration value)

Use account that was used at last shutdown.

Start with Admin

Always startup using the administrator account, regardless of the account used at the time of last shutdown.

Start with Operator

Always startup using an operator account, regardless of the account used at the time of last shutdown.

Start with User

Always startup using a visitor account, regardless of the account used at the time of last shutdown.



If this device is accessible to anyone who is not a system administrator upon startup, select "Start with Operator" or "Start with User" to prevent any accident unexpectedly caused by incorrect setting.

3 After completing the setting, click [OK].

Protect from Incorrect Operation

Specify a password required when changing to the administrator or operator account.

■ Change the password

1 Click [Password Settings].

2 Enter a password to be registered in the [Password] and re-enter it in the [Password (Confirm)] for confirmation, and then click [OK].



■ Change the registered password

1 Click [Change Password].

2 Enter the currently used password in the [Old Password] and then enter a new password in the [New Password] and [New Password (Confirm)], and then click [OK].



■ Delete the registered password

1 Click [Delete Password].

2 Enter the password in the [Password], and then click [OK].



Date & Time

Set the date for the time stored in the device. The in-built date and time can be used for recorded dates and times when data is written from the device.

1 Select [Global] > [Date & Time].

2 Configure the date settings.



3 After completing the setting, click [OK].

Language

The language displayed on the screen of the controller can be changed.

1 Select [Global] > [Language].

2 Select the display language.



The device must be rebooted after changing language settings to display the new language.

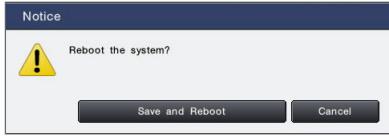
3 After completing the setting, click [OK].

Reboot

The controller can be rebooted without turning off the power.

1 Select [Global] > [Reboot].

2 Click [Save and Reboot].



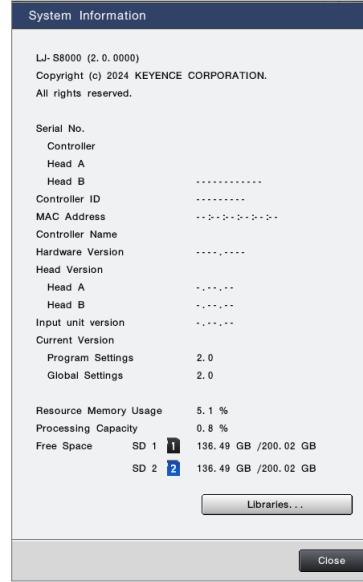
The device will reboot.

System Information

Check hardware information, free space in memory and other aspects of this device.

1 Select [Global] > [System Information].

2 Confirm information.



Model (version number)

Displays the model, application mode and version of the controller.

Serial No.

Displays the serial number of this device and the head connected.

Controller ID

Displays the fixed ID assigned to the controller.

MAC Address

Displays the MAC address of this device (cannot be changed).

Controller Name

Displays the name of the controller set in this device.

Hardware Version

Displays the version of hardware used in this device.

Head version

Displays the version of the head connected.

Input unit version

Displays the version of the input unit connected to this controller.

Current Version

Displays the version of the program settings file and global settings file currently used by this device.

Resource Memory Usage

Displays the capacity of the current resource memory.

Processing Memory Capacity

Displays the capacity of the current working memory.

Free space

Displays the amount of free space on the SD cards currently installed in each slot in the form of "free space/total space".

3 After confirmation, click [Close].

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List of Communication Control Commands

Notes on command input/output

When using non-procedural commands

● Command input during operation

- Usually, command input is accepted during operation. However, if commands need to be executed in a high-speed operation line, the execution of commands may suspend image acceptance.
- The execution time of a command depends on the amount of load on the controller and the type of operation performed on the image processing side. For the use in which a program must wait for command execution to be completed before starting the next inspection, be cautious of the waiting time fluctuation according to the conditions mentioned above.

● Number of characters for command parameters

Any number of parameter characters within the range specified for each command can be entered.

● When an error occurs on command acceptance

An error response "ER, **, nn" will be returned.

The error response consists of the following information:

- **: Received command that caused the error
- nn: 2-digit error code
 - 02: Command error (The received command is invalid.)
 - 03: Command action disabled (The received command cannot work.)
 - 22: Parameter error (The value of parameter data or the number of data pieces is outside the range.)
 - 91: Timeout error

● An example of error output

When the No. 1005 (unavailable number) is specified for program No. changing command (PW), "ER,PW,22" is returned as response data.

When using number-specified commands

Specification and execution of each command number is processed in 1 word.

● Command input during operation

Usually, command input is accepted during operation. However, if commands need to be executed in a high-speed operation line, the execution of commands may suspend image acceptance.

● When an error occurs on command acceptance

The error code is written in the command result address as the execution result. The error response consists of the following information:

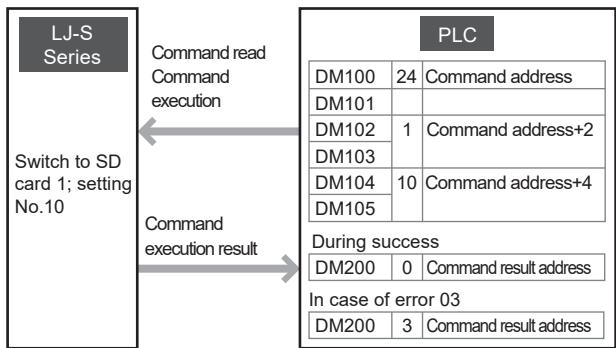
- 02: Command error (The received command is invalid.)
- 03: Command action disabled (The received command cannot work.)
- 22: The number or range of the parameter is incorrect.

● An example of error output

When the No. 1005 (unavailable number) is specified for program No. changing command, "22" is written in the command result address as binary data of 1 word.

● Example: Changing the current program No. to program No. 10 stored in SD card 1 using the PLC-Link.

The detailed command assignments for this example is shown below.



Operation mode and input allowed command

✓ = Possible

Command type	Command detail	Command	Number-specified command No.	Availability by device			
				Non-procedural		PLC Link EtherNet/IP PROFINET EtherCAT	
				Run	Setup	Run	Setup
System control	Trigger issuance	T1	1	✓		✓	
	Switch to Run mode	R0	8		✓		✓
	Switch to Setup mode	S0	9	✓		✓	
	Reset	RS	10	✓		✓	
	Reboot	RB	11	✓		✓	
	Save Program	SS	12	✓		✓	
	Clear error	CE	13	✓	✓	✓	✓
	Changing the operation screen	VW	14	✓		✓	
	Read run/Setup mode	RM	16	✓	✓	✓	✓
Change inspection program	Change inspection programs	PW	24	✓		✓	
	Read program setting	PR	25	✓		✓	
Measurement	Standard image registration (update reference value)	BS	40	✓		✓	
	Write execute condition	EXW	41	✓		✓	
	Read execute condition	EXR	42	✓		✓	
	Change judgment string	CW	43	✓		✓	
	Read judgment string	CR	44	✓		✓	
	Change judgment condition	DW	45	✓		✓	
	Read judgment condition	DR	46	✓		✓	
	Change Defect Level	SLW	47	✓		✓	
	Read Defect Level	SLR	48	✓		✓	
	Dictionary 1 Character Registration	CA	49	✓		✓	
	Dictionary 1 Character Deletion	CD	50	✓		✓	
	Measured Value Correction of the Conversion of the Previously Corrected Measured Value	MCC	52	✓		✓	
	Write Measured Value Correction	MCW	53	✓		✓	
	Read Measured Value Correction	MCR	54	✓		✓	
I/O control	1-point correction. Rewrite with previous measurement value.	MCZ	55	✓		✓	
	Enable/Disable Trigger Input	TE	56	✓	✓	✓	✓
Utility	Enable/Disable Output	OE	57	✓		✓	
	Change Externally Specified String	STW	60	✓		✓	
	Read Externally Specified String	STR	61	✓		✓	
	Clear Statistical Data	TC	64	✓		✓	
	Save Statistical Data	TS	65	✓		✓	
	Clear Archived Image	HC	66	✓		✓	
	Save Archived Image	HS	67	✓		✓	
	Image Capture	BC	68	✓	✓	✓	✓
	Change Output File/Folder	OW	69	✓		✓	
	Echo	EC	-	✓	✓		
System	Write Date & Time	TW	80	✓		✓	
	Read Date & Time	TR	81	✓		✓	
	Read Version Information	VI	82	✓	✓	✓	✓
	Write Time Zone	TZW	83	✓		✓	
	Read Time Zone	TZR	84	✓		✓	

Trigger

T1 Trigger issuance

A trigger is issued.

For non-procedural commands

- Send
T1 [Delimiter]
- Receive
T1 [Delimiter]

For number-specified commands

The number-specified command No. is "1".

- Send

Word Device	*
	1

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.
03	The command was sent when triggers could not be accepted or when trigger input was disabled (when READY* is not turned on).

Real-time performance

This command does not affect the measurement processing time.

System control

R0 Switch to Run mode

This command switches the controller from Setup mode to Run mode. (If the controller is already in Run mode, the command execution finishes normally without making any changes.)

For non-procedural commands

- Send
R0 [Delimiter]
- Receive
R0 [Delimiter]

For number-specified commands

The number-specified command No. is "8".

- Send

Word Device	*
	8

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.
03	When an operation that does not accept switching to Run mode such as [Edit Tool] or [Statistics] is being performed

Real-time performance

This command is instantly executed.

S0 Switch to Setup mode

This command switches the controller from Run mode to Setup mode. (If the controller is already in Setup mode, the command execution finishes normally without making any changes.)

For non-procedural commands

- Send
S0 [Delimiter]
- Receive
S0 [Delimiter]

For number-specified commands

The number-specified command No. is "9".

- Send

Word Device	*
	9

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
03	The command was sent during operation that does not accept switching to Setup mode.
22	An unnecessary parameter is included.

Real-time performance

When a tool is being executed, the controller is switched to Setup mode after the tool execution.

RS Reset

This command performs all of the following:

- Clears all buffers including the image buffer.
- Creates a new file name for the file used to store data.
- Initializes total status output.
- Clears all of history data.
- Clears all of statistical data.
- Clears all number of measurement.
- Clears OUT_DATA0 to OUT_DATA15.

For non-procedural commands

- Send

RS [Delimiter]

- Receive

RS [Delimiter]

For number-specified commands

The number-specified command No. is "10".

- Send

Word Device	*
	10

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

When a tool is being executed, reset is executed after the tool execution.

RB Reboot

This command saves the current program settings and reboots the system.

For non-procedural commands

- Send

RB [Delimiter]

- Receive

RB [Delimiter]

For number-specified commands

The number-specified command No. is "11".

- Send

Word Device	*
	11

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	When some unnecessary parameter was included. (Failure to access the SD card is not considered to be an error and the system is rebooted.)

Real-time performance

- When a tool is being executed, the command is executed after the tool execution.
- When data is being output, the process is synchronized according to the OE timing, and then the command is executed.

SS Save Program

Saves the current program settings and global settings.

For non-procedural commands

- Send

SS [Delimiter]

- Receive

SS [Delimiter]

For number-specified commands

The number-specified command No. is "12".

- Send

Word Device	*
	12

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.
03	The SD card has not been inserted or cannot be accessed.

Real-time performance

This command does not affect the measurement processing time.

CE: Clear error

This command clears the error status. Even when an error status does not exist, the command execution finishes normally.

For non-procedural commands

- Send

CE [Delimiter]

- Receive

CE [Delimiter]

For number-specified commands

The number-specified command No. is "13".

- Send

Word Device	*
	13

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

VW Change Operation Screen

Changes the display to the specified operation screen.

For non-procedural commands

- Send
VW,n,mm [Delimiter]
- Receive
VW [Delimiter]

For number-specified commands

The number-specified command No. is "14".

Send

Word Device	*	*+1	*+2
Return value	14	n	mm

* Starting word device (command address)

Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

n	Tab type
	• 0: Tool list tab
	• 1: S** tab
mm	Tab number (0 to 9 (S00 to S09))

Execution result

0	Success
22	The number or the range of the parameter is incorrect.
03	<ul style="list-style-type: none"> When the tab number does not exist. When the operation screen tab cannot be operated because a dialog is opened.

Real-time performance

This command does not affect the measurement processing time.

RM Read Run/Setup mode

Reads the status of the controller (i.e. whether it is in Run mode or Setup mode).

For non-procedural commands

- Send
RM [Delimiter]
- Receive
RM,n [Delimiter]

For number-specified commands

The number-specified command No. is "16".

Send

Word Device	*
Return value	16

* Starting word device (command address)

Receive

Word Device	*	*+1	*+2	*+3
Return value	Execution result			n

* Starting word device (command result address)

Parameters (common)

n	Controller status
	• 0: Setup mode
	• 1: Run mode

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

Change inspection program

PW Change programs

This command closes all open dialogs and loads the program of the specified No. (nnn) from the SD card.

- Any changes to the setting data is discarded.
- If the command successfully finishes, the global setting file is saved after the command execution.

For non-procedural commands

- Send

PW,d,nnn [Delimiter]

- Receive

PW [Delimiter]

For number-specified commands

The number-specified command No. is "24".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5
	24		d	n nn		

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

d	SD card number • 1: SD1 • 2: SD2
nnn	Program No. (0 to 999)

Execution result

0	Success
22	The number or the range of the parameter is incorrect.
03	<ul style="list-style-type: none"> • The program does not exist. • The SD card has not been inserted or cannot be accessed. • The controller ID lock is applied to the specified program.

Real-time performance

The program is changed after measurement processing finishes.

PR Read program setting

This command returns the SD card number and the inspection program of the program currently being read.

For non-procedural commands

- Send

PR [Delimiter]

- Receive

PR,d,nnn [Delimiter]

For number-specified commands

The number-specified command No. is "25".

- Send

Word Device	*
	25

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3	*+4	*+5
Return value			d	n nn		

* Starting word device (command result address)

Parameters (common)

d	SD card number • 1: SD1 • 2: SD2
nnn	Program No. (0 to 999)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

Measurement

BS Standard image registration

This command saves the latest current image as a standard image with number nnn, and then calculates the reference value based on the saved standard image. If no argument is specified, the command recalculates the reference value based on the current standard image.

- Reference**
 - If a file with the same number exists, that file will be overwritten unless it is read-only.
 - For number-specified commands, setting 0 for the first argument will recalculate the reference value based on the current standard image.

For non-procedural commands

- Send**
BS [Delimiter]

Recalculates the reference value based on the current standard image.

BS,1,nnn [Delimiter]

Registers the latest current image as standard and calculates the reference value.

- Receive**
BS [Delimiter]

For number-specified commands

The number-specified command No. is "40".

- Send**

Word Device	*
Return value	40
Word Device	*
	40

* Starting word device (command address)

- Receive**

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

nnn Standard image No. (0 to 399)

Execution result

0	Success
22	<ul style="list-style-type: none"> The number or the range of the parameter is incorrect. A number other than between 000 and 399 is specified as the standard image No.
03	<ul style="list-style-type: none"> The SD card has not been inserted or cannot be accessed. The SD card is full and no more images can be registered. The file of the specified number is read-only. The registration of the standard image data failed. Insufficient processing memory causing failure to calculate the reference value. The head is invalid or connected incorrectly.

Real-time performance

This command is executed after temporarily stopping the current measurement.

EXW Write execute condition

This command changes the number of the execution condition currently enabled to the specified number.

For non-procedural commands

- Send**
EXW,n [Delimiter]
- Receive**
EXW [Delimiter]

For number-specified commands

The number-specified command No. is "41".

- Send**

Word Device	*	*+1	*+2	*+3
	41			1

* Starting word device (command address)

- Receive**

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

n 0 to 99 (Execute number)

Execution result

0	Success
22	The number or the range of the parameter is incorrect.

EXR Read execute condition

This command reads the number of the execute condition currently enabled.

For non-procedural commands

- Send**
EXR [Delimiter]
- Receive**
EXR,n [Delimiter]

For number-specified commands

The number-specified command No. is "42".

- Send**

Word Device	*
	42

* Starting word device (command address)

- Receive**

Word Device	*	*+1	*+2	*+3
Return value	Execution result		n	

* Starting word device (command result address)

Parameters (common)

n 0 to 99 (Execute number)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

CW Change judgment string

The judgment string of the OCR tool and OCR2 tool with tool number nnn, along with the reference pattern string of the 1D code reader tool and the 2D code reader tool are rewritten to the specified string ssss. If you do not specify the ssss judgment string, the latest read result for that tool is set.

Reference

- If you do not specify the ssss judgment string, the latest read result for that tool is used as the judgment string.
- In order to store the received characters as ASCII characters, special characters such as Year4 and eYear (0) cannot be specified.
- The following limitations apply when using the OCR/OCR2 tool:
 - The characters that can be used with the OCR tool are "English upper/lower case letters:-#*". The characters that can be used with the OCR2 tool are "English upper/lower case letters:-#*()+". Letter that cannot be used are considered errors.
 - When rewriting with the latest reading result, a space is set when a measurement is not made (OCR tool: 20 characters, OCR2 tool: 40 characters). If the number of read characters does not reach the maximum number of characters, a space is set.
 - If the character is "? (Unrecognizable)", a space is set.
 - If no string is specified (CW,nnn,m,"**Delimiter**)**,** the specified string is cleared.
 - If it is unmeasured, the space will be set.
- The following limitations apply when using the 1D code reader tool and 2D code reader tool:
 - it will be cleared.
 - The judgment string ssss can go up to 200 characters.

For non-procedural commands

Send
CW,nnn,m,"ssss" **Delimiter**

Rewrite judgment string with the specified string

CW,nnn,m **Delimiter**

Set the most recent reading result to a judgment string

Receive
CW **Delimiter**
Parameters

nnn Tool No. (100 to 199)

m Line No./matching condition No.

- For OCR tool or OCR 2 tool: 1 fixed
- For 1D code reader tool, 2D code reader tool: 1 to 16

ssss Judgment String

- For OCR tool: Character count 0 to 20
- For OCR2 tool: Character count 0 to 40
- For 1D code reader tool: Character count 0 to 128
- For 2D code reader tool: Character count 0 to 200

For number-specified commands

The number-specified command No. is "43".

Send (t=0)

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7
	43		nnn	m	t	s1	s2	...

* Starting word device (command address)

Send (t=1)

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	...
	43		nnn	m	t	s1	s2	...					

* Starting word device (command address)

Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters

nnn	Tool No. (100 to 199)
m	Line No./matching condition No. <ul style="list-style-type: none"> For OCR tool or OCR 2 tool: 1 fixed For 1D code reader tool, 2D code reader tool: 1 to 16
t	<ul style="list-style-type: none"> 0: use the most recent reading result. 1: Set the character specified in ssss.
ssss	Judgment string (Use 2 words per character, the end code is 0 (zero)) <ul style="list-style-type: none"> For OCR tool: Character count 0 to 20 For OCR2 tool: Character count 0 to 40 For 1D code reader tool: Character count 0 to 128 For 2D code reader tool: Character count 0 to 512

Execution result

0	Success
03	<ul style="list-style-type: none"> When a tool other than OCR, OCR2, 1D code reader, or 2D code reader is specified When the specified tool has a configuration error
22	<ul style="list-style-type: none"> The number or the range of the parameter is incorrect. An unnecessary parameter is included. or when an unusable character is specified

Real-time performance

This command is executed after temporarily stopping the current measurement.

CR Read judgment string

The judgment string of the OCR tool and the OCR2 tool with tool number nnn, along with the reference pattern string of the 1D code reader tool and the 2D code reader tool are read, then the same string is returned as "judgment string" and "reference pattern string" on the tool editing screen. If the end of the judgment string is reached by the number specification command, it stores 0 and ends.

For non-procedural commands

- Send

CR,nnn,m [Delimiter]

- Receive

CR,ssss [Delimiter]

- Parameters

nnn	Tool No. (100 to 199)
m	Line No./matching condition No. • For OCR tool or OCR 2 tool: 1 fixed • For 1D code reader tool, 2D code reader tool: 1 to 16
ssss	Judgment String • For OCR tool: Character count 0 to 20 • For OCR2 tool: Character count 0 to 40 • For 1D code reader tool: Character count 0 to 128 • For 2D code reader tool: Character count 0 to 200

For number-specified commands

The number-specified command No. is "37".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5
	37		nnn	m		

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	...
Return value	Execution result		s1	s2	s3				

* Starting word device (command result address)

- Parameters

nnn	Tool No. (100 to 199)
m	Line No./matching condition No. • For OCR tool or OCR 2 tool: 1 fixed • For 1D code reader tool, 2D code reader tool: 1 to 16
ssss	Judgment string (Use 2 words per character, the end code is 0 (zero)) • For OCR tool: Character count 0 to 20 • For OCR2 tool: Character count 0 to 40 • For 1D code reader tool: Character count 0 to 128 • For 2D code reader tool: Character count 0 to 512

Execution result

0	Success
22	The number or the range of the parameter is incorrect. • When tools other than OCR, OCR2, 1D code reader or 2D code reader are specified. • When the judgment string is not set. • The specified reference pattern does not exist.
03	

Real-time performance

This command does not affect the measurement processing time.

DW Change judgment condition

Changes the upper limit and lower limit in the judgment conditions for the specified tool.

For non-procedural commands

- Send

DW,nnn,aaa,b,mmm [Delimiter]

- Receive

DW [Delimiter]

For number-specified commands

The number-specified command No. is "45".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9
	45		nnn	aaa	b	mmm				

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

Tool No. (100 to 199)



When the multi-region mode is ON, the area number can be specified by specifying the following values.
100 * Tool number (100 to 199) + area number (0 to 31)
If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.

nnn

aaa

Item ID for judgment condition type
“Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)” (Page A-28)

b

Specify upper limit (0) or lower limit (1).

mmm

Judgment condition value (in the case of a number-specified command, contents vary depending on the [Decimal Point] setting for PLC-Link, EtherNet/IP, PROFINET, or EtherCAT)
• “Fixed-point” When selected: The setting value is multiplied by 1000 and is a signed 32-bit integer data.
• “Floating-point” When selected: Single-precision floating point data

Reference

Use the CW command to rewrite judgment strings for the OCR tool, OCR2 tool, 1D code reader tool, or the 2D code reader tool.

Execution result

0 Success

22 The number, the number of digits, or the range of the parameter is incorrect.

03

- The specified type does not exist for that tool.
- A screen where judgment conditions can be changed (custom menu, statistics, etc.) is open.
- The new value is incorrect.

Real-time performance

This command does not affect the measurement processing time.

DR Read judgment condition

Reads the upper limit and lower limit in the judgment conditions for the specified tool.

For non-procedural commands

- Send
DR,nnn,aaa,b [Delimiter]
- Receive
DR,mmm [Delimiter]

For number-specified commands

The number-specified command No. is "46".

Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7
	46		nnn	aaa		b		

* Starting word device (command address)

Receive

Word Device	*	*+1	*+2	*+3
Return value	Execution result		mmm	

* Starting word device (command result address)

Parameters (common)

nnn	Tool No. (100 to 199) When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.
aaa	Item ID for judgment condition type □ "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
b	Specify upper limit (0) or lower limit (1).

Reference Use the CR command to read judgment strings for the OCR tool, OCR2 tool, 1D code reader tool, or the 2D code reader tool.

Execution result

0	Success
22	The number, the number of digits, or the range of the parameter is incorrect.
03	The specified type does not exist for that tool.
05	Command response output failed (insufficient command response output area)

Real-time performance

This command does not affect the measurement processing time.

SLW Change defect Level

Rewrites the defect level of the specified defect tool.

For non-procedural commands

- Send
SLW,nnn,mmm [Delimiter]
- Receive
SLW [Delimiter]

For number-specified commands

The number-specified command No. is "47".

Send

Word Device	*	*+1	*+2	*+3	*+4	*+5
	47		nnn	mmm		

* Starting word device (command address)

Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

nnn	Tool No. (100 to 199) When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.
mmm	Defect level value

Execution result

0	Success
22	The number, the number of digits, or the range of the parameter is incorrect.
03	<ul style="list-style-type: none"> When the specified tool is not a defect tool. When the custom menu screen is open. The new value is incorrect.

Real-time performance

This command does not affect the measurement processing time.

SLR Read Defect Level

Reads the defect level of the specified defect tool.

For non-procedural commands

- Send
SLR,nnn [Delimiter]
- Receive
SLR,mmm [Delimiter]

For number-specified commands

The number-specified command No. is "48".

Send

Word Device	*	*+1	*+2	*+3
	48			nnn

* Starting word device (command address)

Receive

Word Device	*	*+1	*+2	*+3
Return value	Execution result		mmm	

* Starting word device (command result address)

Parameters (common)

	Tool No. (100 to 199)
nnn	<p>Reference When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.</p>
mmm	Defect level value

Execution result

0	Success
22	The number, the number of digits, or the range of the parameter is incorrect.
03	When the specified tool is not a defect tool.
05	Command response output failed (insufficient command response output area)

Real-time performance

This command does not affect the measurement processing time.

CA Dictionary 1 Character Registration

Register the characters scanned by the OCR tool or OCR2 tool in the dictionary.

For non-procedural commands

- Send
CA,nnn,m,aa,ccc [Delimiter]
- Receive
CA [Delimiter]

For number-specified commands

The number-specified command No. is "49".

Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13	*+14	*+15	*+16
	49		nnn		m		aa		ccc								

* Starting word device (command address)

Receive

Word Device	*	*+1
Return value	Execution result	

* Starting word device (command result address)

Parameters (common)

nnn	Tool No. (100 to 199)
m	Detection result line number (1)
aa	Character No. of Detection Results • For OCR tool: 1 to 20 • For OCR2 tool: 1 to 40
ccc	Registered character type • For OCR tool: -1 to 65 (do nothing when -1) • For OCR2 tool: -1 to 68 (do nothing when -1)

Execution result

0	Success
03	<ul style="list-style-type: none"> The SD card has not been inserted or cannot be accessed. When the tool does not exist or is not OCR/OCR2. When the built-in dictionary is selected by the tool or when there is no specified dictionary file. When the dictionary registration fails.
22	The number or the range of the parameter is incorrect.

Real-time performance

This command is instantly executed.

CD Dictionary 1 Character Deletion

Removes the last registration number character of the specified character type from the dictionary.

For non-procedural commands

- Send

CD,nnn,ccc [Delimiter]

- Receive

CD [Delimiter]

For number-specified commands

The number-specified command No. is "50".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8
	50		nnn		ccc				

* Starting word device (command address)

- Receive

Word Device	*	*+1
Return value	Execution result	

* Starting word device (command result address)

Parameters (common)

nnn	Tool No. (100 to 199)
ccc	Character type of deletion target • For OCR tool: -1 to 65 (do nothing when -1) • For OCR2 tool: -1 to 68 (do nothing when -1)

Execution result

0	Success
03	<ul style="list-style-type: none"> The SD card has not been inserted or cannot be accessed. When the tool does not exist or is not , OCR/OCR2. When the built-in dictionary is selected by the tool or when there is no specified dictionary file. When there is no registration of specified character type. When dictionary deletion failed.
22	The number or the range of the parameter is incorrect.

Real-time performance

This command is instantly executed.

Character types specified by CA/CW command

For the registered character types specified by CA command and the deletion target character types used by CD command, corresponding codes are used to specify them.

The following table shows character types and the corresponding codes.

Character type	Code	Character type	Code
Not specified	-1	-	36
0	0	.	37
1	1	:	38
2	2	/	39
3	3	a	40
4	4	b	41
5	5	c	42
6	6	d	43
7	7	e	44
8	8	f	45
9	9	g	46
A	10	h	47
B	11	i	48
C	12	j	49
D	13	k	50
E	14	l	51
F	15	m	52
G	16	n	53
H	17	o	54
I	18	p	55
J	19	q	56
K	20	r	57
L	21	s	58
M	22	t	59
N	23	u	60
O	24	v	61
P	25	w	62
Q	26	x	63
R	27	y	64
S	28	z	65
T	29	*	Cannot be specified
U	30	#	Cannot be specified
V	31	(Space)	Cannot be specified
W	32	(66
X	33)	67
Y	34	+	68
Z	35		

MCC Measured Value Correction of the Conversion of the Previously Corrected Measured Value

Calculates the previously corrected measurements for any value.

For non-procedural commands

- Send

MCC,nnn,m,a [Delimiter]

- Receive

MCC,c [Delimiter]

- Parameters

	Tool No. (100 to 199)
nnn	<p> When the multi-region mode is ON, the area number can be specified by specifying the following values. $100 * \text{Tool number (100 to 199)} + \text{area number (0 to 31)}$ If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.</p>
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) Item ID for judgment condition type (for height measurement or trend height measurement)  "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
a	Numerical value
c	Correction value

For number-specified commands

The number-specified command No. is "52".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7
	52		nnn	m	a			

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3
Return value	Execution result		c	

* Starting word device (command result address)

- Parameters

	Tool No. (100 to 199)
nnn	<p> When the multi-region mode is ON, the area number can be specified by specifying the following values. $100 * \text{Tool number (100 to 199)} + \text{area number (0 to 31)}$ If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.</p>
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) Item ID for judgment condition type (for height measurement or trend height measurement)  "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
a	Numerical value
c	Correction value

Execution result

0	Success
03	<ul style="list-style-type: none"> When a tool does not exist, or when a tool other than height measurement, trend height measurement, profile measurement, or continuous profile measurement is specified When a non-target measurement item number is specified when specifying the profile measurement or the continuous profile measurement When the calculation of the previously corrected measurement has failed
22	<ul style="list-style-type: none"> When the number of parameters is different. When the range of the parameter is incorrect When the number of parameter digits is large

Real-time performance

This command does not affect the measurement processing time.

MCW Write Measured Value Correction

Rewrite the correction value setting and calculate the correction value.
Perform calculation by either of the following methods according to a specified parameter.

- (1) For the specified tool, specify the values before and after the 1-point correction, then perform the correction.
- (2) For the specified tool, the specified value is corrected by subtracting the specified offset from the value after the correction, to obtain the correction value.
- (3) For the specified tool, specify the values before and after corrections 1 and 2 for the 2-point correction, then perform the correction.
- (4) For the specified tool, the specified coefficient A and coefficient B are back-calculated from the corrected value in the 2-point correction, and is used as the correction value.

For non-procedural commands

Send

MCW,nnn,m,l,c,f	<input type="button" value="Delimiter"/>	(1)
MCW,nnn,m,l,o	<input type="button" value="Delimiter"/>	(2)
MCW,nnn,m,l,c1,f1,c2,f2	<input type="button" value="Delimiter"/>	(3)
MCW,nnn,m,l,a,b	<input type="button" value="Delimiter"/>	(4)

Receive

MCW	<input type="button" value="Delimiter"/>
-----	--

Parameters

nnn	Tool No. (100 to 199) <input checked="" type="checkbox"/> When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) AL (all measurement items) Item ID for judgment condition type (for height measurement or trend height measurement) <input checked="" type="checkbox"/> "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
I	Correction method <ul style="list-style-type: none"> 0: 1-Point Correction (1)(2) 1: 2-Point Correction (3)(4)
c	Value before correction
f	Value after correction
o	Offset value
c1	Value 1 before correction
c2	Value 2 before correction
f1	Value 1 after correction
f2	Value 2 after correction
a	Coefficient A
b	Coefficient B

For number-specified commands

The number-specified command No. is "53".

Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13
	53	nnn	m	l	t	c	f							

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11
	53	nnn	m	l	t							

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13	*+14	*+15	*+16	*+17
	53	nnn	m	l	t	c1	f1	c2	f2									

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13
	53	nnn	m	l	t	a	b							

* Starting word device (command address)

Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters

nnn	Tool No. (100 to 199) <input checked="" type="checkbox"/> When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) AL (all measurement items) Item ID for judgment condition type (for height measurement or trend height measurement) <input checked="" type="checkbox"/> "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
I	Correction method <ul style="list-style-type: none"> 0: 1-Point Correction (1)(2) 1: 2-Point Correction (3)(4)
t	Specification Method <ul style="list-style-type: none"> 0: Specified correction value 1: Offset, coefficient specification
c	Value before correction
f	Value after correction
o	Offset value
c1	Value 1 before correction
c2	Value 2 before correction
f1	Value 1 after correction
f2	Value 2 after correction
a	Coefficient A
b	Coefficient B

Execution result

0	Success
03	<ul style="list-style-type: none"> When a tool does not exist, or when a tool other than height measurement, trend height measurement, profile measurement, or continuous profile measurement is specified When a non-target measurement item number is specified when specifying the profile measurement or the continuous profile measurement When the correction calculation fails
22	<ul style="list-style-type: none"> When the number of parameters is different. When the range of the parameter is incorrect When the number of parameter digits is large

Real-time performance

This command is executed after temporarily stopping the current measurement.

MCR Read Measured Value Correction

Returns the value of the measured value correction set by the specified tool.

For non-procedural commands

- Send

MCR,nnn,m [Delimiter]

- Receive

MCR,0,c,f,o [Delimiter]

for 1-point correction

MCR,1,c1,f1,c2,f2,a,b [Delimiter]

for 2-Point Correction

- Parameters

	Tool No. (100 to 199)
nnn	<p>[Reference] When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.</p>
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) Item ID for judgment condition type (for height measurement or trend height measurement) "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
c	Value before correction
f	Value after correction
o	Offset value
c1	Value 1 before correction
c2	Value 2 before correction
f1	Value 1 after correction
f2	Value 2 after correction
a	Coefficient A
b	Coefficient B

For number-specified commands

The number-specified command No. is "54".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5
	54		nnn	m		

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9
Return value	Execution result		0	c	f		o			
Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9
Return value	Execution result	1	c1	f1	c2	f2	a	b		

* Starting word device (command result address)

Parameters

nnn	Tool No. (100 to 199)
m	<ul style="list-style-type: none"> Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) Item ID for judgment condition type (for height measurement or trend height measurement) "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)
c	Value before correction
f	Value after correction
o	Offset value
c1	Value 1 before correction
c2	Value 2 before correction
f1	Value 1 after correction
f2	Value 2 after correction
a	Coefficient A
b	Coefficient B

Execution result

0	Success
03	<ul style="list-style-type: none"> When a tool does not exist, or when a tool other than height measurement, trend height measurement, profile measurement, or continuous profile measurement is specified When a non-target measurement item number is specified when specifying the profile measurement or the continuous profile measurement When the correction calculation fails
22	<ul style="list-style-type: none"> When the number of parameters is different. When the range of the parameter is incorrect When the number of parameter digits is large

Real-time performance

This command does not affect the measurement processing time.

MCZ 1-point correction. Rewrite with previous measurement value.

Write a value for the 1-point correction value (before correction) of the specified measurement item.

"Correct Measurement Results by an Offset Value (1-Point Correction)" (Page 5-14)

Perform calculation by either of the following methods according to a specified parameter.

- (1) Perform processing for all measurement items with [Update Pre-Correction Measured Value with ZERO Button] selected.
- (2) Perform processing for specified measurement items among those with [Update Pre-Correction Measured Value with ZERO Button] selected.

 Point Execute the auto zero processing by writing a measured value before correction.

For non-procedural commands

- Send

MCZ,s	<input type="text"/> Delimiter	(1)
MCZ,s,t,nnn,m,nnn,m ...	<input type="text"/> Delimiter	(2)

- Receive

MCZ

For number-specified commands

The number-specified command No. is "55".

- Send

Word Device	*	*+1	*+2	*+3							
	56			s							

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	...
	55			s	t	nnn	m				

* Starting word device (command result address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

- Parameters (common)

s	Specify a value to write <ul style="list-style-type: none"> • 0: Write "0" • 1: Write a measured value before correction
t	Number of items to be written (1 to 6)
nnn	Tool No. (100 to 199) <p> When the multi-region mode is ON, the area number can be specified by specifying the following values. 100 * Tool number (100 to 199) + area number (0 to 31) If the area number is not specified (when specified with a value of 100 to 199), the area with the lowest number is used.</p>
m	<ul style="list-style-type: none"> • Measurement item No. (if 0 to 31, profile measurement or continuous profile measurement) • Item ID for judgment condition type (for height measurement or trend height measurement) <p> "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)</p>

Execution result

0	Success
03	<ul style="list-style-type: none"> • When a tool does not exist, or when a tool other than height measurement, trend height measurement, profile measurement, or continuous profile measurement is specified • When a non-target measurement item number is specified when specifying the profile measurement or the continuous profile measurement • When the correction calculation fails
22	<ul style="list-style-type: none"> • When the number of parameters is different. • When the range of the parameter is incorrect • When the number of parameter digits is large

Real-time performance

This command is executed after temporarily stopping the current measurement.

I/O control

TE Enable/disable trigger input

When "TE,0" is executed, the READY terminal is set to remain off and thus no trigger input will be accepted. When "TE,1" is executed, trigger input will be accepted.

 When "TE,0" is executed, the laser will turn off.

For non-procedural commands

- Send
TE,n [Delimiter]
- Receive
TE [Delimiter]

For number-specified commands

The number-specified command No. is "56".

- Send

Word Device	*	*+1	*+2	*+3
	56			n

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

n	Models
	<ul style="list-style-type: none"> • 0: Trigger input disabled • 1: Permit trigger input.

Execution result

0	Success
22	The number or the range of the parameter is incorrect.

Real-time performance

This command does not affect the measurement processing time.

OE Enable/disable output

This command disables the data/image output to the output buffer and clears the data in the buffer, so that data output to external devices is controlled. This command controls the following output functions:

- Results output (terminal block, Ethernet, RS-232C, PLC-Link, EtherNet/IP, PROFINET, EtherCAT, SD card, USB HDD, PC Program, FTP)
- Image output (SD card, FTP, USB HDD, PC Program)

For non-procedural commands

- Send
OE,n [Delimiter]
- Receive
OE [Delimiter]

For number-specified commands

The number-specified command No. is "57".

- Send

Word Device	*	*+1	*+2	*+3
	57			n

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

n	Models
	<ul style="list-style-type: none"> • 0: Output disabled • 1: Permit output

Execution result

0	Success
22	The number or the range of the parameter is incorrect.

Real-time performance

This command does not affect the measurement processing time.

Details of command behavior when executed

Data output

- Output is stopped for each trigger. (As for output to RS-232C, Ethernet, SD card, USB HDD, PLC-Link, EtherNet/IP, PROFINET, or EtherCAT, when output is disabled during result data output for 1 trigger, data output for that trigger does not stop.)
- When enabled, output is resumed at the next trigger execution.

Parallel terminal output

- Immediately stop the output to the terminal block of STO, OUT_DATA 0 to 15, OR, and put it in the normal state.
- Although the total judgment results change even when output is prohibited, OR does not reflect on the terminal block.
- STO and OUT_DATA 0 to 15 resume output at the next trigger execution.

Relationship with TEST

- There is no priority setting between OE and TEST terminal. The latest status, enabled or disabled, is reflected to the internal operation.
- For example, inputting "OE,1" (enable) when TEST=ON (disable) enables output. (Then, specifying ON (disable) when TEST=OFF (enable) disables output.)
- Output is enabled or disabled based on the status (level) of TEST immediately after the controller is turned on, reset, or the program is changed. For example, inputting "OE,1" (enable) when TEST is ON (disable) enables output. (Then, when the program is changed later, output is disabled when TEST=ON (disable).)

Utility

STW Change Externally Specified String

Changes the content of the externally specified string.

For non-procedural commands

- Send

STW,n,"ssss" [Delimiter]

- Receive

STW [Delimiter]

- Parameters

n	<ul style="list-style-type: none"> Specify the Externally Specified String to be changed (0 to 9) Externally Specified String for screen capture (1000)
ssss	Changing string (number of characters 0 to 64)

For number-specified commands

The number-specified command No. is "60".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	...
	60		n	s1		s2		...	

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

- Parameters

n	<ul style="list-style-type: none"> Specify the Externally Specified String to be changed (0 to 9) Externally Specified String for screen capture (1000)
ssss	<ul style="list-style-type: none"> Changing string (number of characters 0 to 64) Two words per character are used, and the termination code is 0 (zero)

Execution result

0	Success
03	When the Externally Specified String cannot be utilized (in the case of old version of program setting, etc.)
22	<ul style="list-style-type: none"> An unnecessary parameter is included. When the range of the parameter is incorrect

Real-time performance

This command is instantly executed.

 Only ASCII characters can be specified if SFTP transfer is enabled for "FTP" (Page 8-4) and the externally specified string being referred to by the file naming conventions for the image output is rewritten with this command.

STR Read Externally Specified String

Reads the content of the externally specified string.

For non-procedural commands

- Send

STR,n [Delimiter]

- Receive

STR,ssss [Delimiter]

- Parameters

n	<ul style="list-style-type: none"> Specify the Externally Specified String to be read (0 to 9) Externally Specified String for screen capture (1000)
ssss	Read string (number of characters 0 to 64)

For number-specified commands

The number-specified command No. is "62".

- Send

Word Device	*	*+1	*+2	*+3
	62		n	

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	...
Return value	Execution result		s1		s2		s3		...

* Starting word device (command result address)

- Parameters

n	<ul style="list-style-type: none"> Specify the Externally Specified String to be read (0 to 9) Externally Specified String for screen capture (1000)
ssss	<ul style="list-style-type: none"> Read string (number of characters 0 to 64) Two words per character are used

Execution result

0	Success
03	When the Externally Specified String cannot be utilized (in the case of old version of program setting, etc.)
22	<ul style="list-style-type: none"> An unnecessary parameter is included. When the range of the parameter is incorrect

Real-time performance

This command is instantly executed.

TC Clear statistical data

This command clears the statistical data and then resumes taking statistics.

For non-procedural commands

- Send

TC [Delimiter]

- Receive

TC [Delimiter]

For number-specified commands

The number-specified command No. is "64".

- Send

Word Device	*
	64

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

It stops the taking of statistics and is executed immediately.

TS Save statistical data

This command selects the type of statistical data file to be saved to the SD card.

- The measured values files and the statistics files create their own CSV files respectively.
- The naming rule of the file which will store the data conforms to the file naming rules of statistics for both of measured values files and the statistics files.
- If a folder for saving the data does not exist, a new folder will be created.
- If the file for saving the data already exists, it will be overwritten (regardless of read-only or other file attributes).
- Once the data is saved, it will not be output any more (including data saved from the statistics menu).
- In the case of the number specification command, the output destination folder name is fixed at "LJ-S/stat" of the SD card 2.

For non-procedural commands

- Send**
TS,n,ssss [Delimiter]

- Receive**
TS [Delimiter]

- Parameters**

n	File type for saving
	<ul style="list-style-type: none"> 0: Measured values file (a save file using the list of measured values) 1: Statistics files (a save file using process monitor)
ssss	Output Folder Name (a string with a maximum of 221 characters, a double-byte character is counted as two single-byte characters)

For number-specified commands

The number-specified command No. is "65".

- Send**

Word Device	*	*+1	*+2	*+3
	65			n

* Starting word device (command address)

- Receive**

Word Device	*
Return value	Execution result

* Starting word device (command result address)

- Parameters**

n	File type for saving
	<ul style="list-style-type: none"> 0: Measured values file (a save file using the list of measured values) 1: Measured values file (a save file using process monitor)

Real-time performance

This command does not affect the measurement processing time.

Execution result

0	Success
	<ul style="list-style-type: none"> The number or the range of the parameter is incorrect. The file type is invalid. The folder name is invalid. The number of specified characters is 0 or exceeds the maximum number. An invalid character is included (0x7F, 0x80, 0xA0, 0xFD and up, ',', '?', "", '<', '>', ' ') A single-byte period or space exists at the beginning or ending of the folder name.
22	<ul style="list-style-type: none"> The saving failed. The SD card is not inserted. The saving destination folder or file cannot be created. The saving destination file cannot be opened. The SD card capacity is full. There is no target of statistical measurement set.
03	<ul style="list-style-type: none"> The number or the range of the parameter is incorrect. The file type is invalid. The folder name is invalid. The number of specified characters is 0 or exceeds the maximum number. An invalid character is included (0x7F, 0x80, 0xA0, 0xFD and up, ',', '?', "", '<', '>', ' ') A single-byte period or space exists at the beginning or ending of the folder name.

HC Clear archived profile

This command clears the archived images.

For non-procedural commands

- Send**
HC [Delimiter]
- Receive**
HC [Delimiter]

For number-specified commands

The number-specified command No. is "66".

- Send**

Word Device	*
	66

* Starting word device (command address)

- Receive**

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

HS Save archived image

This command saves the archived image to the SD card or USB HDD.

- If a folder for saving the data does not exist, a new folder will be created.
- The export destination folder is "LJ-S/hist/[Examination setting number]/YYMMDD_HHMMSS" of SD card 2 or USB HDD.
- If the file for saving the data already exists, it will be overwritten (regardless of read-only or other file attributes).
- Even when the error 03 occurs during the process, the command tries to save all archived images to avoid interruption of the process.
- All specified archives are saved regardless of whether they are already saved or not.
- If there is no archived image for saving, the error 03 is returned.

For non-procedural commands

- Send**
HS,n,m,h,1 [Delimiter]
HS,n,m,h,1,d [Delimiter]

- Receive**
HS [Delimiter]

- Parameters**

n	Compression format
	<ul style="list-style-type: none"> 0: No compression (BMP) 1: 1/2 2: 1/4 3: 1/8 9: JPEG 10: PNG
m	Type of the archived image (if the image archive condition is total status NG, the buffer of 1 is read even when 0 is specified.)
	<ul style="list-style-type: none"> 0: Latest Archive 1: Total NG Archive
h	Number of measurement
	<ul style="list-style-type: none"> AL: All measurement counts NW: Latest measurement Integer value: Number of measurement
d	Device
	<ul style="list-style-type: none"> 0: SD Card 2 1: USB HDD

● For number-specified commands

The number-specified command No. is "67".

• Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11
	67		n	m	h		1		d			

* Starting word device (command address)

• Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

• Parameters

n	Compression format • 0: No compression (BMP) • 1: 1/2 • 2: 1/4 • 3: 1/8 • 9: JPEG • 10: PNG
m	Type of the archived image • 0: Latest Archive • 1: Total NG Archive
h	Number of measurement (binary of 2 words) • 1 to 1000000000: Number of measurement • 0: Latest measurement (NW) • -1: All measurement counts (AL)
d	Device • 0: SD Card 2 • 1: USB HDD

● Execution result

0	Success
22	The number or the range of the parameter is incorrect. <ul style="list-style-type: none">• Data saving failed at least once (per image).• The SD card or USB HDD is not inserted.• The saving destination folder or file cannot be created.• The saving destination file cannot be opened.• The SD card or USB HDD capacity is full.• When the following parameter settings and results exist.<ul style="list-style-type: none">• When NW or an integer value is specified for number of measurement and the archived image with the specified number of measurement does not exist.• When AL is specified and no archived images exist.• When AL is specified and the image archived at the time of receiving the command is not available for output (overwritten).
03	An unnecessary parameter is included.
	<ul style="list-style-type: none">• The SD card is not writable.• The SD card is not found.• FTP output failed.

● Real-time performance

This command does not affect the measurement processing time.

BC Image capture

This command captures an image of the screen and saves it to the SD card or FTP server.

The file name for saving follows the setting in □ "Image Capture Settings" (Page 8-13) of the global setting.

● For non-procedural commands

• Send

BC	Delimiter
BC,n	Delimiter

• Receive

BC	Delimiter
----	-----------

● For number-specified commands

The number-specified command No. is "68".

• Send

Word Device	*	*+1	*+2	*+3
	68		n	

* Starting word device (command address)

• Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

● Parameters (common)

n	Destination • None: SD2 • 0: SD2 • 1: FTP
---	--

● Execution result

0	Success
22	An unnecessary parameter is included.
03	<ul style="list-style-type: none">• The SD card is not writable.• The SD card is not found.• FTP output failed.

● Real-time performance

This command does not affect the measurement processing time.

OW Change output file/folder

This command changes the output file/folder.

- When changing a data output file, a new result file is created using the latest date and time.
- When changing an image output folder, a new image output folder is created using the latest date and time.

For non-procedural commands

- Send

OW,n [Delimiter]

- Receive

OW [Delimiter]

For number-specified commands

The number-specified command No. is "69".

- Send

Word Device	*	*+1	*+2	*+3
69			n	

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

n	Select the target for changing • 0: Result output file change (SD2, FTP, USB HDD) • 1: Image output folder change (SD2, FTP, USB HDD, PC application)
---	---

Execution result

0	Success
22	The number or the range of the parameter is incorrect.

Real-time performance

This command is instantly executed.

EC Echo

This command returns the same character string as the one that was sent from the external device.

 The number-specified commands cannot be used.

For non-procedural commands

- Send

EC,ssss [Delimiter]

- Receive

EC,ssss [Delimiter]

- Parameters

ssss	String (character string of 128 characters or less consisting of alphabets and numbers)
------	---

For number-specified commands

The number-specified commands cannot be used.

Execution result

0	Success
22	<ul style="list-style-type: none"> • When the number of parameters is different. • The parameter is longer than 128 characters long. • The parameter includes other than alphabet or numbers.

Real-time performance

This command does not affect the measurement processing time.

System

TW Write Date/Time

This command sets the date and time of the controller.

For non-procedural commands

- Send

TW,yy,mo,dd,hh,mi,ss [Delimiter]

TW,yyyy,mo,dd,hh,mi,ss [Delimiter]

- Receive

TW [Delimiter]

For number-specified commands

The number-specified command No. is "80".

- Send

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13
	80	yy	mo	dd	hh	mi	ss							

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13
	80	yyyy	mo	dd	hh	mi	ss							

* Starting word device (command address)

- Receive

Word Device	*
Return value	Execution result

* Starting word device (command result address)

Parameters (common)

yy	When year (0 to 99, lower two digits of the western calendar (16 for 2016)) 00 - 99 is specified, 2000 is added and processed.
yyyy	Year (2000 to 2099)
mo	Month (1 to 12)
dd	Day (1 to 31)
hh	Hour (0 to 23, 24-hour format)
mi	Minute (0 to 59)
ss	Second (0 to 59)

Execution result

0	Success
22	The number or the range of the parameter is incorrect.
03	The date/time setting failed.

Real-time performance

This command does not affect the measurement processing time.

TR Read date/time

This command reads the current date and time on the controller.

For non-procedural commands

- Send

TR [Delimiter]

- Receive

TR,yy,mo,dd,hh,mi,ss [Delimiter]

For number-specified commands

The number-specified command No. is "81".

- Send

Word Device	*
	81

* Starting word device (command address)

- Receive

Word Device	*	*+1	*+2	*+3	*+4	*+5	*+6	*+7	*+8	*+9	*+10	*+11	*+12	*+13
Return value	Execution result	yy	mo	dd	hh	mi	ss							

* Starting word device (command result address)

Parameters (common)

yy	Year (0 to 99, lower two digits of the western calendar (16 for 2016))
mo	Month (1 to 12)
dd	Day (1 to 31)
hh	Hour (0 to 23, 24-hour format)
mi	Minute (0 to 59)
ss	Second (0 to 59)

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

VI Read Version Information

Returns the controller system information (model number, ROM version).

For non-procedural commands

- Send

VI [Delimiter]

- Receive

VI,nnnn,vvvv [Delimiter]

- Parameters

- nnnn: String of model type
- vvvv: ROM version (14-character string)

For number-specified commands

The number-specified command No. is "82".

- Send

Word Device	*	*+1			
	82				

- Receive

Word Device	*	*+1	*+2	*+3			
Return value	Execution result	nnn	g	m	hw	mj	mn

- Parameters

nnn	Model type number (4 digits)
g	Package (0 = no E, 1 = E)
m	Fixed to 1
hw	The top first position of the major version in the ROM version information is represented as a numeric value.
mj	The top second position of the major version in the ROM version information is represented as a numeric value.
mn	The minor version in the ROM version information is represented as a numeric value.

Execution result

0	Success
22	An unnecessary parameter is included.

Real-time performance

This command does not affect the measurement processing time.

TZW Write Time Zone

Configure the SNTP timezone.

For non-procedural commands

- Send

TZW,n [Delimiter]

- Receive

TZW [Delimiter]

For number-specified commands

The number-specified command is "83".

- Send

Word Device	*	*+1	*+2	*+3
	83			n

- Receive

Word Device	*
Return value	Execution result

Parameters (common)

n	Timezone (0 to 33)
---	--------------------

Execution result

22	The number or the range of the parameter is incorrect.
----	--

Real-time performance

This command does not affect the measurement processing time.

TZR Read Time Zone

The SNTP time zone is read.

For non-procedural commands

- Send

TZR [Delimiter]

- Receive

TZR,n [Delimiter]

For number-specified commands

The number-specified command is "84".

- Send

Word Device	*	*+1	
	84		

- Receive

Word Device	*	*+1	*+2
Return value	Execution result		n

Parameters (common)

n	Timezone (0 to 33)
---	--------------------

Execution result

22	An unnecessary parameter is included.
----	---------------------------------------

Real-time performance

This command does not affect the measurement processing time.

Control/Data Output via the PLC-Link

Using the PLC-Link with the RS-232C or Ethernet interface enables the following operations.

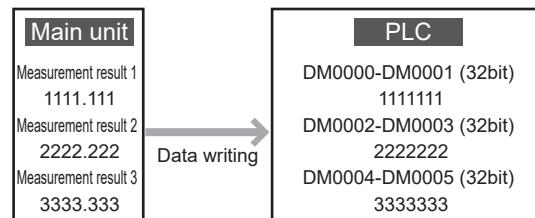
- Outputting data via PLC-Link:
Allows measurement data in this machine to be output directly to the DM (data memory) of the PLC.
- Controlling this machine via PLC-Link:
Allows the operation of this machine by reading of the commands stored in the DM (data memory) of the PLC.

- Reference**
- DM (data memory) is referred to as data register (D) for the Mitsubishi Electric PLC, as data memory (D) for the Omron PLC, and as data register (M) for the YASKAWA Electric PLC.
 - EtherNet/IP, PROFINET and EtherCAT cannot be used in conjunction with PLC-Link. When using the RS-232C port, nonprocedural RS-232C communication cannot be used in conjunction with PLC-Link.

Example of the PLC-Link usage

Example 1: Data output

- **Outputting the measurement results 1 to 3 to KV-7000 series.**

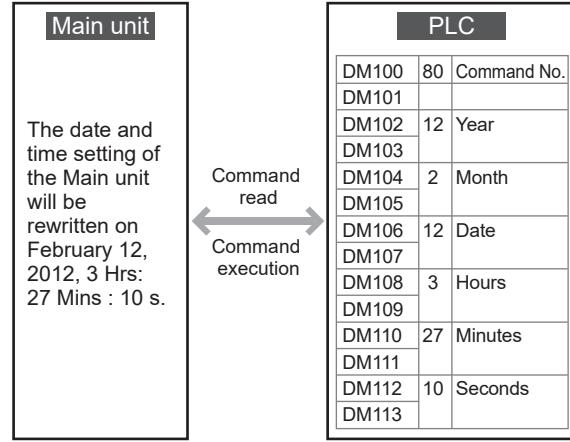


(In the case of decimal point treatment is fixed point)

- The measurement results in this machine are saved to the specified DM of the PLC for each trigger.
- 2 DMs (32 bits) are used for 1 measurement result.

Example 2: Command control (number-specified)

- **Changing the date and time setting on this machine using 80 "TW command"**



- This machine reads the command No. and required parameters previously stored in the DM of the PLC using the terminal input or polling to execute the command.
- The assigned command No. uses 16 bits and command parameters use 32 bits (little endian) in binary when saved to the DM.

Types of Compatible PLC-Link Connections

The following PLCs are compatible with the PLC-Link connection on this machine.



- The range of data memories differ depending on the system. For more details, refer to the manual for each PLC.
- For the majority of PLCs, only connections via link unit are supported.

Via RS-232C interface

Keyence Corporation

Series name	PLC Controller	Link unit	PLC operation mode	PLC type
KV	KV-700	KV-L20	KV BUILDER mode	KV-L20 Series
	KV-1000	KV-L20R	KV STUDIO mode	KV-L20 Series
	KV-3000, KV-5000, KV-5500, KV-7300, KV-7500, KV-8000	KV-XL202, KV-L20V, KV-L21V	KV STUDIO mode	KV-L20 Series
	KV Nano	KV-N10L, KV-NC10L, KV-NC20L	KV STUDIO mode	KV-L20 Series

Mitsubishi Electric Corporation

Series name	PLC Controller	Link unit	PLC operation mode	PLC type
MELSEC-AnS	A1S, A1SH, A1SJ, A1SJH1, A2S, A2SH, A171S, A171SH	A1SJ71 (U) C24-R2, A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN Series
	A1CPUC24-R2	Calculator link port	Exclusive protocol format 1	MELSEC AnN Series
	A2US, A2USH	A1SJ71 (U) C24-R2, A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN Series
MELSEC-A0J2	A0J2, A0J2H	A0J2-C214-S1	Exclusive protocol format 1	MELSEC AnN Series
MELSEC-AnN	A1N, A2N, A3N	AJ71C24, AJ71C24-S3, AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN Series
MELSEC-AnA	A2A, A3A	AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN Series
MELSEC-AnU	A2U, A3U, A4U	AJ71C24-S6, AJ71C24-S8, AJ71UC24	Exclusive protocol format 1	MELSEC AnN Series
MELSEC-QnA	Q2A, Q2A-S1, Q3A, Q4A	AJ71QC24 (N), AJ71QC24 (N) R2, AJ71QC24 (N) R4	Exclusive protocol format 5	MELSEC Q/L series
	Q2AS, Q2AS-S1, Q2ASH, Q2ASH-S1	A1SJ71QC24, A1SJ71QC24-R2	Exclusive protocol format 5	MELSEC Q/L series
MELSEC-Q	Q00CPU, Q01CPU	QJ71C24, QJ71C24 (N) -R2	MC protocol format 5	MELSEC Q/L series
	Q02CPU, Q02HCPU, Q02UCPU, Q03UDECPU, Q04UDEHCPU, Q06UDEHCPU, Q10UDEHCPU, Q13UDEHCPU, Q20UDEHCPU, Q26UDEHCPU, Q06HCPU, Q12HCPU, Q25HCPU, Q02UCPU, Q03UDVCPU, Q04UDVCPU, Q06UDVCPU, Q13UDVCPU, Q26UDVCPU	QJ71C24, QJ71C24 (N) -R2	MC protocol format 5	MELSEC Q/L series
	Q02CPU-A, Q02HCPU-A, Q06HCPU-A	A1SJ71 (U) C24-R2 A1SJ71 (U) C24-PRF	Exclusive protocol format 1	MELSEC AnN Series
	L02CPU, L26CPU-BT	LJ71C24, LJ71C24-R2	MC protocol format 5	MELSEC Q/L series
MELSEC iQ-R	R04CPU	RJ71C24	MC protocol format 5	MELSEC Q/L series
MELSEC iQ-F	FX5U	None *	MC protocol format 5	MELSEC Q/L series
MELSEC-FX	FX1S	FX1N-232-BD, FX2NC-232ADP	Exclusive protocol communication	MELSEC FX Series
	FX3G	FX3G-232-BD, FX3U-232ADP	Exclusive protocol communication	MELSEC FX Series
	FX3U, FX3UC	FX3U-232-BD, FX3U-232ADP	Exclusive protocol communication	MELSEC FX Series

* Connection via link unit is not supported.

Omron Corporation

Series name	PLC Controller	Link unit	PLC operation mode	PLC type
SYSMAC SPM1	SRM1-C01 SRM1-C02	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC CPM1 SYSMAC CPM1A	CPM1 CPM1A	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC CPM2A	CPM2A-30CD□, CPM2A-40CD□, CPM2A-60CD□	CPM1-C1F01	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC CPM2C	CPM2C-10CD□, CPM2C-20CD□	CPM1-C1F01 CPM2C-C1F01	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC CQM1H	CQM1H-CPU11*, CQM1H-CPU21*, CQM1H-CPU51/61	CPM1-C1F01 CQM1H-SCB41	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC C	C120, C120F	C120-LK201-V1	Upper link (SYSWAY)	SYSMAC C Series
	C200H	C200H-LK201 (-V1)	Upper link (SYSWAY)	SYSMAC C Series
	C200HS-CPU01, C200HS-CPU03, C200HS-CPU21/23, C200HS-CPU31/33	C200H-LK201 (-V1)	Upper link (SYSWAY)	SYSMAC C Series
	C500, C500F, C1000H, C1000HF, C2000, C2000H	C120-LK201-V1 C500-LK201-V1 C500-LK203	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC α	C200HE-CPU11, C200HE-CPU32, C200HE-CPU42	C200H-LK201 (-V1)	Upper link (SYSWAY)	SYSMAC C Series
	C200HG-CPU33, C200HG-CPU43, C200HG-CPU53, C200HG-CPU63	C200H-LK201 (-V1)	Upper link (SYSWAY)	SYSMAC C Series
	C200HX-CPU34, C200HX-CPU44, C200HX-CPU54, C200HX-CPU64, C200HX-CPU65-Z, C200HX-CPU85-Z	C200H-LK201 (-V1)	Upper link (SYSWAY)	SYSMAC C Series
SYSMAC CJ	CJ1M-CPU11-ETN, CJ1M-CPU12, CJ1M-CPU12-ETN, CJ1M-CPU13, CJ1M-CPU13-ETN, CJ1M-CPU22, CJ1M-CPU23, CJ1G-CPU44, CJ1G-CPU45, CJ1G-CPU42H, CJ1G-CPU43H, CJ1G-CPU44H, CJ1G-CPU45H, CJ1H-CPU64H-R, CJ1H-CPU65H, CJ1H-CPU65H-R, CJ1H-CPU66H, CJ1H-CPU66H-R, CJ1H-CPU67H, CJ1H-CPU67H-R, CJ2M-CPU11, CJ2M-CPU12, CJ2M-CPU13, CJ2M-CPU14, CJ2M-CPU15, CJ2M-CPU31, CJ2M-CPU32, CJ2M-CPU33, CJ2M-CPU34, CJ2M-CPU35, CJ2H-CPU64-EIP, CJ2H-CPU65-EIP, CJ2H-CPU66-EIP, CJ2H-CPU67-EIP, CJ2H-CPU68-EIP	CJ1W-SCU21 (-V1), CJ1W-SCU22, CJ1W-SCU41	Upper link (SYSWAY)	SYSMAC CJ/CS1/CP1 Series
SYSMAC CS1	CS1G-CPU42 (H), CS1G-CPU43 (H), CS1G-CPU44 (H), CS1G-CPU45 (H), CS1H-CPU63 (H), CS1H-CPU64 (H), CS1H-CPU65 (H), CS1H-CPU66 (H), CS1H-CPU67 (H)	CS1W-SCU21 (-V1)	Upper link (SYSWAY)	SYSMAC CJ/CS1/CP1 Series
SYSMAC CP1	CP1H-Y20DT-D, CP1H-XA40D□-□, CP1H-X40D□-□, CP1L-M60D□-□, CP1L-M40D□-□, CP1L-M30D□-□, CP1L-L20D□-□, CP1L-L14D□-□, CP1E-NA20D□-□, CP1E-N60D□-□, CP1E-N40D□-□, CP1E-N30D□-□	CP1W-CIF01	Upper link (SYSWAY)	SYSMAC CJ/CS1/CP1 Series

* The CQM1H-SCB41 link unit cannot be used.

YASKAWA Electric Corporation

Series name	PLC Controller	Link unit	PLC operation mode	PLC type
MP2000	MP2200, MP2300, MP2310, MP2300S	217IF-01, 218IF-01, 218IF-02	MEMOBUS	YASKAWA MP Series
MP900	MP920*, MP930*	217IF**	MEMOBUS	YASKAWA MP Series

* Also compatible with the built-in RS-232C interface on the system.

** Cannot be connected to MP930.

Via Ethernet Interface

Keyence Corporation

Series name	PLC Controller	Link unit	PLC type
KV	KV-700, KV-1000	KV-LE20, KV-LE20A	KV Series
	KV-3000, KV-5000*, KV-5500*	KV-LE20V, KV-LE21V, KV-EP21V**	KV Series
	KV-7300, KV-7500*, KV-8000*	KV-XLE02, KV-LE20V, KV-LE21V, KV-EP21V	KV Series
	KV Nano	KV-NC1EP	KV Series

* Also compatible with the built-in Ethernet interface on the system.

** Only CPU version 2 or later can be used for KV-3000, KV-5000 and KV-5500.

Mitsubishi Electric Corporation

Series name	PLC Controller	Link unit	PLC type
MELSEC-Q	Q00CPU, Q01CPU, Q02CPU, Q02HCPU, Q02UCPU, Q03UDECPU*, Q04UDEHCPU*, Q06UDEHCPU*, Q10UDEHCPU*, Q13UDEHCPU*, Q20UDEHCPU*, Q26UDEHCPU*, Q06HCPU, Q12HCPU, Q25HCPU, Q03UDVCPU*, Q04UDVCPU*, Q06UDVCPU*, Q13UDVCPU*, Q26UDVCPU*	QJ71E71 QJ71E71-100	MELSEC Q/L series
MELSEC-L	L02CPU*, L26CPU-BT*	None**	MELSEC Q/L series
MELSEC iQ-R	R04CPU*, R04ENCPU*	RJ71EN71	MELSEC Q/L series
MELSEC iQ-F	FX5U*/FX5UC*	None**	MELSEC Q/L series

* Also compatible with the built-in Ethernet interface on the system.

** Connection via link unit is not supported.

Omron Corporation

Series name	PLC Controller	Link unit	PLC type
SYSMAC CJ	CJ1M-CPU11-ETN*, CJ1M-CPU12, CJ1M-CPU12-ETN*, CJ1M-CPU13, CJ1M-CPU13-ETN*, CJ1M-CPU22, CJ1M-CPU23, CJ1G-CPU44, CJ1G-CPU45, CJ1G-CPU42H, CJ1G-CPU43H, CJ1G-CPU44H, CJ1G-CPU45H, CJ1H-CPU64H-R, CJ1H-CPU65H, CJ1H-CPU65H-R, CJ1H-CPU66H, CJ1H-CPU66H-R, CJ1H-CPU67H, CJ1H-CPU67H-R, CJ2M-CPU11, CJ2M-CPU12, CJ2M-CPU13, CJ2M-CPU14, CJ2M-CPU15, CJ2M-CPU31*, CJ2M-CPU32*, CJ2M-CPU33*, CJ2M-CPU34*, CJ2M-CPU35*, CJ2H-CPU64-EIP*, CJ2H-CPU65-EIP*, CJ2H-CPU66-EIP*, CJ2H-CPU67-EIP*, CJ2H-CPU68-EIP*	CJ1W-ETN11, CJ1W-ETN21	SYSMAC CJ/CS1/CP1 Series
SYSMAC CS1	CS1G-CPU42 (H), CS1G-CPU43 (H), CS1G-CPU44 (H), CS1G-CPU45 (H), CS1H-CPU63 (H), CS1H-CPU64 (H), CS1H-CPU65 (H), CS1H-CPU66 (H), CS1H-CPU67 (H)	CS1W-ETN11, CS1W-ETN21	SYSMAC CJ/CS1/CP1 Series
SYSMAC CP1	CP1H-Y20DT-D, CP1H-XA40D□-□, CP1H-X40D□-□	CP1W-CIF41, CJ1W-ETN21**	SYSMAC CJ/CS1/CP1 Series
	CP1L-M60D□-□, CP1L-M40D□-□, CP1L-M30D□-□, CP1L-L20D□-□, CP1L-L14D□-□, CP1E-NA20D□-□, CP1E-N60D□-□, CP1E-N40D□-□, CP1E-N30D□-□	CP1W-CIF41	SYSMAC CJ/CS1/CP1 Series

* Also compatible with the built-in Ethernet interface on the system.

** The CJ unit adapter, CP1W-EXT01, is required.

YASKAWA Electric Corporation

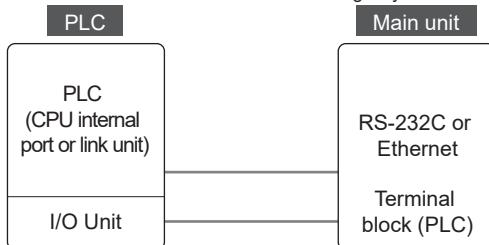
Series name	PLC Controller	Link unit	PLC type
MP2000	MP2200, MP2300, MP2310*, MP2300S*, MP2400*	218IF-01, 218IF-02	YASKAWA MP Series

* Also compatible with the built-in Ethernet interface on the system.

Preparing the PLC

1. Wiring overview

The PLC is wired to this machine in the following way.



Reference

- When the controller is not receiving commands from the PLC or when it is polling, the PLC does not need to be connected to the terminal block (PLC).
- Since this machine is defined as a modem, when connecting to a device that complies with the terminal definition via RS-232C, connect the RD signal of this machine to the RD signal of the device and the SD signal of this machine to the SD signal of the device.

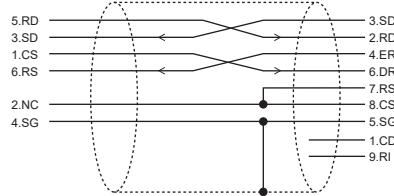
2. Wiring for the PLC-Link and setting the link unit (RS-232C)

When connecting to a Keyence KV Series (other than the KV-XL202)

- Use OP-26486 (D-sub 9-pin female connector) and OP-26487 (2.5 m straight cable).
- Set the link unit operation mode to [KV-Builder mode] (for the KV-700) or [KV-STUDIO mode] (for the KV-Nano, KV-1000/3000/5000/5500/7300/7500/8000).

LJ-S Series
(RJ-11 modular jack)

PC/KV-L20 Series
(9-pin)



When connecting to an Omron SYSMAC PLC

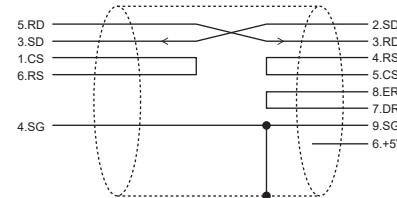
Reference When connecting to a SYSMAC C, adapt the wiring described here to the pins on the actual connectors used for the connection.

- Use OP-84384 (D-sub 9-pin male connector) and OP-26487 (2.5 m straight cable) for the SYSMAC (9-pin).
- Set the PLC side communication port operation mode to "upper link (SYSWAY)".
- Set the 1:1 or 1:N process to "1:N process".
- Set the unit number to "No. 0".
- Set the CS control to "None".
- When enabling settings using CX-Programmer 6.0 or later, make sure to set the [Optional settings on/off] item to [On]. When set to "Off", changes to other settings will not be enabled.

For 9-pin

LJ-S Series
(RJ-11 modular Jack)

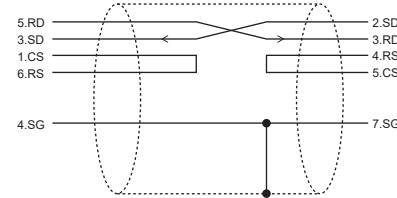
SYSMAC
(9 pins)



For 25-pin

LJ-S Series
(RJ-11 modular Jack)

SYSMAC
(25 pins)



Point

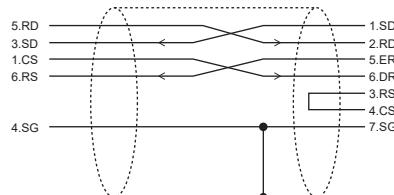
- If OP-26486 and OP-26487 are used as is to connect to a SYSMAC (9-pin), it may cause damage to this machine or the connected device. Do not use this connector.
- The controller's SG and power source 0V are insulated.

When connecting to a Keyence KV-XL202 Series PLC

- Process the KV-side connector of the OP-26487 (2.5 m straight cable) into loose wires, and then wire it directly to the terminal block of the KV as shown in the following figure.
- Set the link unit operation mode to [KV-STUDIO mode].

LJ-S Series
(RJ-11 modular jack)

KV-XL202
(7-pin terminal block)



Connecting to a MELSEC AnN, Q/L/iQ-R/iQ-F Series PLC

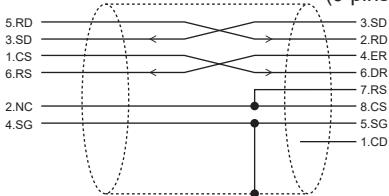
- Use OP-86930 (D-sub 9-pin male connector) and OP-26487 (2.5 m straight cable) for the MELSEC AnN, Q/L/iQ-R series.
- Use OP-26486 (D-sub 9-pin female connector) and OP-26487 (2.5 m straight cable) for the MELSEC iQ-F series.
- The operation mode of the PLC side communication port is set to "MC protocol format 5" for Q series and L series, iQ-R series, and iQ-F series, and "dedicated protocol format 1" for the A series.
- When using Q series and iQ-R series, set "save during RUN" to "permit".
- Set the checksum setting to [On].

Reference

- When connected to the A Series, "RS-232C CD terminal unchecked" must be defined in the ladder. Refer to the manual for the Mitsubishi Electric computing link unit for more details.
- In the MELSEC AnN, Q/L/iQ-R series, it is necessary to convert to a D-sub 9 pin male connector when using the OP-26486 (D-sub 9 pin female connector). Use a commercially available gender converter (D-sub 9 pin female to D-sub 9 pin male, straight connection).
- To use the Q Series link unit QJ71C24 (N)-R2, set "Baud rate 115200 bit/s, data length 8 bits, stop bit 1, even parity", and the switch setting in the PC parameters to "0BEE (hexadecimal)".

LJ-S Series
(RJ-11 modular Jack)

MELSEC
AnN, Q / L / iQ-R / iQ-F series
(9 pins)



Point The controller's SG and power source 0V are insulated.

When connecting to a Mitsubishi MELSEC FX Series (Outside the FX5 Series) PLC

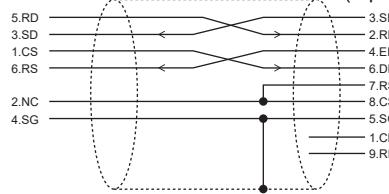
- Use OP-26486 (D-sub 9-pin female connector) and OP-26487 (2.5 m straight cable).
- Assignment of the communication channels starts from the "communication function expansion board" and the "communication special adapter" which are closer to the CPU.
- Set the PLC side communication port operation mode to [Exclusive Protocol Communication]. Set the checksum setting to [On].
- Set the H/W type to [Normal/RS-232C], the transmission control procedure to [Type 1 (without CR, CF)], the station number to [00H].

LJ-S Series

(RJ-11 modular Jack)

MELSEC

FX series
(9 pins)



Point

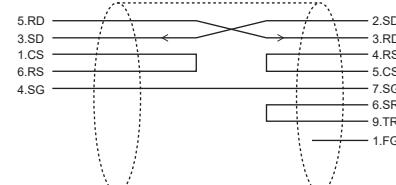
- When connecting to a MELSEC FX5 series, please refer to "when connecting to a MELSEC AnN, Q/L/iQ-R/iQ-F series".
- The controller's SG and power source 0V are insulated.

Connecting to a YASKAWA MP Series PLC

- Work on OP-26487 (2.5 m straight cable) and connect it to the commercially available D-sub 9 pin male connector as shown in the figure below.
- Set the communication protocol to "MEMOBUS".
- Set Master/Slave to "Slave".
- Set the transmission mode to "RTU".
- Set the device address to "1".
- Describe the MSG-RCV processing in the ladder. (Set the automatic reception to "Specified" for a module that allows automatic reception.) Refer to the manual for the YASKAWA Electric communication unit for more details.

LJ-S Series
(RJ-11 modular Jack)

MP Series
(9 pins)



Point

- If OP-26486 and OP-26487 are used as is for connection, it may cause damage to this machine or the connected device. Do not use this connector.
- The controller's SG and power source 0V are insulated.

3. Wiring for the PLC-Link and setting the PLC side (Ethernet)

- Make sure that the specified IP address is unique and different from the IP addresses for other devices.
- For all devices on a connected network, use the same subnet mask. For additional networks use a unique and different subnet mask.
- Use a category 5e or greater shielded twisted pair (STP) cable for connection. When connecting the equipment directly (1 to 1), use a cross cable. When connecting through a hub, use a straight cable.

When connecting to a Keyence KV Series PLC

Use KV BUILDER or KV STUDIO for setting.

● IP address

Set the IP address which is specified for the PLC-Link settings on this machine.

● Port number (VT)

Set the port number which is specified for the port in the PLC-Link settings on this machine.

When connecting to an Omron SYSMAC PLC

Change the settings using CX-Programmer. Before starting this setting, complete NODE No. for the PLC-Link settings on this machine. (Normally specify "1" for the number.)

● IP address

Set the IP address which is specified for the PLC-Link settings on this machine.

● FINS UDP port

Select [Define user], and set the specified port number which is specified for the PLC-Link settings on this machine.

● IP address table

Set the IP address and node address specified in the [Ethernet] screen of the global settings on this machine. The node address is normally [1].

● IP router table

Set this only when using a router. Set the IP of a router for the router address. Set the IP address specified in the [Ethernet] screen of the global settings on this machine.

 Specify a NODE No. for the PLC side communication port which is different from the NODE No. for the PLC-Link setting on this machine.

When connecting to a Mitsubishi MELSEC link unit

● When it is a Q/L series

Change settings using the network parameters in GX Developer or GX Works 2.

○ MELSECNET/Ethernet

- Network types: Select [Ethernet].
- Mode: Select [Online].

○ Operation settings

- Data communication code setting: Select [Binary code communication].
- Initial timing setting: Select [Always Open].
- IP address setting: Set the IP address which is specified for the PLC-Link settings on this machine.
- Send frame setting: Select [Ethernet (V2.0)].
- Authorize writing during RUN: Select [Permit].

● When it is iQ-R series

Change settings using the unit parameters in GX Works 3. [Primary Settings] > [Other Device Connection Configuration Settings] > [Advanced Settings] from the unit list, add [UDP Connection Device] to Ethernet configuration and configure as the following:

○ Communication method

Select either [Fixed Buffer (if present) or [Random Access Buffer].

○ Sequencer (port number)/sensor device (port number)

Set the port number of the PLC to either (setting range: 1025 to 4999, 5010 to 65534)

○ Sensor device (IP Address)

Set the IP of a router for this machine.

○ Confirm existence

Select [Don't Confirm Existence].

○ Authorize writing during RUN

Select [Permit].

Connecting to a Mitsubishi MELSEC PLC with built-in Ethernet port



- The built-in Ethernet port does not support Auto open UDP port (port number initial value: 5000) like the QJ1E71-100. Specify the communications port on this machine to a value from 1025 to 4999, or 5010 to 65535.
- Do not set more than one controller to the same port number. When connecting multiple controllers via a hub, set each controller with a different communication port number, and set multiple local port numbers that correspond to them.

When it is a Q/L series

Change settings using the PC parameters in GX Developer or GX Works 2.

Built-In Ethernet port settings

- IP address**
Set the IP address which is specified for the PLC-Link settings on this machine.
- Data communication code setting**
Select [Binary code communication].
- Authorize writing during RUN**
Select this check box.

Open settings: Add these settings.

- Protocol**
Select [UDP].
- Open method**
Select [MC protocol].
- Local port number**
Specify a hexadecimal value within the range 0401 to 1387, and 1392 to FFFE. Numbers from 1388 to 1391 (5000 to 5009 in decimal) are reserved.
Specify the [Port] setting in this machine with the decimal notation of the hexadecimal value specified here. (Example, if the local node port number is 1387, specify 4999 in this machine).

When it is iQ-R/iQ-F series

Change settings using the unit parameters in GX Works 3.

Own Node Setup

- IP address**
Set the IP address which is specified for the PLC-Link settings on this machine.
- Data communication code setting**
Select [Binary].
- Authorize writing during RUN**
Select allow all (SLMP) (only in the case of iQ-R)

Other device connection configuration settings

- [Primary Settings] > [Other Device Connection Configuration Settings] > [Advanced Settings] from the unit list, add [SLMP Connection Device] to Ethernet configuration and configure as follows.
- Protocol**
Set [UDP].
 - Sequencer (port number) / sensor device (port number)**
Set the port number of the PLC to either (setting range: 1025 to 4999, 5010 to 65534)
 - Sensor device (IP Address)**
Set the IP of a router for this machine.

Connecting to a YASKAWA MP Series PLC

Use MP720 for setting.

Communication protocol

Select "EXTENSION MEMOBUS".

Master/Slave

Select [Slave].

Code

Select [BIN].

Select [UDP] for connection type.

Remote IP address

Set the IP address which is specified for the PLC-Link settings on this machine.

Local port number

Set the port number which is specified for the port in the PLC-Link settings on this machine.

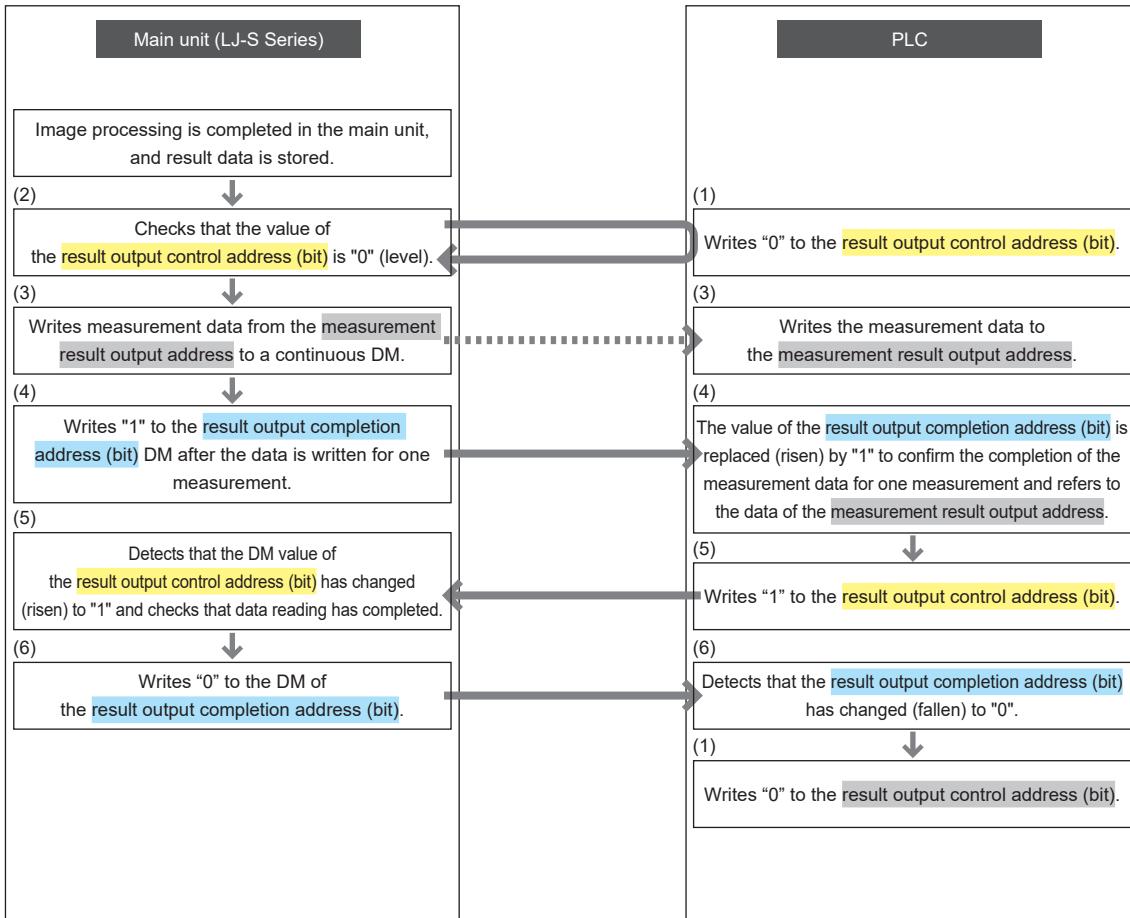
Describe the MSG-RCV processing in the ladder. (Set the automatic reception to "Specified" for a module that allows automatic reception.)

Refer to the manual for the YASKAWA Electric communication unit for more details.

Outputting Measurement Data via PLC-Link

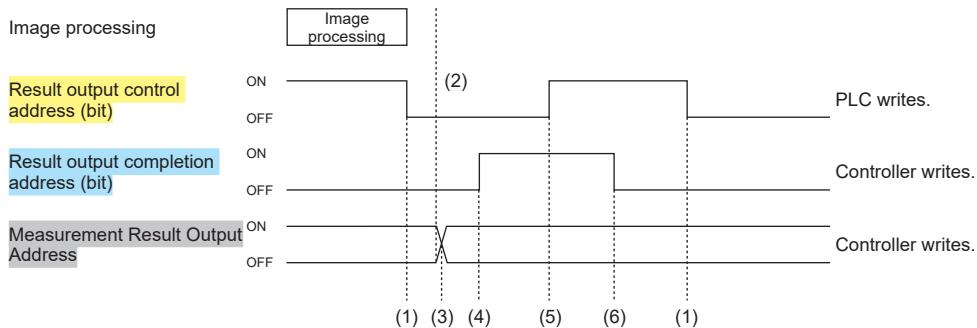
Data output procedure (Data Output Flow)

This machine outputs data via the PLC-Link in the following manner.



- For processing with the [Acknowledge result output completion] and [Enable Handshake] options enabled, all result data can be retrieved on the PLC side. If all result data is not necessary and only the latest result data needs to be retrieved on the PLC side, the following settings can reduce the time required to output the results.
If you disable [Enable Handshake], you can restrict Result Ack Address (bit) value confirmation in Steps 2 and 5 (in this case, this machine outputs the result data regardless of whether data has been completely read or not on the PLC side). Moreover, if the [Acknowledge result output completion] is disabled, writing can be restricted to the Result Ready Address (bit) in Steps 4 and 6 (on the PLC it cannot be determined whether the result data has been updated).

Timing Chart



See the descriptions from following pages for required settings.

Using the PLC-Link via RS-232C (Measurement Data Output)

Change the settings on this machine to output data via the PLC-Link.

-  When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

1 From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.

2 Select [PLC-Link (RS-232C)] in [Mode].

3 In [PLC Type], select the PLC type for the connected PLC model.

When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.

For more details on the [PLC Type] to be selected for the connected PLC model, refer to  "Types of Compatible PLC-Link Connections" (Page 9-26).

4 Change the communication settings as required.

● Baud Rate

Select the baud rate from 9600 (initial configuration value) or from 19200, 38400, 57600, 115200, 230400 (bps).

● Stop Bit

Select [1] (initial value) or [2] for the stop bit.

● Parity Bit

Select [Even] (initial value), [Odd], or [None] for the parity bit.

5 Select the data expression method in [Decimal Point].

● Fixed-point (initial value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● Floating-point

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

 The setting in [Decimal Point] is applied only to the measured values. The data other than measured values, such as number of measurements, are always output with the same integer as the displayed value.

6 Specify the starting address of the data memory to which this machine outputs data for the PLC unit in the [Result Output Address] field as required.

As all measurement data on this machine is output in 32 bits, a word device for 1 data is 2 words.

 This machine can write data to the PLC within the following data memory ranges.

- KV-L20 Series: 00000 to 65535
- MELSEC AnA Series: 0000 to 8191
- MELSEC Q/I/Q-R/I/Q-F Series: 00000 to 32767
- MELSEC FX Series: 0000 to 7999
- SYSMAC C Series: 0000 to 9999
- SYSMAC CJ/CS1/CP1 Series: 00000 to 32767
- YASKAWA MP Series: 0000 to 4095

If the data is written outside the specified data memory range, an error message appears, indicating communication is interrupted. Additionally, the data memory range actually available for the device of the same series varies depending on the PLC specifications and settings, and therefore, there may be a case where the range cannot be used up to the maximum.

7 Check the [Acknowledge result output completion] to be notified that data output is completed.

Unchecking this option can reduce the communication time. However, it is necessary to pay attention to the data reception timing control at the PLC side in this case. See  "Data output procedure (Data Output Flow)" (Page 9-34) for details on various data communication with the PLC.

8 To be notified of data output completion, specify the data memory address to which the data is output in the [Result Ready Address (bit)].

When data output to the PLC is successfully completed, this machine writes "1" to this memory.

9 After completing the setting, click [OK].

10 Restart this machine.

Using the PLC-Link via Ethernet (Measurement Data Output)

Change the settings on this machine to output data via the PLC-Link.

- [Reference]** When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

1 From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.

2 Select [PLC-Link (Ethernet)] in [Mode].

3 In [PLC Type], select the PLC type for the connected PLC model.

When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.

For more details on the [PLC Type] to be selected for the connected PLC model, refer to **□ "Types of Compatible PLC-Link Connections"** (Page 9-26).

4 Change the settings as required.

● IP Address

Enter the IP address for the unit that the controller is communicating with.

● Port

Enter the port number to be used for the PLC-Link.

● Resend Time (ms)

Enter the resend time (ms) for use if a communication error occurs.

● NODE No. (when selecting SYSMAC)

Enter the node number used to identify the controller.

5 Select the data expression method in [Decimal Point].

● Fixed-point (initial value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● Floating-point

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

- [Reference]** The setting in [Decimal Point] is applied only to the measured values. The data other than measured values, such as number of measurements, are always output with the same integer as the displayed value.

6 Specify the starting address of the data memory to which this machine outputs data for the PLC unit in the [Result Output Address] field as required.

As all measurement data on this machine is output in 32 bits, a word device for 1 data is 2 words.

- [Reference]** This machine can write data to the PLC within the following data memory ranges.

- KV Series: 00000 to 65535
- MELSEC Q/L/iQ-R/iQ-F Series: 00000 to 32767
- SYSMAC CJ/CS1/CP1 Series: 00000 to 32767
- YASKAWA MP Series: 0000 to 4095

If the data is written outside the specified data memory range, an error message appears, indicating communication is interrupted. Additionally, the data memory range actually available for the device of the same series varies depending on the PLC specifications and settings, and therefore, there may be a case where the range cannot be used up to the maximum.

7 Check the [Acknowledge result output completion] to be notified that data output is completed.

Unchecking this option can reduce the communication time. However, it is necessary to pay attention to the data reception timing control at the PLC side in this case. See **□ "Data output procedure (Data Output Flow)"** (Page 9-34) for details on various data communication with the PLC.

8 To be notified of data output completion, specify the data memory address to which the data is output in the [Result Ready Address (bit)].

When data output to the PLC is successfully completed, this machine writes "1" to this memory.

9 After completing the setting, click [OK].

10 Restart this machine.

- [Reference]** The changes will not take effect until this machine is restarted.

Data output setting

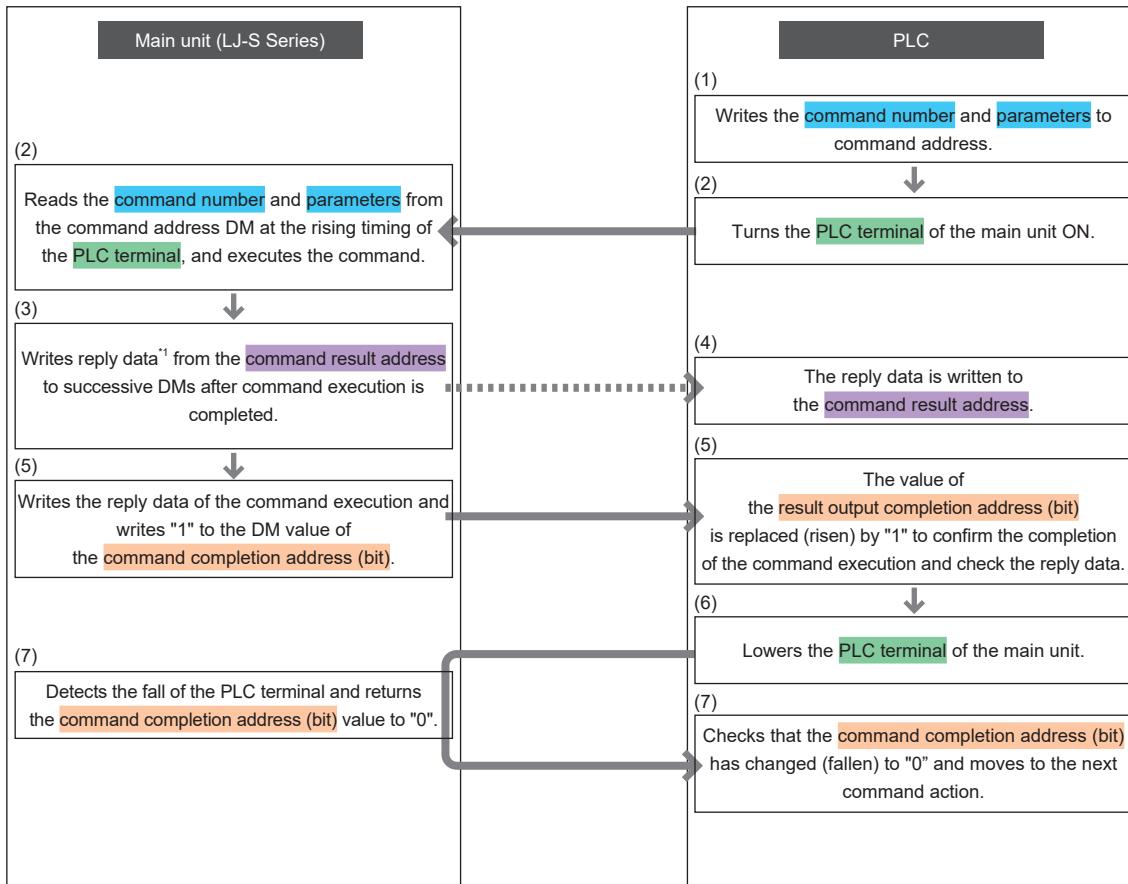
- All of the output data and output order via the PLC-Link are specified in the [PLC-Link] screen of the [Output Settings]. For details, see **□ "PLC-Link"** (Page 6-12).
- Every time a trigger is input, the measurement results set in the output data setting are written to the specified result output address.
- After the measurement result for 1 trigger is written, 1 is written to the specified result ready address (bit).

Controlling this machine via PLC-Link (PLC terminal)

Shorting/opening the PLC terminals directly allows commands to be read and executed as with command execute address (bit). Wiring to the PLC terminals is required (page 9-30).

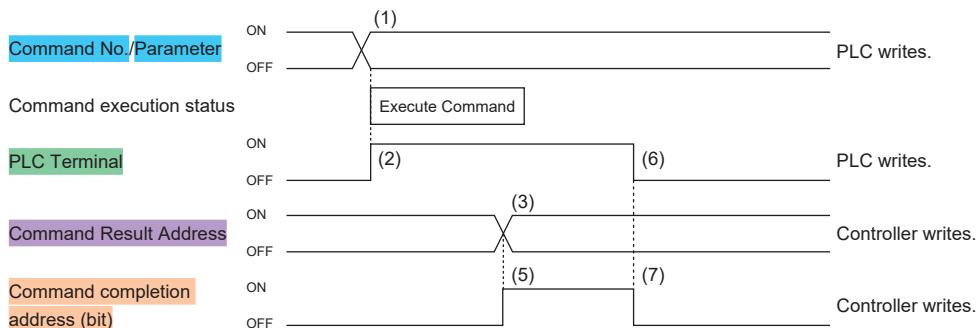
Command execution procedure via PLC terminal (Command Processing Flow)

A command is executed between this machine and the PLC in the following manner.



- The returned data varies depending on the commands. For more details, see "Operation mode and input allowed command" (Page 9-3) and confirm the received data of each command.

Timing Chart



See the descriptions from following pages for required settings.

Using the PLC-Link via RS-232C (PLC Terminal)

Change the settings to control this machine via the PLC-Link (PLC terminal). The number-specified commands can be used for controlling the system.

□ "Operation mode and input allowed command" (Page 9-3)

- Reference** When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

1 From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.

2 Select [PLC-Link (RS-232C)] in [Mode].

3 In [PLC Type], select the PLC type for the connected PLC model.

When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.

For more details on the [PLC Type] to be selected for the connected PLC model, refer to □ "Types of Compatible PLC-Link Connections" (Page 9-26).

4 Change the settings as required.

● **Baud Rate**

Select the baud rate from 9600 (initial configuration value) or from 19200, 38400, 57600, 115200, 230400 (bps).

● **Stop Bit**

Select [1] (initial value) or [2] for the stop bit.

● **Parity Bit**

Select [Even] (initial value), [Odd], or [None] for the parity bit.

5 Select the data expression method in [Decimal Point].

● **Fixed-point (initial value)**

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● **Floating-point**

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

6 Select [PLC Terminal] in [Command Execute Event].

7 In the [Command Complete Address (bit)], specify the data memory address used by this machine to notify of the completion of command execution.

Check the written results when the command complete address (bit) changes to 1.

8 In the [Command Address], specify the starting address of the data memory in which instruction (command) codes and parameters for this machine are stored.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command No. is stored in the starting address in 16bit-binary and the command parameters are stored successively from the starting address +2 in 32bit-binary for 1 data item.

9 In the [Command Result Address], specify the starting address of the data memory which stores the data string returned to the PLC as a result of the command execution.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command response is stored in the starting address in 16bit-binary and the command data is stored successively from the starting address +2 in 32bit-binary for 1 data item.

10 After completing the setting, click [OK].

11 Restart this machine.

Using the PLC-Link via Ethernet (PLC Terminal)

Change the settings to control this machine via the PLC-Link (PLC terminal). The number-specified commands can be used for controlling the system.

□ "Operation mode and input allowed command" (Page 9-3)

- Reference** When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

1 From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.

2 Select [PLC-Link (Ethernet)] in [Mode].

3 In [PLC Type], select the PLC type for the connected PLC model.

When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.

For more details on the [PLC Type] to be selected for the connected PLC model, refer to □ "Types of Compatible PLC-Link Connections" (Page 9-26).

4 Change the settings as required.

● **IP Address**

Enter the IP address for the unit that the controller is communicating with.

● **Port**

Enter the port number to be used for the PLC-Link.

● **Resend Time (ms)**

Enter the resend time (ms) for use if a communication error occurs.

5 Select the data expression method in [Decimal Point].

● **Fixed-point (initial value)**

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● **Floating-point**

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

6 Select [PLC Terminal] in [Command Execute Event].

7 In the [Command Complete Address (bit)], specify the data memory address used by this machine to notify of the completion of command execution.

Check the written results when the command complete address (bit) changes to 1.

8 In the [Command Address], specify the starting address of the data memory in which instruction (command) codes and parameters for this machine are stored.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command No. is stored in the starting address in 16bit-binary and the command parameters are stored successively from the starting address +2 in 32bit-binary for 1 data item.

9 In the [Command Result Address], specify the starting address of the data memory which stores the data string returned to the PLC as a result of the command execution.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command response is stored in the starting address in 16bit-binary and the command data is stored successively from the starting address +2 in 32bit-binary for 1 data item.

10 After completing the setting, click [OK].

A confirmation message will appear if any setting is changed.

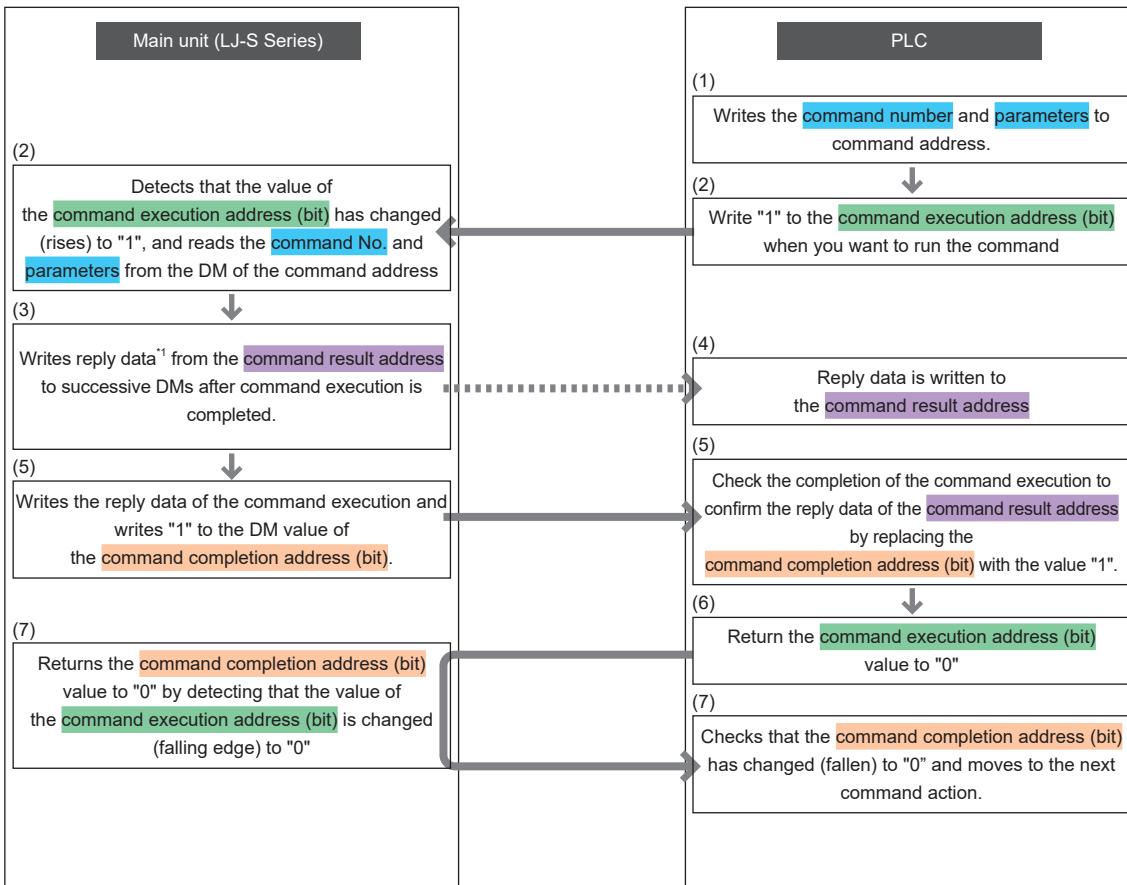
11 Restart this machine.

Controlling this machine via PLC-Link (Polling)

Set this machine to perform constant monitoring (polling) on the bit changes in the command execute address (bit) to read and execute a command.

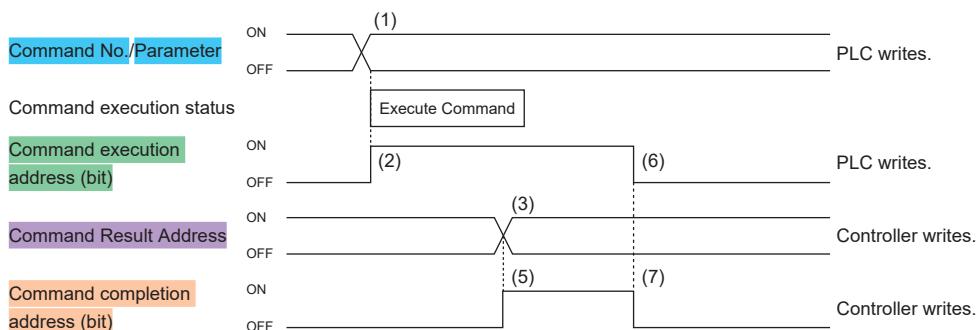
Command execution procedure via Polling (Command Processing Flow)

A command is executed between this machine and the PLC in the following manner.



- The returned data varies depending on the commands. For more details, see □ "Operation mode and input allowed command" (Page 9-3) and confirm the received data of each command.

Timing Chart



See the descriptions from following pages for required settings.

Using the PLC-Link via RS-232C (Polling)

Change the settings to control this machine via the PLC-Link (Polling). The number-specified commands can be used for controlling the system.

□ "Operation mode and input allowed command" (Page 9-3)

- Reference** When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

1 From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.

2 Select [PLC-Link (RS-232C)] in [Mode].

3 In [PLC Type], select the PLC type for the connected PLC model.

When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.

For more details on the [PLC Type] to be selected for the connected PLC model, refer to □ "Types of Compatible PLC-Link Connections" (Page 9-26).

4 Change the settings as required.

● **Baud Rate**

Select the baud rate from 9600 (initial configuration value) or from 19200, 38400, 57600, 115200, 230400 (bps).

● **Stop Bit**

Select [1] (initial value) or [2] for the stop bit.

● **Parity Bit**

Select [Even] (initial value), [Odd], or [None] for the parity bit.

5 Select the data expression method in [Decimal Point].

● **Fixed-point (initial value)**

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● **Floating-point**

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

6 Select [Polling] in [Command Execute Event].

7 In the [Command Execute Address (bit)], specify the data memory address which indicates the command execution timing.

For control via polling, reading data from this machine will start when this bit device changes to 1.

8 In the [Command Complete Address (bit)], specify the data memory address used by this machine to notify of the completion of command execution.

Check the written results when the command complete address (bit) changes to 1.

9 In the [Command Address], specify the starting address of the data memory in which instruction (command) codes and parameters for this machine are stored.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command No. is stored in the starting address in 16bit-binary and the command parameters are stored successively from the starting address +2 in 32bit-binary for 1 data item.

10 In the [Command Result Address], specify the starting address of the data memory which stores the data string returned by this machine as a result of the command execution.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command response is stored in the starting address in 16bit-binary and the command data is stored successively from the starting address +2 in 32bit-binary for 1 data item.

11 After completing the setting, click [OK].

12 Restart this machine.

Using PLC-Link via Ethernet (Polling)

Change the settings to control this machine via the PLC-Link (Polling). The number-specified commands can be used for controlling the system.

□ "Operation mode and input allowed command" (Page 9-3)

- Reference** When this machine is changed to Run mode, the warning message "Failed to establish a link with the PLC." may be repeatedly displayed. In this case, the PLC-Link settings or connection of an active PLC may be incorrect.

- 1** From [Global], select [Communications & I/O] > [PLC-Link] in Setup mode.
 - 2** Select [PLC-Link (Ethernet)] in [Mode].
 - 3** In [PLC Type], select the PLC type for the connected PLC model.
- When the connection destination model is selected, the relevant setting items for the selected PLC type are displayed.
For more details on the [PLC Type] to be selected for the connected PLC model, refer to □ "Types of Compatible PLC-Link Connections" (Page 9-26).

4 Change the settings as required.

● IP Address

Enter the IP address for the unit that the controller is communicating with.

● Port

Enter the port number to be used for the PLC-Link.

● Resend time (ms)

Enter the resend time (ms) for use if a communication error occurs.

5 Select the data expression method in [Decimal Point].

● Fixed-point (initial value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data (address m: lower 16 bit, address m+1: higher 16 bit).

● Floating-point

Uses the measured result in the data memory as a single-precision floating-point data (32 bits).

6 Select [Polling] in [Command Execute Event].

7 In the [Command Execute Address (bit)], specify the data memory address which indicates the command execution timing.

For control via polling, reading data from this machine will start when this bit device changes to 1.

8 In the [Command Complete Address (bit)], specify the data memory address used by this machine to notify of the completion of command execution.

Check the written results when the command complete address (bit) changes to 1.

9 In the [Command Address], specify the starting address of the data memory in which instruction (command) codes and parameters for this machine are stored.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command No. is stored in the starting address in 16bit-binary and the command parameters are stored successively from the starting address +2 in 32bit-binary for 1 data item.

10 In the [Command Result Address], specify the starting address of the data memory which stores the data string returned by this machine as a result of the command execution.

- Only a starting address can be specified. Multiple addresses cannot be specified at a time.
- Using the number-specified commands format, the command response is stored in the starting address in 16bit-binary and the command data is stored successively from the starting address +2 in 32bit-binary for 1 data item.

11 After completing the setting, click [OK].

12 Restart this machine.

Troubleshooting

Problems and Countermeasures

The message "Initializing PLC-Link Try No. **" appears repeatedly at the bottom right of the screen.

The system failed to establish PLC-Link communication with the PLC, and the initialization process is occurring in order to reconnect.

When connected by RS-232C

Check the PLC-Link communication settings, connection cable, and status at the device the cable is connected to.

When connected by Ethernet

Check the PLC-Link communication settings, IP address, connection cable (cross cable if connected directly), and status at the device the cable is connected to.

When a trigger command is issued by PLC-Link, the capture timing is later compared with trigger signal input from the terminal block.

When a command is executed from PLC-Link, more time is required before execution starts and variation is larger compared with when the terminal block is used (in particular with polling control).

If the timing variation is a problem when capturing an object moving at a high speed, input the trigger from the terminal block.

I tried to read data when the STO output from the terminal block changes to rise, but could not obtain the data properly.

STO is the data strobe signal for terminal output. Therefore, it cannot be used as the strobe signal for any other data output.

Refer to the result ready address for the timing as to when to read data by PLC-Link.

PLC-Link is established, however, data cannot be written to the connected PLC.

There is a limit to the range of data memory that can be written. Check the range that can be written to at the connected PLC.

Monitoring of the communications status is being performed with the RS-232C or Ethernet monitor, however, the text is garbled.

The RS-232C or Ethernet monitor does not support monitoring of the communications used in PLC-Link communications.

Error Messages

Message	Cause	Corrective Action	Error factor No.
Failed to establish a link with the PLC.	An error occurred in the connection with the PLC when the [PLC-Link (RS-232C)] or [PLC-Link (Ethernet)] function was enabled.	Check the connection with the PLC and the settings of the PLC. If PLC-Link is not used, change communication mode to [Disable PLC-Link]. If an error message is displayed after trigger input, check that the data memory destination specified is within the range that matches the PLC format.	13301
Unable to output to the PLC-Link due to a full output buffer.	The controller output buffer for outputting via PLC-Link is full. (When handshake is OFF)	Reduce the amount of data to be output so the data is output via PLC-Link at a faster rate than it builds up. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data are not written when the buffer is full.	13302
The delay of the handshake control causes skipping of the PLC communication result output.	The controller output buffer for outputting via PLC-Link is full. (When handshake is ON)	Reduce the amount of data to be output so the data is output via PLC-Link at a faster rate than it builds up. Or, extend the time between triggers/processing to allow for data to be output. Note: When the output buffer is full, measurement waits until the buffer is emptied.	13303

Control/Data Output via I/O Terminals

This machine has the following I/O terminals:

Parallel I/O Interface

Uses a specialized parallel connection cable (3 m) OP-51657 (optional)

Terminal Block Interface

The standard installed on this machine is a detachable type terminal block (OUT, IN, and I/O Connector).

Main functions available with I/O terminals

Input

● Capture

Trigger input

Allows a camera to capture the profile of the head at a specified timing.

Laser ON input (to head)

Laser irradiation is possible when Laser ON input is on.

● Control

- Command input: Instructs change of a program or execute conditions, etc.
- Control input: Interrupts data output or image capture.

Output

● Data output

Judgment output: Outputs upper/lower limit measurement results on the processed images.

● Control

Control output: Outputs signals for system errors or synchronization with external devices.

Terminal Block Interface

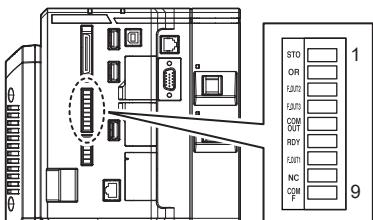
Standard specifications

Terminal block specifications for this machine are as follows.

NOTICE

Tightening above the specified torque may cause damage to the terminal block.

OUTPUT connector



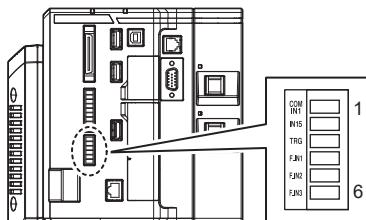
- Suitable wiring**

AWG16–28

- Terminal block screw torque**

0.25 Nm or less

INPUT connector



- Suitable wiring**

AWG16–28

- Terminal block screw torque**

0.25 Nm or less

Terminal Layout

- OUTPUT connector**

No	Terminal name	Signal	Terminal block display at time of shipment	Signal Description ^{*2}	Circuit diagram
1	OUT22	STO	STO	Strobe signal output for data output	B
2	OUT23	OR	OR	Total status output	B
3	F_OUT2	ERROR ^{*1}	F_OUT2	Error output ^{*1}	B
4	F_OUT3	RUN ^{*1}	F_OUT3	Run mode output ^{*1}	B
5	COMOUT1	-	COMOUT	Common for terminal block outputs	-
6	F_OUT0	READY ^{*1}	RDY	Trigger input permission output ^{*1}	B
7	F_OUT1	EXPOSURE_BUSY	F_OUT1	Signal output during capturing	B
8	N.C.	-	-	-	-
9	COMOUT_F	-	COMF	Common terminal for F_OUT	-

*1 It is the default assigned value on the terminal where the signal assignment can be changed. These assignments may vary if the Global settings have been changed.

*2 For details about the signal description, refer to **“Main functions of the input/output terminal block”** (Page 9-45).

Reference

- Power source 0V and COMOUT1 and COMOUT_F are all isolated.
- COMOUT1 is a common terminal exclusively used for terminal outputs 1 and 2.
- COMOUT_F is a common terminal exclusively used for terminal outputs 3 to 4 and 6 to 7.

- INPUT connector**

No	Terminal name	Signal	Terminal block display at time of shipment	Signal Description ^{*2}	Circuit diagram
1	COMIN1	-	COMIN1	Common for terminal block inputs	-
2	IN15	PLC ^{*1}	IN15	PLC command readout request ^{*1}	A3
3	F_IN0	TRG	TRG	Trigger input	A2
4	F_IN1	-	F_IN1	-	A2
5	F_IN2	TEST ^{*1}	F_IN2	Trial run input ^{*1}	A2
6	F_IN3	EXT ^{*1}	F_IN3	Disable trigger input ^{*1}	A2

*1 It is the default assigned value on the terminal where the signal assignment can be changed. These assignments may vary if the Global settings have been changed.

*2 For details about the signal description, refer to **“Main functions of the input/output terminal block”** (Page 9-45).

Reference

- Power source 0V and COMIN1 are both isolated.
- COMIN1 is the common terminal for inputs IN1 2 to 6.

Main functions of the input/output terminal block

The I/O terminals on this machine have the following functions.

 The output signals STO, OR, and OUT_DATA0 to 15 are output only in Run mode.

Terminal Block Interface (OUT)

Signal	Signal Description	Overview
STO	Strobe signal output for data output	Used to read the data of the total status output (OR) and OUT_DATA0 to OUT_DATA15, based on leading edge synchronization.
OR	Total status output	Used to output the OR result for the judged value of tools specified in the output settings.
ERROR	Error output	This signal is output while any of system errors occur with the dialog displayed on the screen. For details on typical system errors, refer to  "Error Message" (Page A-77). In the Global Settings of  "ERROR Output Settings" (Page 8-14), enabling or disabling the error output for the SD card-related errors, etc. can be specified.
RUN	Run mode output	This signal is output while this machine operates in Run mode.
COMOUT1	Common for terminal block outputs	Output common terminal for terminal block interface (OUT) 1 to 2.
READY	Trigger input permission output	Turns on when trigger input is acceptable.
EXPOSURE_BUSY	Signal output during capturing	This is the signal output during capture (scanning). Do not move the measured workpiece while this signal is on.
COMOUT_F	High-speed general-purpose output common terminal	Output common terminal for the terminal block interface (OUT) 3, 4, 6, 7.

Terminal Block Interface (IN)

Signal	Signal Description	Overview
COMIN1	Common for terminal block inputs	Input common terminal for terminal block interface (IN) 2 to 6.
PLC	PLC command readout request	Used to execute command control via the PLC terminal using the PLC-Link (leading edge synchronization). As the request acceptance may be delayed depending on other process conditions, hold the ON state for input until the command complete address (bit) on the PLC unit changes to 1 (the command execution is confirmed).
TRG	Trigger input	Starts head image (leading edge synchronization). The input is accepted when READY is ON.
TEST	Trial run input	Used to suspend the status output for trial run or any other reasons. The result data not output at the time of input are deleted. While this signal is on, OR output, STO output, and data output of OUT_DATA0 to 15 is forcibly set to normal state (level synchronization). The data output from the communication port is also canceled and stopped during the input. As soon as the input turns off, the measurement result obtained immediately after that will start being output again.
EXT	Disable trigger input	Used to suspend the acceptance of triggers. When the input turns on, READY terminal is forced to be off to stop the acceptance of all triggers (level synchronization).

I/O terminals of the head

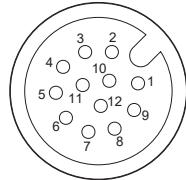
Provide 24 VDC to the power I/O connector using the power I/O cable for head, and connect the Ethernet cable for head to the Ethernet connector.

- Power I/O cable for head
(OP-88949 (2 m) / OP-88950 (5 m) / OP-88951 (10 m))

Cable label	Wire color
24V	Brown
24V	Red
0V	Blue
0V	Black
INCOM	White
LD_ON	Green
TRG	Pink
MEM_CLR	Gray/Pink
READY	Yellow
ERROR	Gray
EXP_BUSY	Purple
OUTCOM	Red/Blue
FG	Shield

Connector pin layout

■ Power I/O connector

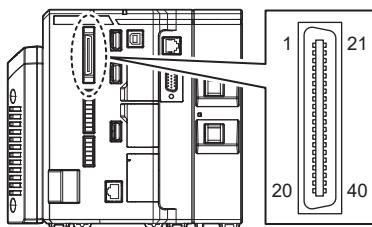


No	Name	Cable label	Terminal statement	Circuit diagram
1	24V	24V	24 VDC input	-
9	24V	24V		
2	0V	0V	24 VDC input (GND)	-
7	0V	0V		
3	INCOM	INCOM	Common for input	-
4	LASER_ON	LD_ON	Laser ON input	A1
5	TRG	TRG	Trigger input	A1
11	MEM_CLEAR	MEM_CLR	Memory clear input	A1
6	READY	READY	Trigger input permission output	B
8	ERROR	ERROR	Error output	B
10	EXPOSURE_BUSY	EXP_BUSY	Capture-in-progress output	B
12	OUTCOM	OUTCOM	Common for output	-
SHELL	FG	FG	-	-

NOTICE

- The LASER_ON terminal is short-circuited when the head power I/O cable is shipped.
- The head and controller are connected by providing power to them simultaneously or by providing power to the head first and then to the controller.
- When you use the head connecting it to the LJ-S8000 Series controller, only the LASER_ON terminal is effective.

Parallel I/O Interface



Reference For wiring the connector, use the specialized parallel connection cable (3 m) OP-51657 (optional).

Pin Layout: Cable colors when optional OP-51657 is used

No	Terminal name	Signal	Signal Description ²	Circuit diagram	Cable color
1	COMIN2	-	Connector input common terminal	-	Brown
2	IN0	CMD_PARAM0	Command parameter bit 0	A3	Red
3	IN1	CMD_PARAM1	Command parameter bit 1	A3	Orange
4	IN2	CMD_PARAM2	Command parameter bit 2	A3	Yellow
5	IN3	CMD_PARAM3	Command parameter bit 3	A3	Green
6	IN4	CMD_PARAM4	Command parameter bit 4	A3	Blue
7	IN5	CMD_PARAM5	Command parameter bit 5	A3	Purple
8	IN6	CMD_PARAM6 ¹	Command parameter bit 6 ¹	A3	Gray
9	IN7	CMD_PARAM7 ¹	Command parameter bit 7 ¹	A3	White
10	IN8	CMD_CODE0	Command input bit 0	A3	Black
11	IN9	CMD_CODE1	Command input bit 1	A3	Brown
12	IN10	CMD_CODE2	Command input bit 2	A3	Red
13	IN11	CMD_CODE3	Command input bit 3	A3	Orange
14	IN12	CST	Command confirmation input	A3	Yellow
15	IN13	RESET	Reset	A3	Green
16	IN14	PST ¹	Output data switch input ¹	A3	Blue
17	COMOUT2	-	Connector output common terminal	-	Purple
18	OUT0	ACK ¹	Verification of successfully executed command input ¹	B	Gray
19	OUT1	NACK ¹	Verification of unsuccessfully executed command input ¹	B	White
20	OUT2	BUSY	BUSY Signal	B	Black
21	OUT3	CMD_READY	Command input permission	B	Brown
22	OUT4	- ¹	- ¹	B	Red
23	OUT5	- ¹	- ¹	B	Orange
24	OUT6	OUT_DATA0	Data output bit 0	B	Yellow
25	OUT7	OUT_DATA1	Data output bit 1	B	Green
26	OUT8	OUT_DATA2	Data output bit 2	B	Blue
27	OUT9	OUT_DATA3	Data output bit 3	B	Purple
28	OUT10	OUT_DATA4	Data output bit 4	B	Gray
29	OUT11	OUT_DATA5	Data output bit 5	B	White
30	OUT12	OUT_DATA6	Data output bit 6	B	Black
31	OUT13	OUT_DATA7	Data output bit 7	B	Brown
32	OUT14	OUT_DATA8	Data output bit 8	B	Red
33	OUT15	OUT_DATA9	Data output bit 9	B	Orange
34	OUT16	OUT_DATA10	Data output bit 10	B	Yellow
35	OUT17	OUT_DATA11	Data output bit 11	B	Green
36	OUT18	OUT_DATA12 ¹	Data output bit 12 ¹	B	Blue
37	OUT19	OUT_DATA13 ¹	Data output bit 13 ¹	B	Purple
38	OUT20	OUT_DATA14 ¹	Data output bit 14 ¹	B	Gray
39	OUT21	OUT_DATA15 ¹	Data output bit 15 ¹	B	White
40	COMOUT2	-	Connector output common terminal	-	Black

*1 It is the default assigned value on the terminal where the signal assignment can be changed. These assignments may vary if the Global settings have been changed.

*2 For details about the signal description, refer to **“Main functions of the input/output terminal block”** (Page 9-45).

Reference

- COMOUT2 for Pin 17 and Pin 40 are common.
- COMIN2 is a common terminal for input for the parallel I/O connector.
- COMOUT2 is a common terminal for output for the parallel I/O connector.
- Power source 0V and COMIN1, COMIN2, COMOUT1, COMOUT2, and COMOUT_F are all isolated.

Main Parallel Interface Action

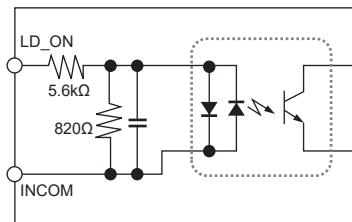
Parallel I/O Interface

Signal	Signal Description	Overview
COMIN2	Connector input common terminal	Common input terminal for the parallel I/O interface.
CMD_PARAM0	Command parameter input bit 0 (LSB)	
CMD_PARAM1	Command parameter input bit 1	
CMD_PARAM2	Command parameter input bit 2	
CMD_PARAM3	Command parameter input bit 3	Used to input parameters necessary for commands from the parallel I/O interface in binary.
CMD_PARAM4	Command parameter input bit 4	
CMD_PARAM5	Command parameter input bit 5	
CMD_PARAM6	Command parameter input bit 6	
CMD_PARAM7	Command parameter input bit 7 (MSB)	
CMD_CODE0	Command input bit 0 (LSB)	
CMD_CODE1	Command input bit 1	Used to input command codes from the parallel I/O interface in binary.
CMD_CODE2	Command input bit 2	
CMD_CODE3	Command input bit 3 (MSB)	
CST	Command confirmation input	Execute commands and parameters from the parallel I/O interface (rising synchronization). <ul style="list-style-type: none"> When confirming the CST acceptance, confirm the falling of CMD_READY after CST input. When confirming the completion of command execution, confirm the rise of ACK (success) or NACK (failure) after CST input.
RESET	Reset	Used to perform reset operation. <ul style="list-style-type: none"> The OR output, OUT_DATA 0 to 15 becomes normal. The measurement count returns to 0. All tools undergo a measurement reset. All of archived image data are deleted. All of the data in the output buffer are reset. The name of a new output file for the measurement result is created in SD card 2. A new name for the image output folder is created in the SD card and the FTP.
PST	Output data switch input	Used to give an order to change data when handshake output is used. After the first STO output, if there is no PST input even if the set output period time has elapsed, data switching will be performed automatically as a timeout (except when set to perform handshake).  "With handshake" (Page 9-61)
COMOUT2	Connector output common terminal	Common output terminal for the parallel I/O interface. This will be internally common with No. 40 COMOUT2.
ACK	Execution success confirmation output for command inputs	Output when the command from parallel I/O interface is completed normally.
NACK	Execution failure confirmation output for command inputs	Output when the command from the parallel I/O interface ends abnormally.
BUSY	BUSY Signal Output	This signal is outputted during measurement processing or command processing. The next measurement processing or command processing accepted during BUSY may delay the start of execution.
CMD_READY	Permission output for command input	Output when it is possible to accept command execution from the parallel I/O interface. If input when CMD_READY is OFF, CST is ignored.
OUT_DATA0	Data output bit 0 (LSB)	
OUT_DATA1	Data output bit 1	
DOUT_DATA2	Data output bit 2	
OUT_DATA3	Data output bit 3	
OUT_DATA4	Data output bit 4	
OUT_DATA5	Data output bit 5	
OUT_DATA6	Data output bit 6	
OUT_DATA7	Data output bit 7	
OUT_DATA8	Data output bit 8	
OUT_DATA9	Data output bit 9	
OUT_DATA10	Data output bit 10	
OUT_DATA11	Data output bit 11	
OUT_DATA12	Data output bit 12	
OUT_DATA13	Data output bit 13	
OUT_DATA14	Data output bit 14	
OUT_DATA15	Data output bit 15 (MSB)	
OUTPUT_IMG_BUSY	This signal is output while images are being output.	Output while images are being output.
OUTPUT_IMG_STATUS	This signal is output when there is image output data.	Output when there are remaining images that need to be output in an image output buffer.
COMOUT2	Connector output common terminal	Common output terminal for the parallel I/O interface. This is internally common with No. 17 COMOUT2 and No. 40 COMOUT2.

I/O circuit

Input circuit diagram

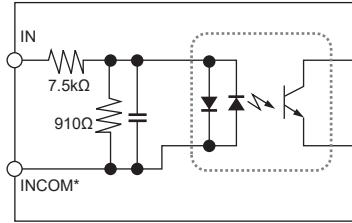
Circuit A1 (LD_ON on the head)



Item	Specifications	Remarks
Max. applied voltage	26.4V	
Minimum ON voltage	19V	
Maximum OFF voltage	3mA	Turns on if the voltage condition or current condition is satisfied.
Maximum OFF current	5V	Turns off if the voltage condition or current condition is satisfied.
Maximum OFF current	1mA	Turns on if the voltage condition or current condition is satisfied.

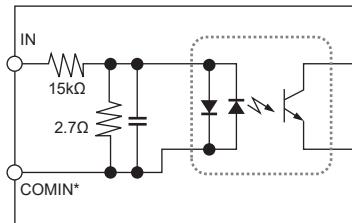
Point Power source 0V, INCOM, and OUTCOM are isolated.

Circuit A2 (corresponds to F_IN0 to 3 and EV on the controller)



Item	Specifications	Remarks
Max. applied voltage	26.4V	
Minimum ON voltage	19V	
Min. ON current	2.2mA	Turn ON if either voltage or current condition is satisfied.
Maximum OFF current	5V	Turns off if the voltage condition or current condition is satisfied.
Maximum OFF current	1mA	Turns on if the voltage condition or current condition is satisfied.

Circuit A3 (other inputs on the controller)



Item	Specifications	Remarks
Max. applied voltage	26.4V	
Minimum ON voltage	19V	Turns on if the voltage condition or current condition is satisfied.
Maximum OFF voltage	1.2mA	
Maximum OFF current	3V	Turns off if the voltage condition or current condition is satisfied.
Maximum OFF current	0.3mA	Turns on if the voltage condition or current condition is satisfied.

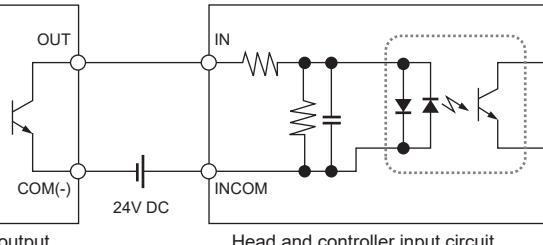
Point The commons which are connected differ according to the IN terminals.

The common terminal for IN connectors 2 - 6 is INCOM, the common terminal for parallel I/O connectors 2 - 16.

Example of input connections

Example of NPN output connection

When connecting an NPN output to the LJ-S Series head or controller input

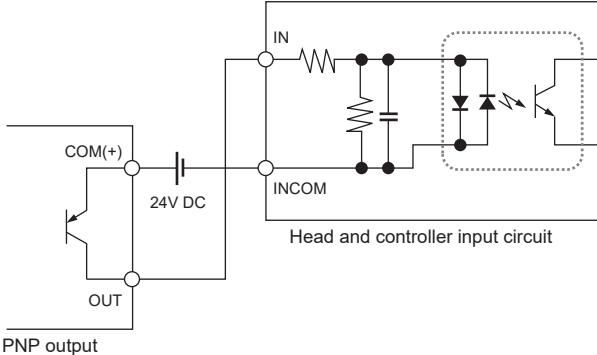


NPN output

Head and controller input circuit

Example of PNP output connection

When connecting an PNP output to the LJ-S Series head or controller input

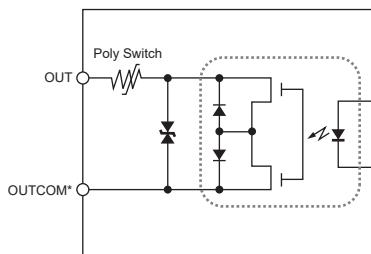


PNP output

Head and controller input circuit

Output circuit diagram

Circuit B



Item	Specifications	Remarks
Max. applied voltage	30V	
Max. sink current	50mA	
Leakage current	0.1mA	When OFF / Maximum
Residual voltage	1.4V	When ON / Maximum (@ 50 mA)
	1.0V	When ON / Maximum (@ 20 mA)



- Power source 0V, IN_COM, and OUT_COM are isolated.
- Since this unit utilizes a photo MOSFET in the output elements, any one of the NPN inputs, or PNP inputs is Point connectable.

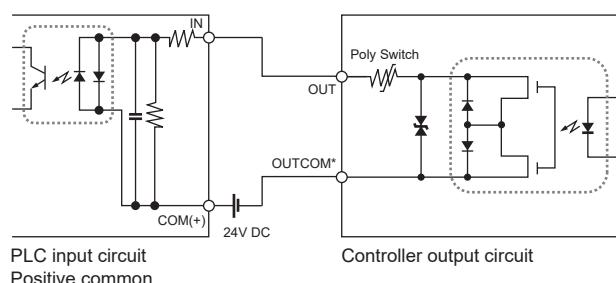
Example of output connections



If the input instrument is compatible with the NPN open collector outputs, then refer to this connection example.

Example of PLC input connection 1

When connecting an output from the controller to a PLC with a positive common

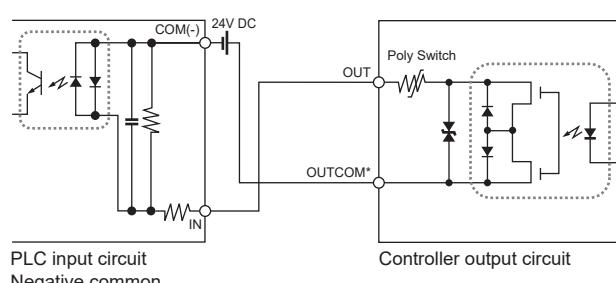


PLC input circuit
Positive common

Controller output circuit

Example of PLC input connection 2

When connecting an output from the controller to a PLC with a negative common

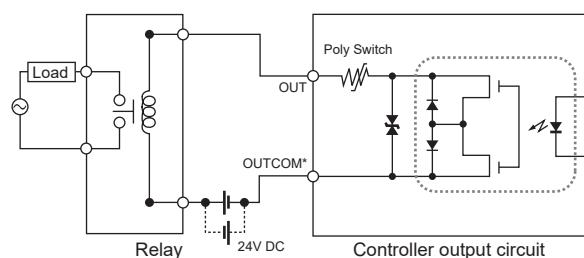


PLC input circuit
Negative common

Controller output circuit

Example of relay input connection

When connecting an output from the controller to a relay



Relay

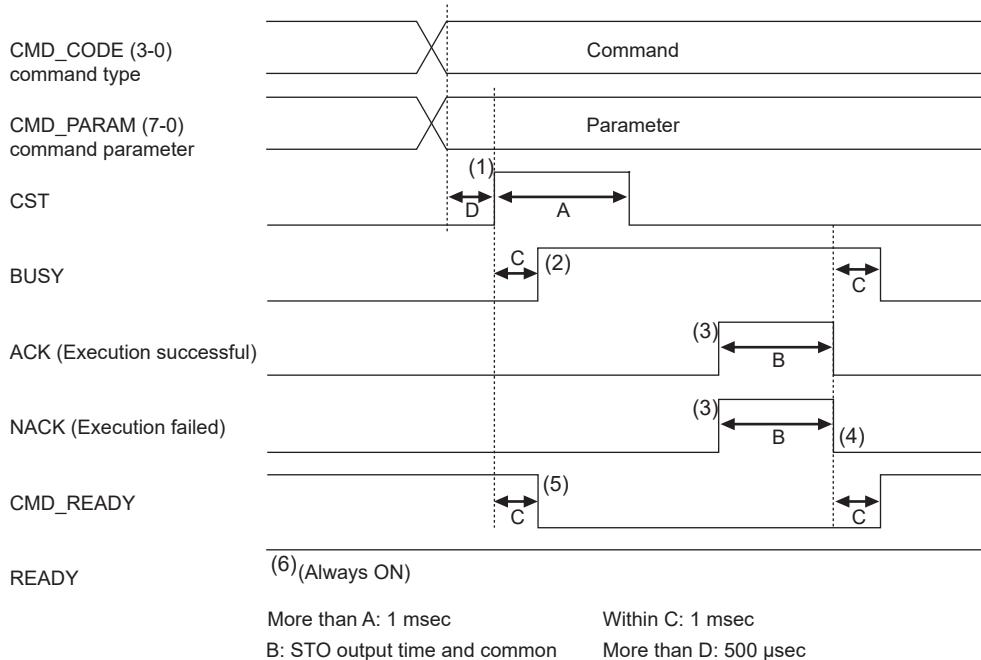
Controller output circuit

Using Command Inputs via I/O Terminals

Command input timing

 Except for image capture and clear error, commands can be input only when the controller is operating in Run mode.

Basic flow (an example of real-time command execution)



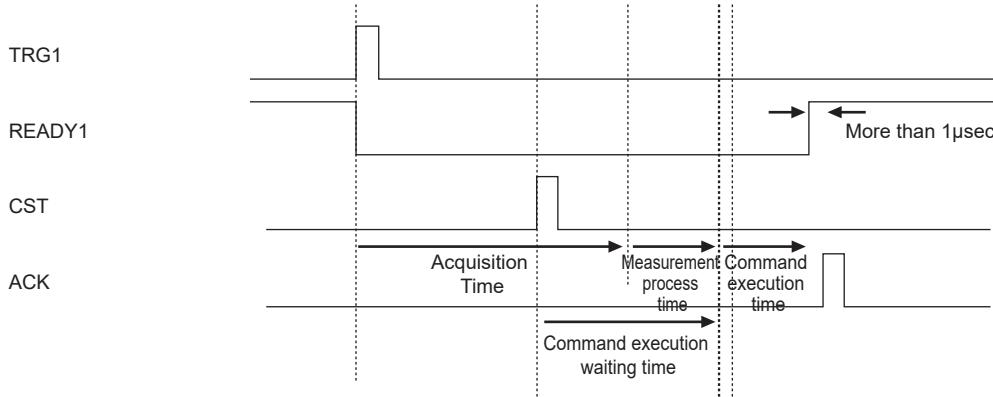
- (1) A command input is confirmed at the leading edge of CST.
- (2) BUSY turns on to indicate that measurement processing or a command from the terminal block is being executed.
- (3) The result of the command execution (success or failure) can be checked by either ACK or NACK being turned on for STO output ON time.
- (4) CMD_READY turns ON when ACK or NACK turns off.
- (5) When CST is input with CMD_READY turned off, CST is ignored. In this case, neither an ACK nor NACK response is given for CST.
- (6) If a command is not based on real-time execution, READY turns off during execution of the command.

Timing of commands which are not based on real-time execution

● When no command request is received

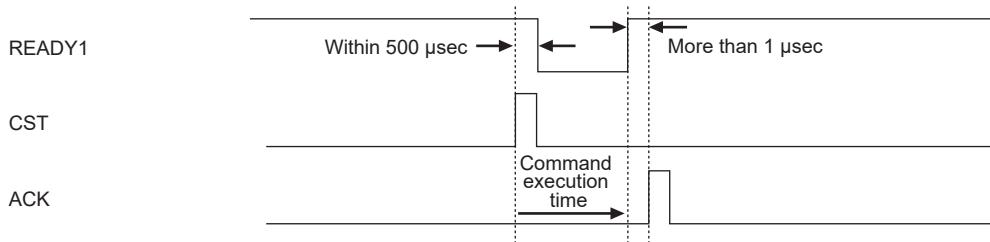


● When a command request is received



- When a command request is received during processing, the command is executed as soon as image processing is completed.
- READY signal does not turn ON until the command execution is completed. Therefore, a next trigger input is not accepted until READY signal turns ON.

● When there is no image capture



The command is executed immediately and READY signal turns off during the command execution.

I/O command inputs available

The I/O command inputs available on this machine are shown below.

Value	Command name	Command detail	CMD_CODE				CMD_PARAM							
			3	2	1	0	7	6	5	4	3	2	1	0
0	Save Program	This is the same function as the SS command.	0	0	0	0	None							
1	Specify parameter in upper 8 bits		0	0	0	1	0 to 255							
2	Change programs (SD card 1)	This is the same function as the PW command (SD1 fixed).	0	0	1	0	0 to 255: Inspection setting number							
3	Change programs (SD card 2)	This is the same function as the PW command (SD2 fixed).	0	0	1	1	0 to 255: Inspection setting number							
4	Standard image registration	The same function as BS (with parameters) command	0	1	0	0	IN7 - IN6 Fixed to 0 IN5 to IN0: Destination number							
5	Update Reference Value	The same function as BS (without parameters) command	0	1	0	1	None							
6	Image Capture	This is the same function as the BC command.	0	1	1	0	IN0: Data output (0: SD2, 1: FTP)							
7	Write execute condition	This is the same function as the EXW command.	0	1	1	1	0 to 99: Execute number							
8	Clear error	This is the same function as the CE command.	1	0	0	0	None							
9	Change Output File/Folder	This is the same function as the OW command.	1	0	0	1	IN0: Changes data output files when set to 1 IN1: Changes image output folders when set to 1							
10	Change Operation Screen	This is the same function as the VW command.	1	0	1	0	IN7 to IN6: Specified screen type (specified by 0, 1) IN3 to IN0: Screen number (specified by 0 to 9)							
11	Save Statistical Data	This is the same function as the TS command.	1	0	1	1	IN0: Type of file for writing data • 0: Measured value • 1: Statistical data							

1: ON (short), 0: OFF (open)



- Except for image capture and clear error, I/O commands can be input only when the controller is operating in Run mode.
- To confirm a command, input the command to CMD_PARAM 0 to 7, CMD_CODE 0 to 3 and then turn the CST input on (recognition of the leading edge).
- ACK output and NACK output ON time is of the same duration as STO output time.
- As the commands based on real-time execution are executed along with the measurement process, execution of that kind of command does not affect the image processing. However, command execution time for this case will take longer than when the command alone is solely executed.

0. Save programs

Saves the setting.

Parameters

None

1. Specify parameter in upper 8 bits

Specifies the upper bits of a parameter used with a different command.



The specified parameter is held until the next command execution or shut down of the controller.

Parameters

- When referencing with [Change Programs]: Specifies the upper 8 bits of the parameter.
- When referencing with [Standard image registration]:
CMD_PARAM7 to 4: Not used
CMD_PARAM3 to 0: Upper 4 bits of destination number

2. Change programs (SD card 1)

Changes the current program to the target program, specified in 16 bits, on the SD card 1.

Parameters

Program No. 0 to 255 (To select 256 to 999, specify the upper bits 15 to 8 in the parameter of "1. Specify parameter in upper 8 bits", and the lower bits 7 to 0 in this parameter.)

3. Change programs (SD card 2)

Changes the current program to the target program, specified in 16 bits, on the SD card 2.

Parameters

Program No. 0 to 255 (To select 256 to 999, specify the upper bits 15 to 8 in the parameter of "1. Specify parameter in upper 8 bits", and the lower bits 7 to 0 in this parameter.)

4. Standard image registration

Regarding the head specified by the head number, it registers the latest input image as standard.

Parameters

- CMD_PARAM 5 to 0: Destination No. 0 to 63 (When specifying destination No. 64 to 899, select [1. Specify parameter in upper 8 bits] for the upper bits, and specify 5 to 0 in this parameter.)
- CMD_PARAM 7 to 6: 0 is fixed.

5. Update Reference Measurement Value

The command recalculates a reference measured value using the latest standard image.

Parameters

None

6. Image capture

This command captures an image on the screen.

Parameters

CMD_PARAM0: Output location of the captured image (0: SD2, 1: FTP)

7. Write execute condition

This command changes the number of the execution condition currently enabled to the specified number.

Parameters

CMD_PARAM6 to 0: Value of execute number (0 to 99)

8. Clear error

This command clears the error status.

Parameters

None

9. Change output file/folder

- When changing a data output file, a new result file is created using the latest date and time.
- When changing an image output folder, a new image output folder is created using the latest date and time.

Parameters

CMD_PARAM 1 to 0: Select target. (1: data output file, 2: image output folder, 3: both)

10. Change operation screen

Changes the display to the specified operation screen.

Parameters

- CMD_PARAM6: Specified screen type (0: Tool list 1: Customized operation screen)
- CMD_PARAM 3 to 0: Screen number (0 to 9: Customized screen No.)

11. Save statistical data

Output the accumulated statistical data to the SD card 2. For details about the content of the file to be written, refer to "Save the recorded measurement results on the SD card 2 (Export)" (page 7-25).

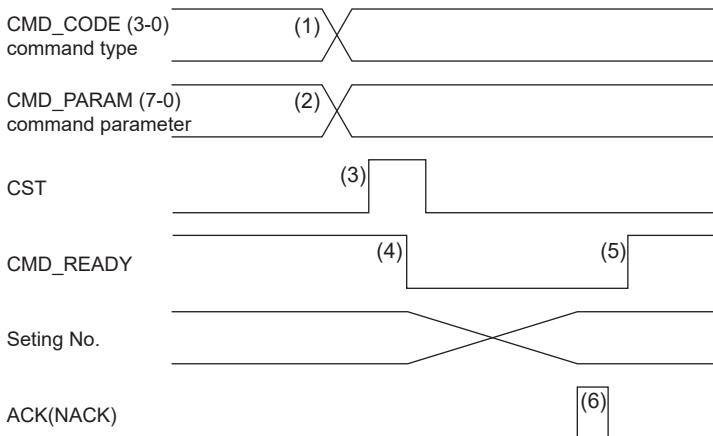
Parameters

CMD_PARAM0: Type of file for writing data (0: Measured value 1: Statistical data)

I/O command control procedures

Use the following procedures to operate this machine via the I/O commands.

Example of changing to the program 15 on the SD card 1 using the I/O commands.



Enter the command codes of the change program (SD card 1) command in CMD_CODE0 to 3.

CMD_CODE3:0(OFF)
CMD_CODE2:0(OFF)
CMD_CODE1:1(ON)
CMD_CODE0:0(OFF)

Enter the codes of program 15 to which the setting is changed in CMD_PARAM 7 to 0.

CMD_PARAM7:0(OFF)
CMD_PARAM6:0(OFF)
CMD_PARAM5:0(OFF)
CMD_PARAM4:0(OFF)
CMD_PARAM3:1(ON)
CMD_PARAM2:1(ON)
CMD_PARAM1:1(ON)
CMD_PARAM0:1(ON)

Turn the input of CST on.

CMD_READY turns off and program change starts.

When the setting is changed to program 15, ACK turns ON for a certain time, and then CMD_READY turns on after ACK falls.



ACK output and NACK output duration time is the same as the time set with STO (initial value: 10 ms).

Outputting Data Values via I/O Terminals

Output order

According to the output order, the data specified in the output settings is output from OUT_DATA 0 to 15 sequentially.

The items and order for output can be specified by □ "OUT Terminal" (Page 6-6) as required.

Examples of output details and timing are shown in the following pages.



STO output is generated one time even when none of the output settings is specified.

When this machine is operating in Setup mode or TEST terminal is ON, the data is not output.

Example of output

If measurement is performed using the settings below, the timing chart is as in the following figure.

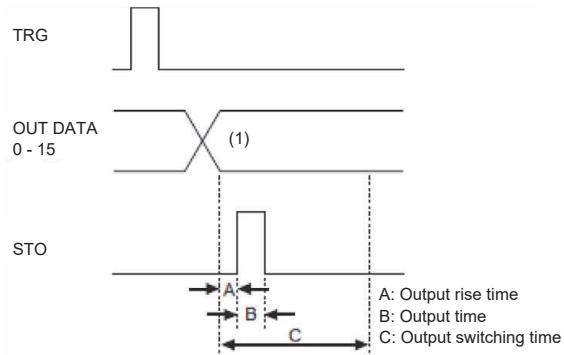
○ Measurement requirements

- T100: Height measurement
- T101: Profile Measurement
- T102: Inspection for defects/stains.

○ Output Settings

- 3 tool judgments in total: T100 to T102 measurement conditions

On the output device, read OUT_DATA 0 to 15 in synchronization with the leading edge of STO.



	(1)
OUT6	T100 Judgment value
OUT7	T101 Judgment value
OUT8	T102 Judgment value
OUT9	0
OUT10	0
OUT11	0
OUT12	0
OUT13	0
OUT14	0
OUT15	0
OUT16	0
OUT17	0
OUT18	0
OUT19	0
OUT20	0
OUT21	0

For details on how to set A to C in the diagram above, refer to □ "External Terminal" (Page 8-2).

If the duration of output cycle via the I/O is longer than the trigger input cycle, priority is given to measurement processing. Therefore, output delay may be caused, which will lead to the data being omitted. To avoid this, set the output cycle time shorter than the trigger input cycle time.

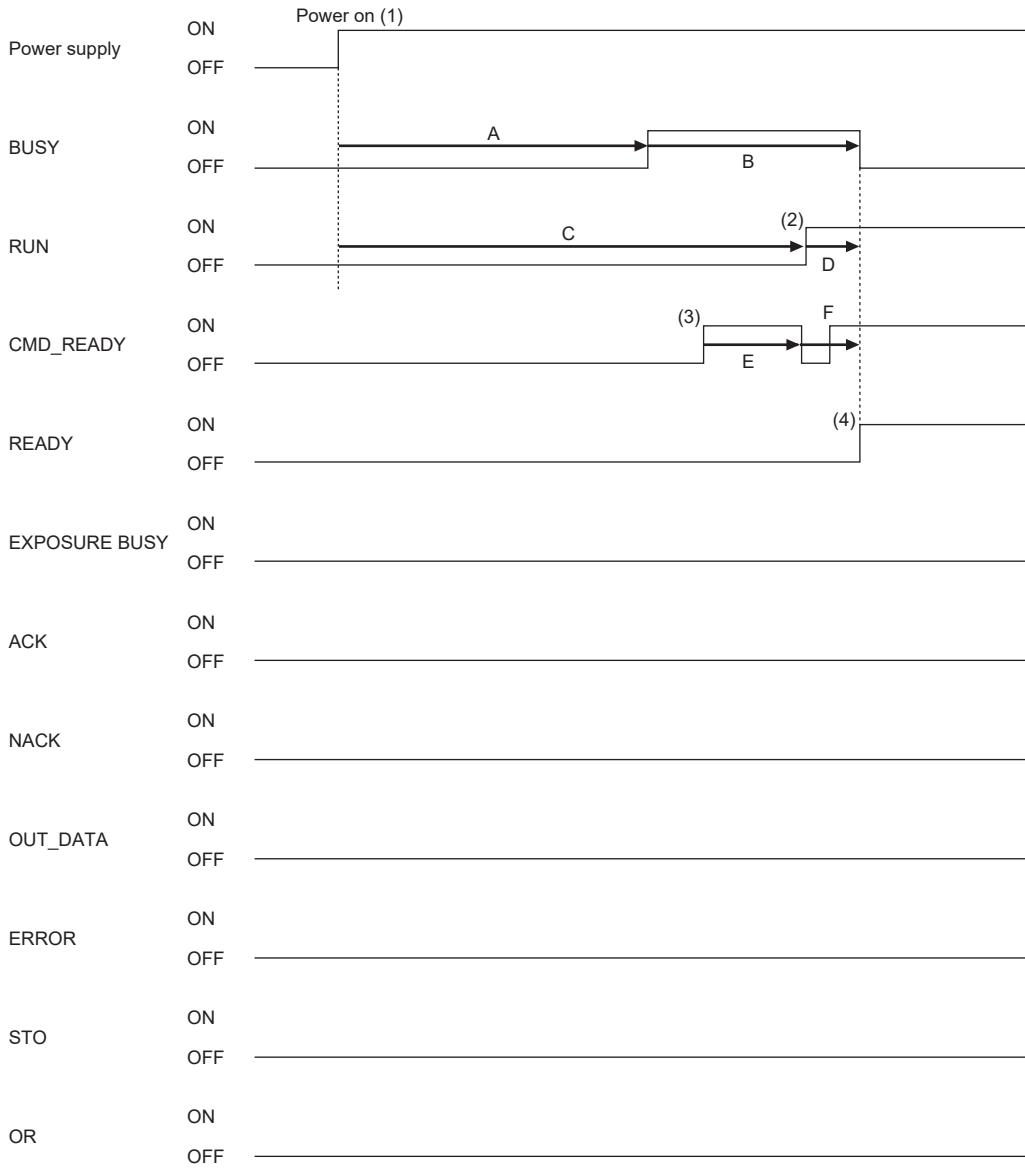
Timing Chart

Operations at startup

(1) Operations at startup



- To input a trigger after startup, check that the READY is ON.
- To execute a command after startup, check that the CMD_READY is ON.



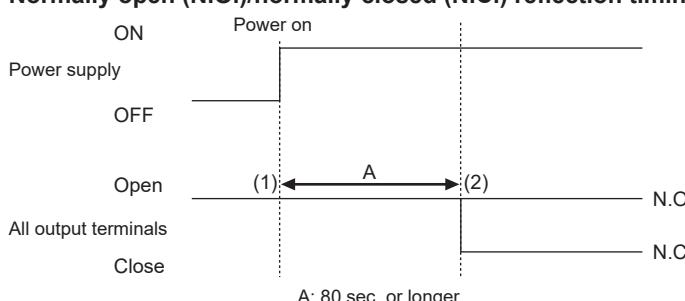
(1) Provide power to the head controller when or after power is supplied to the head.

(2) When the system enters Run mode, the RUN terminal turns on (When the startup mode is [Run mode]).

(3) After startup, turn CMD_READY ON and then OFF one time. After that when it turns ON, command inputs will be accepted.

(4) The READY signal turns ON when capturing becomes available.

● Normally open (N.O.)/normally closed (N.C.) reflection timing



(1) The state immediately after startup will be normally open (N.O.), regardless of the settings.

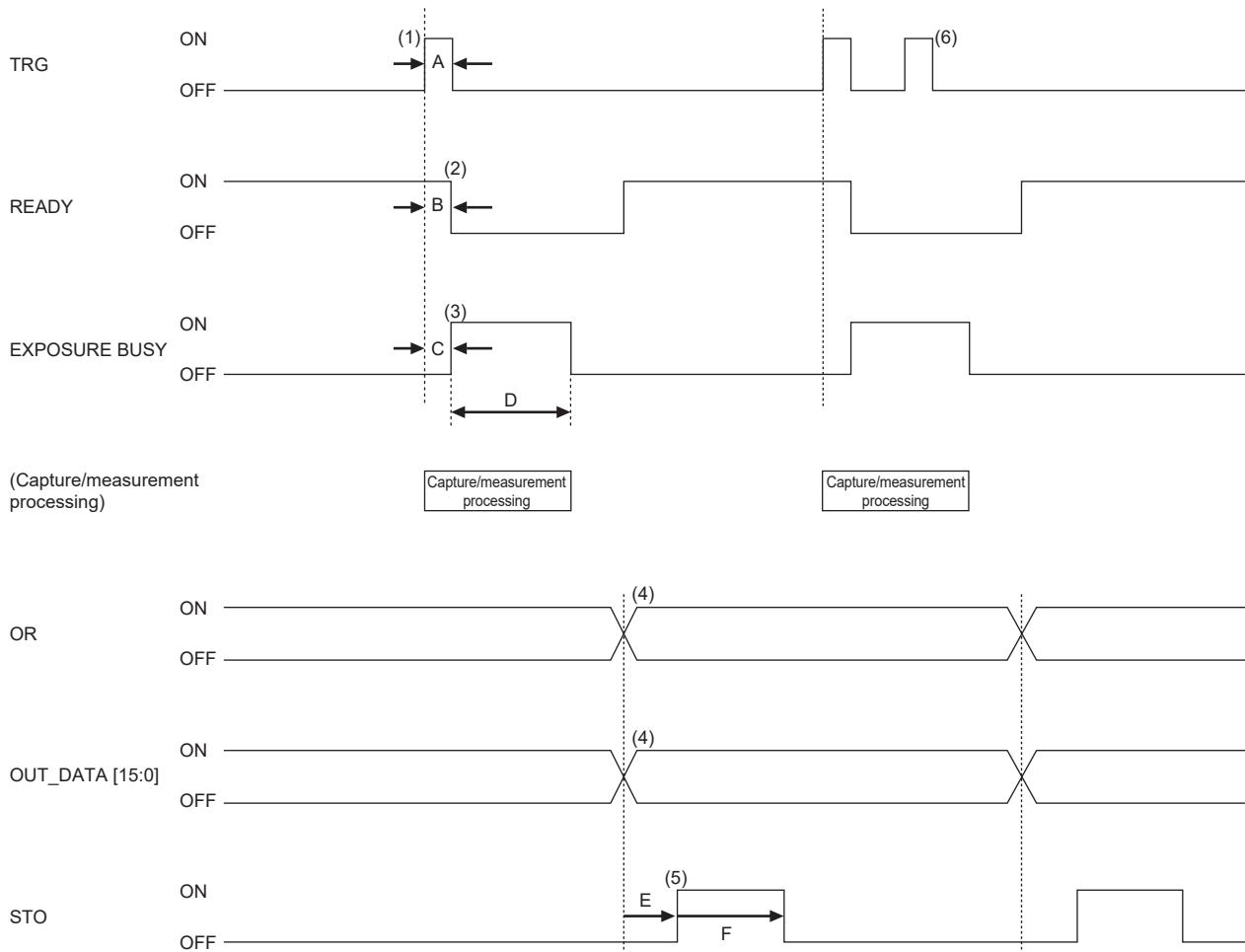
(2) The normally closed settings are reflected after a certain period of time.

Standard operation at trigger input

(1) Standard operation at trigger input

Point

- Trigger input: Check that READY is ON before trigger input.
- Workpiece movement: Move the workpiece after EXPOSURE BUSY turns off.
- Reading OR and OUT_DATA: Read them in synchronization with STO.



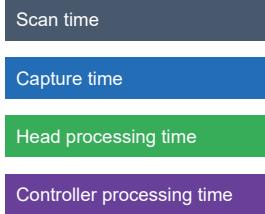
- | | |
|-----|--|
| (1) | Check that READY is on before inputting TRG. |
| (2) | READY turns off when a trigger input is accepted. |
| (3) | EXPOSURE BUSY is kept on during capturing. Do not move the measured workpiece while EXPOSURE BUSY is on. |
| (4) | When capturing and measurement are finished, total status output OR is output. |
| (5) | Read output data (OR, OUT_DATA) in synchronization with the rise of STO. |
| (6) | TRG input is not accepted when READY is off. |

The LJ-S8000 Series processing process scans (operates) the internal optical system by TRG input and continuously acquires (captures) profile data. The continuously acquired profile data is corrected inside the head before being transferred to the controller (head processing). The controller measures the transferred image data according to the tool settings (controller processing).

This section shows typical charts based on differences in scan time, capture time, head processing time, and controller processing time.

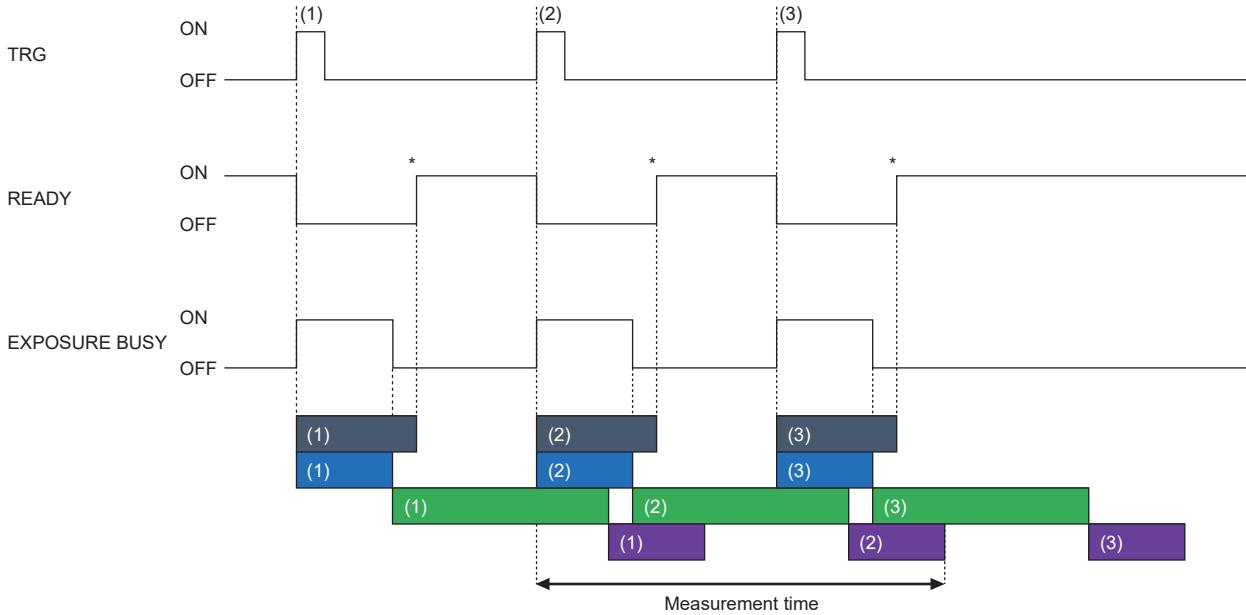
- Reference • The respective times can be checked on the actual device by going to [Head Settings] > [Speed Up] > [Advanced Settings].
- When irregular reflection removal is turned off in a one-head connection, the theoretical values can also be checked on the simulator.

In the chart, scan time, capture time, head processing time, and controller processing time are indicated with the following color coding.



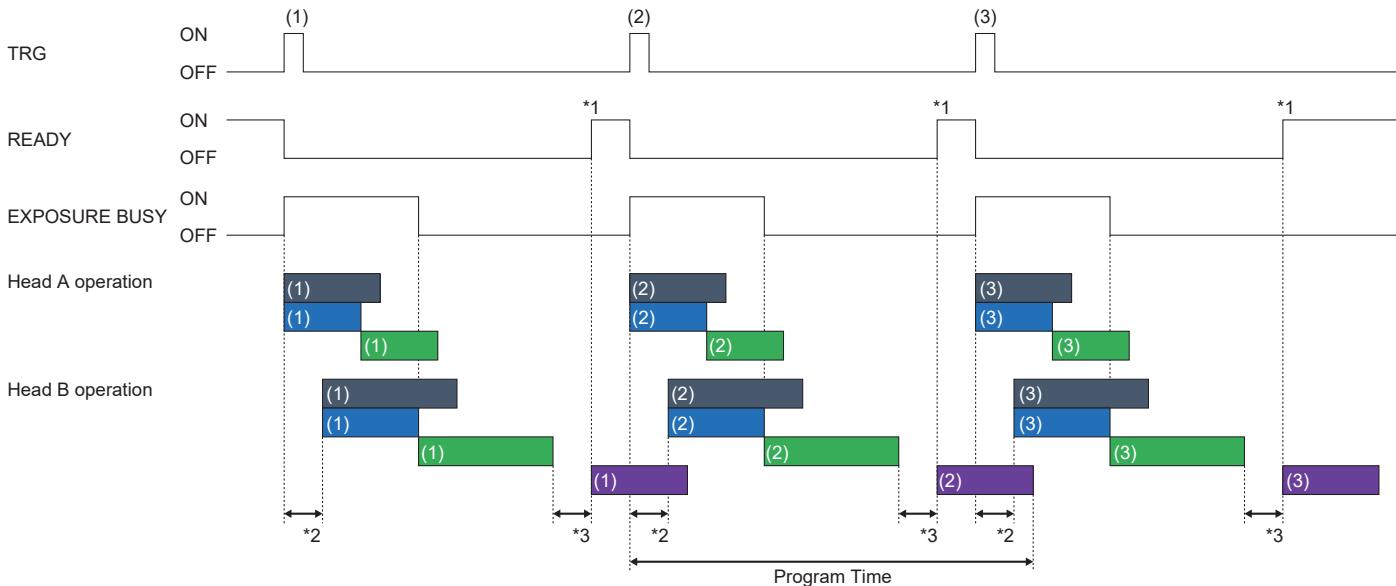
(2) Longest head processing

When one head is connected



* When one head is connected, the READY signal turns on when scanning is completed.

When two heads are connected

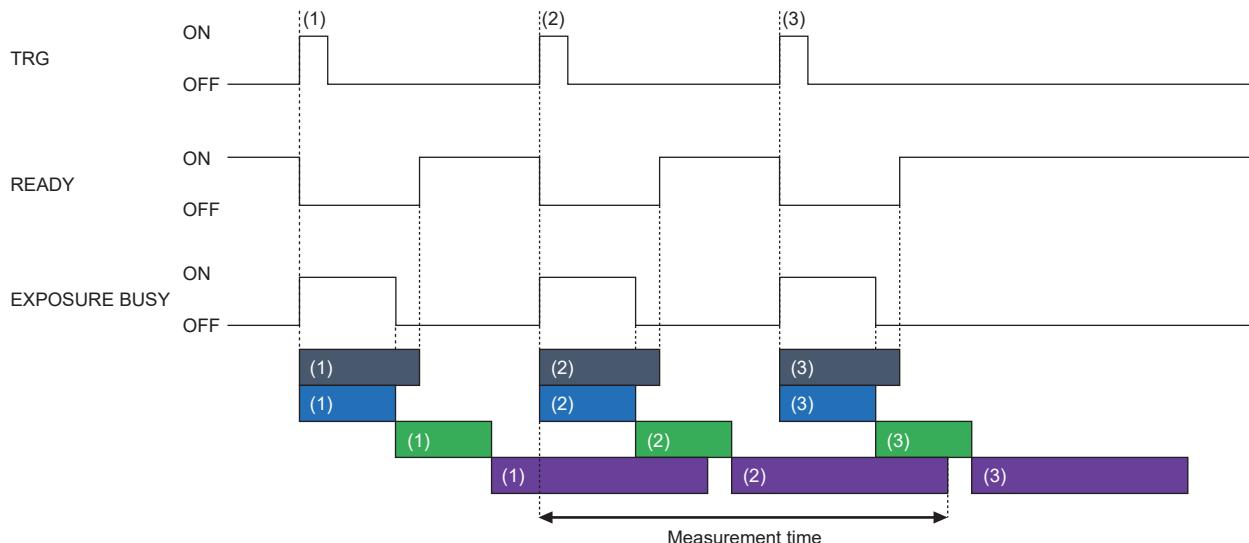


*1 The controller starts processing after image data of both heads are sent to the controller (*3).

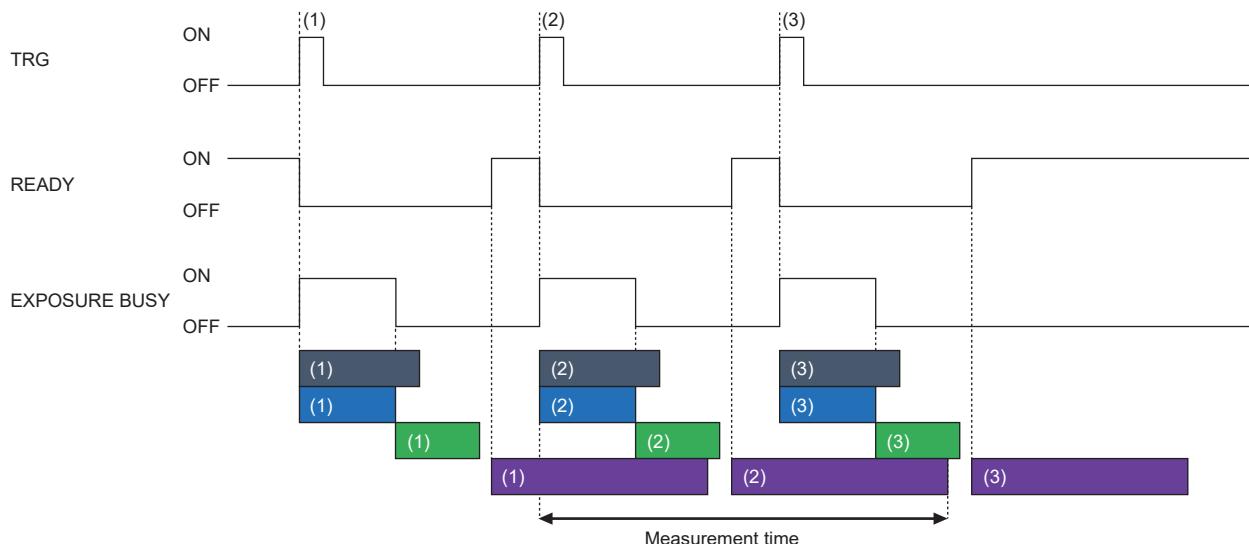
*2 Trigger delay time (effective when trigger delay is set): 0 to 999 ms

(3) Longest controller processing

When one head is connected and the image buffer count is 3

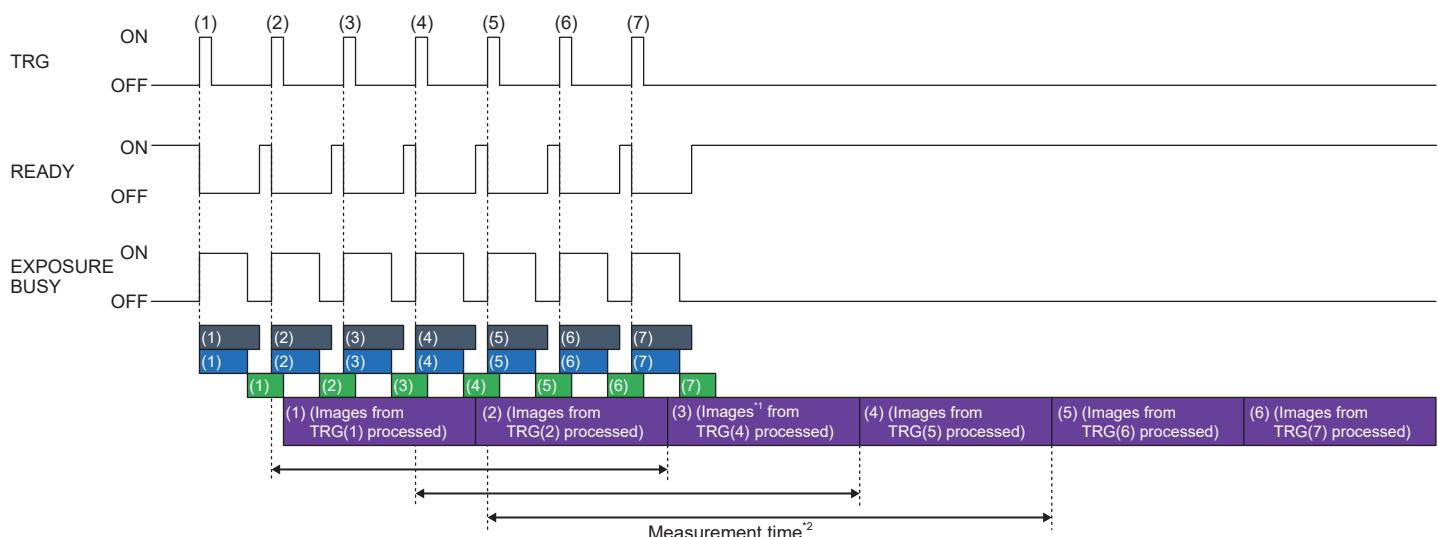


When two heads are connected and the image buffer count is 3



When one head is connected and the image buffer count is 3

This chart is for measurements when controller processing is longer than the scan-to-head processing and uses the advanced image buffer.



When starting the third measurement processing, the scan-to-head processing for TRG(7) is performed.

*1 Since the image buffer count is 3, the controller retains the images from TRG (4), (5), and (6) (the image from TRG (3) is overwritten and discarded), and the image from TRG (4) is used for the third measurement processing.

Seven triggers are issued, but measurement is not processed for the discarded image, so the number of measurements is 6.

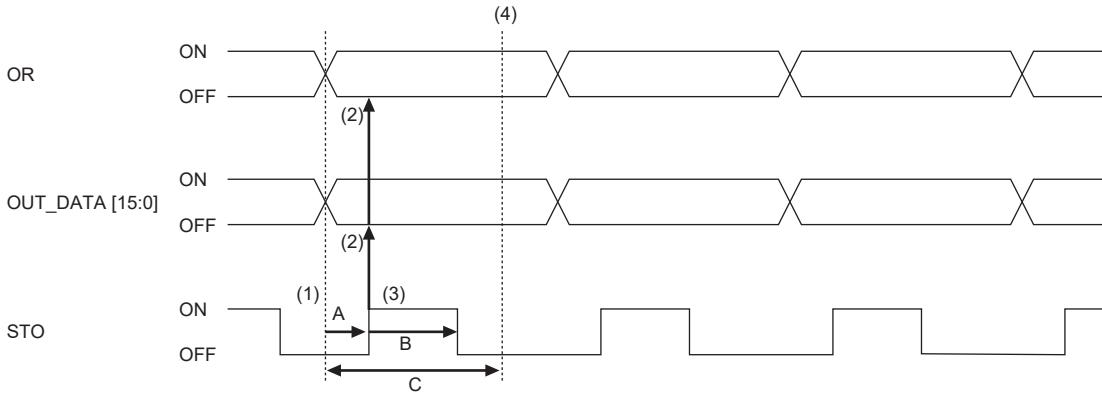
*2 If capture is being performed with an advance image buffer, the measurement time will vary in accordance with the processing.

Standard operation of the data output terminals

(1) Standard operation of judgment output terminals (OR, OUT_DATA)

Point Read OR and OUT_DATA in synchronization with STO.

In the case of no handshake (trigger interval \geq time to rise of output)



A: Time to rise of output (1 to 999 ms)

B: Output duration (1 to 999 ms)

C: Output switching time (2 to 1000 ms)

Where, A + B ≤ C.

* To change the values of A through C, refer to "External Terminal" (page 8-2).

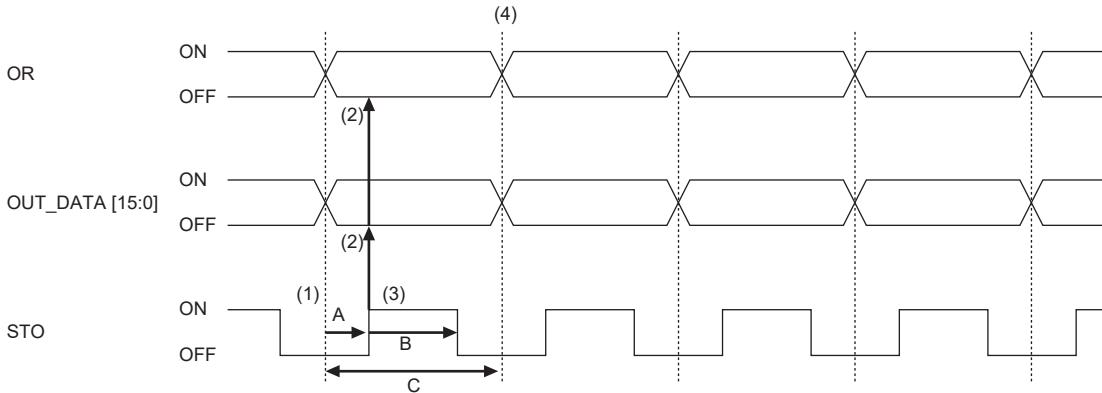
(1) STO turns on when the time to rise of output elapses after the judgment value is determined.

(2) The results in OR and OUT_DATA are read in synchronization with the rise of STO.

(3) STO is kept on during the configured output duration.

(4) The output status is kept until the next judgment value is determined.

In the case of no handshake (trigger interval < time to output rise)



A: Time to rise of output (1 to 999 ms)

B: Output duration (1 to 999 ms)

C: Output switching time (2 to 1000 ms)

Where, A + B ≤ C.

* To change the values of A through C, refer to "External Terminal" (page 8-2).

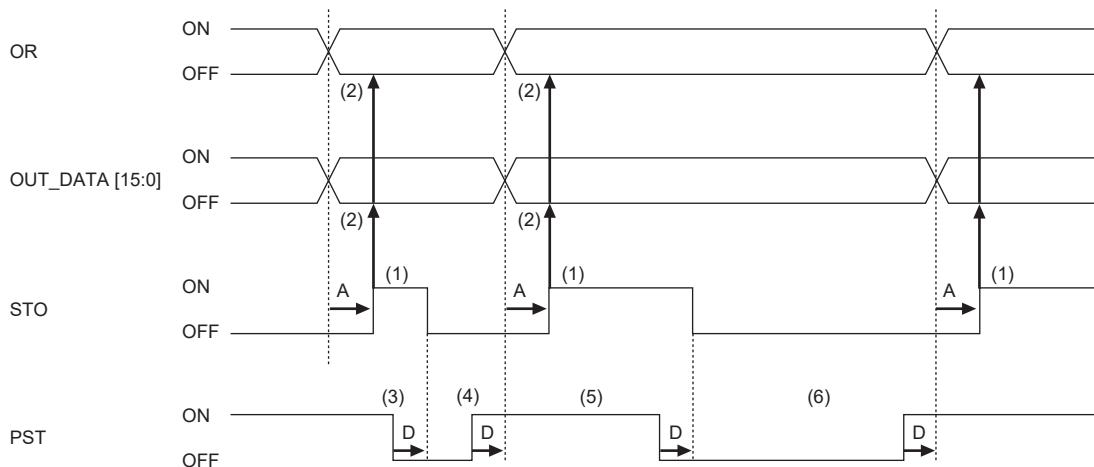
(1) STO turns on when the time to rise of output elapses after the judgment value is determined.

(2) The results in OR and OUT_DATA are read in synchronization with the rise of STO.

(3) STO is kept on during the configured output duration.

(4) If the output buffer contains data, judgment values are switched when the cycle time of the output switching frequency elapses.

With handshake



* To change the time value of A, refer to "External Terminal" (page 8-2).

(1) (According to the previous PST control,) STO turns on when the time to rise of output elapses.

(2) The results in OR and OUT_DATA are read in synchronization with the rise of STO.

(3) For the output request of the next judgment value, change PST from ON to OFF (STO is also turned off).

(4) Changing PST from OFF to ON makes the output request, switches judgment values, and turns STO on.

(5) Output of OR, OUT_DATA, and STO is retained until PST is changed from ON to OFF.

(6) Judgment values are not switched until PST is changed from OFF to ON.

Reference The next judgment value is output via the buffer memory by the output request of PST.
If the buffer memory is full, new data cannot be buffered and overflowed data is not output (discarded).

Operations of inputting using the control terminal

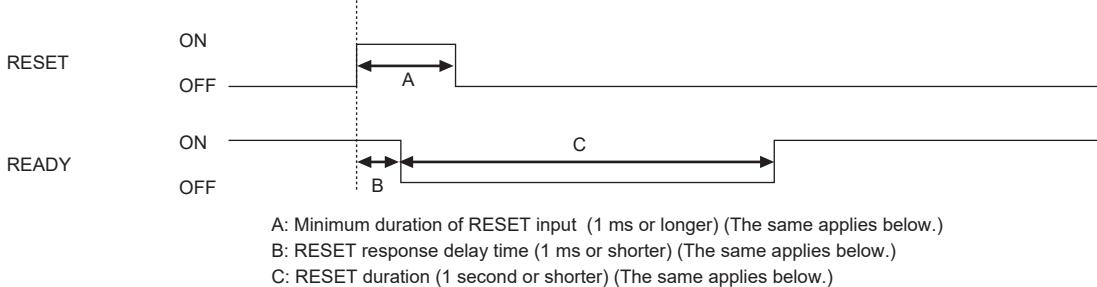
RESET terminal operation

This terminal is used to set the output terminals to normal state and reset the trigger wait state.
When the program is changed, the RESET is performed simultaneously.

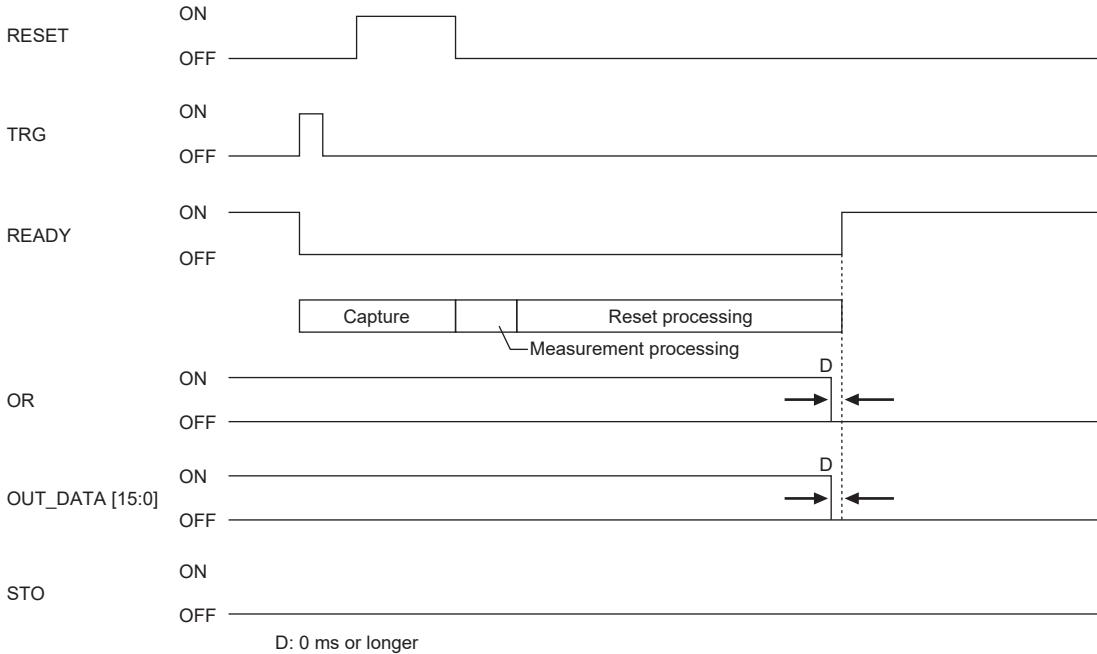
 For details of the RESET operation, refer to "Parallel I/O Interface" (page 9-47).

 Read OR and OUT_DATA in synchronization with STO.

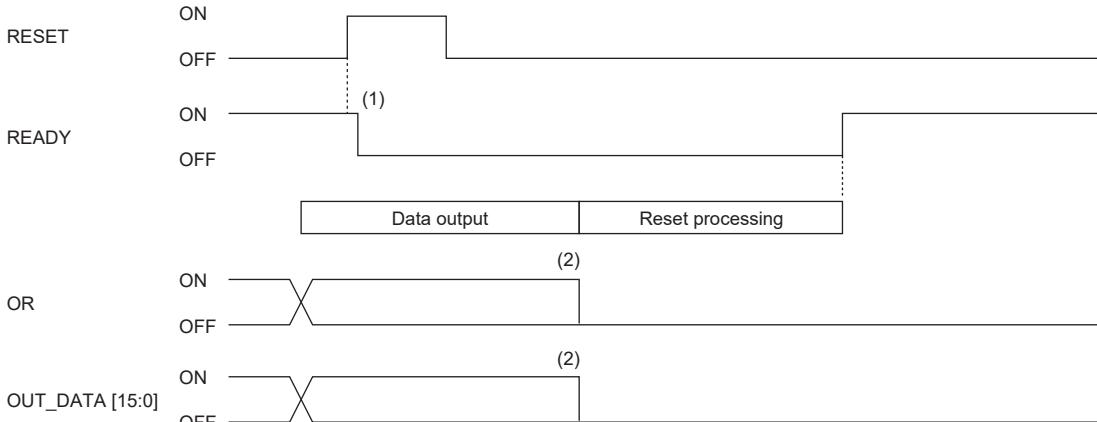
When there is no trigger input (when measurement is not made)



When there is trigger input (during measurement)



When outputting judgment values



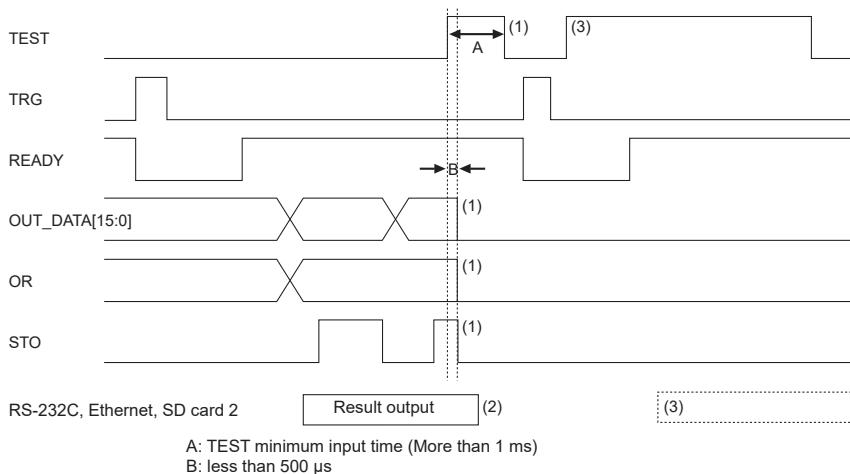
(1) When READY turns on, READY is forcibly turned off, and then turned on when reset finishes.

(2) When the current output for one measurement is completed, OR and OUT_DATA return to the normal statuses.

(2) TEST terminal operation

TEST terminal is used to cancel output operations.

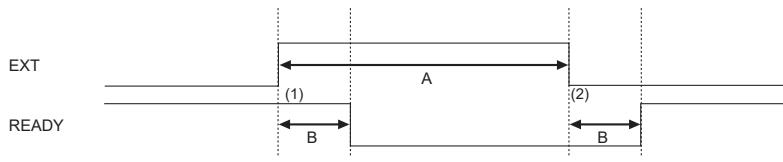
The one shot input allows the result output state to be reset to normal state. It is also used to prevent upper/lower limit judgment from being output even if the image processing during setting adjustment is operated using the level input.



- (1) While the TEST input is ON, terminal output (OUT_DATA[15:0], OR, STO) is forcibly set to normal state. (The response delay is within 500 µs).
- (2) For output to RS-232C and Ethernet, SD card, PLC-Link, EtherNet/IP, PROFINET, EtherCAT, PC application, even if the TEST terminal is turned on during the result output for one trigger, the result output for one trigger is not stopped.
- (3) If the TEST terminal is ON before data output for 1 trigger starts, all of output for that trigger is stopped, and result output is not performed even when the TEST terminal is turned OFF later on.

(3) EXT terminal operation

The EXT terminal is used to pause an image capture. This is useful in case that external trigger inputs and continuous trigger acceptances need to be stopped due to setting adjustments.



A: EXT minimum input time (More than 1 ms) B: READY response delay (Less than 0.5 ms)

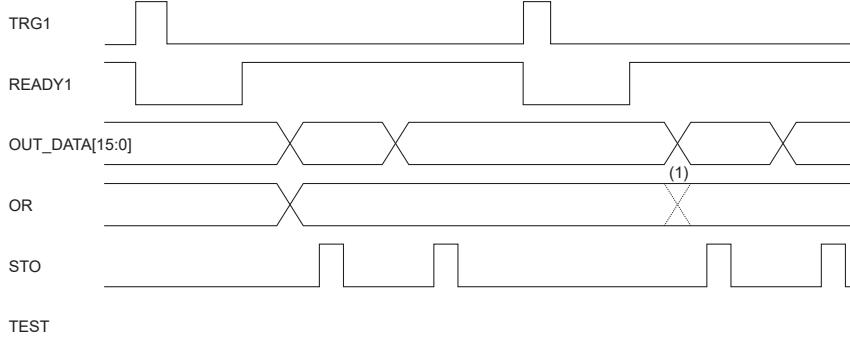
- (1) When the EXT input is ON, the READY output is OFF. At this time, no trigger can be input (all of the external terminals, PLC communication, RS-232C, Ethernet, and mouse). Even if an continuous trigger has been selected, when the READY turns OFF, the image capturing and measurement processing are stopped. The result of the trigger input accepted before the EXT input has turned ON continues being output regardless of the EXT status.
- (2) When the EXT input turns off, the status returns to READY output corresponding to the head state at that time for triggers to be able to be accepted.

(4) Using command inputs via I/O terminals

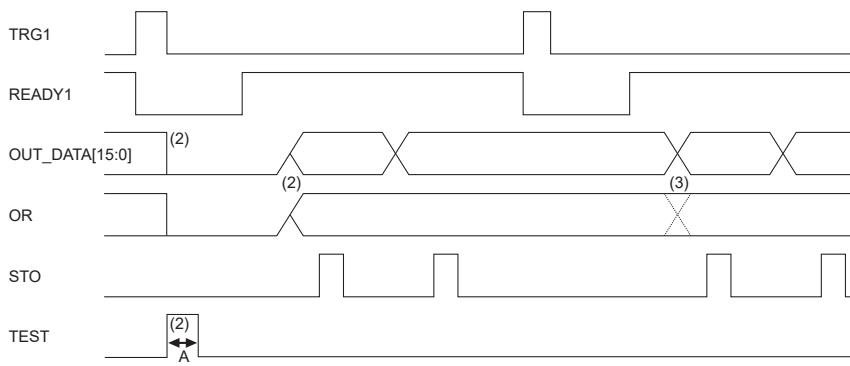
"Using Command Inputs via I/O Terminals" (Page 9-51) For details, see.

(5) TEST terminal operations for the total status output (OR) when the "OR terminal output mode" is set to "Hold Status"

The status condition is normally updated for each trigger. However, if the status is NG, the condition is unchanged until input such as TEST is executed.



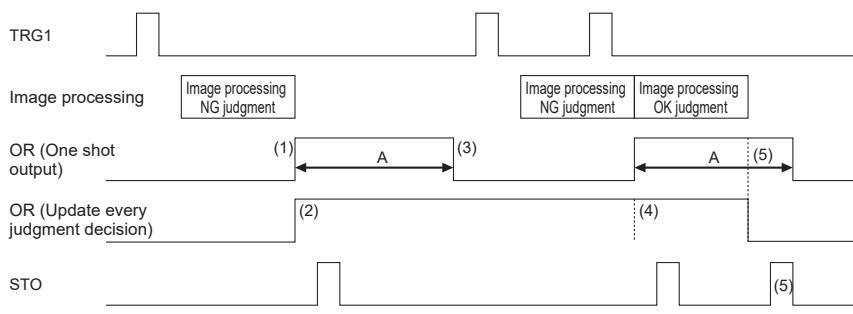
(Continued)



A: TEST minimum input time (More than 1 ms)

- | | |
|-----|---|
| (1) | If [Hold Status] is enabled and the last status is NG, the OR output remains NG regardless of an actual status result. |
| (2) | When the TEST input is turned on/off, the hold status is canceled and all terminals are reset to the normal status. The OR output condition will be updated when the result for the next OR output is output. |
| (3) | As the TEST input is not turned on, if the last status result is NG, the OR output remains NG regardless of an actual status result. |

(6) Output operations of the total status output (OR) when "OR terminal output mode" is set to "One Shot Output"

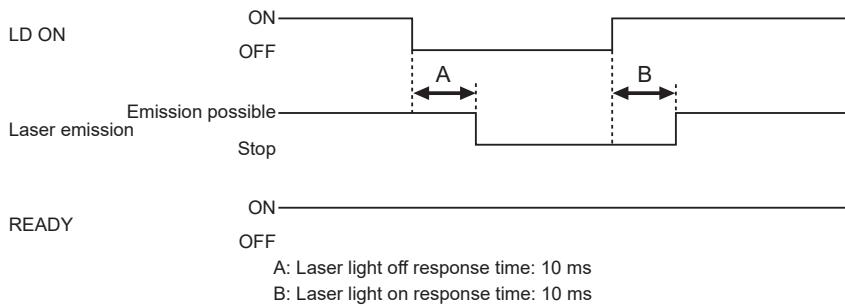


A: One shot time (1 to 9999 ms)

- | | |
|-----|---|
| (1) | If the one shot output is enabled, the OR output is in NG state when the image processing started by trigger input is NG after the image processing finishes (not synchronized with the STO rise). |
| (2) | When "Update Every Judge" is enabled, the OR output is in the NG state along with the STO rise. |
| (3) | If the one shot output is enabled, the OR output holds the NG state for the specified period of time, and then resets the NG state. |
| (4) | When "Update Every Judge" is enabled, the OR output holds the NG state until the next result output for image processing is started. Therefore, if output results are consecutively judged as NG, the OR output holds the NG state. |
| (5) | If image processing is continuously performed with one shot output enabled, the previous NG state may remain at the time of image processing results being finalized by the STO. |

[Reference] If a result is judged as NG while the NG state is held, the OR output holds NG state for one shot time from that timing. If signals need to rise and fall for each NG, set the one shot time to the value smaller than output cycle.

(7) LD ON terminal operation



[Reference] A: Laser light off response time: 10 ms
B: Laser light on response time: 10 ms

- The LD ON terminal is located on the head.
- If the LD ON terminal is turned off during capture, laser emission stops at that point, and the data from that point onward becomes invalid pixels and the capture is completed.
- When a trigger is input while the LD ON terminal is turned off, the image is captured as a black image with all invalid pixels. At this time, the number of measurements is also counted up.

Overview of Control and Data Output by EtherNet/IP

This system supports communication with EtherNet/IP.

EtherNet/IP is an open communications standard with specifications that are managed by ODVA (Open DeviceNet Vendor Association, Inc.). Communication is possible with all devices that support it, regardless of the vendor. The following functions are possible by EtherNet/IP connection.

● Cyclic communication

Cyclic communication at RPI (Request Packet Interval) communication cycle intervals allows high-speed control at intervals of several ms to several tens of ms (implicit communication). In addition, because it is possible to control the controller by referencing and updating variables and devices in the PLC without considering the communication, it allows programs to be written easily on the PLC side.

○ Controlling the controller

Control the controller by using cyclic communication to send the commands for execution.

○ Outputting result data

Data can be output by cyclic communication when the items for output from EtherNet/IP are set in the output settings.

○ Changing execute number

The controller can be controlled by specifying the execute No. by cyclic communication.

 Reference

- Settings such as the cyclic communication cycle (RPI), data size, timeout time, and sending trigger are made on the PLC side. For cyclic communication with this machine, set an RPI of 5 ms or more (1 ms or more when using the communication expansion unit). When COS (Change of State) is selected with a PLC where a sending trigger can be selected (KEYENCE KV Series, etc.), in the same way set a minimum sending interval (Inhibit Time) of 5 ms or more (1 ms or more when using the communication expansion unit).
- In a network where many devices are connected, including EtherNet/IP devices, if a large load is constantly or temporarily applied to the network, then delays and packet loss may occur. Perform sufficient verification prior to operation.
- PLC-Link, PROFINET, and EtherCAT cannot be used in conjunction with EtherNet/IP.

● Message communication

This can be used for communications that do not require punctuality as is needed with cyclic communications (Explicit message).

There is no functional difference between the controller message communication function and cyclic communication function. As a result, it is not necessary to use it in most cases. However, it can be used for EtherNet/IP communications with PLC devices that do not support cyclic communication (SLC5/05 Series, etc.).

Operation Flow

□ "EtherNet/IP Communication Specifications" (Page 9-68)

- Check whether or not the connected PLC is a model that supports EtherNet/IP connections.
- Check the input/output data assignments.

□ "Changing the EtherNet/IP Settings" (Page 9-72)

- Configure the LJ-S Series settings for EtherNet/IP connection. Main setting items: IP address, data size, data configuration of the LJ-S Series

Establishing an EtherNet/IP link

- To check whether or not a link has been established by cyclic communications, select [Global] - [Communications & I/O] - [EtherNet/IP], and check with [Cyclic Communication Status].
- If the EtherNet/IP connection is successful, the controller / communication expansion unit Ethernet port LINK LED (green) begins flashing.

Executing necessary processing

□ "Outputting Measurement Data via EtherNet/IP Cyclic Communication (Data Output)" (Page 9-74)

- The data specified in the output settings is written to the results output area.
- The "Result ready flag" is used to check the completion of data writing.
- The "Result ack flag" is turned ON to report that reading was completed.

□ "Controlling Controller with EtherNet/IP Cyclic Communication (Command Control)" (Page 9-75)

- Communication control commands can be executed.
- Enter the command code and command parameters in the command input area and turn the "Command request flag" ON to execute the command.
- When the "Command ready flag" is ON, the command can be executed.
- The "Command complete flag" is used to check that command execution was completed.

□ "Changing Execute Condition No. Using EtherNet/IP Cyclic Communication (Execute No. Change)" (Page 9-76)

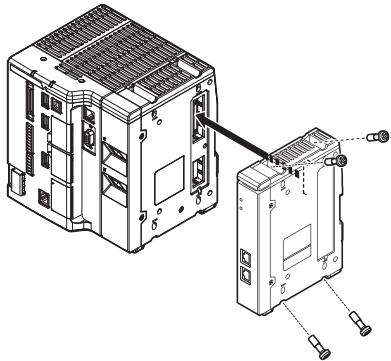
- Change the Exec Cond No. to change the execute condition No.

Prepare EtherNet/IP Unit (when using CB-NEP20E)

Installing the EtherNet/IP Unit

The optional EtherNet/IP unit CB-NEP20E is used when communicating over EtherNet/IP.
Remove the protective cover from the expansion unit connector on the right side of the controller and install the EtherNet/IP unit as shown below.

Point The controller must be turned off before connecting or disconnecting the CB-NEP20E.



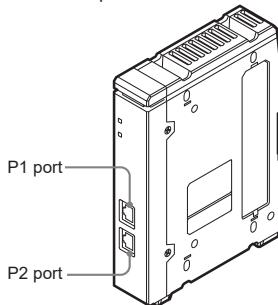
CB-NEP20E EtherNet/IP Unit Specifications

Standard specifications

Item	Description
Compliant standard	IEEE802.3u (100BASE-TX)
Communication speed	100Mbps (100BASE-TX)
Communication cycle	1 ms at the shortest
Connection cable	Category 5e or greater shielded twisted pair (STP) cable
Node interval	100m
Communication port	RJ45 connector × 2
Communication size	1436 bytes
Supported functions	Cyclic communication (Implicit message), Message communication (Explicit message) UCMM/Class3-compliant DLR (Device Level Ring)-compliant
Conformance test version	Complying with Version.CT19.1

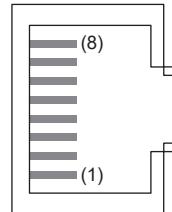
Connecting to an EtherNet/IP Network

Connect the EtherNet/IP network cable to the P1 port or the P2 port of the RJ connector. If an adapter is present downstream of this unit, connect a network cable to the unused port.



Point Use a category 5e or greater STP (shielded twisted pair) cable for the network cable. You can use either a straight cable or a crossover cable.

Wiring example (P1 port / P2 port)



No	Signal name	Function
1	TX+	Transmit data (+)
2	TX-	Transmit data (-)
3	RX+	Receive data (+)
4	-	Connect 75 Ω terminating resistance
5	-	Connect 75 Ω terminating resistance
6	RX-	Receive data (-)
7	-	Connect 75 Ω terminating resistance
8	-	Connect 75 Ω terminating resistance

EtherNet/IP Communication Specifications

Standard specifications

		Controller's Ethernet port	Communication expansion unit
Cyclic communication ^{*1} (Implicit communication)	Connection count	Max. 32	1 (Exclusive Owner) 4 (Input Only)
	Communication size	As set in the communications settings on the PLC side. Up to 248 bytes (when Allen-Bradley SLC5/05 is connected) Up to 496 bytes (when Allen-Bradley ControlLogix/CompactLogix is connected) Up to 1436 bytes (when Keyence KV Series or Omron SYSMAC CJ2/CJ1/CS1/NJ is connected)	
	Sending trigger	As set in the communications settings on the PLC side. • Cyclic • COS ^{*2}	
	Instance ID	• 100: Input data (controller sending) • 101: Output data (controller receiving) (254 during Input Only connection)	• 100: Input data (transmission of communication expansion unit) • 150: Output data (reception of communication expansion unit) (3 for Input Only)
Sending message (Explicit message)	Connection count	Max. 32	Max. 6
	Support Explicit Message format	UCMM/Class3	
Conformance test		Complying with Version.CT19.1	Complying with Version.CT19.1

*1 The conditions for the cyclic communication status to be "connected" are a bidirectional communication (Exclusive Owner) connection or an Input Only connection being established in the case of the controller's Ethernet port and a bidirectional communication (Exclusive Owner) connection being established in the case of a communication expansion unit.

*2 Only the PLC compliant with COS (Keyence's KV-3000/5000/5500/7300/7500/8000, KV-nano, etc.) can be specified. When the COS transmission trigger is selected, the controller sends the data at the timing when the transmission data is changed. (If the transmission data is not changed, it sends the data at specified RPI (communication frequency) intervals.) If the transmission data is continuously changed, the transmission is held during InhibitTime (minimum transmission interval). Changes to the send-data are checked with the Result ready flag and Command complete flag for the controller's Ethernet port and with all the send-data for the communication expansion unit.

When to use message communication and cyclic communication

There is no functional difference between the controller message communication function and cyclic communication function. As a result, it is not necessary to use it in most cases. However, it is necessary for EtherNet/IP communications with PLC devices that do not support cyclic communication (SLC5/05 Series, etc.).



- Since the message communication is communication performed using TCP/IP, it is less suited for high-speed control than cyclic communication, which uses UDP.
- Message communication is communication using TCP/IP. However, depending on the network status and other conditions, it is possible that the data may not arrive. On the PLC side, give consideration to such cases when designing the controls (resending process following timeout, etc.).

Allocation conditions of cyclic communication data

Example of this machine receive-data settings (this machine→Keyence KV-7500 Series)

Example when 1 of this machine is connected to a KV-7500 Series, cyclic communication data size is 496 bytes (addresses 0000 - 0495), and the command response output area is set to 24 bytes (B*****/W**** in the table are examples of KV-7500 link relay and link register address allocation)

Setting status	Address (Byte)	7bit		6bit		5bit		4bit		3bit		2bit		1bit		0bit	
Bit Area	0000	B007	Reserved	B006	Reserved	B005	Reserved	B004	Result OR	B003	Result Ready	B002	Cmd Ready	B001	Cmd Error	B000	Cmd Complete
	0001	B00F	Reserved	B00E	RUN	B00D	Reserved	B00C	ERROR	B00B	BUSY	B00A	EXPOSURE-BUSY	B009	TRG_ack	B008	READY
	0002	B017	Reserved	B016	Reserved	B015	Reserved	B014	Reserved	B013	Reserved	B012	Reserved	B011	Reserved	B010	Reserved
	0003	B01F	OUTPUT-IMG-STATUS	B01E	OUTPUT-IMG-BUSY	B01D	Reserved	B01C	Reserved	B01B	Reserved	B01A	Reserved	B019	Reserved	B018	Reserved
Tool Judgment Area	0004	B027	Tool Judge Value7	B026	Tool Judge Value6	B025	Tool Judge Value5	B024	Tool Judge Value4	B023	Tool Judge Value3	B022	Tool Judge Value2	B021	Tool Judge Value1	B020	Tool Judge Value0
	0005	B02F	Tool Judge Value15	B02E	Tool Judge Value14	B02D	Tool Judge Value13	B02C	Tool Judge Value12	B02B	Tool Judge Value11	B02A	Tool Judge Value10	B029	Tool Judge Value9	B028	Tool Judge Value8
	0006	B037	Tool Judge Value23	B036	Tool Judge Value22	B035	Tool Judge Value21	B034	Tool Judge Value20	B033	Tool Judge Value19	B032	Tool Judge Value18	B031	Tool Judge Value17	B030	Tool Judge Value16
	0007	B03F	Tool Judge Value31	B03E	Tool Judge Value30	B03D	Tool Judge Value29	B03C	Tool Judge Value28	B03B	Tool Judge Value27	B03A	Tool Judge Value26	B039	Tool Judge Value25	B038	Tool Judge Value24
	0008	B047	Tool Judge Value39	B046	Tool Judge Value38	B045	Tool Judge Value37	B044	Tool Judge Value36	B043	Tool Judge Value35	B042	Tool Judge Value34	B041	Tool Judge Value33	B040	Tool Judge Value32
	0009	B04F	Tool Judge Value47	B04E	Tool Judge Value46	B04D	Tool Judge Value45	B04C	Tool Judge Value44	B04B	Tool Judge Value43	B04A	Tool Judge Value42	B049	Tool Judge Value41	B048	Tool Judge Value40
	0010	B057	Tool Judge Value55	B056	Tool Judge Value54	B055	Tool Judge Value53	B054	Tool Judge Value52	B053	Tool Judge Value51	B052	Tool Judge Value50	B051	Tool Judge Value49	B050	Tool Judge Value48
	0011	B05F	Tool Judge Value63	B05E	Tool Judge Value62	B05D	Tool Judge Value61	B05C	Tool Judge Value60	B05B	Tool Judge Value59	B05A	Tool Judge Value58	B059	Tool Judge Value57	B058	Tool Judge Value56
Error code area	0012 0013	W000	Error Code														
Reserved area	0014 0015	W001	Reserved														
Measurement count area	0016 0017 0018 0019	W002	Total Count														
	0020 0021 0022 0023		Command Result														
	0024 0025 0026 0027		Command Data 1														
	0028 0029 0030 0031		Command Data 2														
	:																
Command output area	0044 0045 0046 0047	W010	Command Data 6														
Result output area	0048 0049 0050 0051		Result Data 1														
	0052 0053 0054 0055	W012	Result Data 2														
	:																

● Name and Operation of Input Signals

Allocated area	Name	Remarks
Bit Area	Cmd Complete	Turns on when command processing is complete.
	Cmd Error	Turns off when command processing is successful and turns on when it fails.
	Cmd Ready	Turns on when command processes can be received.
	Result Ready	Turns on when data transmission is complete.
	Result OR	Used to output the OR result for the judged value of tools specified in the output settings.
	READY	Output when trigger input is acceptable.
	TRG_ack	Becomes ON when Trigger input is accepted. Becomes OFF when Trigger input is set to OFF.
	BUSY	This signal is output during image processing or command processing.
	EXPOSURE_BUSY	This signal is output during the capturing of a height image. The workpiece must be kept stationary while this signal is on.
	ERROR	This signal is output while any of system errors occur with the dialog displayed on the screen. For details on typical system errors, see □ "Error Messages" (Page 9-101). Also, in the Global Settings of □ "ERROR Output Settings" (Page 8-14), enabling or disabling the error output for the SD card-related errors, etc. can be specified.
	RUN	This signal is output when the controller is in Run mode.
	OUTPUT_IMG_BUSY	Output while images are being output.
	OUTPUT_IMG_STATUS	Output when there are remaining images that need to be output in an image output buffer.
	Tool Judge Value0	Returns the judgment value allocated to the bit allocation region (Address 0004:bit0).
Tool Judgment Area	Tool Judge Value1	Returns the judgment value allocated to the bit allocation region (Address 0004:bit1).

	Tool Judge Value63	Returns the judgment value allocated to the bit allocation region (Address 0011:bit7).
Error code area	Error Code	Error code corresponding to the error cause.
Measurement count area	Total Count	Indicates the number of measurement.
Command output area	Command Result	Indicates the command execution results.
	Command Data 1	Returns the command execution result data 1.
	Command Data 2	Returns the command execution result data 2.

	Command Data6	Returns the command execution result data 6.
Result output area	Result Data 1	Returns the measurement result data 1.
	Result Data 2	Returns the measurement result data 2.

Example of this machine receive-data settings (Keyence→KV-7500 Series → this machine)

Example when 1 of this machine is connected to a KV-7500 Series and cyclic communication data size is 496 bytes (addresses 0000 - 0495) (B****/W**** in the table are examples of KV-7500 link relay and link register address allocation)

Setting status	Address (Byte)	7bit		6bit		5bit		4bit		3bit		2bit		1bit		0bit																
Bit Area	0000	B067	Reserved	B066	Reserved	B065	Reserved	B064	Error reset request	B063	Result ack	B062	Reserved	B061	Reserved	B060	Command request															
	0001	B06F	Reserved	B06E	Reserved	B06D	Reserved	B06C	Reserved	B06B	Reserved	B06A	Reserved	B069	Reserved	B068	TRG															
	0002	B077	Reserved	B076	Reserved	B075	Reserved	B074	Reserved	B073	Reserved	B072	TEST	B071	EXT	B070	RESET															
	0003	B07F	Reserved	B07E	Reserved	B07D	Reserved	B07C	Reserved	B07B	Reserved	B07A	Reserved	B079	Reserved	B078	Reserved															
Reserved area	0004	B087	Reserved	B086	Reserved	B085	Reserved	B084	Reserved	B083	Reserved	B082	Reserved	B081	Reserved	B080	Reserved															
	0005	B08F	Reserved	B08E	Reserved	B08D	Reserved	B08C	Reserved	B08B	Reserved	B08A	Reserved	B089	Reserved	B088	Reserved															
	0006	B097	Reserved	B096	Reserved	B095	Reserved	B094	Reserved	B093	Reserved	B092	Reserved	B091	Reserved	B090	Reserved															
	0007	B09F	Reserved	B09E	Reserved	B09D	Reserved	B09C	Reserved	B09B	Reserved	B09A	Reserved	B099	Reserved	B098	Reserved															
	0008	B0A7	Reserved	B0A6	Reserved	B0A5	Reserved	B0A4	Reserved	B0A3	Reserved	B0A2	Reserved	B0A1	Reserved	B0A0	Reserved															
	0009	B0AF	Reserved	B0AE	Reserved	B0AD	Reserved	B0AC	Reserved	B0AB	Reserved	B0AA	Reserved	B0A9	Reserved	B0A8	Reserved															
	0010	B0B7	Reserved	B0B6	Reserved	B0B5	Reserved	B0B4	Reserved	B0B3	Reserved	B0B2	Reserved	B0B1	Reserved	B0B0	Reserved															
	0011	B0BF	Reserved	B0BE	Reserved	B0BD	Reserved	B0BC	Reserved	B0BB	Reserved	B0BA	Reserved	B0B9	Reserved	B0B8	Reserved															
	0012	W0F2	ExecCondNo																													
	0013																															
Execution condition No.	0014	W0F3	Reserved																													
	0015																															
Command input area	0016	W0F4	Command number																													
	0017																															
	0018																															
	0019																															
	0020	W0F6	Command Parameter1																													
	0021																															
	0022																															
	0023	W0F8	Command Parameter2																													
	0024																															
	0025																															
	0026	W0FA	Command Parameter3																													
	0027																															
	0028																															
	0029																															
	0030																															
	0031																															
	...																															

 ExecCondNo is only loaded when there are changes, so can also be used when changing execution conditions via commands.

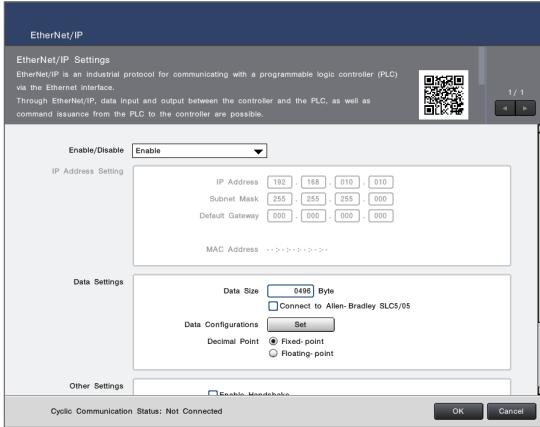
● Name and Operation of Output Signals

Allocated area	Name	Remarks
Bit Area	Command Request	Requests command execution when the signal switches from OFF to ON.
	Result ack	Provides notification of data acquisition when the signal switches from OFF to ON.
	Error reset request	Clears Error when the signal switches from OFF to ON.
	TRG	Allows the head to capture images (leading edge synchronization). The input is accepted when READY is ON.
	RESET	<ul style="list-style-type: none"> Used to perform reset operation. The Result OR output will become 0. The measurement count returns to 0. All of archived image data are deleted. All of the data in the output buffer are reset. A new measurement result output destination file is created. A new image output destination folder is created. The trigger waiting state of individual triggers is canceled.
	EXT	Used to suspend the occurrence of internal triggers and the acceptance of external triggers. While this is on, READY is forced to be off to stop the acceptance of all triggers (level synchronization).
	TEST	<ul style="list-style-type: none"> Used to suspend the status output and other outputs for trial run or any other reasons. The result data not output at the time of input are deleted. Resets the Result OR output during input. As soon as the input turns off, result outputs for the processed images will resume.
	Command number	The command No. is written.
	Cmd Parameter1	The command argument 1 is written.
	Cmd Parameter2	The command argument 2 is written.
	Cmd Parameter3	The command argument 3 is written.

Changing the EtherNet/IP Settings

Displaying the EtherNet/IP settings screen

The settings can be changes in the "EtherNet/IP" screen.



- Controller Ethernet settings such as the IP address and subnet mask are changed according to **[Network]** (Page 8-2).
- If the EtherNet/IP settings were changed, it is necessary to restart the LJ-S Series in order to apply the settings.

1 Select [Global] > [Communications & I/O] - [EtherNet/IP] or [EtherNet/IP Unit].

2 In [Enable/Disable], select [Enable] or [Enable unit].

Reference PLC-Link, PROFINET, and EtherCAT cannot be used in conjunction with EtherNet/IP.

3 Change the settings as required.

Data Size

Specifies the data size of Assembly Object in the cyclic communication and the message communication (Default: 496 byte). For the cyclic communication, a connecting PLC is given priority to specify data size. Therefore, the data size specified here may differ from that in actual processing. Use a PLC compatible with Large Forward Open in order to transact data exceeding 496 byte.

Connect to Allen-Bradley SLC5/05

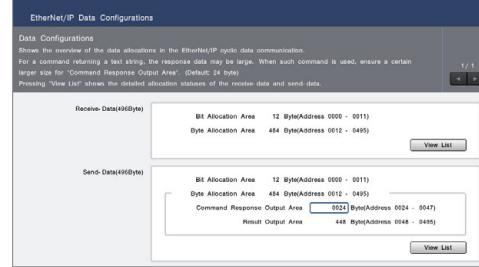
Checking the box limits the data size settable up to 248 byte. PLCs specified here do not support the cyclic communication, therefore, the data size of Assembly Object in the message communication should be changed according to the specifications of the PLCs.

Reference

- Although there is no problem if the cyclic communication data size set at the controller is not the same as the cyclic communication data size on the PLC side, it is recommended that the same value as the PLC data size be set so that the allocated data can be sent and received correctly.
- The value set here is used as the data size when accessing assembly object input data (instance 100, attribute 3) and output data (instance 101 [if using the unit's Ethernet port] / 150 [if using the communication expansion unit], attribute 3) during message communication.

Data Configurations

Click [Set] to display an overview of data allocations in EtherNet/IP cyclic communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for "Command Response Output Area" (Default: 24 byte). Clicking [View List] shows the detailed allocation statuses of the receive-data and send-data.



Receive-data

Displays an overview of the allocations for data received by the controller from the PLC.

Send-data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

Decimal Point

Select the data notation of result data output and decimal-related commands.

Fixed-point (initial value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

Floating-point

The data is handled as 32-bit single-precision floating decimal point data.

Communication expansion unit network settings

Point

- If incorrect settings are used, the controller and other network equipment may not work properly. Consult your system administrator or network administrator about setting values.
- For communication through the controller's EtherNet/IP port, set the IP address, subnet mask, and default gateway on the [Network Setting] screen.

Reference

When [Disable] or [Enable] is selected for [Enable/Disable], the setting details of the controller's Ethernet port are displayed.

IP Address

Enter the IP address (Default value: 192.168.10.20).

Subnet Mask

Enter a subnet mask (Default value: 255.255.255.0).

Default Gateway

Enter a default gateway IP address (Default value: 0.0.0.0).

Point

The set value is common with the P1 port and P2 port of the communication expansion unit.

Enable DHCP (only when [Enable Unit] is selected)

Select this check box when the network setting information (IP address, subnet mask, and default gateway) is provided by a DHCP server when the controller starts. (Default: Disable)

Point

- When DHCP is enabled, the settings of the IP address, subnet mask, and default gateway cannot be changed on the [EtherNet/IP] menu.
- If the DHCP server has not been started, the controller retries DHCP processing until there is a reply from the server. Clear this check box to change to manual assignment of the settings.

Reference

For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

● Enable Handshake

After confirming that the PLC has received the measurement result output data, select whether to write the next result data. If enabled, the controller turns on the "Result ready flag" after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on "Result ack flag". The unit detects this and turns off the Result ready flag. The PLC turns off the "Result ack flag" to request the controller to load the next output data.

● Create EDS File

Outputs an EDS file and icon that include information related to the controller EtherNet/IP functions. The naming convention for each file is as follows.

Controller:

- Keyence_3010_0101.eds
- LJ-S_Series.ico

In the case of the communication expansion unit

- Keyence_3011_0101.eds
- LJ-S-CB-NEP.ico



- The file output path is SD2:/LJ-S/EDS on the controller and SD2/LJ-S/EDS_EX on the communication expansion unit.
- Since the EDS file does not contain the information that was set or changed in the controller global settings, the created EDS file will always contain the same information.

4 Select [OK].

Outputting Measurement Data via EtherNet/IP Cyclic Communication (Data Output)

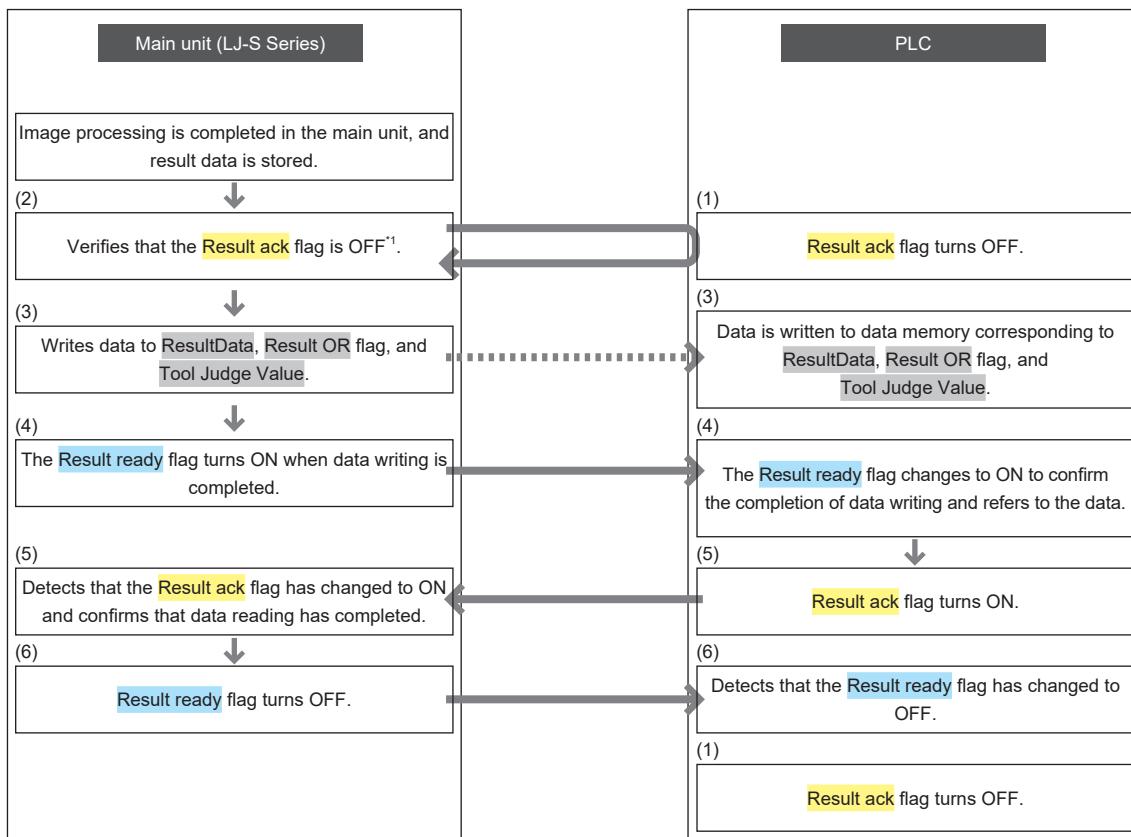
Change the output settings for data output using EtherNet/IP.

Data output flow (example of connection with PLC EtherNet/IP unit)

Set the data and address for output in the output settings.
The controller outputs data via EtherNet/IP in the following manner.

Reference

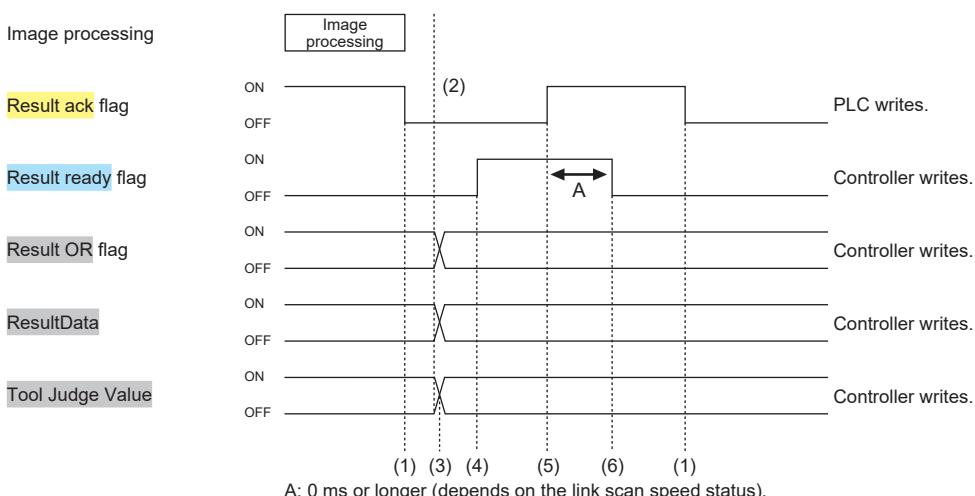
- Data output via EtherNet/IP is performed only in Run mode. Data is not output in setup mode.
- With EtherNet/IP, images and other binary data cannot be output.
- If data output via EtherNet/IP was not executed, no data is output. In this case, the "Result ready flag" does not change.



Reference

- If results output is executed when the "Result ack flag" is still ON, the data is stored in the output buffer, however, it is not written to ResultData. When the "Result ack flag" turns OFF, the data in the buffer is written. Be aware that if the inspection flow continues to be executed when the "Result ack flag" remains ON, overflow of the output buffer will occur and output will be skipped.
- When handshake is OFF, output data is overwritten and updated without checking whether the Result ack flag is OFF. To take the rise of Result ready flag as a data reference synchronization signal, turn the Result ack flag ON at each output, which will turn the Result ready flag OFF.

Timing Chart



Reference

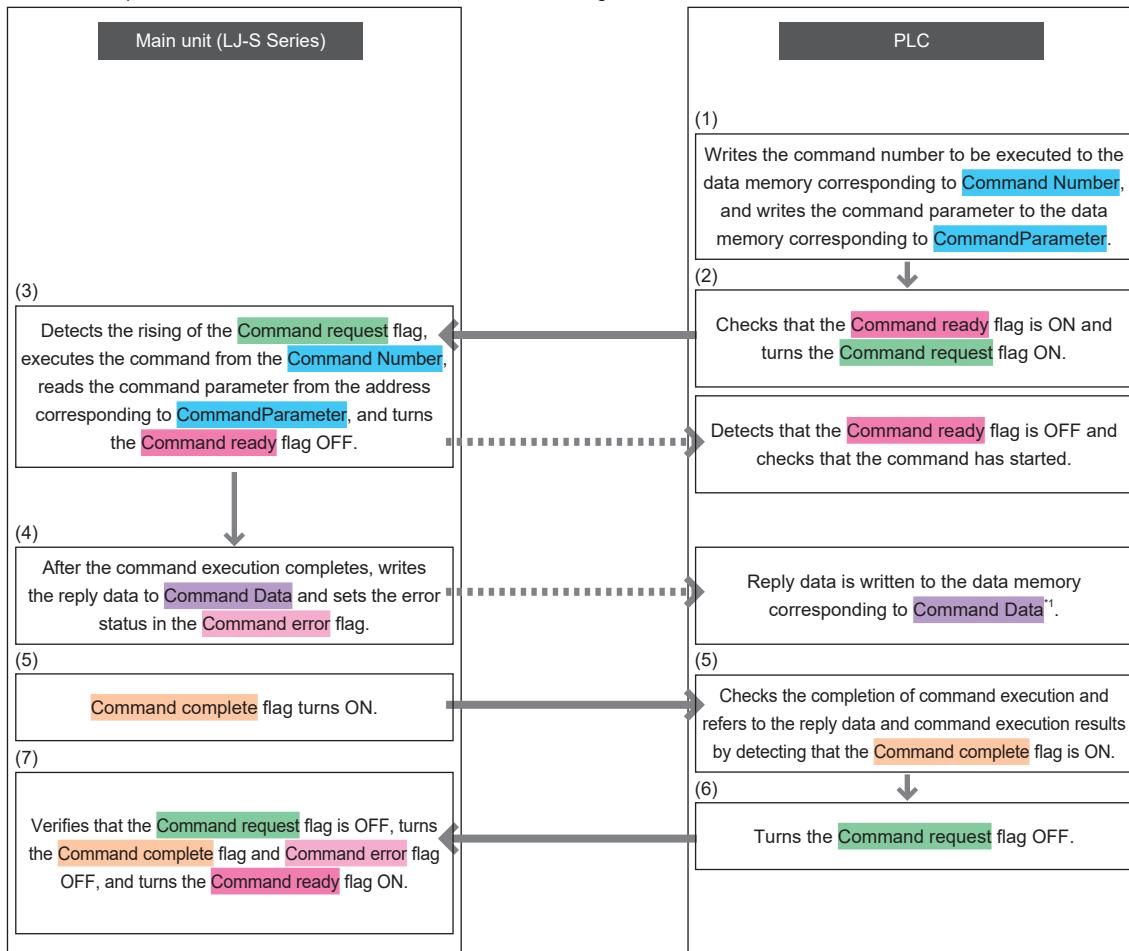
- The "Result OR flag" is updated in coordination with results output with EtherNet/IP as the output destination. When the "Result OR flag" is used, it is necessary to configure the output setting so that 1 or more data item is output via EtherNet/IP.

Controlling Controller with EtherNet/IP Cyclic Communication (Command Control)

The communication control commands can be executed at any time.

Flow of command process using EtherNet/IP (example of connection with PLC EtherNet/IP unit)

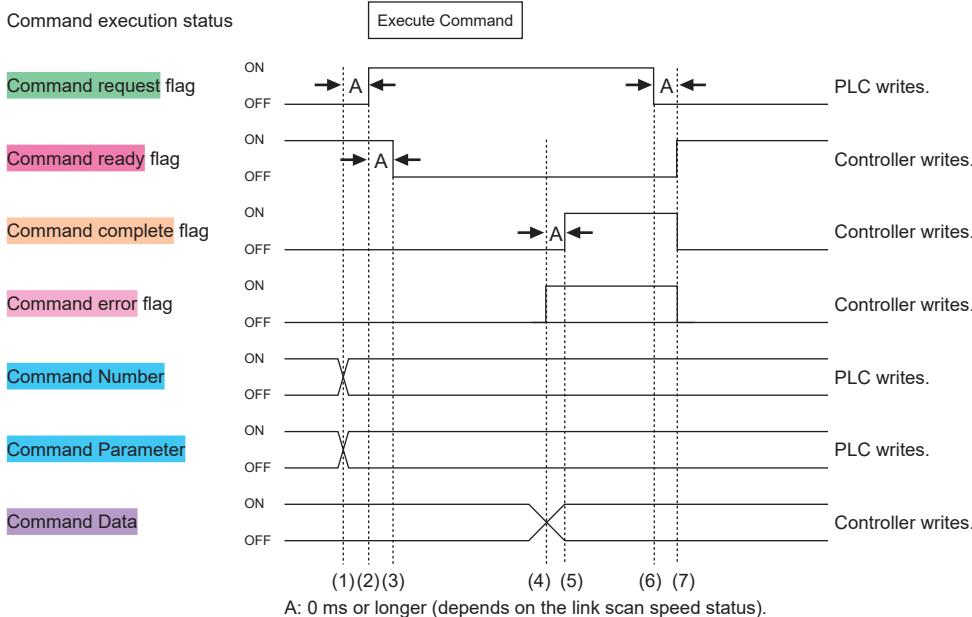
The controller performs command control via EtherNet/IP in the following manner.



- In the case of a command for which there is no response data, data is not output in response to the Command Data.

Reference When an error occurs, the command execution results are written to Command Result (0: Success, <Error code>: Failure). The error codes conform to □ "When an error occurs on command acceptance" (Page 9-2).

Timing Chart



Changing Execute Condition No. Using EtherNet/IP Cyclic Communication (Execute No. Change)

The execute condition No. can be changed at any time.

Flow of execute No. change using EtherNet/IP (example of connection with PLC EtherNet/IP unit)

The controller changes the link value of the execute No. using EtherNet/IP in the following manner.
The changed value is applied at the next measurement.



Troubleshooting

Problems and Countermeasures

● Checking whether or not the EtherNet/IP connection is correct

Select the controller [Global] - [Communications & I/O] - [EtherNet/IP], then check [Cyclic Communication Status:] at the bottom of the [EtherNet/IP] screen. When [Not Connected] is shown here, the communication has failed. Check the cable (cross cable when connected directly), IP address, communications settings on the PLC side, and other items again.



When connecting to an Allen-Bradley SLC5/05, because cyclic communication is not performed, [Not Connected] is displayed even when the connection is correct.

● The Result OR flag is not output.

The "Result OR flag" is updated in coordination with results output with EtherNet/IP as the output destination. When the "Result OR flag" is used, it is necessary to configure the output setting so that 1 or more data item is output via EtherNet/IP.

● The Result ready flag remains ON and does not change.

The Result ack flag may not be controlled properly. The "Result ready flag" turns OFF when the "Result ack flag" rise is recognized in sending (controller receiving). This is true whether the handshake is ON or OFF.

● I tried to read data when the STO output from the terminal block changes to rise, but could not obtain the data properly.

STO is the data strobe signal for terminal output. Therefore, it cannot be used as the strobe signal for any other data output.
Refer to the "Result ready flag" for the timing as to when to read data by EtherNet/IP.

● Although results data is output beginning from byte address 0048, it is unknown where the data is output to on the PLC (KV Series) side.

With the KV Series, when automatic allocation is used for the first LJ-S Series, the LJ-S Series results data is written beginning from link register W0012. With KV series automatic allocation, allocation byte addresses 0000-0011 are for the link relay (beginning from B0000), and byte addresses 0012 beginning from 00 are for the link register. Allocation begins at the start from W0000, with 1 register used for each 2-byte address.
When the results data byte address is 0048, then $(48 - 12)/2 = \text{No. } 18 \rightarrow 12H$, and results data is written beginning from W0012.

Error Messages

Message	Cause	Corrective Action	Error factor No.
EtherNet/IP communication failed.	Cyclic communication was interrupted. (When recovery is possible, recovery occurs automatically.)	<ul style="list-style-type: none"> Check that the Ethernet cable is connected correctly. Check whether both the controller and the master side were restarted after the communication settings were updated. Change the cyclic communication cycle and timeout time on the PLC side. With the factory default, ERROR output is not set. Set this on the "ERROR Output Settings" screen (page 8-14). 	13601
EtherNet/IP output failed due to a full buffer.	The buffer for output via EtherNet/IP is full.	Change the RPI setting so the data is output via EtherNet/IP at a faster rate than it builds up. Or, extend the time between triggers. Note: Results data is not written when the buffer is full.	13602
The delay of the handshake control causes skipping of the EtherNet/IP communication result output.	When the EtherNet/IP handshake is ON, delayed handshake caused results output via EtherNet/IP to be skipped.	Change the RPI setting so the data from the tool is output via EtherNet/IP at a faster rate than it builds up. Or, extend the time between triggers. Note: Output does not occur when the output buffer is full.	13603
The EtherNet/IP unit cannot be recognized.	The EtherNet/IP unit is not recognized, and the controller cannot use EtherNet/IP communication.	<ul style="list-style-type: none"> Make sure the EtherNet/IP unit is installed correctly. Make sure the EtherNet/IP unit is not damaged. Do not connect/disconnect the EtherNet/IP unit while the controller and unit are powered on. 	13604
Non-supported EtherNet/IP unit.	An EtherNet/IP expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.	13605

Communicating with the Controller Using EtherNet/IP Message Communication

For details on the basic specifications of communication, refer to "EtherNet/IP Communication Specifications" (Page 9-68).

Object configuration

The EtherNet/IP functions provided by the controller's Ethernet port and the communication expansion unit include the following objects. These objects can be accessed using message communication.

Class (Object name)	Class ID	Instance ID	Controller's Ethernet port	Communication expansion unit
Identity Object	1 (01H)	1 (01H)	✓	✓
Message Router Object	2 (02H)	1 (01H)	✓	-
Assembly Object	4 (04H)	100 (64H): Input	✓	✓
		101 (65H): Output	✓	-
		150 (96H): Output	-	✓
Connection Manager Object	6 (06H)	1 (01H)	✓	✓
Device Level Ring Object	71(47H)	1 (01H)	-	✓
QoS Object	72(48H)	1 (01H)	-	✓
Measurement Object	113 (71H)	1 (01H)	✓	✓
Port Object	244 (F4H)	1 (01H)	✓	-
TCP/IP Interface Object	245 (F5H)	1 (01H)	✓	✓
EtherNet Link Object	246 (F6H)	1 (01H)	✓	✓

✓: Supported, -: Not supported



- For details of the procedure for issuing messages with the PLC device that is used, refer to the PLC instruction manual.
- This manual primarily explains the Measurement Object, which is an object unique to the controller. For details of other objects, refer to the EtherNet/IP specifications that are issued by ODVA (www.odva.org).

Notation in this explanation

The following terms are used when explaining object attributes and services.

● Data notation

- The bit position in the data is indicated as "Bit n". (Bit0 is indicated as LSB.)
- Array type data is indicated by []. Example: DWORD [10] (array with 10 DWORD-type elements)

● Data type

The data type is prescribed as follows in the EtherNet/IP specifications.

Data type	Explanation	Range	
		Min.	Max.
BOOL	Boolean	0: FALSE	1: TRUE
SINT	Short integer	-128	127
INT	Integer	-32768	32767
DINT	Double precision integer	-2^{31}	$2^{31}-1$
USINT	Unsigned short integer	0	255
UINT	Unsigned integer	0	65535
UDINT	Unsigned double precision integer	0	$2^{32}-1$
BYTE	Bit string: 8 bits	-	-
WORD	Bit string: 16 bits	-	-
DWORD	Bit string: 32 bits	-	-
REAL	Floating decimal point	Range of single-precision floating decimal points	



All values are stored as little endians.

ClassID: 4 (04H) Assembly Object

Explanation

The same data that is sent and received by cyclic communications can be accessed and controlled directly by messages. This can be used to perform control using the same data format as with cyclic communication for models that do not support cyclic communication (such as Allen-Bradley SLC5/05).

 Be aware that with messages, it is not possible to perform time-specific control as it is with cyclic communications.

Instance: 100 (64H)

This is information concerning the input assembly and is sent using cyclic communication by the controller.

Attribute

Attribute ID	Access	Name	Data type	Details
3 (03H)	Get	data	Byte array	This information is specified by the input data for the cyclic communication data allocation in the global settings. It includes the controller status, command execution results, results data, and other information.
4 (04H)	Get	size	UINT	Attribute3 size (bytes) This is the size that is specified for cyclic communications data size in the cyclic communication data allocation in the global settings.

Example of input assembly data format

The input assembly configuration is as prescribed in the cyclic communication data allocation in the global settings.

For the purpose of explanation, the configuration is shown with the settings listed below.

- Cyclic communication data size: 496 bytes (Addresses 0000 - 0495)
- Command response output area: 24 bytes

Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
0000	Reserved	Reserved	Reserved	Result OR	Result Ready	Cmd Ready	Cmd Error	Cmd Complete
0001	Reserved	RUN	Reserved	ERROR	BUSY	EXPOSURE_BUSY	TRG_ack	READY
0002	Reserved							
0003	OUTPUT_IMG_STATUS	OUTPUT_IMG_BUSY	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0004	Tool Judge Value7	Tool Judge Value6	Tool Judge Value5	Tool Judge Value4	Tool Judge Value3	Tool Judge Value2	Tool Judge Value1	Tool Judge Value0
0005	Tool Judge Value15	Tool Judge Value14	Tool Judge Value13	Tool Judge Value12	Tool Judge Value11	Tool Judge Value10	Tool Judge Value9	Tool Judge Value8
0006	Tool Judge Value23	Tool Judge Value22	Tool Judge Value21	Tool Judge Value20	Tool Judge Value19	Tool Judge Value18	Tool Judge Value17	Tool Judge Value16
0007	Tool Judge Value31	Tool Judge Value30	Tool Judge Value29	Tool Judge Value28	Tool Judge Value27	Tool Judge Value26	Tool Judge Value25	Tool Judge Value24
0008	Tool Judge Value39	Tool Judge Value38	Tool Judge Value37	Tool Judge Value36	Tool Judge Value35	Tool Judge Value34	Tool Judge Value33	Tool Judge Value32
0009	Tool Judge Value47	Tool Judge Value46	Tool Judge Value45	Tool Judge Value44	Tool Judge Value43	Tool Judge Value42	Tool Judge Value41	Tool Judge Value40
0010	Tool Judge Value55	Tool Judge Value54	Tool Judge Value53	Tool Judge Value52	Tool Judge Value51	Tool Judge Value50	Tool Judge Value49	Tool Judge Value48
0011	Tool Judge Value63	Tool Judge Value62	Tool Judge Value61	Tool Judge Value60	Tool Judge Value59	Tool Judge Value58	Tool Judge Value57	Tool Judge Value56
0012	Error Code							
0013								
0014	Reserved							
0015								
0016	Total Count							
0017								
0018								
0019								
0020	Command Result							
0021								
0022								
0023								
0024	Command Data 1							
0025								
0026								
0027								

Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
0028								
0029								
0030								
0031								
:								
0044								
0045								
0046								
0047								
0048								
0049								
0050								
0051								
0052								
0053								
0054								
0055								
:								

● Service

Service code	Name	Details
14 (0EH)	GetAttributeSingle	Acquires the attribute value.

Instance: 101 (65H)/150(96H)

This is information concerning the output assembly and is received using cyclic communication by the controller.
The number is 101 when using the unit's Ethernet port and 150 when using the communication expansion unit.

Attribute

Attribute ID	Access	Name	Data type	Details
3 (03H)	Get/Set	data	Byte array	This information is specified by the output data for the cyclic communication data allocation in the global settings. Controller controls, command input, and other data can be written to it.
4 (04H)	Get	size	UINT	Attribute3 size (bytes) This is the size that is specified for cyclic communications data size in the cyclic communication data allocation in the global settings.

Example of output assembly data format

The output assembly configuration is as prescribed in the cyclic communication data allocation in the global settings.

For the purpose of explanation, the configuration is shown with the settings listed below.

- Cyclic communication data size: 496 bytes (Addresses 0000 - 0495)

Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
0000	Reserved	Reserved	Reserved	Error reset request	Result ack	Reserved	Reserved	Cmd Request
0001	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	TRG
0002	Reserved	Reserved	Reserved	Reserved	Reserved	TEST	EXT	RESET
0003	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0004	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0005	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0006	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0007	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0008	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0009	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0010	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0011	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
0012	ExecCondNo							
0013								
0014	Reserved							
0015								
0016								
0017	Command number							
0018								
0019								
0020								
0021	Command Parameter1							
0022								
0023								
0024								
0025	Command Parameter2							
0026								
0027								
0028								
0029	Command Parameter3							
0030								
0031								
:								

Service

Service code	Name	Details
14 (0EH)	GetAttributeSingle	Acquires the attribute value.
16 (10H)	SetAttributeSingle	Sets the attribute value. Whether or not it can be set depends on the attribute access properties.

ClassID: 113 (71H) Measurement Object

Explanation

This object is unique to the controller, and provides the attributes and services that are necessary to control the controller by means of messages. For details concerning control by attributes, refer to the control sequence for cyclic communication.

Instance: 1 (01H)

Attribute

Attribute ID	Access	Name	Data type	Details
100 (64H)	Get	Measurement Object Status	BYTE	Indicates the controller status. <ul style="list-style-type: none"> Bit 0: ERROR Bit 1: Reserved Bit 2: RUN
101 (65H)	Get	Process Status	DWORD	Indicates the measurement status. <ul style="list-style-type: none"> Bit 0: READY Bit 1: Reserved Bit 2: Reserved Bit 3: Reserved Bit 4: Reserved Bit 5: Reserved Bit 6: Reserved Bit 7: Reserved Bit 8: TRG_ack Bit 9: Reserved Bit 10: Reserved Bit 11: Reserved Bit 12: Reserved Bit 13: Reserved Bit 14: Reserved Bit 15: Reserved Bit 16: BUSY Bit 17: EXPOSURE_BUSY Bit 18: Reserved Bit 19: Reserved Bit 20-31: Reserved
102 (66H)	Get/Set	RESET	BOOL	Initializes the measurement process. 0->1: Initialize the measurement process.
103 (67H)	Get/Set	TEST	BOOL	Restricts the output. Clears the output buffer when 0->1. <ul style="list-style-type: none"> 1: Restrict output 0: Permit output
104 (68H)	Get/Set	EXT	BOOL	Restricts trigger input. <ul style="list-style-type: none"> 1: Restrict trigger input. 0: Permit trigger input.
105 (69H)	Get/Set	TRG	BYTE	Inputs trigger. <ul style="list-style-type: none"> Bit 0: TRG Bit 1-7: Reserved
113 (71H)	Get	Results Status	BYTE	Indicates the results output status. <ul style="list-style-type: none"> Bit 0: Result ready flag Bit 1: Result OR flag
107 (6BH)	Get/Set	Result ack flag	BOOL	Performs results output handshake control.
108 (6CH)	Get	Inspection Result	DWORD [124]	Displays the results data. The data size is fixed at 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and at 496 bytes in other cases. The amount that was specified in the cyclic communication allocations can be acquired from the starting address.
109 (6DH)	Get/Set	Command request flag	BOOL	Requests the communication control command. <ul style="list-style-type: none"> 1: Request command execution. 0: Does not request command execution.
110 (6EH)	Get/Set	Command Command Number Command Param	Structure DWORD DWORD	Specifies the communication control command No. and parameters. The data size is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and 496 bytes in all other cases. *At setup, only the size that requires update can be specified (4-byte integer multiple).
111 (6FH)	Get	Command Status	BYTE	Indicates the command execution status. <ul style="list-style-type: none"> Bit 0: Command complete flag Bit 1: Command error flag Bit 2: Command ready flag
112 (70H)	Get	Command Result Command Result Command Data	Structure DWORD DWORD	Indicates the command execution results. The data size is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and 496 bytes in all other cases. The data size varies depending on the command execution result. The maximum data size is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and 496 bytes in all other cases.
113 (71H)	Get	Total count	UDINT	Indicates the number of measurement.

Attribute ID	Access	Name	Data type	Details
114 (72H)	Get/Set	Exec Cond No	UINT	If a value was specified that exceeds the maximum value for the execute No., then the value is set as the maximum value + 1. The update timing for Set is the same as for EXW, however, it is different from EXW in that update occurs even when operation is stopped. With Get, an IMMEDIATE execute No. is acquired and returned.
115 (73H)	Get	NGCount	UDINT	Indicates the NG count.
116 (74H)	Get/Set	Program ID	Structure	Sets and references the program No.
		SD No.	UINT	Specifies the SD card No. (1 - 2).
		Program No.	UINT	Specifies the program No. (0 - 999).
118 (76H)	Get	Program Load Status	UINT	Indicates the status/results of program change by attribute 116. • 0: Program change successful • 1: Program change failed • 2: Program change in progress

For Get access, the GetAttributeSingle service (0EH) is used. For Set, the SetAttributeSingle service (10H) is used.

● Service

Service code	Name	Details
5 (05H)	Reset	Initializes the measurement process.
14 (0EH)	GetAttributeSingle	Acquires the attribute value.
16 (10H)	SetAttributeSingle	Sets the attribute value. Whether or not it can be set depends on the attribute access properties.
75 (4BH)	Capture	Execute the imaging.
76 (4CH)	Execute Command	Issues a command request. The command execution results are returned by message response.
77 (4DH)	GetResultsData	Acquires the measurement results.
78 (4EH)	Execute No. Rewrite	Changes the execute No.
79 (4FH)	GetArea AllocationInfo	Acquires the cyclic communication allocation settings.
80 (50H)	Clear error	Clears the error status.

● Service details

○ Reset service (05H)

Initializes the measurement process. The executed contents are the same as for I/O control reset control.

- Send parameter: None
- Response data: None

○ Image service (4BH)

Enter a trigger to acquire the profile.

- Send parameter

Name	Data type	Details
TriggerBit	BYTE	Head information to instruct capture • Bit 0: TRG

- Returned error code

Error Code	Name	Details
09 (09H)	Abnormal parameter value	A parameter value other than 1 was specified.
21 (15H)	Parameter size is too large.	A parameter was specified with a size larger than 2 bytes.
19 (13H)	Parameter size is too small.	Parameter is missing.
16 (10H)	Status error	The "Ready" which corresponds to the specified trigger is OFF (not in Run mode, receive image capture not permitted, etc.).

- Result data: None

 In the communication process using messages, a processing delay of several tens of ms or longer occurs. If this is a problem, use cyclic communication or terminal input for control.

○ **Communication control command execution service (4CH)**

Executes communication control commands.

- Send parameter

Name	Data type	Details
Command Number	DWORD	Specifies the communication control command No.
Command Param	DWORD	Specifies the command parameters. A maximum of 492 bytes of parameters can be specified (4-byte integer multiple). For more information on the command specification method, see "Detailed Explanation of Communication Control Commands".

- Returned error code

Error Code	Sub code	Name	Details
00 (00H)		Command execution completion	Command execution was completed.
19 (13H)		Parameter too small error	The parameter was not specified in the send-data.
21 (15H)		Parameter too large error	Parameter larger than 496 bytes was specified in the send-data.
31 (1FH)	2	Command error	The specified command does not exist.
	3	Command operation prohibited	Operation of the received command is not possible.
	5	Command response error	The command results area is insufficient.
	22	Parameter error	The parameter number or range is incorrect.
16 (10H)		Status error	The "Command ready flag" is OFF.

- Results data

When the execution of a command that includes command results is successful, the results data is returned in the format shown below.

Name	Data type	Details
Command Data	DWORD []	Returns the command execution results. The data contained in this area corresponds to the Command Data part. The maximum size of the returned data is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and 496 bytes in all other cases.

 In the communication process using messages, a processing delay of several tens of ms or longer occurs. If this is a problem, use cyclic communication or terminal input for control.

○ **Results data acquisition service (4DH)**

Acquires the final measurement results.

- Send parameter

Name	Data type	Details
Size	UINT	Specify the result size in bytes to be fetched (result data is 4 bytes. Must be a multiple of 4).
Offset	UINT	Specify the offset (byte) of the result data to be fetched (result data is 4 bytes. Must be a multiple of 4).

- Returned error code

Error Code	Name	Details
09 (09H)	Abnormal parameter value	Offset or size value is incorrect.
21 (15H)	Parameter size is too large.	Parameter size is too large.
19 (13H)	Parameter size is too small.	Parameter size is insufficient.

- Results data

Name	Data type	Details
Result	BYTE []	Returns results data with the specified offset and size. The maximum data size is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and 496 bytes in all other cases.

 • In the communication process using messages, a processing delay of several tens of ms or longer may occur. If this is a problem, use cyclic communication or terminal input for control.
 • The results data that can be acquired is up to the size specified in the cyclic communication allocations.
 • When this command is used, set the handshake to OFF.

○ **Execute number change service (4EH)**

Changes the execute number.

- Send parameter

Name	Data type	Details
No	DWORD	Execute number to set

- Returned error code

Error Code	Name	Details
09 (09H)	Abnormal parameter value	Size value is incorrect.
21 (15H)	Parameter size is too large.	Parameter size is too large.
19(13H)	Parameter size is too small.	Parameter size is insufficient.

- Result data: None

 In the communication process using messages, a processing delay of several tens of ms or longer occurs. If this is a problem, use cyclic communication or terminal input for control.

○ **Area allocation information acquisition service (4FH)**

Acquires the address and size for the areas allocated to cyclic communication.

- Send parameter

Name	Data type	Details
Direction	UINT	Direction • 0: Receiving side • 1: Sending side
Index	UINT	When Direction is 0 (receiving side) • 0: Bit area • 1: Fixed byte data area • 2: CommandParam area When Direction is 1 (sending side) • 0: Bit area • 1: Fixed byte data area • 2: CommandData area • 3: ResultData area

- Returned error code

Error Code	Name	Details
09 (09H)	Abnormal parameter value	A parameter value other than 0, 1, 2, and 3 was specified.
21 (15H)	Parameter size is too large.	A parameter was specified with a size larger than 2 bytes.
19 (13H)	Parameter size is too small.	Parameter is missing.

- Results data

Name	Data type	Details
Size	UINT	Size of specified area
Offset	UINT	Starting address of specified area

○ **Clear error service (50H)**

Clears the error status.

- Send parameter

Name	Data type	Details
Index	UINT	Error to be cleared • Bit 0: Error

- Returned error code

Error Code	Name	Details
09 (09H)	Abnormal parameter value	A parameter value other than 1 was specified.
21 (15H)	Parameter size is too large.	A parameter was specified with a size larger than 2 bytes.
19 (13H)	Parameter size is too small.	Parameter is missing.

- Result data: None

 In the communication process using messages, a processing delay of several tens of ms or longer occurs. If this is a problem, use cyclic communication or terminal input for control.

Controlling the controller using EtherNet/IP message communication

Using message communication

The controller functions as the message communication server. The procedure for issuing message communication varies depending on the device. However, information such as the following must be specified. For details, refer to "EtherNet/IP Communication Specifications" (Page 9-68) and the manual of each device.

IP address

Specify the controller IP address.

Class, instance

Specify the following classes and instances that are provided by the controller EtherNet/IP function.

Class name	Class ID	Instance ID
Identity Object	1 (01H)	1 (01H)
Message Router Object	2 (02H)	1 (01H)
Assembly Object	4 (04H)	100 (64H): Input 101 (65H): Output (when using the controller's Ethernet port) 150 (96H): Output (when using a communication expansion unit)
Connection Manager Object	6 (06H)	1 (01H)
Measurement Object	113 (71H)	1 (01H)
Port Object	244 (F4H)	1 (01H)
TCP/IP Interface Object	245 (F5H)	1 (01H)
EtherNet Link Object	246 (F6H)	1 (01H)



- The primary classes that are used for message communication are the following:
- Measurement Object: This object is unique to the controller, and is tasked with all image sensor controls.
 - Assembly Object: With a PLC that does not support cyclic communication, by directly reading and writing the data of this object, it is possible to achieve control that is the same as cyclic communication.

Attributes

Specify the attributes that exist in the specified class and instance. For details of the attributes of each class, refer to "EtherNet/IP Communication Specifications" (Page 9-68) and the specifications of the EtherNet/IP functions issued by ODVA.



- To obtain the specifications issued by ODVA, refer to the URL below.
ODVA home page: www.odva.org/

Services

Specify the contents for execution. The primary services that can be used with the controller are the following:

- Access to attributes:
GetAttributeSingle/SetAttributeSingle
- Object-specific service:
Services that are prepared for individual objects.

Control using message communication

When using messages to control the controller, access Measurement Object.

Measurement Object provides the following services.

Service name	Service ID	Explanation
Reset	5 (05H)	Resets the controller measurement contents. It is the same as the reset command in the communications control commands.
GetAttribute Single	14 (0EH)	Acquires the specified attribute value.
SetAttribute Single	16 (10H)	Writes a value to the specified attribute.
Capture	75 (4BH)	Inputs the specified trigger signal and performs image capture.
Execute Command	76 (4CH)	Executes communication control commands.
GetResultsData	77 (4DH)	Acquires the measurement results.
Execute No. Rewrite	78 (4EH)	Changes the execute No.
GetArea AllocationInfo	79 (4FH)	Acquires the allocation information for each area (command response output area, system variable allocation area, results output area, etc.) that were allocated for cyclic communication data.
Clear error	80 (50H)	Clears the error status.

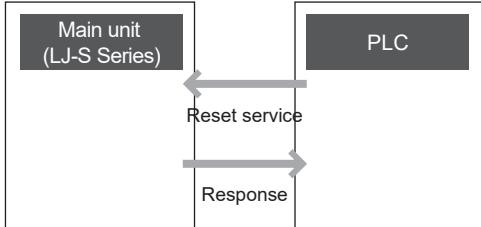
For details about each service, see "EtherNet/IP Communication Specifications" (Page 9-68).

Resetting the controller using EtherNet/IP message communication

Controller measurement can be reset using message communication by means of the Measurement Object reset service.

Reset service (05H) control image

Resets the measurement contents. The contents that are executed are the same as I/O reset.



Example of data

Send-data

Class ID	71H	Measurement Object
Instance ID	01H	Fixed value
Service ID	05H	Reset service
Attribute ID	-	-
Data	-	-

Response

Execution result	Execution result
Additional code	None

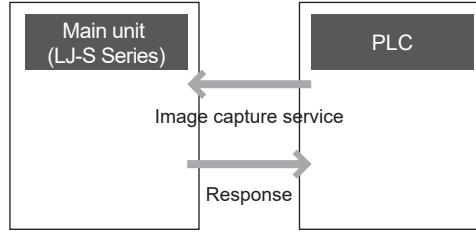
Execution result

0 (00H)	Service execution was successful.
---------	-----------------------------------

Controlling image capture with EtherNet/IP message communication

Image capture service (4BH) control image

Enter the trigger and acquire the profile.



[Reference] The following conditions must be satisfied in order to use this service.

- EtherNet/IP must be enabled when started.
- READY is true (READY state)

Example of data

When trigger is the input, specify 0x01 with the trigger information bits 0 as 1.

Send-data

Class ID	71H	Measurement Object
Instance ID	01H	Fixed value
Service ID	4BH	Image capture service
Attribute ID	-	-
Data 0th byte	01H	bit0: Trg enabled Bit1-7: Invalid

Response

Execution result	Execution result
Additional code	None

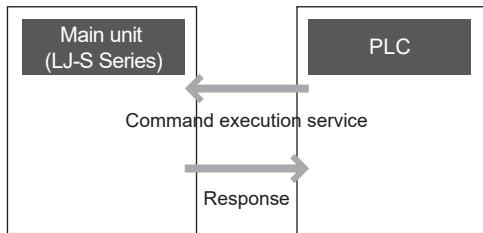
Execution result

0 (00H)	Service execution was successful.
9 (09H)	Data value is not correct (not a valid value).
16 (10H)	Service was not available (one of the specified triggers was not in ready state.)
19 (13H)	Incorrect data size (too small)
21 (15H)	Incorrect data size (too large)

Command control with EtherNet/IP message communication

Command execution service (4CH) control image

Executes command data.



Reference

- The following conditions must be satisfied in order to use this service.
 - EtherNet/IP must be enabled when started.
 - The "Command ready flag" must be true (service is available).
- The upper limit for the data that can be specified and acquired by command input and command output with this service is 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and is 496 bytes in all other cases. This size is unrelated to the command area size that was allocated for the cyclic communication area on the Global screen.
- The command output data returns a response corresponding to the size of the results data for the executed command.

Example of data

When specifying number specified command 24 (PW) and changing to program 10 in SD1

Send-data

Class ID	71H	Measurement Object	
Instance ID	01H	Fixed value	
Service ID	4CH	Command execution service	
Attribute ID	-	-	
Data	0th byte	18H	Number specified command No. 24 (Change inspection program)
	1st byte	00H	
	2nd byte	00H	
	3rd byte	00H	
	4th byte	01H	SD No.1 (01H)
	5th byte	00H	
	6th byte	00H	
	7th byte	00H	
	8th byte	0AH	Program No.10 (0AH)
	9th byte	00H	
	10th byte	00H	
	11th byte	00H	

Response data

Execution result	Execution result	
Additional code	Refer below.	
Data	0th byte	Execution result byte No. 0
	1st byte	00H
	2nd byte	00H
	3rd byte	00H

Execution result

0 (00H)	Service execution was successful.
19 (13H)	Incorrect data size (too small)
21 (15H)	Incorrect data size (too large)
31 (1FH)	A vendor-specific error occurred. The detailed reason is indicated in the additional code.
16 (10H)	Status error The "Command ready flag" is OFF.

Additional code

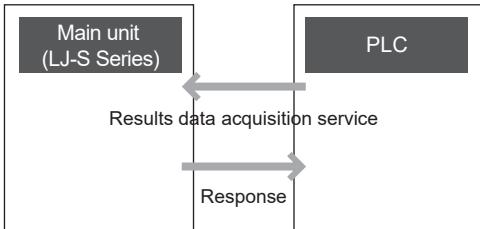
Contain binary command error codes.

2 (02H)	Command error	The specified command does not exist.
3 (03H)	Command operation prohibited	Operation of the received command is not possible.
5 (05H)	Command response error	The command results area is insufficient.
22 (16H)	Parameter error	The parameter number or range is incorrect.

Acquiring measurement data by EtherNet/IP message communications (Acquire Data)

Results data acquisition service (4DH) control image

Specify the offset and size in bytes for the results data that was allocated in the output settings, and acquire the results data.



The upper limit size for the results data that can be acquired is the results data area size that was allocated in the cyclic communication area. However, it is limited to 248 bytes when the selected PLC type is Allen-Bradley SLC5/05, and to 496 bytes in all other cases. If a larger size is specified, data is returned only in the maximum size that can be returned.



The following conditions must be satisfied in order to use this service.

- EtherNet/IP must be enabled when started.
- Results data must be allocated in the cyclic communication area.
- Output data with destination [EtherNet/IP] must be set in the output settings.
- Measurement with the current settings must be completed (number of measurement = 1 or more).

Example of data

Acquiring 20 bytes starting from byte 12 in the results data

Send-data

Class ID	71H	Measurement Object
Instance ID	01H	Fixed value
Service ID	4DH	GetResultsData Services
Attribute ID	-	-
Data	0th byte	14H
	1st byte	00H
	2nd byte	0CH
	3rd byte	00H
	Acquire 20 bytes.	Acquire results data beginning from byte No. 12

Response data

Execution result	Execution result
Additional code	None
Data	0th byte
	1st byte
	2nd byte
	3rd byte
	(...)
	16th byte
	17th byte
	18th byte
	19th byte
	Results data byte No. 12

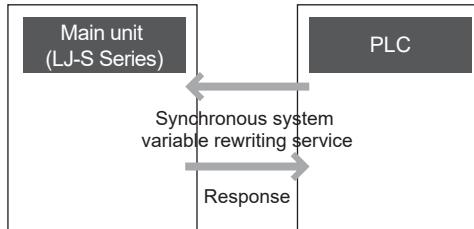
Execution result

0 (00H)	Service execution was successful.
9 (09H)	Data value is incorrect. (Offset or size is negative, or value is too large.)
19 (13H)	Incorrect data size (too small)
21 (15H)	Incorrect data size (too large)

Changing the execute number using EtherNet/IP message communication (Change Execute Condition Number)

Execute number change service (4EH) control image

Change the execute number to the specified value.



The following conditions must be satisfied in order to use this service.

- EtherNet/IP must be enabled when started.

Example of data

Writing execute number 5

Send-data

Class ID	71H	Measurement Object
Instance ID	01H	Fixed value
Service ID	4EH	Execute number change service
Attribute ID	-	-
Data	0th byte	05H
	1st byte	00H
	2nd byte	00H
	3rd byte	00H
	Value written as the execute number	

Response data

Execution result	Execution result
Additional code	None

Execution result

0 (00H)	Service execution was successful.
9 (09H)	Data value is not correct (not within valid range).
19 (13H)	Incorrect data size (too small)
21 (15H)	Incorrect data size (too large)

Overview of control and data output by PROFINET

This system supports communication with PROFINET.

PROFINET is an open communication standard prescribed by PI (PROFIBUS & PROFINET International). In this system, the controller's Ethernet port conforms to Conformance Class A.

The following functions are possible by PROFINET connection.

● Cyclic communication

Communication at update time intervals allows for high-speed control at intervals of several ms to several tens of ms. In addition, because it is possible to control the controller by referencing and updating variables and devices in the PLC without considering the communication, it allows programs to be written easily on the PLC side.

○ Controlling the controller

Control the controller by using cyclic communication to send the commands for execution.

○ Outputting result data

Data can be output by cyclic communication when the items for output from PROFINET are set in the output settings ().

○ Changing execute number

The controller can be controlled by specifying the execute No. by cyclic communication.

Reference

- Set a cyclic communication update time of 4 ms or more.
- In a network where many devices are connected, including PROFINET devices, if a large load is constantly or temporarily applied to the network, then delays and packet loss may occur. Perform sufficient verification prior to operation.
- PLC-Link, EtherNet/IP, and EtherCAT cannot be used in conjunction with PROFINET.

● Record data communication (acyclic communication)

This method can be used for communication which does not require regularity like the cyclic communication. With this communication method, special commands are used to read and write from/to data records (1024 bytes/record), and it is possible to access areas that exceed the maximum size (1408 bytes) for cyclic communication.

Operation Flow

□ “PROFINET communication specifications” (Page 9-92)

- Check whether or not the connected PLC is a model that supports PROFINET connections.
- Check the input/output data assignments.

□ “Changing the PROFINET settings” (Page 9-96)

- Configure the controller settings for PROFINET connection.
Main setting items: Controller IP address, PROFINET device name, data configuration

Establishing PROFINET communications

- To check whether or not PROFINET communications have been established, check [Communication Status] in the PROFINET memory monitor, or check [Communication Status] from the [Global] - [PROFINET] screen.
- If the PROFINET connection is successful, the controller Ethernet port LINK LED (green) begins flashing.

Executing necessary processing

□ “Output of measurement data using PROFINET cyclic communications (Data Output)” (Page 9-98)

- The data specified in the output settings is written to the results output area.
- The “Result ready flag” is used to check the completion of data writing.
- The “Result ack flag” is turned ON to report that reading was completed.

□ “Controlling the controller with PROFINET cyclic communication (Command Control)” (Page 9-99)

- Communication control commands (page 9-2) can be executed.
- Enter the command code and command parameters in the command input area and turn the “Command request flag” ON to execute the command.
- When the “Command ready flag” is ON, the command can be executed.
- The “Command complete flag” is used to check that command execution was completed.

□ “Changing the execute condition No. using PROFINET cyclic communication (Execute Condition No. Change)” (Page 9-100)

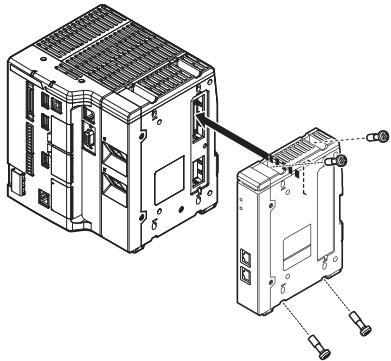
- Change the Exec Cond No. to change the execute condition No.

Prepare PROFINET Unit (when using CB-NEP20EA)

Installing the PROFINET Unit

The optional PROFINET unit CB-NEP20EA is used when communicating over PROFINET unit.
Remove the protective cover from the expansion unit connector on the right side of the controller and install the PROFINET unit as shown below.

Point The controller must be turned off before connecting or disconnecting the CB-NEP20EA.



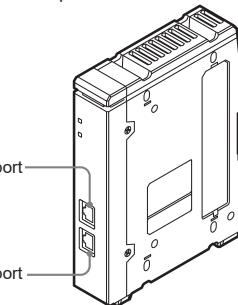
CB-NEP20EA PROFINET Unit Specifications

Standard specifications

Item	Description
Compliant standard	IEEE802.3u (100BASE-TX)
Communication speed	100Mbps (100BASE-TX)
Communication cycle	1 ms at the shortest
Connection cable	Category 5e or greater shielded twisted pair (STP) cable
Node interval	100m
Communication port	RJ45 connector × 2
Communication size	1252 bytes
Supported functions	Cyclic communication (Implicit message), Message communication (Explicit message) UCMM/Class3-compliant DLR (Device Level Ring)-compliant
Conformance test version	Complying with Version.CT19.1

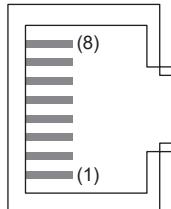
Connecting to an PROFINET Network

Connect the PROFINET network cable to the P1 port or the P2 port of the RJ connector. If an adapter is present downstream of this unit, connect a network cable to the unused port.



Point Use a category 5e or greater STP (shielded twisted pair) cable for the network cable. You can use either a straight cable or a crossover cable.

Wiring example (P1 port / P2 port)



No	Signal name	Function
1	TX+	Transmit data (+)
2	TX-	Transmit data (-)
3	RX+	Receive data (+)
4	-	Connect 75 Ω terminating resistance
5	-	Connect 75 Ω terminating resistance
6	RX-	Receive data (-)
7	-	Connect 75 Ω terminating resistance
8	-	Connect 75 Ω terminating resistance

PROFINET communication specifications

Standard specifications

The PROFINET communications of this system support 2 types of communication: cyclic communication and record data communication (acyclic communication).

Cyclic communication

This function performs cyclic communication at a regular update time interval, and is suitable for real-time control.

- The update time and communication size are specified by connection settings on the PLC side. (Maximum communication size is 1408 bytes)

Record data communication (acyclic communication)

This communication method uses special commands to access "records" that divide byte information into 1024-byte units.

- There are two types of commands: Read Record and Write Record. When a command is executed, a response is returned.
- This method can be used for communication which does not require real time processing.
- It can access areas larger than the maximum size (1408 bytes) in cyclic communication.
- An index is allocated to each record, and data access is performed by specifying the index and size.

The accessible ranges for each byte information are as follows:

- Controller receive-data: Read Record and Write Record are possible.

Index	Accessible address
	LJ-S port
1	0012 to 1035
2	1036 to 2059
3	(None)

- Controller send-data: Read Record only

Index	Accessible address
	LJ-S port
10	0012 to 1035
11	1036 to 2059
12	2060 to 3083
13	3084 to 4107
14	(None)

The Read Record and Write Record commands are issued from the PLC using blocks "RDREC" (SFB 52) and "WRREC" (SFB 53).

 When the Write Record command is issued and cyclic communications are used to write to the Parameter module, a memory area conflict may occur. When using the Write Record command, design so that a conflict between the cyclic communications and memory area does not occur.

Cyclic communication data allocation state

Examples of controller send-data settings

Examples with the command response output area set to 24 bytes

Setting status	Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
Bit Area	0000	Reserved	Reserved	Reserved	Result OR	Result Ready	Cmd Ready	Cmd Error	Cmd Complete
	0001	Reserved	RUN	Reserved	ERROR	BUSY	EXPOSURE_BUSY	TRG_ack	READY
	0002	Reserved							
	0003	OUTPUT_IMG_STATUS	OUTPUT_IMG_BUSY	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Tool Judgment Area	0004	Tool Judge Value 7	Tool Judge Value 6	Tool Judge Value 5	Tool Judge Value 4	Tool Judge Value 3	Tool Judge Value 2	Tool Judge Value 1	Tool Judge Value 0
	0005	Tool Judge Value 15	Tool Judge Value 14	Tool Judge Value 13	Tool Judge Value 12	Tool Judge Value 11	Tool Judge Value 10	Tool Judge Value 9	Tool Judge Value 8
	0006	Tool Judge Value 23	Tool Judge Value 22	Tool Judge Value 21	Tool Judge Value 20	Tool Judge Value 19	Tool Judge Value 18	Tool Judge Value 17	Tool Judge Value 16
	0007	Tool Judge Value 31	Tool Judge Value 30	Tool Judge Value 29	Tool Judge Value 28	Tool Judge Value 27	Tool Judge Value 26	Tool Judge Value 25	Tool Judge Value 24
	0008	Tool Judge Value 39	Tool Judge Value 38	Tool Judge Value 37	Tool Judge Value 36	Tool Judge Value 35	Tool Judge Value 34	Tool Judge Value 33	Tool Judge Value 32
	0009	Tool Judge Value 47	Tool Judge Value 46	Tool Judge Value 45	Tool Judge Value 44	Tool Judge Value 43	Tool Judge Value 42	Tool Judge Value 41	Tool Judge Value 40
	0010	Tool Judge Value 55	Tool Judge Value 54	Tool Judge Value 53	Tool Judge Value 52	Tool Judge Value 51	Tool Judge Value 50	Tool Judge Value 49	Tool Judge Value 48
	0011	Tool Judge Value 63	Tool Judge Value 62	Tool Judge Value 61	Tool Judge Value 60	Tool Judge Value 59	Tool Judge Value 58	Tool Judge Value 57	Tool Judge Value 56
Error code area	0012	Error code							
Reserved area	0013								
Measurement count area	0014	Reserved							
	0015								
Command output area	0016								
	0017	Total count							
	0018								
	0019								
	0020								
	0021	Command Result							
	0022								
	0023								
	0024								
	0025	Command Data 1							
	0026								
Result output area	0027								
	0028								
	0029	Command Data 2							
	0030								
	0031								
	:								
	0044								
	0045	Command Data 6							
	0046								
	0047								
Result output area	0048								
	0049	Result Data 1							
	0050								
	0051								
	0052								
	0053	Result Data 2							
	0054								
	0055								
	:								

● Name and Operation of Input Signals

Allocated area	Name	Remarks
Bit Area	Cmd Complete	Turns on when command processing is complete.
	Cmd Error	Turns off when command processing is successful and turns on when it fails.
	Cmd Ready	Turns on when command processes can be received.
	Result Ready	Turns on when data transmission is complete.
	Result OR	Used to output the OR result for the judged value of tools specified in the output settings.
	READY	Output when trigger input is acceptable.
	TRG_ack	Becomes ON when Trigger input is accepted. Becomes OFF when Trigger input is set to OFF.
	BUSY	This signal is output during image processing or command processing.
	EXPOSURE_BUSY	This signal is output during the capturing of a height image. The workpiece must be kept stationary while this signal is on.
	ERROR	This signal is output while any of system errors occur with the dialog displayed on the screen. For details on typical system errors, see □ "Error Messages" (Page 9-101). Also, in the Global Settings of □ "ERROR Output Settings" (Page 8-14), enabling or disabling the error output for the SD card-related errors, etc. can be specified.
	RUN	This signal is output when the controller is in Run mode.
	OUTPUT_IMG_BUSY	Output while images are being output.
	OUTPUT_IMG_STATUS	Output when there are remaining images that need to be output in an image output buffer.
Tool Judgment Area	Tool Judge Value0	Returns the judgment value allocated to the bit allocation region (Address 0004:bit0).
	Tool Judge Value1	Returns the judgment value allocated to the bit allocation region (Address 0004:bit1).
	...	
	Tool Judge Value63	Returns the judgment value allocated to the bit allocation region (Address 0011:bit7).
Error code area	Error Code	Error code corresponding to the error cause.
Measurement count area	Total Count	Indicates the number of measurement.
Command output area	Command Result	Indicates the command execution results.
	Command Data 1	Returns the command execution result data 1.
	Command Data 2	Returns the command execution result data 2.

	Command Data6	Returns the command execution result data 6.
Result output area	Result Data 1	Returns the measurement result data 1.
	Result Data 2	Returns the measurement result data 2.

Examples of controller receive-data settings

Setting status	Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
Bit Area	0000	Reserved	Reserved	Reserved	Error reset request	Result ack	Reserved	Reserved	Command Request
	0001	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	TRG
	0002	Reserved	Reserved	Reserved	Reserved	Reserved	TEST	EXT	RESET
	0003	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved area	0004	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0005	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0006	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0007	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0008	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0009	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0010	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0011	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Execution condition No.	0012	ExecCondNo							
Reserved area	0013								
Command input area	0014	Reserved							
	0015								
	0016								
	0017	Command Number							
	0018								
	0019								
	0020								
	0021	Cmd Parameter1							
	0022								
	0023								
	0024								
	0025	Cmd Parameter2							
	0026								
	0027								
	0028								
	0029	Cmd Parameter3							
	0030								
	0031								
...									

 ExecCondNo is only loaded when there are changes, so can also be used when changing execution conditions via commands.

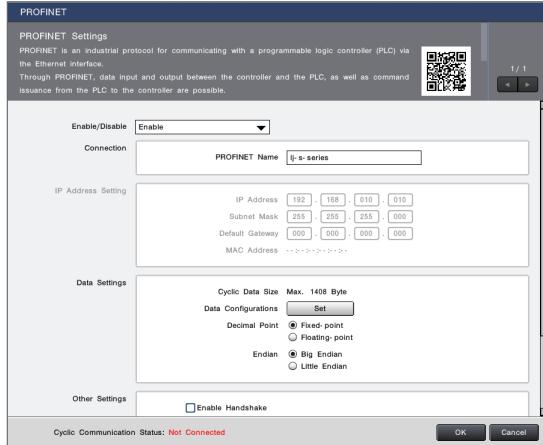
● Name and Operation of Output Signals

Allocated area	Name	Remarks
Bit Area	Command Request	Requests command execution when the signal switches from OFF to ON.
	Result ack	Provides notification of data acquisition when the signal switches from OFF to ON.
	Error reset request	Clears Error when the signal switches from OFF to ON.
	TRG	Allows the head to capture images (leading edge synchronization). The input is accepted when READY is ON.
	RESET	Used to perform reset operation. <ul style="list-style-type: none"> The Result OR output will become 0. The measurement count returns to 0. All of archived image data are deleted. All of the data in the output buffer are reset. A new measurement result output destination file is created. A new image output destination folder is created. The trigger waiting state of individual triggers is canceled.
	EXT	Used to suspend the occurrence of internal triggers and the acceptance of external triggers. While this is on, READY is forced to be off to stop the acceptance of all triggers (level synchronization).
	TEST	Used to suspend the status output and other outputs for trial run or any other reasons. <ul style="list-style-type: none"> The result data not output at the time of input are deleted. Resets the Result OR output during input. As soon as the input turns off, result outputs for the processed images will resume.
Execution condition No.	ExecCondNo	Change Execute Condition No.
Command input area	Command number	The command No. is written.
	Cmd Parameter1	The command argument 1 is written.
	Cmd Parameter2	The command argument 2 is written.
	Cmd Parameter3	The command argument 3 is written.

Changing the PROFINET settings

Displaying the PROFINET settings screen

Various settings can be changed on the [PROFINET] screen.



- [Reference]**
- Controller Ethernet settings such as the IP address and subnet mask are changed according to **“Network”** (Page 8-2).
 - If the PROFINET settings were changed, it is necessary to restart the controller in order to apply the settings.

1 Select [Global] - [Communications & I/O] - [PROFINET].

The [PROFINET] screen appears.

2 To enable/disable PROFINET communication, select/clear the [Enable PROFINET] or [Enable PROFINET unit] check box.

3 Specify [PROFINET Name].

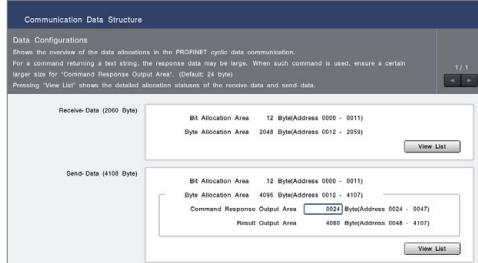
4 Change the settings as required.

● PROFINET Name

Specifies a unique name of this controller so that the connecting PLC can identify the controller in PROFINET network. Unless a proper name is specified, the PLC cannot find the controller and cannot ensure PROFINET communication. A name to be specified here must be identical to that given to this controller when the PLC configures its PROFINET specifications.

● Data Configurations

Click [Set] to display an overview of data allocations in the PROFINET cyclic data communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for [Command Response Output Area] (Default: 24 byte). Clicking [View List] shows the detailed allocation statuses of the receive-data and send-data.



○ Receive-data

Displays an overview of the allocations for data received by the controller from the PLC.

○ Send-data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

● Decimal Point

Select the data notation of result data output and decimal-related commands.

○ Fixed-point (initial configuration value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

○ Floating-point

The data is handled as 32-bit single-precision floating decimal point data.

[Reference] For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

● Communication expansion unit network settings

! Point

- If incorrect settings are used, the controller and other network equipment may not work properly. Consult your system administrator or network administrator about setting values.

- For communication through the controller's Ethernet port, set the IP address, subnet mask, and default gateway on the [Network Setting] screen. For details, see **“Ethernet (Non-Procedural)”** (Page 6-8).

! Reference

When [Disable] or [Enable] is selected for [Enable/Disable], the setting details of the controller's Ethernet port are displayed.

○ IP address

Enter the IP address (Default value: 192.168.10.20).

○ Subnet mask

Enter a subnet mask (Default value: 255.255.255.0).

○ Default gateway

Enter a default gateway IP address (Default value: 0.0.0.0).

! Point

The set value is common with the P1 port and P2 port of the communication expansion unit.

● Cyclic Data Size

The maximum data size for the cyclic communication available with the controller is displayed (1408 bytes).

! Point

The actual data size to be sent or received will depend on the setting on the PLC.

● Endian

Endian is a method of arranging multi-byte data in the PLC data memory. Select a correct endian according to the type of PLC (default: big endian). The endians for typical PLC are as shown below.

- Siemens: Big endian
- Omron: Little endian

● Enable Handshake

After confirming that the PLC has received the measurement result output data, select whether to write the next result data. If enabled, the controller turns on the “Result ready flag” after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on “Result ack flag”. The unit detects this and turns off the Result ready flag. The PLC turns off the “Result ack flag” to request the controller to load the next output data.

● Issue Alarm Manually

Checking [Issue Alarm Manually] box will issue an alarm under PROFINET protocol through an alarm CR function. Click the wheel button of the mouse to actually issue the alarm.

● Create GSDML File

Outputs a GSDML file and icon that include information related to the controller PROFINET functions. The naming convention for each file is as follows.

Controller

- GSDML-V2.43-Keyence-LJ-S_Series-20240322.xml
- GSDML-01FD-0BBE-LJ-S_Series.bmp

Communication expansion unit (CB-NPN20EA)

- GSDML-V2.34-Keyence-LJ-S8K-CB-NPN20E-20200305.xml
- GSDML-01FD-LJ-S8K-CB-NPN20E.bmp



- The file output path is SD2:LJ-S/GSDML on the controller and SD2:/LJ-S3d/GSDML_EX on the communication expansion unit.
- Because the GSDML file does not contain the information that was set or changed in the controller global settings, the created GSDML file will always contain the same information.

5 Select [OK].



PLC-Link, EtherNet/IP, and EtherCAT cannot be used in conjunction with PROFINET.

Output of measurement data using PROFINET cyclic communications (Data Output)

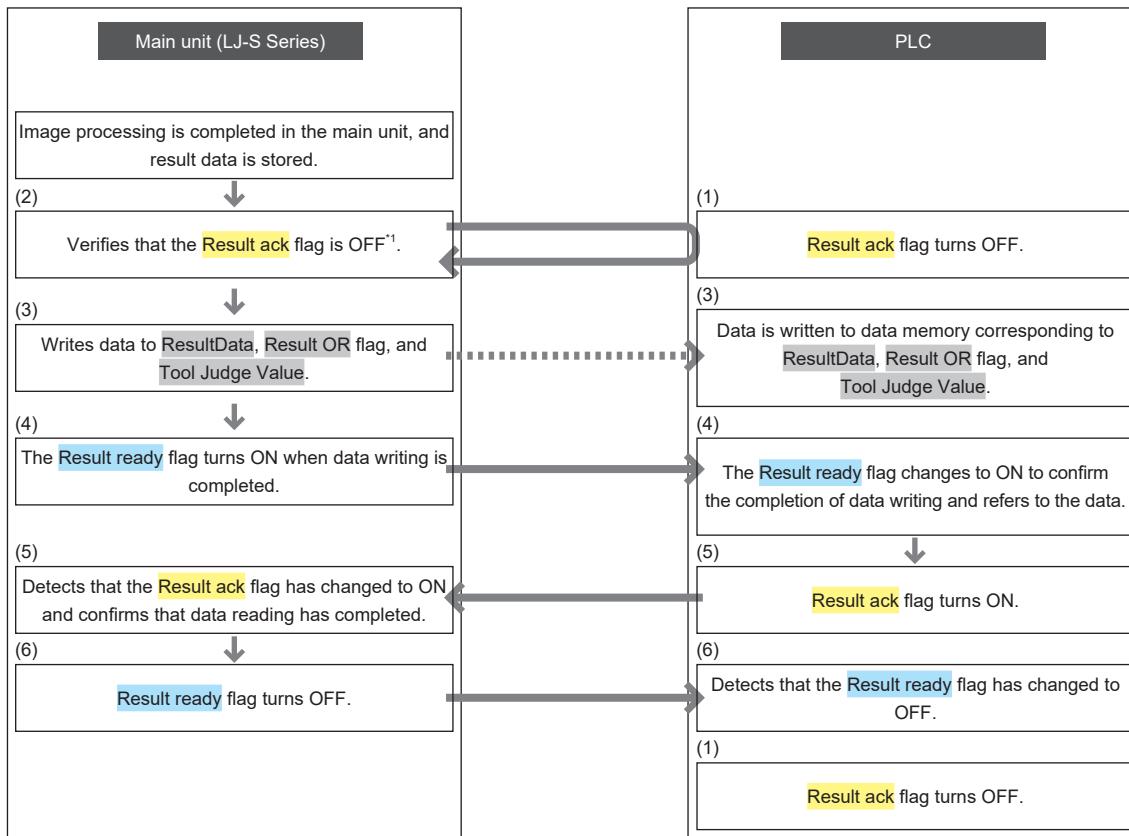
Change the output settings for data output using PROFINET.

Data output flow (example of connection with PLC PROFINET unit)

Set the data and address for output in the output settings.
The controller outputs data via PROFINET in the following manner.

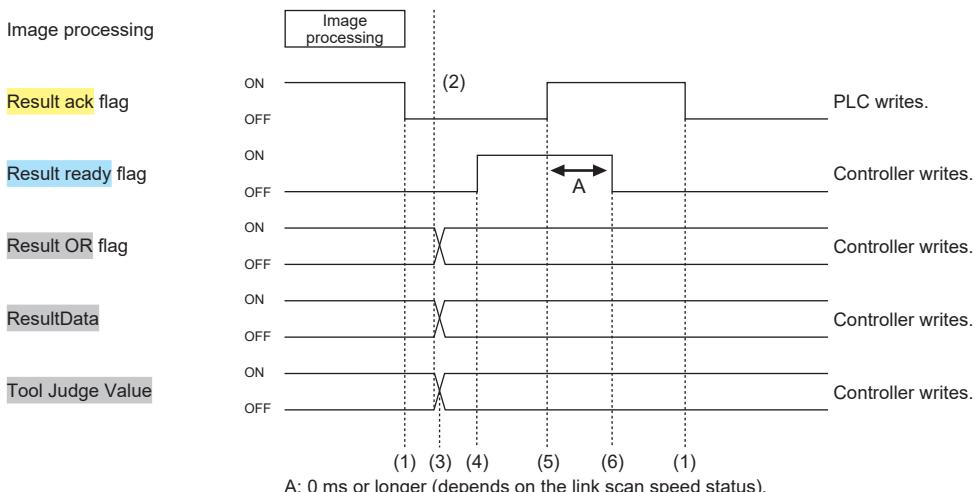


- Data output via PROFINET is performed only in run mode. Data is not output in setup mode.
- With PROFINET, images and other binary data cannot be output.
- If data output via PROFINET was not executed, no data is output. In this case, the "Result ready flag" does not change.



When handshake is OFF, output data is overwritten and updated without checking whether the Result ack flag is OFF. To take the rise of Result ready flag as a data reference synchronization signal, turn the Result ack flag ON at each output, which will turn the Result ready flag OFF.

Timing Chart



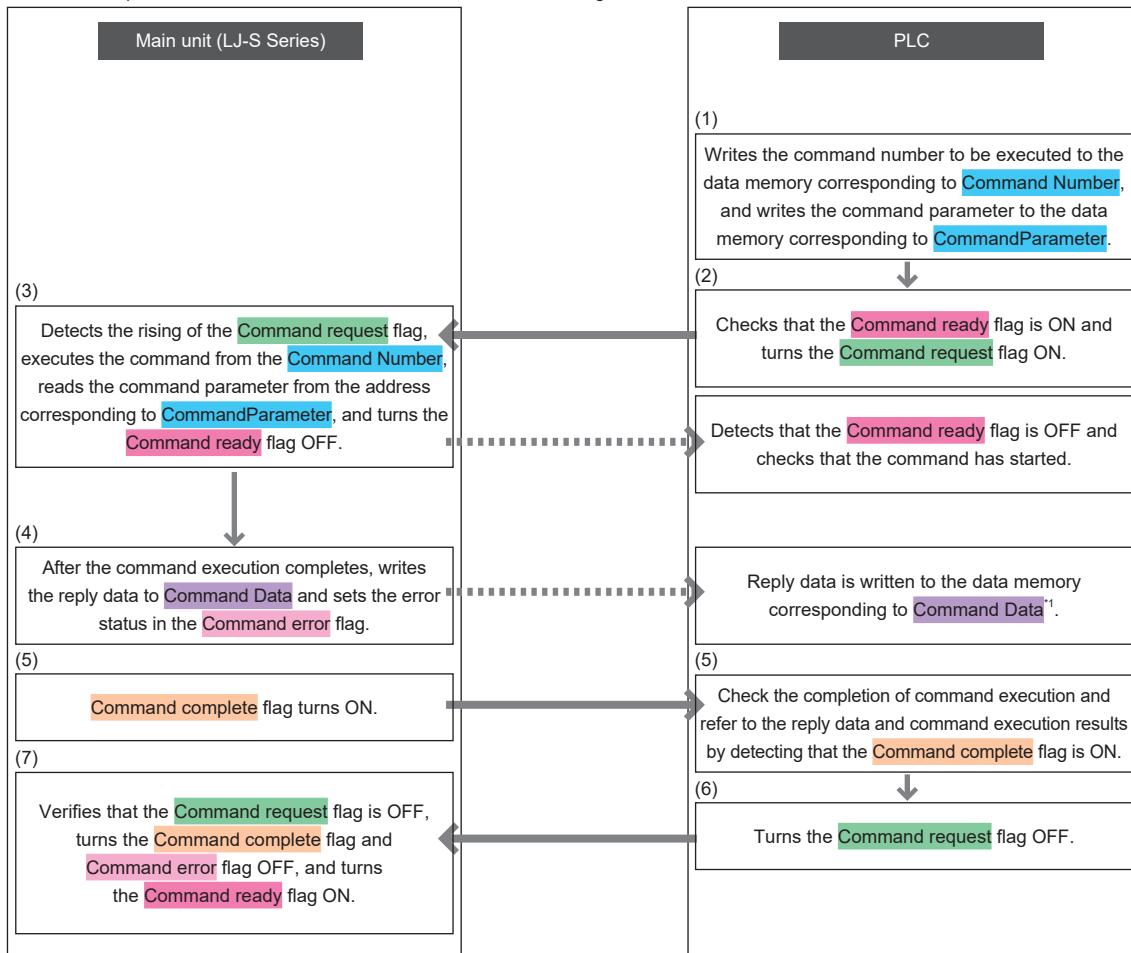
- The "Result OR flag" is updated in coordination with results output with PROFINET as the output destination. When the "Result OR flag" is used, it is necessary to configure the output setting so that 1 or more data item is output via PROFINET.

Controlling the controller with PROFINET cyclic communication (Command Control)

The communication control commands can be executed at any time.

Flow of command process using PROFINET (Example of connection with PLC PROFINET unit)

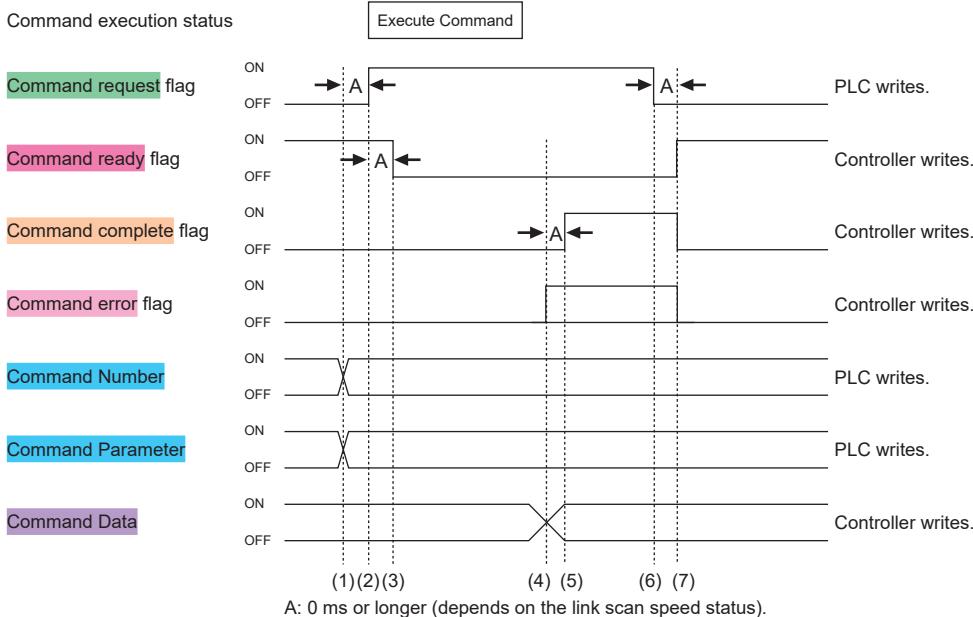
The controller performs command control via PROFINET in the following manner.



In the case of a command for which there is no response data, data is not output in response to the Command Data.

Reference When an error occurs, the command execution results are written to Command Result (0: Success, <Error code>: Failure). The error codes conform to □ "When an error occurs on command acceptance" (Page 9-2).

Timing Chart

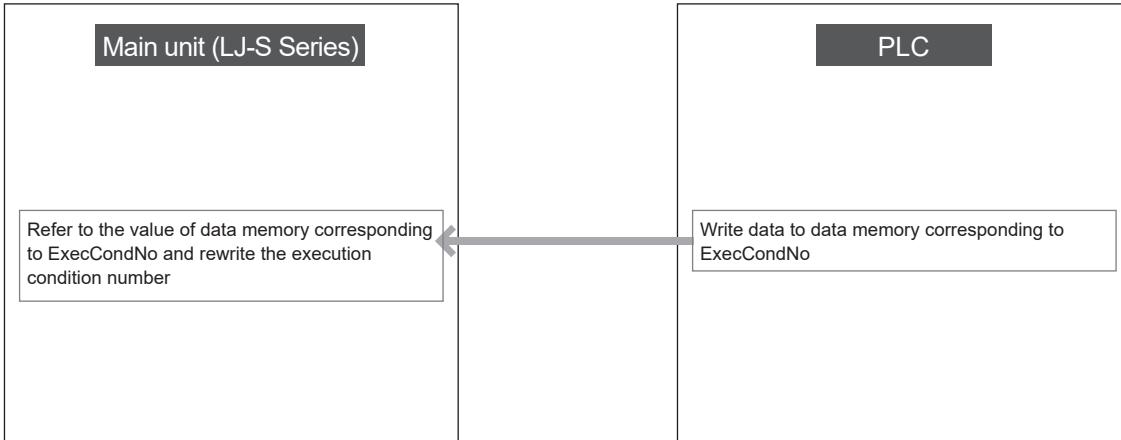


Changing the execute condition No. using PROFINET cyclic communication (Execute Condition No. Change)

The execute condition No. can be changed at any time.

Flow of execute condition No. change using PROFINET (Example of connection with PLC PROFINET unit)

The controller changes the execute condition No. value using PROFINET in the following manner.
The changed value is applied at the next measurement.



Troubleshooting

Problems and Countermeasures

● Checking whether or not the PROFINET connection is correct

Select the controller [Global] - [Communications & I/O] - [PROFINET], then check [Cyclic Communication Status:] at the bottom of the [PROFINET] screen. When [Not Connected] is shown here, the communication has failed. Check the cable connection, IP address, communication settings on the PLC side, and other items again.

● The Result OR flag is not output.

The "Result OR flag" is updated in coordination with results output with PROFINET as the output destination. When the "Result OR flag" is used, it is necessary that at least 1 data item is output via EtherCAT.

● The Result ready flag remains ON and does not change.

The Result ack flag may not be controlled properly. The "Result ready flag" turns OFF when the "Result ack flag" rise is recognized in sending (controller receiving). This is true whether the handshake is ON or OFF.

● I tried to read data when the STO output from the terminal block changes to rise, but could not obtain the data properly.

STO is the data strobe signal for terminal output. Therefore, it cannot be used as the strobe signal for any other data output. Refer to the "Result ready flag" for the timing as to when to read data by PROFINET.

● The Ethernet settings (IP address, etc.) were unintentionally changed.

With PROFINET, the IP address that is set for the controller on the PLC side is applied by overwriting the Ethernet settings (IP address, etc.) on the controller side when communication starts. Set the controller Ethernet settings on the PLC side.

● A different operation from the module address allocated to the PLC occurs.

If a bit module is deleted, an operation that is different from the address set at the PLC side may occur. Do not delete the bit modules.

Error Messages

Message	Cause	Corrective Action	Error factor No.
PROFINET communication failed.	Communication was interrupted. (When recovery is possible, recovery occurs automatically.)	<ul style="list-style-type: none"> Check that the Ethernet cable is connected correctly. Check whether both the controller and the master side were restarted after the communication settings were updated. Change the cyclic communication cycle and timeout time on the PLC side. With the factory default, ERROR output is not set. Set this on the "ERROR Output Settings" screen (page 8-14). 	13701
PROFINET output failed due to a full buffer.	The buffer for output via PROFINET is full.	Change the update time setting on the PLC side so the data is output via PROFINET at a faster rate than it builds up. Or, extend the time between triggers. Note: Results data are not written when the buffer is full.	13702
The delay of the handshake control causes skipping of the PROFINET communication result output.	When the PROFINET handshake is ON, delayed handshake caused results output via PROFINET to be skipped.	Change the update time setting on the PLC side so the data is output via PROFINET at a faster rate than it is output from the tool. Or, extend the time between triggers. Note: Results data are not written when the buffer is full.	13703
The PROFINET unit cannot be recognized.	The PROFINET unit is not recognized, and the controller cannot use PROFINET communication.	<ul style="list-style-type: none"> Make sure the PROFINET unit is installed correctly. Make sure the PROFINET unit is not damaged. Do not connect/disconnect the PROFINET unit while the controller and unit are powered on. 	13704
Non-supported PROFINET unit.	A PROFINET expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.	13705

Overview of Control/Data Output Using EtherCAT

EtherCAT is the open real-time Ethernet network originally developed by Beckhoff. This system operates as an EtherCAT slave, and the functions shown below can be realized by connecting the optional EtherCAT unit CB-NEC20E.

● Process data object communication (cyclic communication)

Communication at update time intervals allows for high-speed control at intervals of several ms to several tens of ms. In addition, because it is possible to control the controller by referencing and updating variables and devices in the PLC without considering the communication, it allows programs to be written easily on the PLC side.

○ Controlling the controller

Control the controller by using cyclic communication to send the commands for execution.

○ Outputting result data

Data can be output by cyclic communication when items to be output from EtherCAT are set by output setting (page 6-16).

○ Change execute condition number: The controller can be controlled by specifying the execute condition number by cyclic communication.

 Reference

- Set a cyclic communication update time of 500 µs or more.
- Even when a cyclic communication update time of 500 µs or more is set, due to the controller measurement settings, dialog box operations, commands, combined use with FTP, remote desktop, or other communications, the controller may temporarily or continuously be subject to the maximum load, causing delays in processing or temporary interruption of communications due to timeout. In such cases, it is necessary to review the cyclic communication settings. Be sure to verify that there are no problems with operating performance, including the issues above, prior to operation.
- In a network where many devices are connected, including EtherCAT devices, if a large load is constantly or temporarily applied to the network, delays and packet loss may occur. Perform sufficient verification prior to operation.
- PLC-Link, EtherNet/IP, and PROFINET cannot be used in conjunction with EtherCAT.

● Mailbox communication (non-cyclic communication)

This method can be used for communication which does not require regularity like the cyclic communication. This communication method uses dedicated commands to read/write data records and can access addresses exceeding the maximum size allowed to cyclic communication (536 bytes for input and 532 bytes for output).

Operation Flow

□ "EtherCAT Communication Specifications" (Page 9-104)

- Check whether the PLC to be connected is a model that supports EtherCAT connection.
- Check the input/output data assignments.

□ "Changing the EtherCAT Settings" (Page 9-109)

- Configure the settings to use EtherCAT to connect the controller.
Major setting items: input/output data assignments

Establish the EtherCAT communication

- You can confirm whether EtherCAT communication has been established or not by checking [Cyclic Communication Status:] on the [EtherCAT Monitor & Diagnostics] screen or [Cyclic Communication Status:] on the [EtherCAT Unit] screen in the global settings.

Executing necessary processing

□ "Output of measurement data using EtherCAT cyclic communications (Data Output)" (Page 9-110)

- The data specified in the output settings is written to the results output area.
- The "Result ready flag" is used to check the completion of data writing.
- The "Result ack flag" is turned ON to report that reading was completed.

□ "Controlling the controller with EtherCAT cyclic communication (Command Control)" (Page 9-111)

- Communication control commands can be executed.
- Enter the command code and command parameters in the command input area and turn the "Command request flag" ON to execute the command.
- When the "Command ready flag" is ON, the command can be executed.
- The "Command complete flag" is used to check that command execution was completed.

□ "Changing the execute condition No. using EtherCAT cyclic communication (Execute Condition No. Change)" (Page 9-112)

- Change the Exec Cond No. to change the execute condition No.

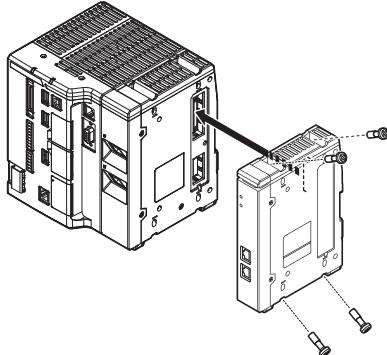
Prepare EtherCAT Connection

Installing the EtherCAT Unit

The optional EtherCAT unit CB-NEC20E is used when communicating over EtherCAT.

Remove the protective cover from the expansion unit connector on the right side of the controller and install the EtherCAT unit as shown below.

- Point**
- The controller must be turned off before connecting or disconnecting the CB-NEC20E.
 - Restart the controller and master station after changing the EtherCAT settings.



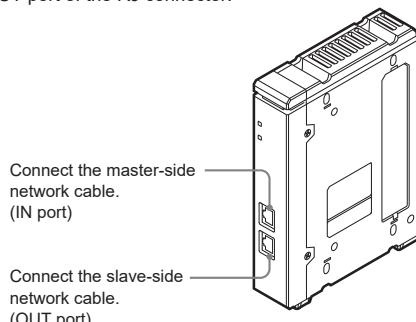
CB-NEC20E EtherCAT Unit Specifications

Standard specifications

Item	
Compliant standard	IEEE802.3u (100BASE-TX)
Communication speed	100 Mbps (100BASE-TX)
Communication cycle	Minimum of 500μs
Connection cable	Category 5e or greater shielded twisted pair (STP) cable
Node interval	100m
Communication port	RJ45 connector × 2
Communication size	536 bytes (input), 532 bytes (output)
Supported functions	Process data object communication (cyclic communication) Mailbox communication (non-cyclic communication) Supports CoE Explicit Device Identification
Conformance test version	Complying with V2.5.0

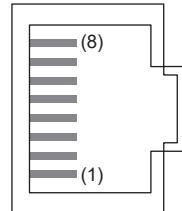
Connecting to an EtherCAT Network

Connect the master-side network cable to the IN port of the RJ connector. If a slave unit is present downstream of this unit, connect a network cable to the OUT port of the RJ connector.



- Point**
- Use a category 5e or greater STP (shielded twisted pair) cable for the network cable. You can use either a straight cable or a crossover cable.

Wiring example (IN port/OUT port)



No	Signal name	Function
1	TX+	Transmit data (+)
2	TX-	Transmit data (-)
3	RX+	Receive data (+)
4	-	Connect 75 Ω terminating resistance
5	-	Connect 75 Ω terminating resistance
6	RX-	Receive data (-)
7	-	Connect 75 Ω terminating resistance
8	-	Connect 75 Ω terminating resistance

EtherCAT Communication Specifications

Standard controller specifications

This system supports two types of EtherCAT communication: "process data object communication (cyclic communication)" and "mailbox communication (non-cyclic communication)."

Process data object communication (cyclic communication)

This is a function that performs periodic communication at specified update time intervals and is suitable for real-time control.

- The update time and communication size depend on the connection settings on the PLC (the maximum size for cyclic communication is 536 bytes for input and 532 bytes for output).

Mailbox communication (non-cyclic communication)

This is a communication method in which dedicated commands are used to access "objects" in which byte information is divided into units of 1000 bytes.

- Commands such as reading (SDO Upload) and writing (SDO Download) are available. When these commands are executed, a response to the command is returned.
- This method can be used for communication which does not require real time processing.
- It is possible to access to the addresses exceeding the maximum size allowed to the cyclic communication (input: 536 bytes, output: 532 bytes).
- Each record is assigned with an index. Data is accessed based on the specified index and size.

The accessible ranges for each byte information are as follows:

Output data (received by the controller) - Read/write

Index	Accessible address
201AH	0020 to 1019
201BH	1020 to 2019
201CH	2020 to 2055

Input data (sent from the controller) - Read only

Index	Accessible address
200BH	0024 to 1023
200CH	1024 to 2023
200DH	2024 to 3023
200EH	3024 to 4023
200FH	4024 to 4103



If the SDO Download command is issued while the Parameter module is being written in the cyclic communication, memory area conflict may occur. Design the use of the SDO Download command in such a way as to avoid the memory area conflict with the cyclic communication.

EtherCAT Connection Supporting Models

For PLC setup methods, refer to the instruction manual included with each PLC.

Beckhoff PLC

PLC model	EtherCAT Communication unit	Version of firmware	Software used	Version of software used
C6920-0050 (TwinCAT)	- (Built in the unit)	Windows7 Ultimate Service Pack1	TwinCAT3	v3.1.4020 (Build4020)

OMRON PLC

PLC model	EtherCAT Communication unit	Version of firmware	Software used	Version of software used
NJ101-9000	- (Built in the unit)	1.1.521	Sysmac Studio	Ver.1.15
NJ301-1100	- (Built in the unit)	1.1.521	Sysmac Studio	Ver.1.15

Process Data Object Map

The data that can be assigned as process data objects are shown below.
Use the configuration software to select the indexes to assign as process data objects.

Index (Hex)	Initial Assignment	Size (Bytes)	Name	Assignable Data Index (Hex)	
1600H	o	5	ControlBit	2011: 01 to 28	This is without exception assigned as PDO.
1601H	o	7	ReservedBit	2012: 01 to 38	This is without exception assigned as PDO.
1602H	o	2	ExecCondNo	2013	This is without exception assigned as PDO.
1603H	o	4	Command Number	2014	This is without exception assigned as PDO.
1604H		32	Parameter 32Byte	2015: 01 to 08	Objects from 1604H to 1608H cannot be assigned at the same time. Select and assign one object at a time.
1605H		64	Parameter 64Byte	2016: 01 to 10	
1606H	o	128	Parameter 128Byte	2017: 01 to 20	
1607H		256	Parameter 256Byte	2018: 01 to 40	
1608H		512	Parameter 512Byte	2019: 01 to 80	
x1A00H	o	4	StatusBit	2001: 01 to 20	This is without exception assigned as PDO.
x1A01H	o	8	Tool Judge Value	2002: 01 to 40	This is without exception assigned as PDO.
x1A02H	o	2	Error Code	2003	This is without exception assigned as PDO.
x1A03H	o	4	Total count	2004	This is without exception assigned as PDO.
x1A04H	o	4	Command Result	2005	This is without exception assigned as PDO.
x1A05H		32	Result Data 32Byte	2006: 01 to 08	Objects from 1A05H to 1A09H cannot be assigned at the same time. Select and assign one object at a time.
x1A06H		64	Result Data 64Byte	2007: 01 to 10	
x1A07H	o	128	Result Data 128Byte	2008: 01 to 20	
x1A08H		256	Result Data 256Byte	2009: 01 to 40	
x1A09H		512	Result Data 512Byte	200A: 01 to 80	

Cyclic communication data allocation state

Examples of controller send-data settings

Examples with the command response output area set to 24 bytes

Setting status	Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
Bit Area	0000	Reserved	Reserved	Reserved	Result OR	Result Ready	Cmd Ready	Cmd Error	Cmd Complete
	0001	Reserved	RUN	Reserved	ERROR	BUSY	EXPOSURE_BUSY	TRG_ack	READY
	0002	Reserved							
	0003	OUTPUT_IMG_STATUS	OUTPUT_IMG_BUSY	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Tool Judgment Area	0004	Tool Judge Value 7	Tool Judge Value 6	Tool Judge Value 5	Tool Judge Value 4	Tool Judge Value 3	Tool Judge Value 2	Tool Judge Value 1	Tool Judge Value 0
	0005	Tool Judge Value 15	Tool Judge Value 14	Tool Judge Value 13	Tool Judge Value 12	Tool Judge Value 11	Tool Judge Value 10	Tool Judge Value 9	Tool Judge Value 8
	0006	Tool Judge Value 23	Tool Judge Value 22	Tool Judge Value 21	Tool Judge Value 20	Tool Judge Value 19	Tool Judge Value 18	Tool Judge Value 17	Tool Judge Value 16
	0007	Tool Judge Value 31	Tool Judge Value 30	Tool Judge Value 29	Tool Judge Value 28	Tool Judge Value 27	Tool Judge Value 26	Tool Judge Value 25	Tool Judge Value 24
	0008	Tool Judge Value 39	Tool Judge Value 38	Tool Judge Value 37	Tool Judge Value 36	Tool Judge Value 35	Tool Judge Value 34	Tool Judge Value 33	Tool Judge Value 32
	0009	Tool Judge Value 47	Tool Judge Value 46	Tool Judge Value 45	Tool Judge Value 44	Tool Judge Value 43	Tool Judge Value 42	Tool Judge Value 41	Tool Judge Value 40
	0010	Tool Judge Value 55	Tool Judge Value 54	Tool Judge Value 53	Tool Judge Value 52	Tool Judge Value 51	Tool Judge Value 50	Tool Judge Value 49	Tool Judge Value 48
	0011	Tool Judge Value 63	Tool Judge Value 62	Tool Judge Value 61	Tool Judge Value 60	Tool Judge Value 59	Tool Judge Value 58	Tool Judge Value 57	Tool Judge Value 56
Error code area	0012	Error code							
Reserved area	0013								
Measurement count area	0014	Reserved							
	0015								
Command output area	0016								
	0017	Total count							
	0018								
	0019								
	0020								
	0021	Command Result							
	0022								
	0023								
	0024								
	0025	Command Data 1							
	0026								
Result output area	0027								
	0028								
	0029	Command Data 2							
	0030								
	0031								
	...								
	0044								
	0045	Command Data 6							
	0046								
	0047								
Result output area	0048								
	0049	Result Data 1							
	0050								
	0051								
	0052								
	0053	Result Data 2							
	0054								
	0055								
	...								

● Name and Operation of Input Signals

Allocated area	Name	Remarks
Bit Area	Cmd Complete	Turns on when command processing is complete.
	Cmd Error	Turns off when command processing is successful and turns on when it fails.
	Cmd Ready	Turns on when command processes can be received.
	Result Ready	Turns on when data transmission is complete.
	Result OR	Used to output the OR result for the judged value of tools specified in the output settings.
	READY	Output when trigger input is acceptable.
	TRG_ack	Becomes ON when Trigger input is accepted. Becomes OFF when Trigger input is set to OFF.
	BUSY	This signal is output during image processing or command processing.
	EXPOSURE_BUSY	This signal is output during the capturing of a height image. The workpiece must be kept stationary while this signal is on.
	ERROR	This signal is output while any of system errors occur with the dialog displayed on the screen. For details on typical system errors, see "Troubleshooting" (Page 9-113). Also, in the Global Settings of "ERROR Output Settings" (Page 8-14), enabling or disabling the error output for the SD card-related errors, etc. can be specified.
	RUN	This signal is output when the controller is in Run mode.
	OUTPUT_IMG_BUSY	Output while images are being output.
	OUTPUT_IMG_STATUS	Output when there are remaining images that need to be output in an image output buffer.
	Tool Judge Value0	Returns the judgment value allocated to the bit allocation region (Address 0004:bit0).
Tool Judgment Area	Tool Judge Value1	Returns the judgment value allocated to the bit allocation region (Address 0004:bit1).
	...	
	Tool Judge Value63	Returns the judgment value allocated to the bit allocation region (Address 0011:bit7).
Error code area	Error Code	Error code corresponding to the error cause.
Measurement count area	Total Count	Indicates the number of measurement.
Command output area	Command Result	Indicates the command execution results.
	Command Data 1	Returns the command execution result data 1.
	Command Data 2	Returns the command execution result data 2.

	Command Data6	Returns the command execution result data 6.
Result output area	Result Data 1	Returns the measurement result data 1.
	Result Data 2	Returns the measurement result data 2.

Examples of controller receive-data settings

Setting status	Address (Byte)	7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
Bit Area	0000	Reserved	Reserved	Reserved	Error reset request	Result ack	Reserved	Reserved	Command Request
	0001	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	TRG
	0002	Reserved	Reserved	Reserved	Reserved	Reserved	TEST	EXT	RESET
	0003	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Reserved area	0004	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0005	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0006	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0007	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0008	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0009	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0010	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	0011	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Execution condition No.	0012	ExecCondNo							
Reserved area	0013								
	0014								
	0015								
Command input area	0016								
	0017	Command Number							
	0018								
	0019								
	0020								
	0021	Cmd Parameter1							
	0022								
	0023								
	0024								
	0025	Cmd Parameter2							
	0026								
	0027								
	0028								
	0029	Cmd Parameter3							
	0030								
	0031								
...									

 ExecCondNo is only loaded when there are changes, so can also be used when changing execution conditions via commands.

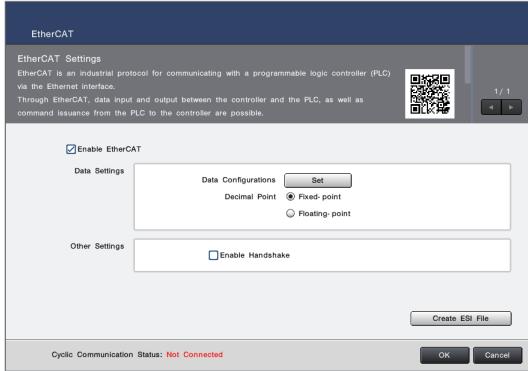
● Name and Operation of Output Signals

Allocated area	Name	Remarks
Bit Area	Command Request	Requests command execution when the signal switches from OFF to ON.
	Result ack	Provides notification of data acquisition when the signal switches from OFF to ON.
	Error reset request	Clears Error when the signal switches from OFF to ON.
	TRG	Allows the head to capture images (leading edge synchronization). The input is accepted when READY is ON.
	RESET	Used to perform reset operation. <ul style="list-style-type: none"> The Result OR output will become 0. The measurement count returns to 0. All of archived image data are deleted. All of the data in the output buffer are reset. A new measurement result output destination file is created. A new image output destination folder is created. The trigger waiting state of individual triggers is canceled.
	EXT	Used to suspend the occurrence of internal triggers and the acceptance of external triggers. While this is on, READY is forced to be off to stop the acceptance of all triggers (level synchronization).
	TEST	Used to suspend the status output and other outputs for trial run or any other reasons. <ul style="list-style-type: none"> The result data not output at the time of input are deleted. Resets the Result OR output during input. As soon as the input turns off, result outputs for the processed images will resume.
Execution condition No.	ExecCondNo	Change Execute Condition No.
Command input area	Command number	The command No. is written.
	Cmd Parameter1	The command argument 1 is written.
	Cmd Parameter2	The command argument 2 is written.
	Cmd Parameter3	The command argument 3 is written.

Changing the EtherCAT Settings

Opening the EtherCAT Setting Screen

On the [Global] - [Communications & I/O] - [EtherCAT Unit] screen, various settings can be changed for input and output of various data by EtherCAT using the EtherCAT unit (CB-NEC20E: option) connected to the controller.



Reference PLC-Link, EtherNet/IP, and PROFINET cannot be used in conjunction with EtherCAT.

1 Select [Global] - [Communications & I/O] - [EtherCAT Unit].

The [EtherCAT] screen appears.

2 Click [Enable EtherCAT] to check the box.

3 Change the settings as required.

For details of the settings for each item, see **Reference** "EtherCAT setting items that can be set with this system" (Page 9-109).

4 Select [OK].

EtherCAT setting items that can be set with this system

■ Enable EtherCAT

Select whether to use EtherCAT. Select this box to enable it.

■ Communication data settings

● Data Configurations

Click [Set] to display an overview of data allocations in the EtherCAT cyclic data communication. For a command returning a text string, the response data may be large. When such command is used, ensure a certain larger size for [Command Response Output Area] (Default: 24 byte). Clicking [View List] shows the detailed allocation statuses of the receive-data and send-data.



○ Receive-Data

Displays an overview of the allocations for data received by the controller from the PLC.

○ Send-Data

Displays an overview of the allocations for data sent from the controller to the PLC. The range for the command response output area in the byte allocation area can be specified.

■ Decimal Point

Select the data notation of result data output and data that handles decimal points with command control.

○ Fixed-point (initial value)

The original data is multiplied by 1000, and handled as a signed 32-bit integer data.

○ Floating-point

The data is handled as 32-bit single-precision floating decimal point data.

Reference For commands that handle integers, command parameters are always rounded to 1 decimal place when they are read, regardless of the setting, and command data output is written using integers.

■ Other Settings

● Enable Handshake

After confirming that the PLC has received the measurement result output data, select whether to write the next result data. If enabled, the controller turns on the "Result ready flag" after the completion of a measurement result output. Upon reception of the ready flag, the PLC reads the output data and turns on "Result ack flag". The unit detects this and turns off the Result ready flag. The PLC turns off the "Result ack flag" to request the controller to load the next output data.

■ Create ESI File

Outputs an ESI file that includes information related to the controller's EtherCAT function. The naming rules for the file are as follows.

- File output path: SD2:/LJ-S/ESI
- ESI file name: Keyence_LJ-S_CB-NEC_Series.xml

Reference Because the ESI file does not contain the information that was set or changed in the controller global settings, the created ESI file will always contain the same information.

Output of measurement data using EtherCAT cyclic communications (Data Output)

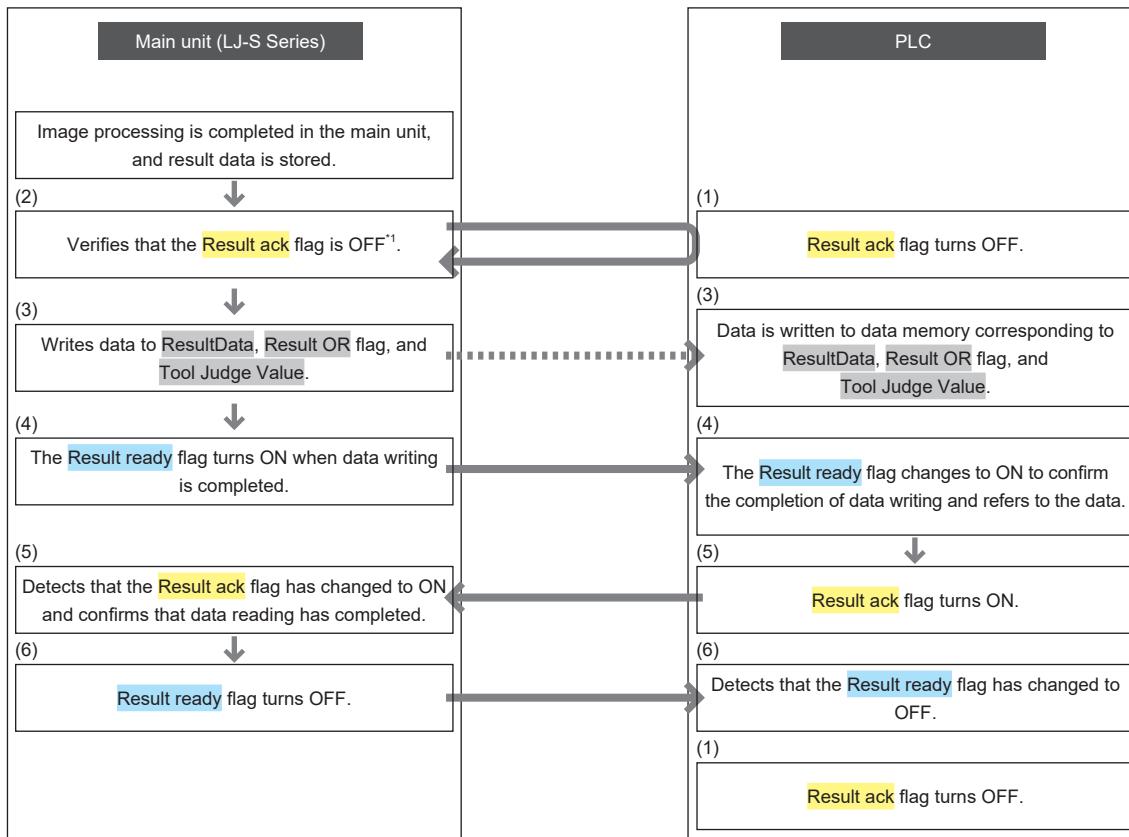
Change the output settings for data output using EtherCAT.

 EtherCAT cannot be used when the PLC-Link, EtherNet/IP, or PROFINET is enabled.

Data output flow (example of connection with PLC EtherCAT unit)

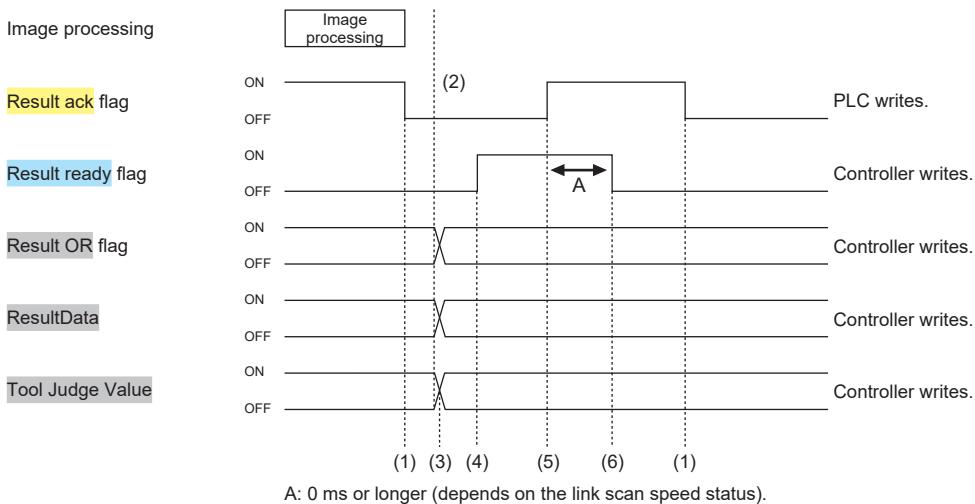
Set the data and address for output in the output settings.
The controller outputs data via EtherCAT in the following manner.

-  • Data output via EtherCAT is performed only in run mode. Data is not output in setup mode.
• With EtherCAT, images and other binary data cannot be output.
• If data output via EtherCAT was not executed, no data is output. In this case, the "Result ready flag" does not change.



- When handshake is OFF, output data is overwritten and updated without checking whether the Result ack flag is OFF. To take the rise of Result ready flag as a data reference synchronization signal, turn the Result ack flag ON at each output, which will turn the Result ready flag OFF.

Timing Chart



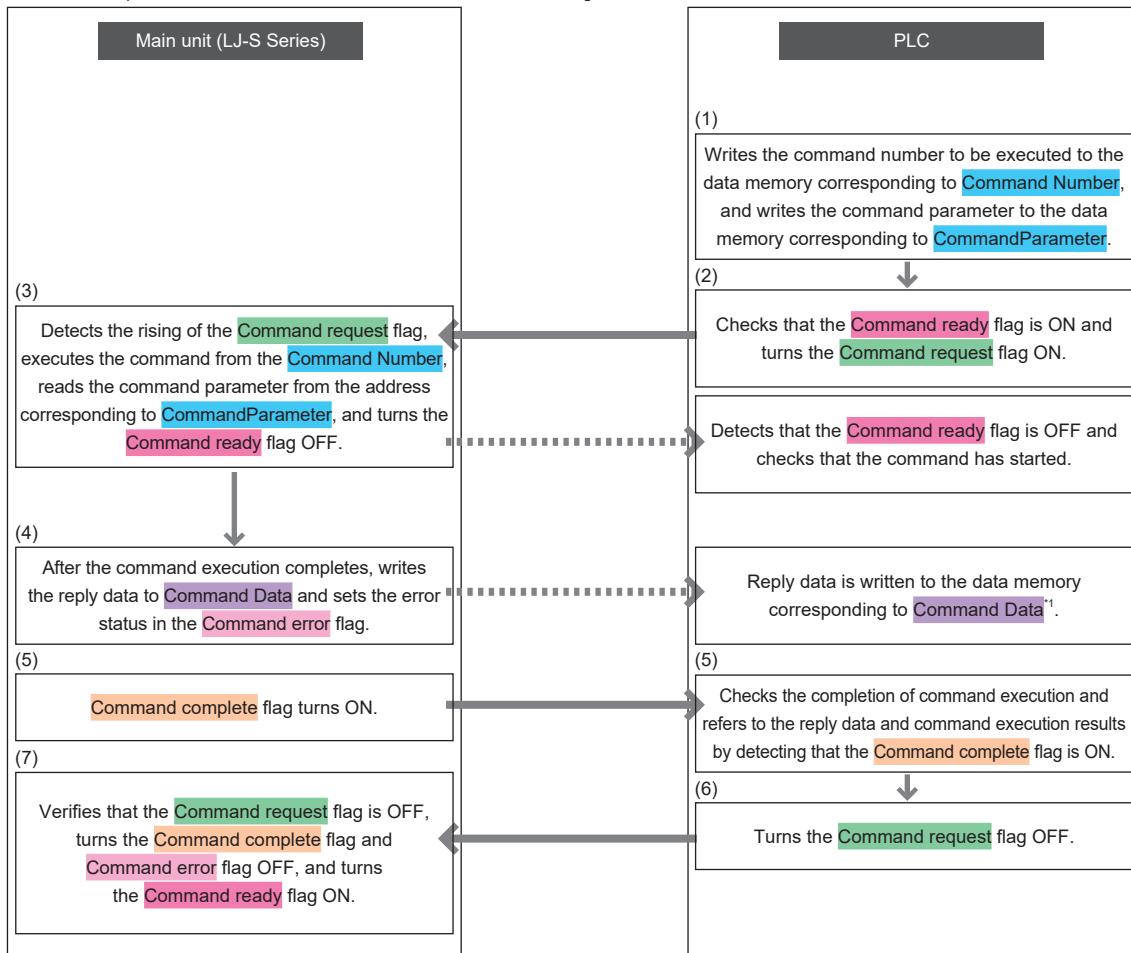
-  The "Result OR flag" is updated in coordination with results output with EtherCAT as the output destination. When the "Result OR flag" is used, it is necessary to configure the output setting so that 1 or more data item is output via EtherNet/IP.

Controlling the controller with EtherCAT cyclic communication (Command Control)

The communication control commands can be executed at any time.

Flow of command process using EtherCAT (Example of connection with PLC EtherCAT unit)

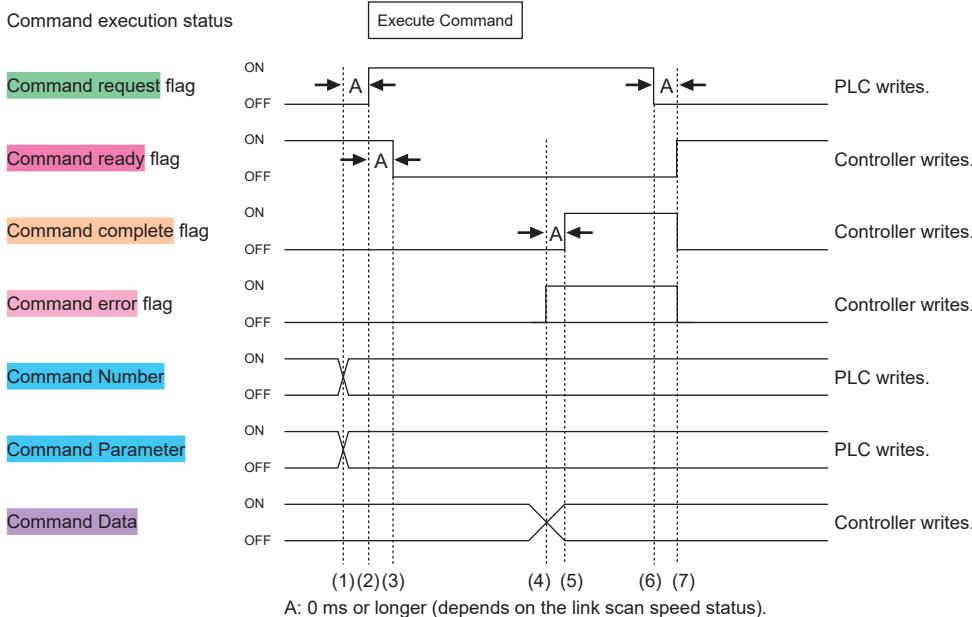
The controller performs command control via EtherCAT in the following manner.



- In the case of a command for which there is no response data, data is not output in response to the Command Data.

Reference When an error occurs, the command execution results are written to **Command Result** (0: Success, <Error code>: Failure). The error codes conform to □ "When an error occurs on command acceptance" (Page 9-2).

Timing Chart



Changing the execute condition No. using EtherCAT cyclic communication (Execute Condition No. Change)

The execute condition No. can be changed at any time.

Flow of execute condition No. change using EtherCAT (Example of connection with PLC EtherCAT unit)

The controller changes the execute condition No. value using EtherCAT in the following manner.
The changed value is applied at the next measurement.



Troubleshooting

Problems and Countermeasures

● I want to check whether the EtherCAT connection has been established successfully.

On the controller, check [Utilities] - [EtherCAT Memory Monitor]. When [Not Connected] is shown here, the communication has failed. Check the cable connection, IP address, communication settings on the PLC side, and other items again.

● The Result OR flag is not output.

The "Result OR flag" is updated in coordination with results output with EtherCAT as the output destination. When the "Result OR flag" is used, it is necessary that at least 1 data item is output via EtherCAT.

● The Result ready flag remains ON and does not change.

The Result ack flag may not be controlled properly. The "Result ready flag" turns OFF when the "Result ack flag" rise is recognized in sending (controller receiving). This is true whether the handshake is ON or OFF.

● I tried to read data when the STO output from the terminal block changes to rise, but could not obtain the data properly.

STO is the data strobe signal for terminal output. Therefore, it cannot be used as the strobe signal for any other data output.
For the data read timing through EtherCAT, reference the Result ready flag.

Error Messages

Message	Cause	Corrective Action	Error factor No.
EtherCAT communication failed.	Cyclic communication was interrupted. (When recovery is possible, recovery occurs automatically.)	<ul style="list-style-type: none"> Check that the Ethernet cable is connected correctly. Check whether both the controller and the master side were restarted after the communication settings were updated. Change the cyclic communication cycle and timeout time on the PLC side. With the factory default, ERROR output is not set. Set this on the [ERROR Output Settings] screen (page 8-14). 	13801
EtherCAT output failed due to a full buffer.	The buffer for output via EtherCAT is full.	Change the update time on the PLC so the data from the tool is output via EtherCAT at a faster rate than it builds up. Or, extend the time between triggers. Note: Result data is not written when the output buffer is full.	13802
The delay of the handshake control causes skipping of the EtherCAT communication result output.	With the EtherCAT handshake ON, a delayed handshake caused results output via EtherCAT to be skipped.	Change the RPI setting so the data from the tool is output via EtherCAT at a faster rate than it builds up. Or, extend the time between triggers. Note: Output does not occur when the output buffer is full.	13803
The EtherCAT unit cannot be recognized.	The EtherCAT unit is not recognized, and the controller cannot use EtherCAT communication.	<ul style="list-style-type: none"> Make sure the EtherCAT unit is installed correctly. Make sure the EtherCAT unit is not damaged. Do not connect/disconnect the EtherCAT unit while the controller and unit are powered on. 	13804
Non-supported EtherCAT unit.	An EtherCAT expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.	13805

Chapter 10 Specifications

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Specifications

Controller specifications

LJ-S8002

Model name		LJ-S8002
Head input		Up to 2 heads of LJ-S8000 Series * When using 2 units, heads A and B are the same model.
Number of devices registered for inspection setting		SD card 1, 2 each up to 1000 (depends on SD card capacity and settings), external switching is possible
Reference image count		Up to 400 per setting (dependent on SD card capacity)
Memory card		<ul style="list-style-type: none"> • SD card slot x2 • Supports OP-87133 (512 MB), CA-SD1G (1 GB), CA-SD4G (4 GB), and CA-SD16G (16 GB) <p>* SD1 slot is equipped with CA-SD4G as standard</p>
Number of tools		Up to 100 pcs / setting
Interface	Control input	20 (5 input terminals, 15 parallel I/Os)
	Control output	28 (6 output terminals, 22 parallel I/Os) Photo MOSFET ¹
	RS-232C	<ul style="list-style-type: none"> • Numerical output and control input/output (exclusive use with PLC-Link using RS-232C) • Supports up to 230400 bps baud rate
	PLC Link	Numeric output and control input/output using Ethernet port or RS-232C port (exclusive use with EtherNet/IP. When using RS-232C port, exclusive use with RS-232C non-procedural communication)
	Ethernet	<ul style="list-style-type: none"> • Value output and control input/output • In addition to the above functions, uploading, downloading, various simulations, transmission / reception of various types of data including image data, and remote desktop are possible by connecting with our PC application software • Supports FTP client & server function, VNC server function (monitor screen display only supported for clients other than PCs), and BOOTP function • 1000BASE-T/100BASE-TX/10BASE-T • Supports jumbo frames
	USB	<ul style="list-style-type: none"> • In addition to numerical output, uploading and downloading of inspection settings, various simulations, transmission / reception of various data including image data, and remote desktop are possible by connection with our PC application software • USB2.0 only
	EtherNet/IP	<ul style="list-style-type: none"> • Numeric input and control input/output using Ethernet port or optional EtherNet/IP unit CB-NEP20E (exclusive use with PLC Link, PROFINET, and EtherCAT) • Compatible with cyclic transmission (up to 1,436 bytes) and message transmission • Up to 32 connections (ETHERNET)/1: Exclusive Owner, 4: Input Only (CB-NEP20E) • Conform to Conformance Test Version.CT19.1 (ETHERNET)/CT19.1 (CB-NEP20E)
	PROFINET	<ul style="list-style-type: none"> • Numeric input/output and control input/output using Ethernet port or optional PROFINET unit CB-NEP20EA (exclusive use with PLC Link, EtherNet/IP, and EtherCAT) • Compatible with cyclic communication (max. 1408 bytes (ETHERNET)/1252 bytes (CB-NPN20EA)) • Compatible with non-cyclic (record data) communication • Conforming to Conformance Class A (ETHERNET)/C (CB-NPN20EA)
	EtherCAT	<ul style="list-style-type: none"> • By connecting the optional EtherCAT unit CB-NEC20E, numeric output and control input/output can be performed (exclusive use with PLC Link, EtherNet/IP, and PROFINET) • Compatible to the cyclic communication (process data object communication) (input: max. 536 byte/output: max.532 byte) • Compatible to the noncyclic communication (mailbox communication) • Supports CoE • Explicit Device Identification • Compliant with the conformance test V2.5.0
	Mouse	Operate various menus with our special mouse (included with the Controller)
	SNTP	Automatic correction of the date and time of this unit is possible by connecting to the SNTP server
	USB HDD	By connecting the HDD (up to 2TB) to the dedicated USB port (USB 3.0 compliant / bus power compatible: rated output 900 mA), various data output including image data is possible
	Monitor output	Analog RGB output XGA 1024 × 768 (24 bit color, 60 Hz)
Cooling fan		Yes
Language		Japanese, English, Simplified Chinese, Traditional Chinese, Korean, Thai, German, French, Italian, Spanish (Mexico), Czech, Hungarian, and Polish
Rating	Power voltage	24 VDC±10%
	Current consumption	Max. 2.5 A (Typ. 28W)
Environmental resistance	Ambient temperature	0 to + 45 °C (DIN rail mounting) / 0 to + 40 °C (bottom mounting)
	Ambient humidity	85%RH or less (no condensation)
Weight		Approx. 2200 g

¹ Positive common connection is supported for NPN input devices, and negative common connection for PNP input devices.

Communication expansion unit specifications

EtherCAT unit (CB-NEC20E)

Model name		CB-NEC20E
Communication	Compliant standard	IEEE802.3u (100BASE-TX)
	Communication speed	100 Mbps (100BASE-TX)
	Communication cycle	Minimum of 500μs
	Connection cable	Category 5e or greater shielded twisted pair (STP) cable
	Node interval	100m
	Communication port	RJ-45×2
Power supply		Supplied from the controller
Environmental resistance	Ambient temperature	0 to +45°C (DIN rail mounted)/0 to +40°C (Bottom mounted)
	Ambient humidity	85%RH or less (No condensation)
Weight		Approx. 500 g

EtherNet/IP unit (CB-NEP20E)

Model name		CB-NEP20E
Communication	Compliant standard	IEEE802.3u (100BASE-TX)
	Communication speed	100 Mbps (100BASE-TX)
	Communication cycle	1 ms at the shortest
	Connection cable	Category 5e or greater shielded twisted pair (STP) cable
	Node interval	100m
	Communication port	RJ-45×2
Power supply		Supplied from the controller
Environmental resistance	Ambient temperature	0 to +45°C (DIN rail mounted)/0 to +40°C (Bottom mounted)
	Ambient humidity	85%RH or less (No condensation)
Weight		Approx. 500 g

PROFINET unit (CB-NPN20EA)

Model name		CB-NEP20EA
Communication	Compliant standard	IEEE802.3u (100BASE-TX)
	Communication speed	100 Mbps (100BASE-TX)
	Communication cycle	1 ms at the shortest
	Connection cable	Category 5e or greater shielded twisted pair (STP) cable
	Node interval	100m
	Communication port	RJ-45×2
Power supply		Supplied from the controller
Environmental resistance	Ambient temperature	0 to +45°C (DIN rail mounted)/0 to +40°C (Bottom mounted)
	Ambient humidity	85%RH or less (No condensation)
Weight		Approx. 500 g

Head Specifications

Model name	LJ-S015	LJ-S025	LJ-S040	LJ-S080	LJ-S160	LJ-S320	LJ-S640			
Reference distance ^{*1}	56.5mm	68.5mm	70mm	160mm	211mm	470.5mm	1116mm			
Measurement range (Z)	±4 mm (F.S. = 8 mm)	±9 mm (F.S. = 18 mm)	±18mm (F.S. = 36 mm)	±23mm (F.S. = 46 mm)	±50 mm (F.S. = 100 mm)	+100/-120mm (F.S. = 220mm)	+180/-250mm (F.S. = 430mm)			
Measurement range XY	X NEAR side	14mm	21mm	31mm	66mm	124mm	243mm			
	X Reference distance	15mm	23mm	35mm	72mm	143mm	295mm			
	X FAR side	16mm	25mm	39mm	78mm	160mm	320mm			
	Y Reference distance	25mm	51.2mm	80mm	160mm	160mm	640mm			
XY Data pitch	5µm	8µm	12.5µm	25µm	50µm	100µm	200µm			
XY Data points	3200 x 5000	3200 x 6400	3200 x 6400	3200 x 6400	3200 x 3200	3200 x 3200	3200 x 3200			
Repeatability	Z (height) ^{*2}	0.3µm	0.4µm	0.5µm	1µm	3µm	5µm			
	XY (distance) ^{*3}	0.5µm	0.7µm	1µm	3µm	5µm	10µm			
Linearity ^{*4}	Standard area	±0.035% of F.S.	±0.03% of F.S.	±0.02% of F.S.	±0.055% of F.S.	±0.02% of F.S.	±0.027% of F.S.			
	High-precision area	-	-	-	±0.03% of F.S.	-	-			
Capture time ^{*5}	Approx. 0.2 seconds at a maximum				Approx. 0.3 seconds at a maximum					
Optical source	Laser optical source	Blue semiconductor laser, wavelength: 405 nm (visible light)								
	Laser class	Class 2M laser product ^{*6} (IEC60825-1, FDA (CDRH) Part1040.10 ^{*7})								
	Output	10mW								
Rating	Power voltage	24 V +25%, -20%								
	Current consumption ^{*8} / Electric power	Max. 4.0 A (for 19.2 V), 3.2 A (for 24 V) / Typ 17 W				Max. 5.5 A (for 19.2 V), 4.4 A (for 24 V) / Typ 17 W				
I/F	Ethernet	1000BASE-T, 100BASE-TX								
	input ^{*9}	LASER_ON, TRG, MEM_CLEAR								
	output ^{*9}	READY, EXPOSURE_BUSY, ERROR								
Environmental resistance	Protective structure ^{*10}	IP65 (IEC60529)								
	Ambient luminance ^{*11}	White lamp: 10000 lx or less								
	Ambient temperature ^{*12}	0 to +45°C								
	Ambient humidity	85%RH or less (no condensation)								
	Vibration resistance	10 to 500 Hz, power spectrum density: 0.033 G2/Hz, X, Y, Z directions (IEC60068-2-64)								
	Shock resistance	15G (IEC60068-2-27)								
Material		Aluminum								
Weight		Approx. 2300 g	Approx. 2100 g	Approx. 2600 g	Approx. 2600 g	Approx. 3600 g	Approx. 3700 g	Approx. 4300 g		

*1 The reference distance is the distance from the bottom edge of the head to the measurement center of the Z-axis (height). *For the attachment reference plane, see "Dimensions" (page 10-11).

*2 Measured object is a standard object as determined by us. The value of σ, which is the average height of 200x200 points in the center of the visual field measured by the height tool with reciprocating scanning being turned off.

*3 Measured object is a standard object as determined by us. The value of σ, which is the result of measuring the distance of two circles in a grayscale image by the circle-to-circle distance tool with reciprocating scanning being off, where the diameters of the circles are 500 points, the distance between the circles is 1000 points, and the circles are positioned in the center of the visual field.

*4 Measured object is a standard object as determined by us. The average height of 200x200 points measured by the height tool with reciprocating scanning being turned off. About the high-precision area, see "Measurement range drawing" (page 10-5).

*5 With the YZ range being minimum, and Y-thinning being maximum.

*6 Never look directly at a beam through an optical apparatus (magnifying glass, magnifier, microscope, telescope, binocular, etc.). Viewing laser output with an optical apparatus may damage the eyes.

*7 The laser classification is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No. 56 of the FDA (CDRH).

*8 The maximum value may be exceeded when an extreme acceleration is made.

*9 The controller connection type is enabled only for laser ON input.

*10 When an OP cable is connected.

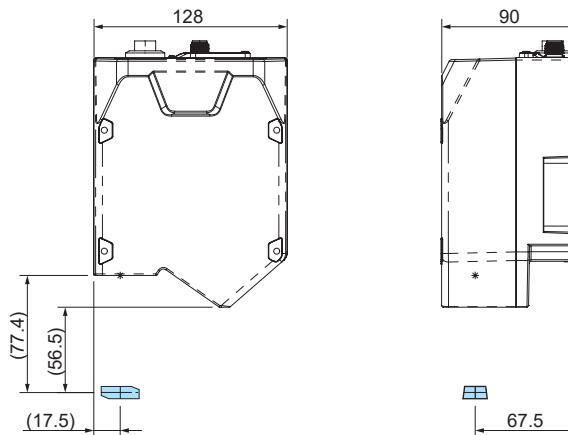
*11 Illuminance on a sensor head light-receiving surface when a light is shined on white paper during white-paper measurement.

*12 The head must be mounted to a metal plate for use.

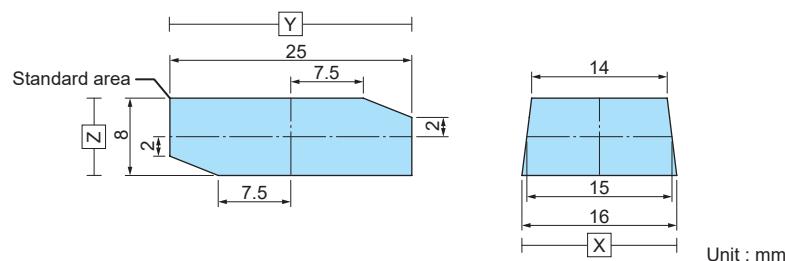
Measurement range drawing

Measurement ranges for the LJ-S Series are indicated below. Measures the shape of the object within the Z-axis measurement range and the trapezoidal area surrounded by the X-axis measurement range.

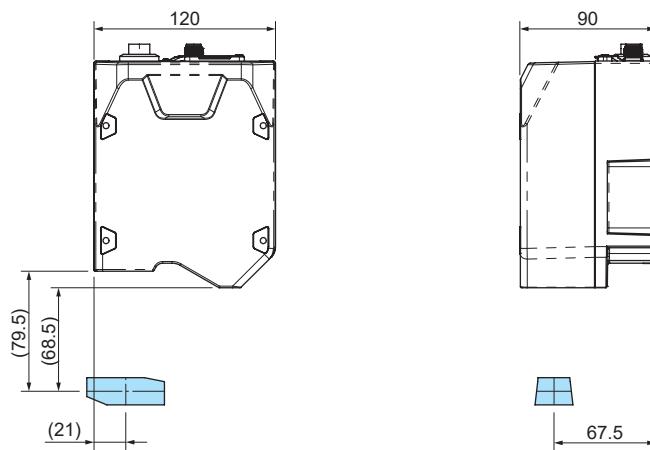
LJ-S015



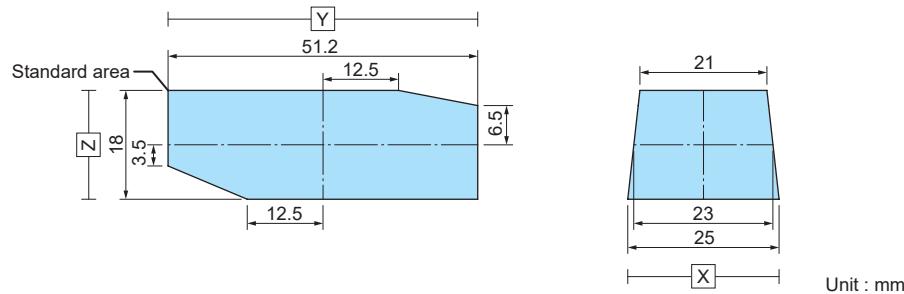
Measurement range details

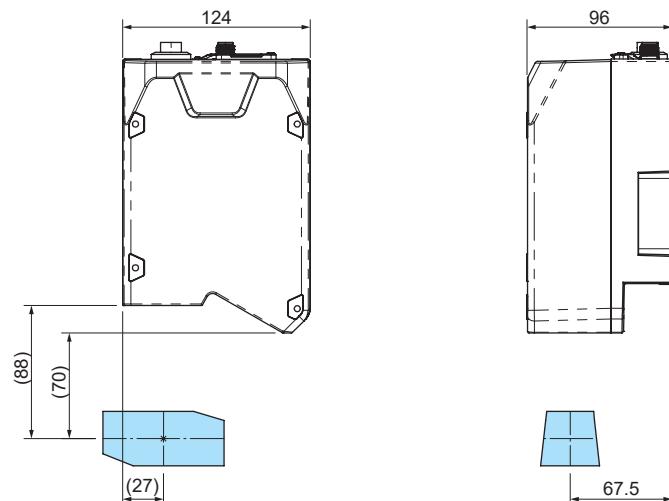
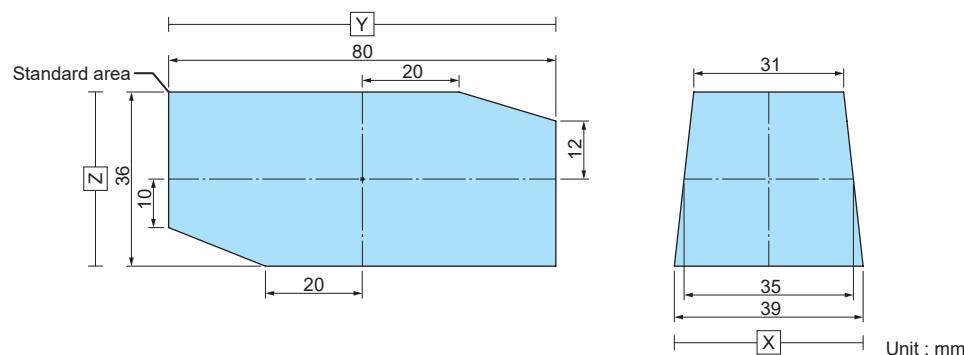
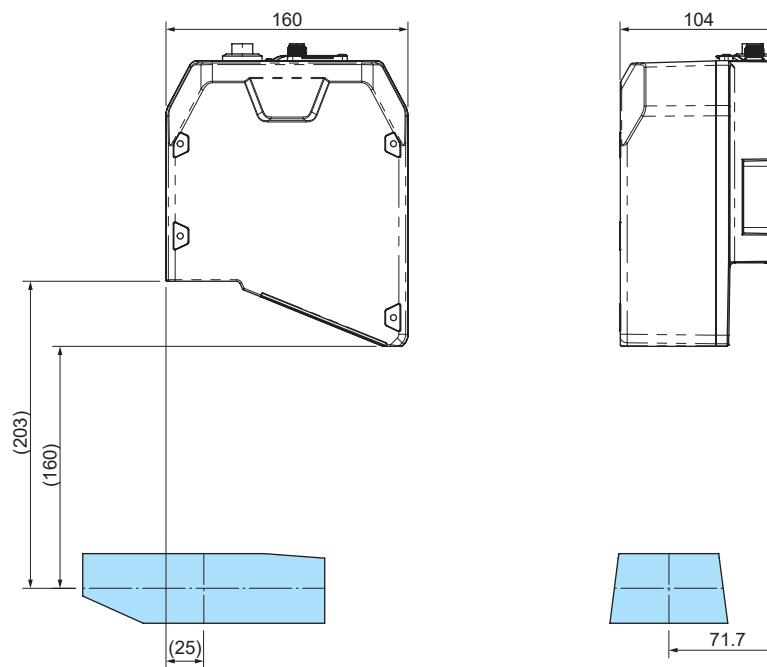
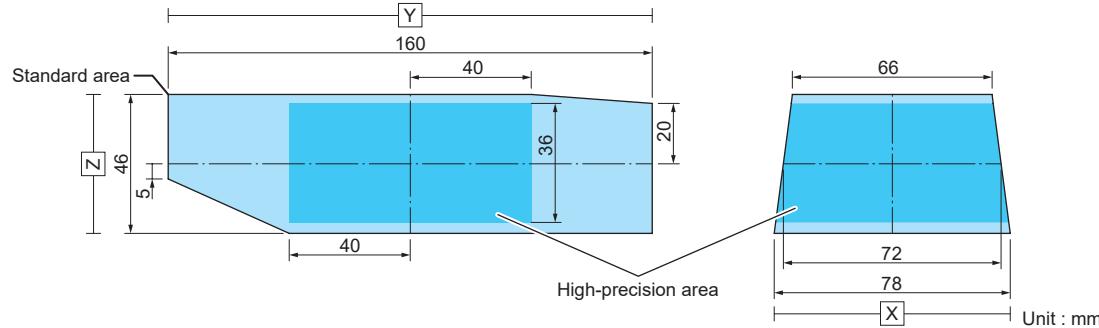


LJ-S025

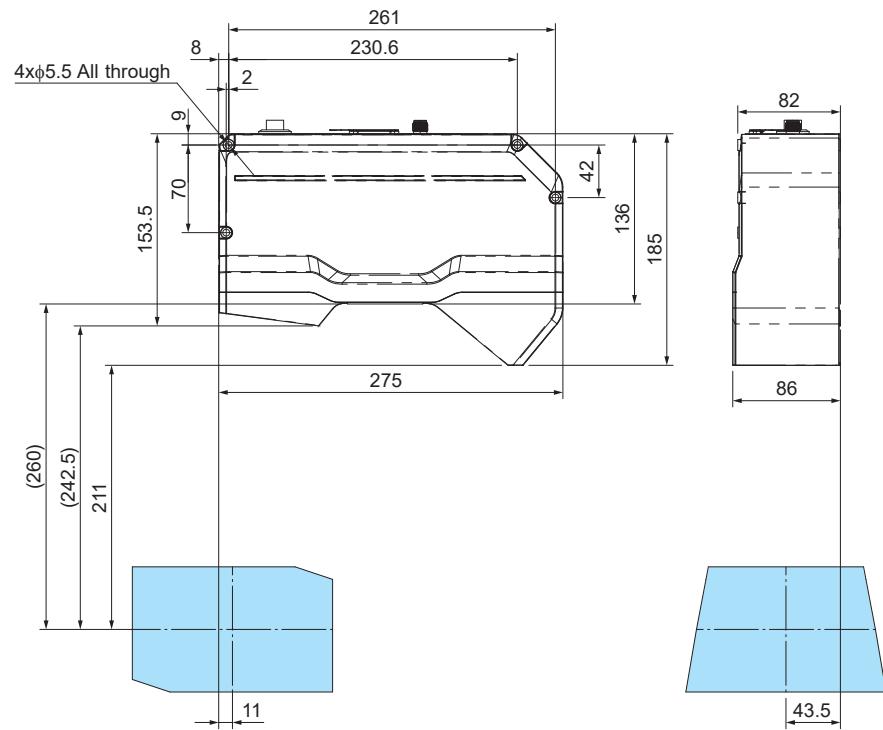


Measurement range details

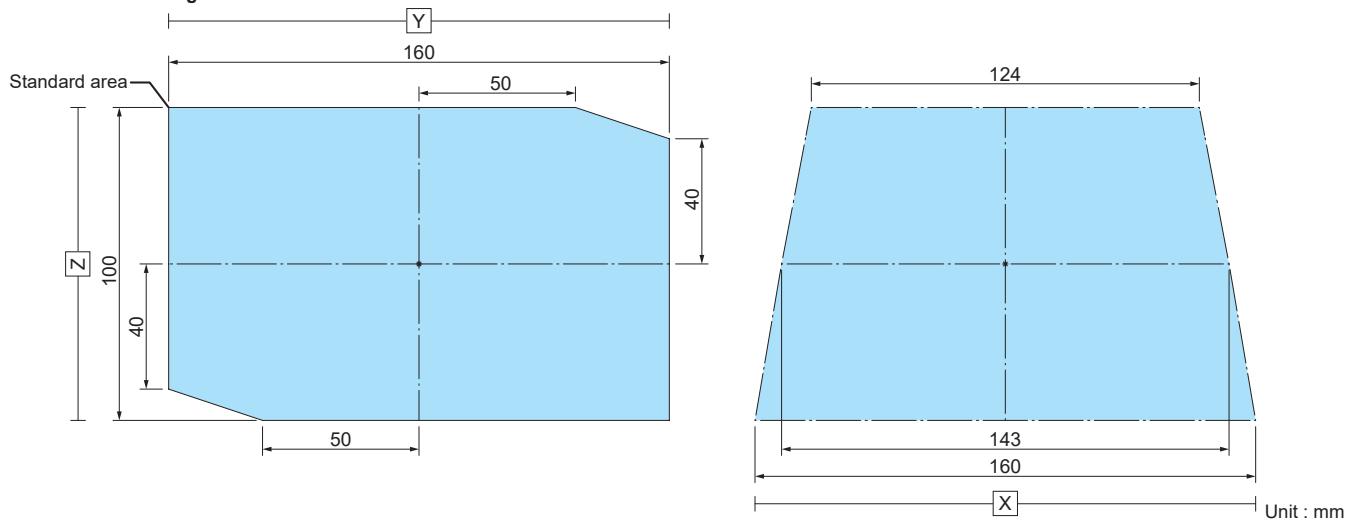


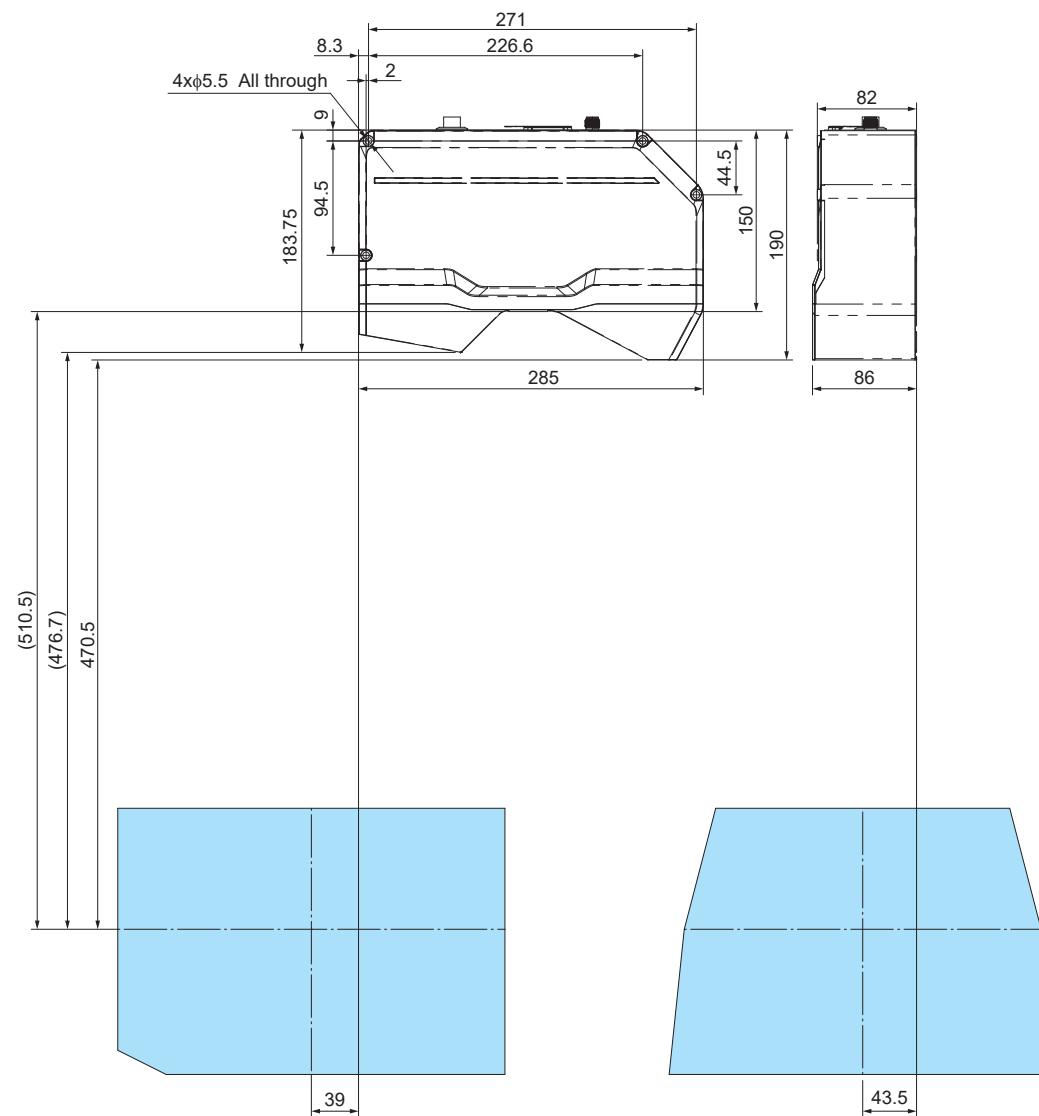
LJ-S040**Measurement range details****LJ-S080****Measurement range details**

LJ-S160

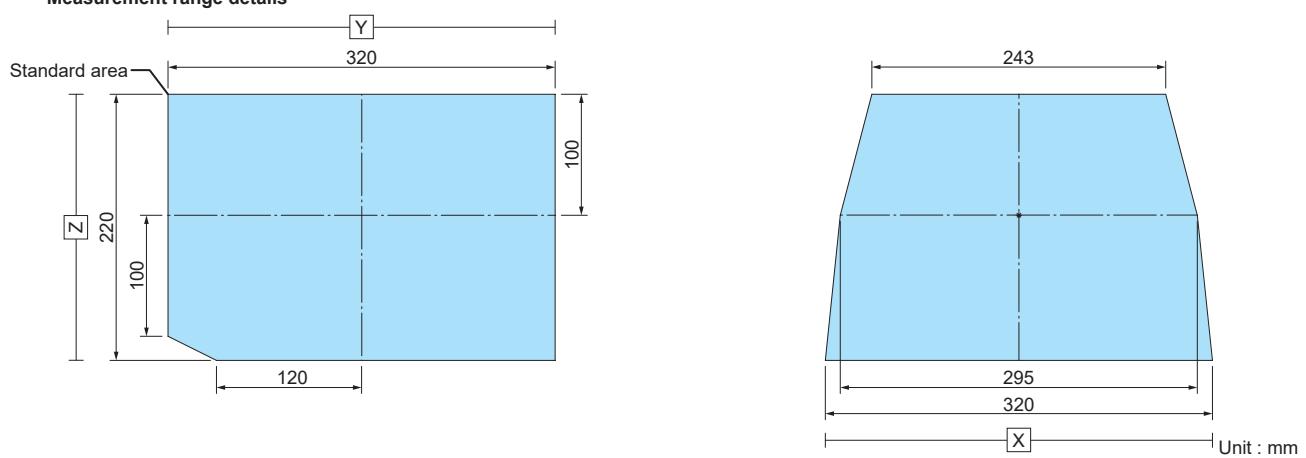


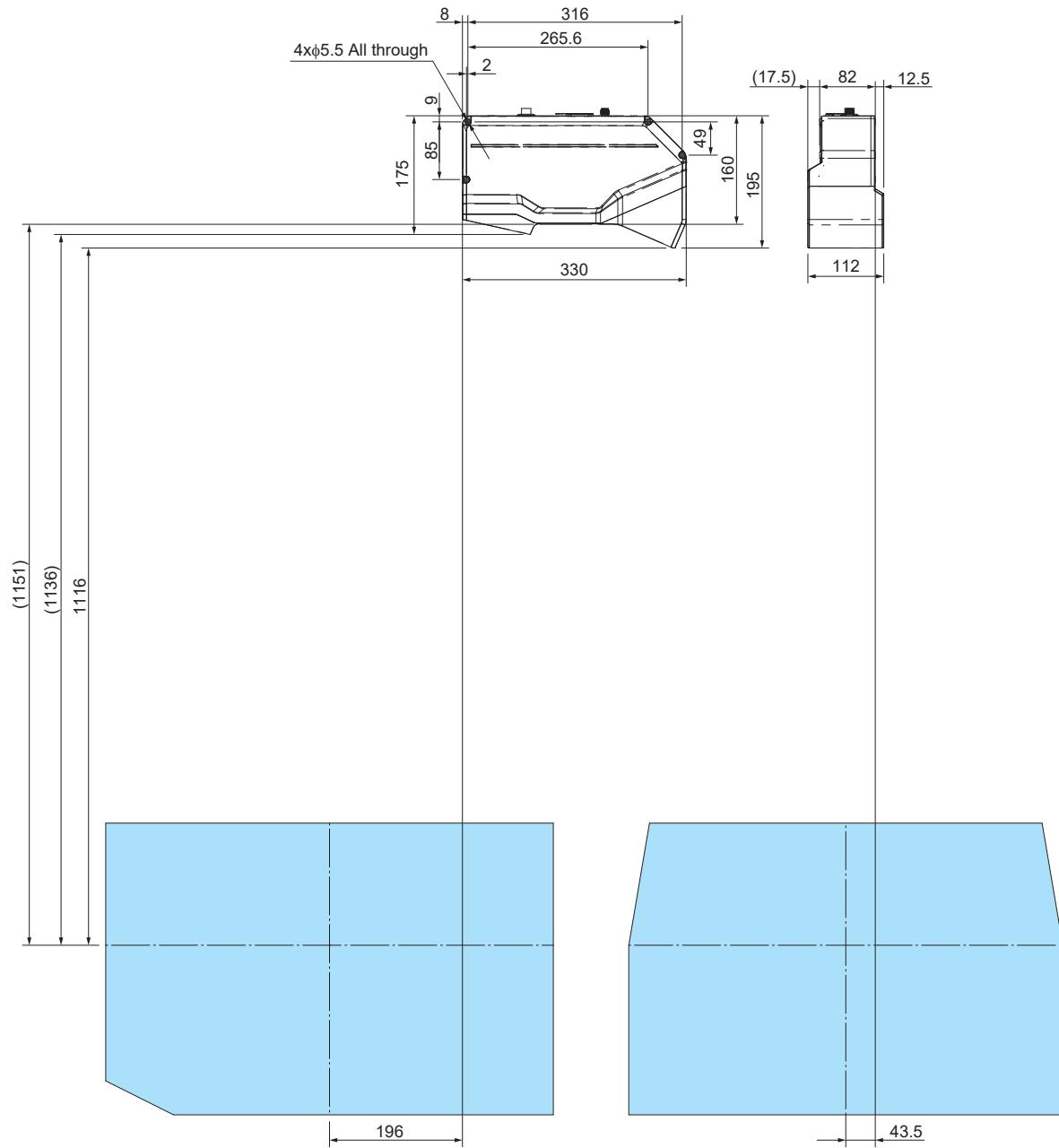
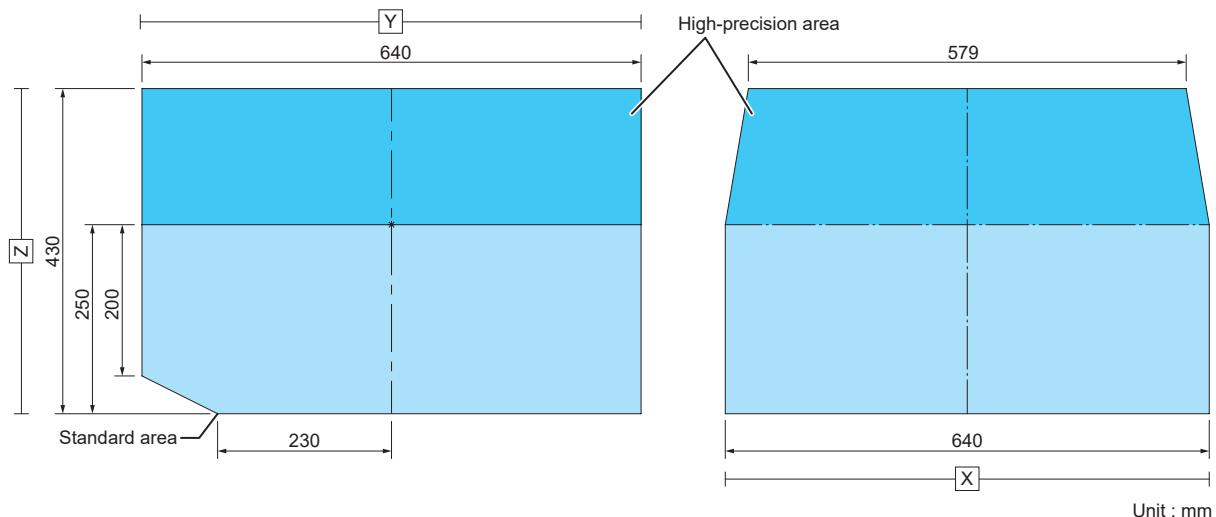
Measurement range details



LJ-S320

Measurement range details



LJ-S640**Measurement range details**

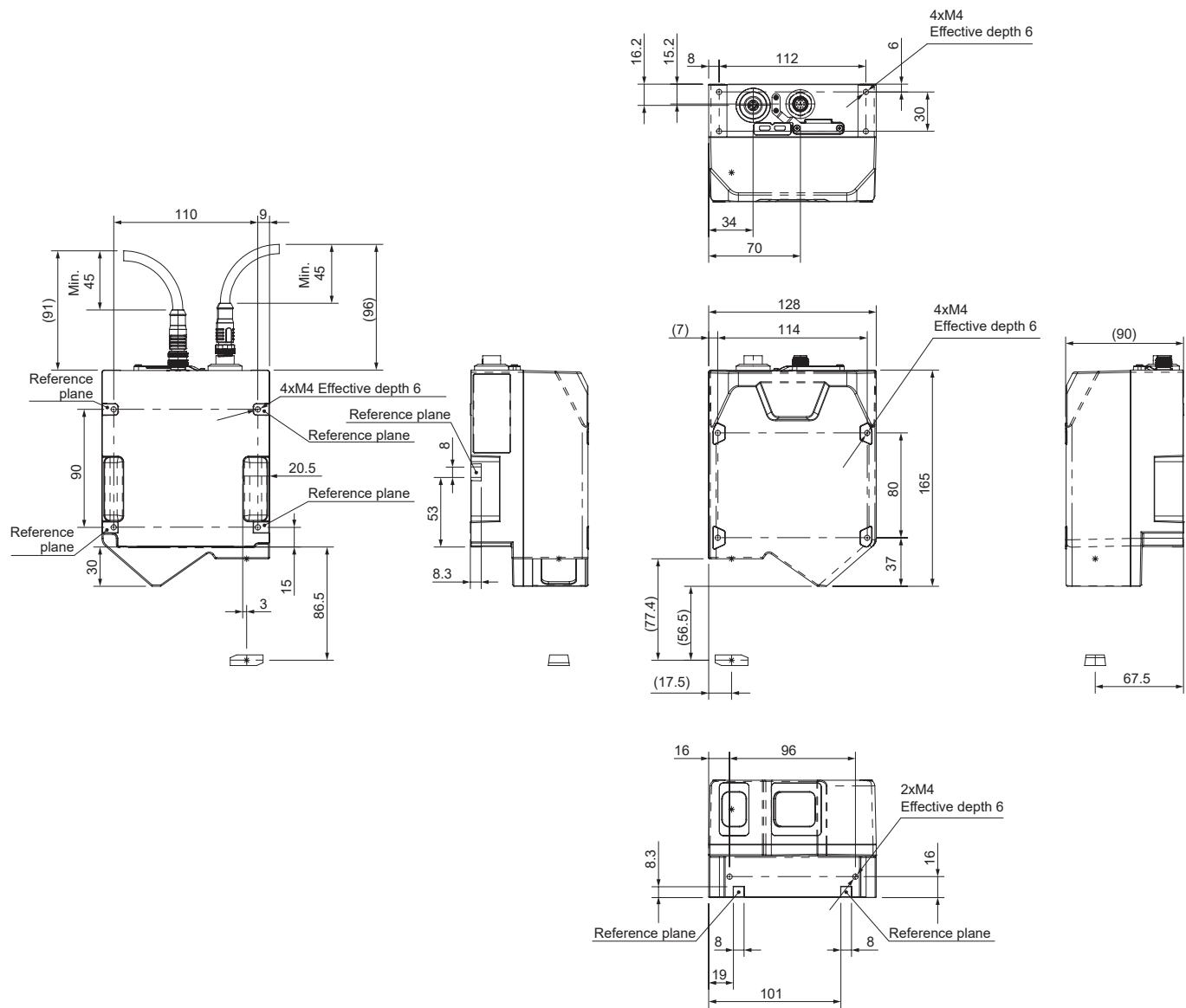
Monitor Specifications

Model name		CA-MP120
Liquid crystal panel	Display element	a-Si TFT active matrix
	Effective display area	245(W)x184(H) mm
	Display dot count	1024(W)x768(H) dots or 800(W)x600(H) dots
	Display colors	16,777,216 colors
Backlight	Lifespan	Average lifespan: 100,000 hours (when installed vertically at 25°C)
Input/output	Input signal	Analog RGB signal (0.7 Vp-p, 75Ω) horizontal, vertical frequency signal
	Input signal mode	1024(W)x768(H) vertical frequency 60 Hz or 800(W)x600(H) vertical frequency 60 Hz
	Input signal connector	Dense mini D-sub15 female pin (3WAY, inch screw)
Rating	Power voltage	24 VDC±10%
	Current consumption	1.0 A or less
	Ambient temperature	0 to +40°C
	Ambient humidity	85%RH or less
Structure	Embedded panel on front, dust-proof according to IP65f, droplet proof	
Weight	Approx. 2.3 kg	

Dimensions

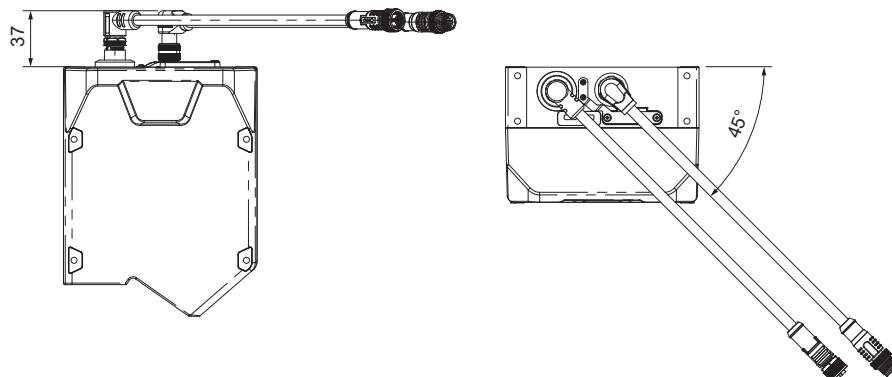
Head

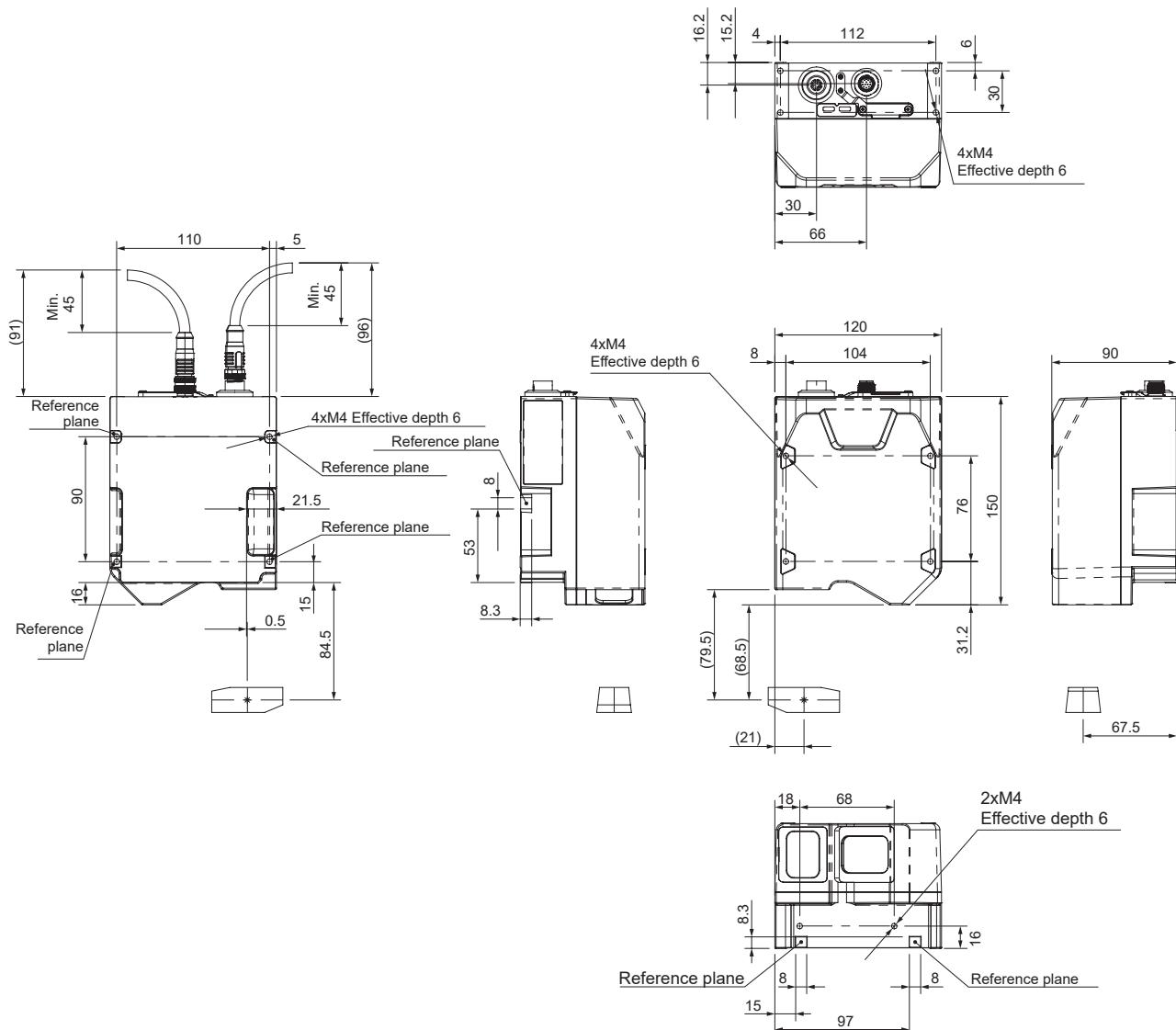
LJ-S015



For the reference plane, see □ "Reference plane for the head" (page 10-26).

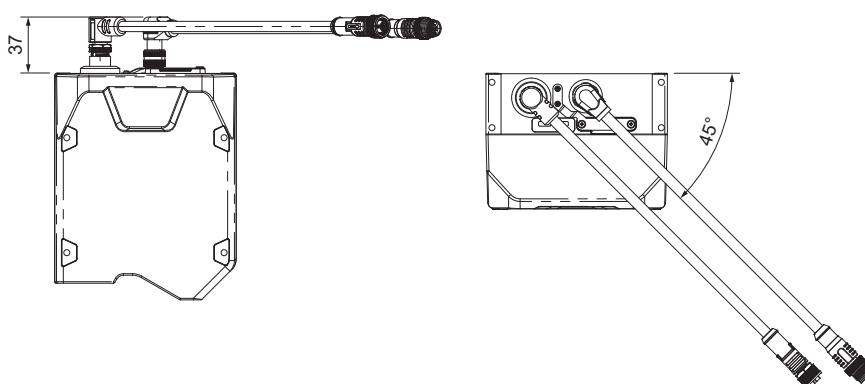
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.

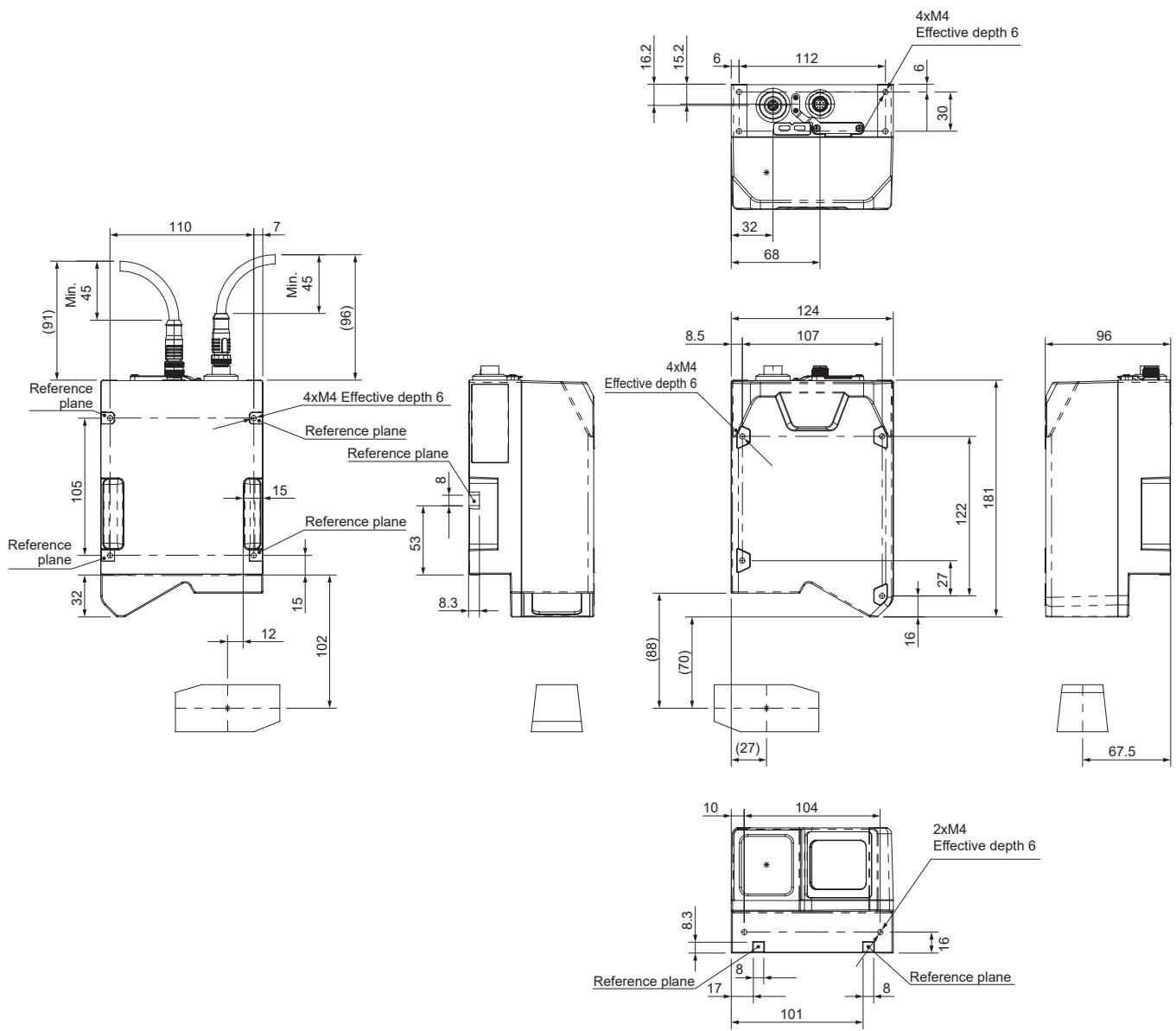


LJ-S025

For the reference plane, see □ "Reference plane for the head" (page 10-26).

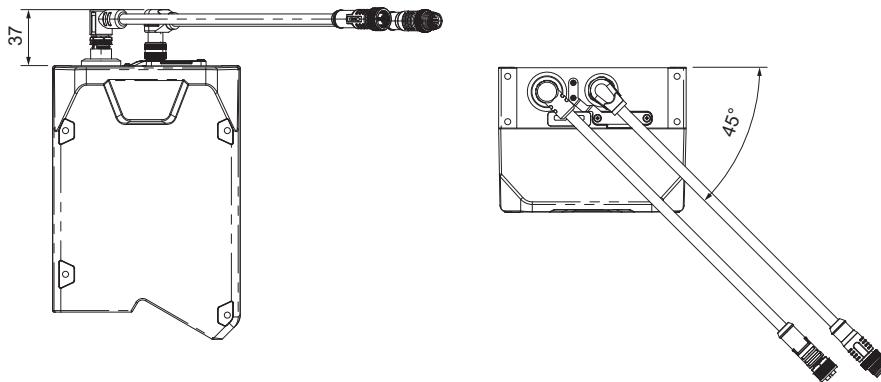
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.

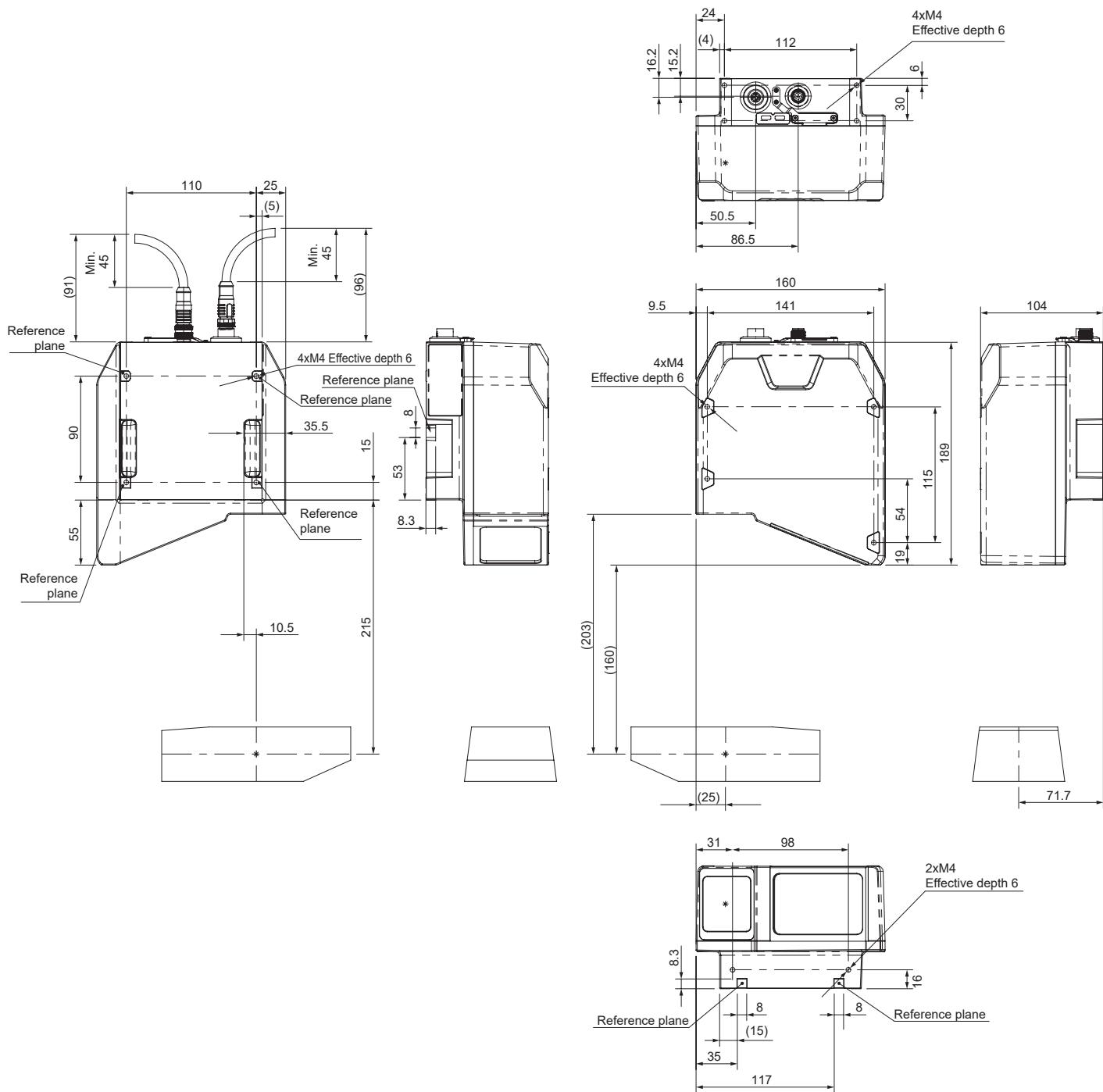


LJ-S040

For the reference plane, see □ "Reference plane for the head" (page 10-26).

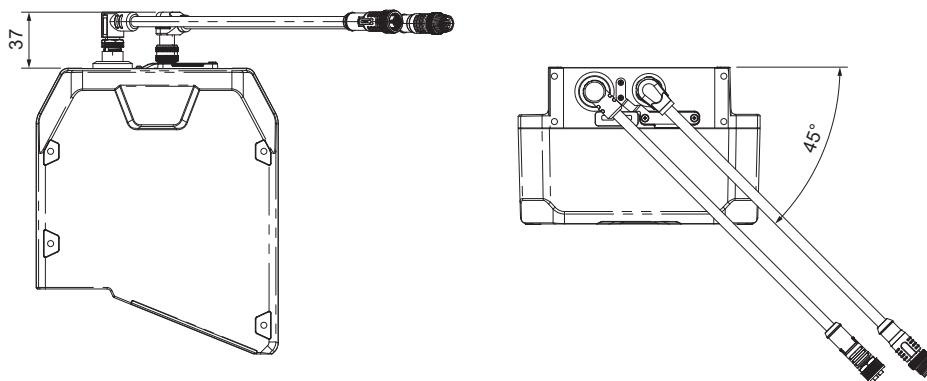
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.

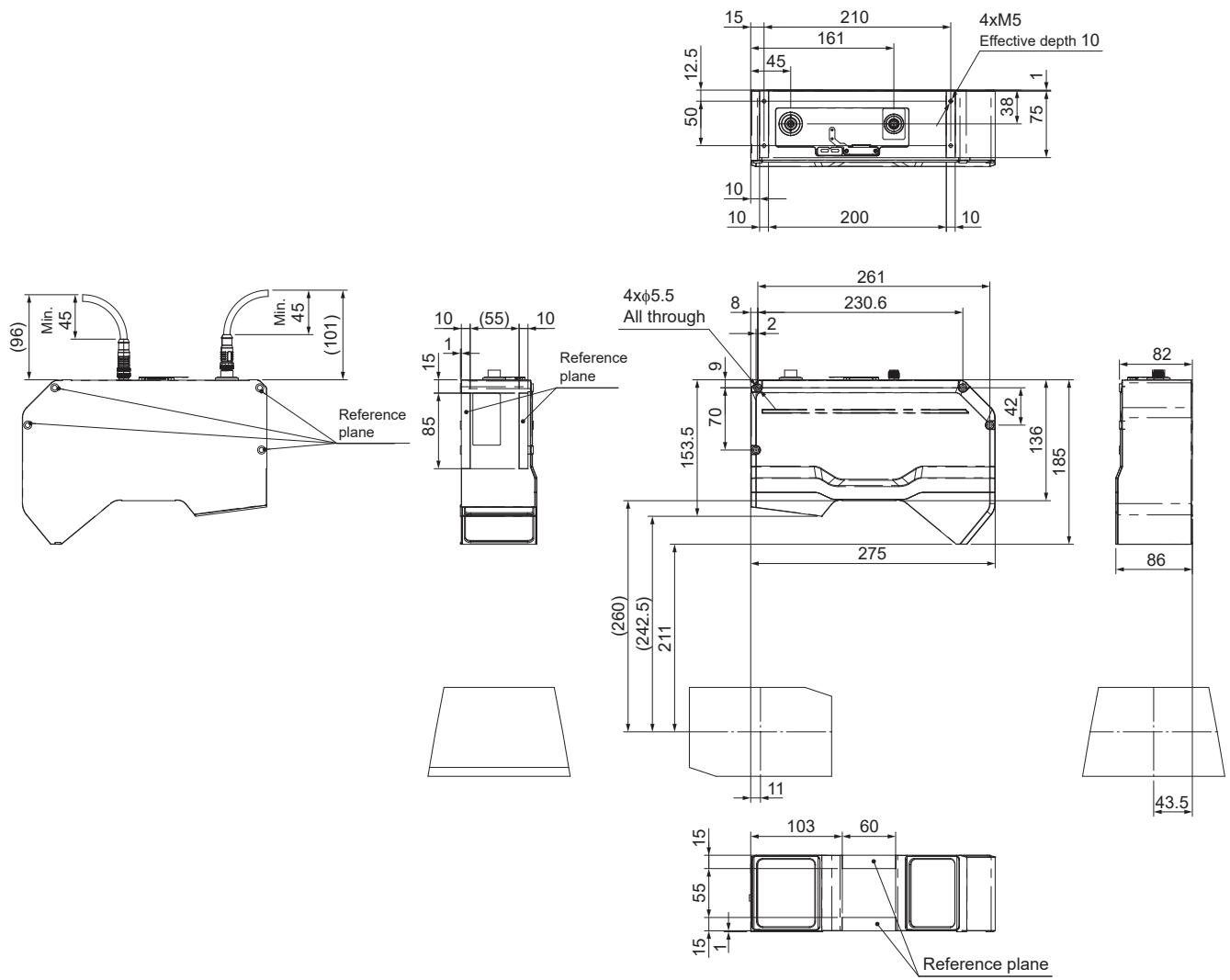


LJ-S080

For the reference plane, see □ "Reference plane for the head" (page 10-26).

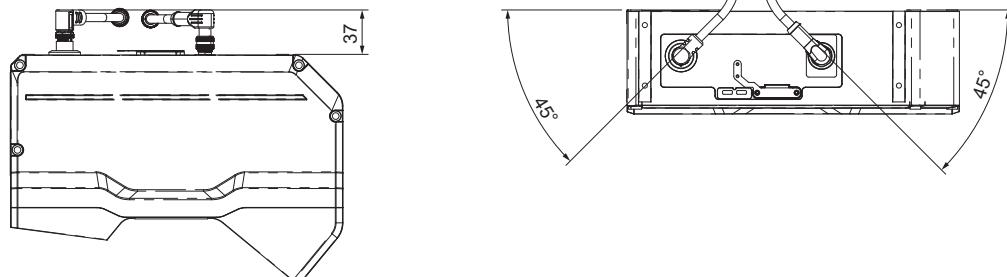
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.



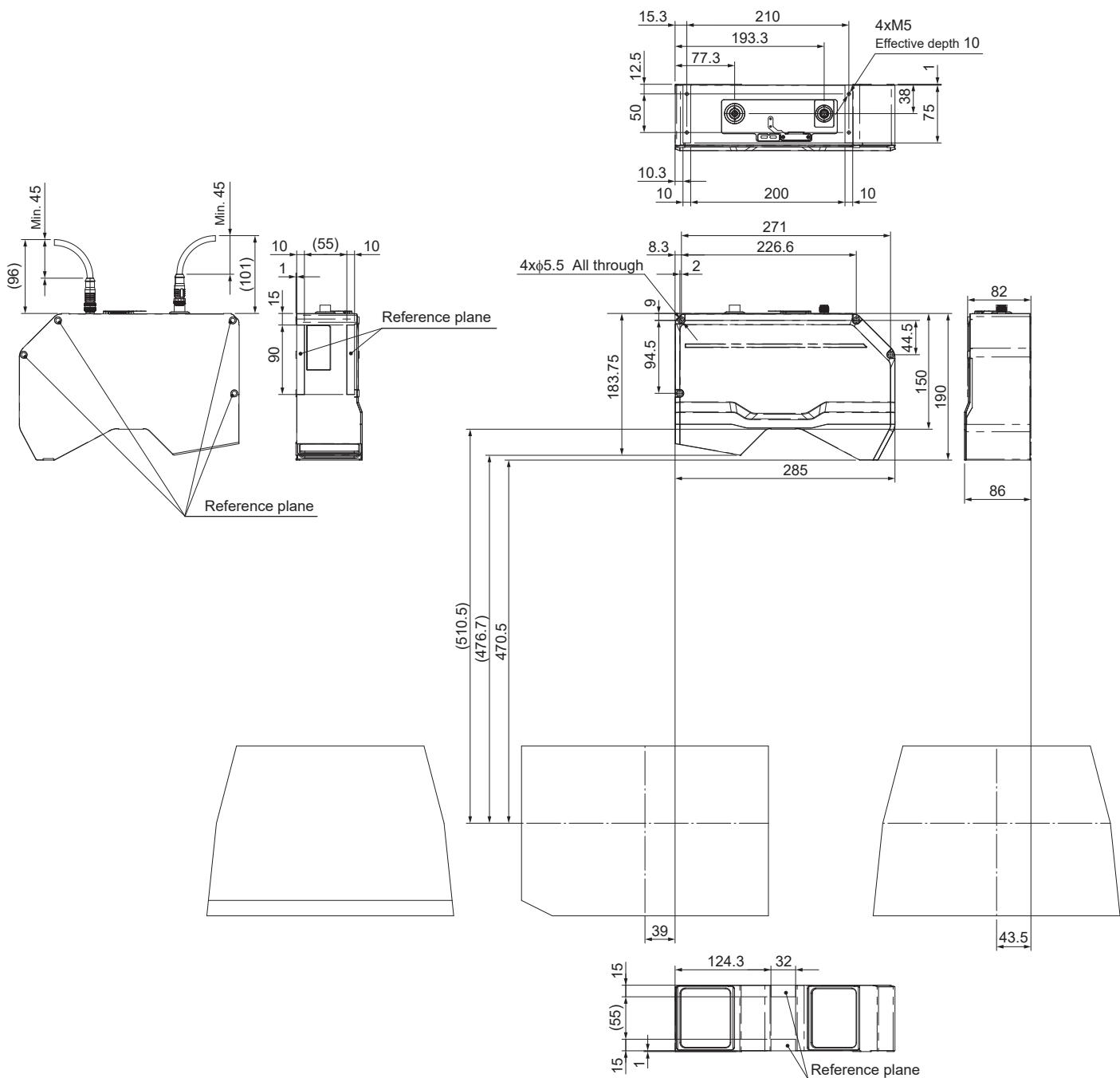
LJ-S160

For the reference plane, see □ "Reference plane for the head" (page 10-26).

- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.

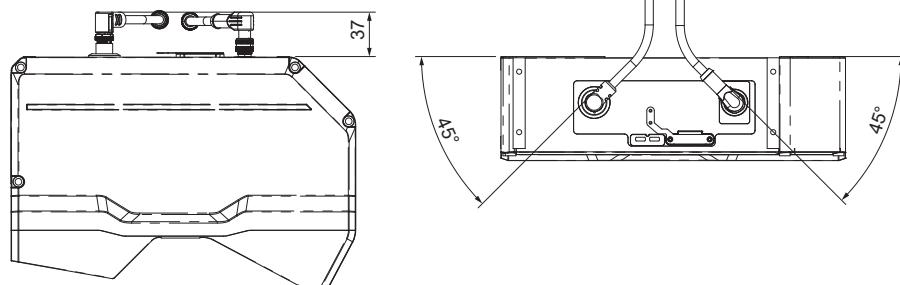


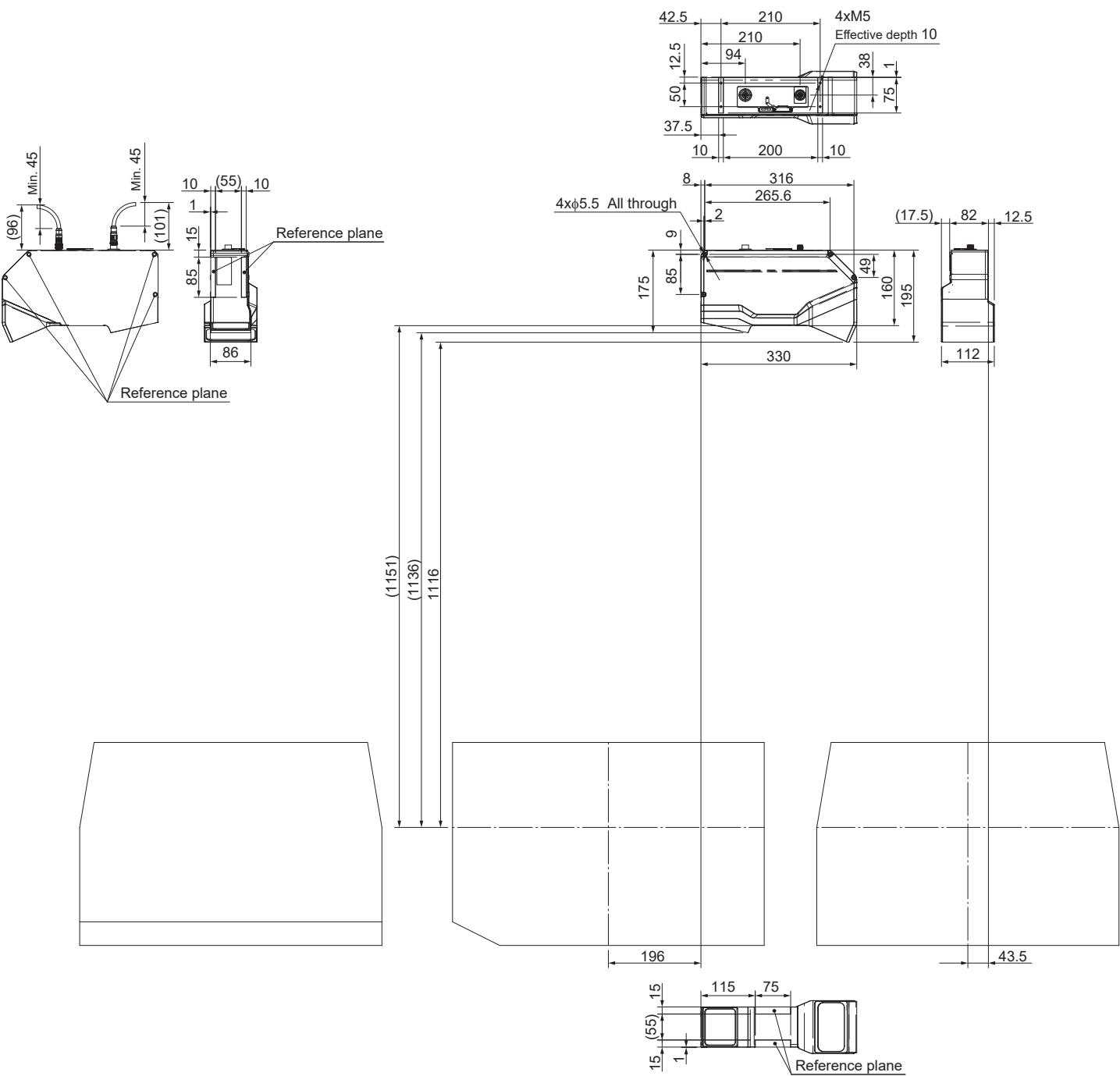
LJ-S320



For the reference plane, see “Reference plane for the head” (page 10-26).

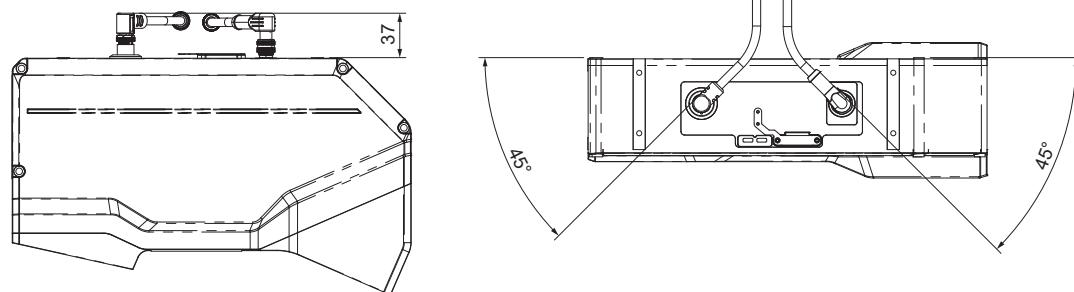
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.



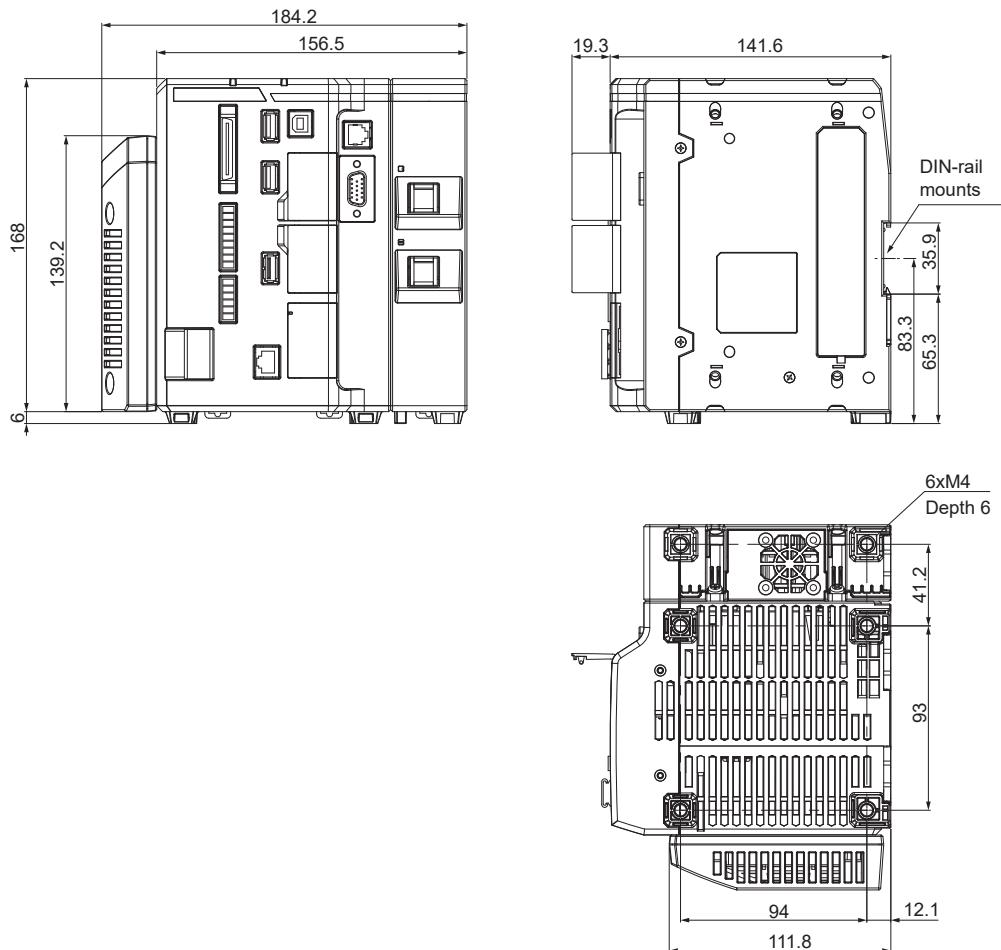
LJ-S640

For the reference plane, see □ "Reference plane for the head" (page 10-26).

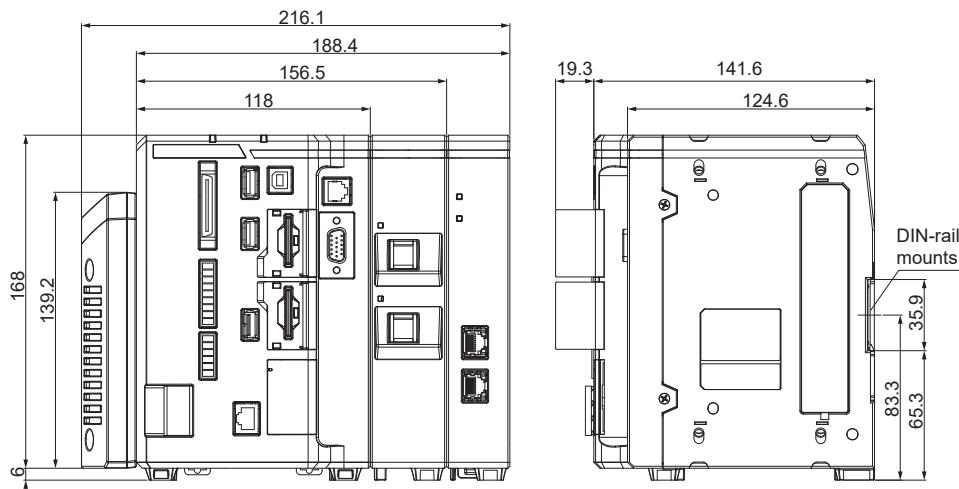
- When using L-shaped Ethernet Cable (OP-88825) and L-shaped Power I/O cable (OP-88826) with sensor head.

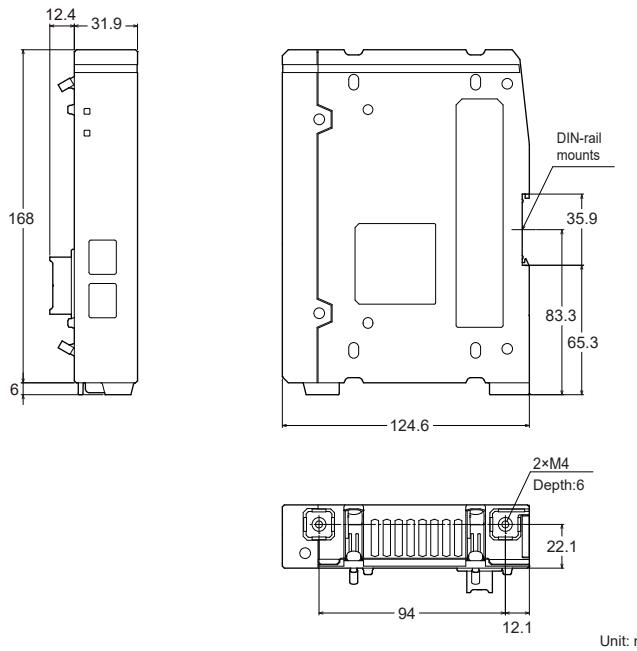
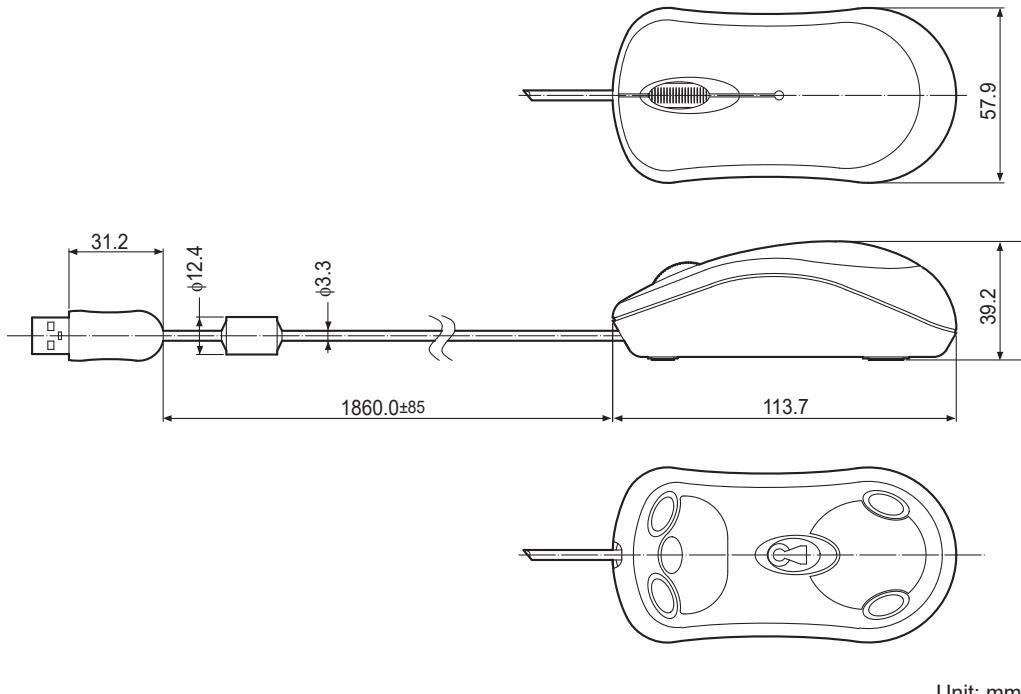


Controller (LJ-S8002)



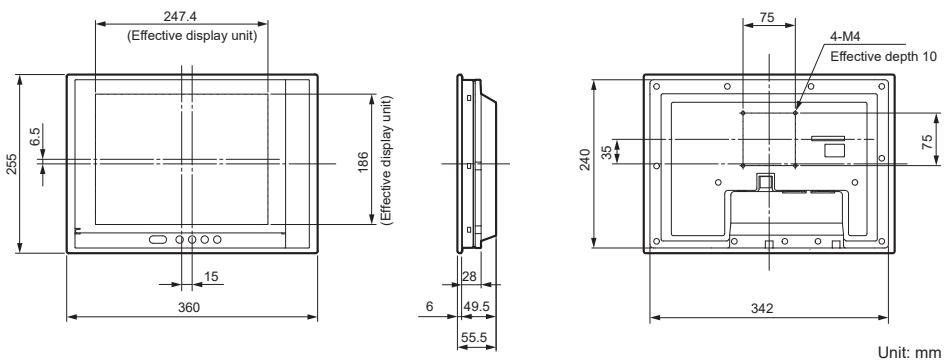
With Communication Expansion Unit (CB-NEC20E/CB-NEP20E/CB-NPN20EA)



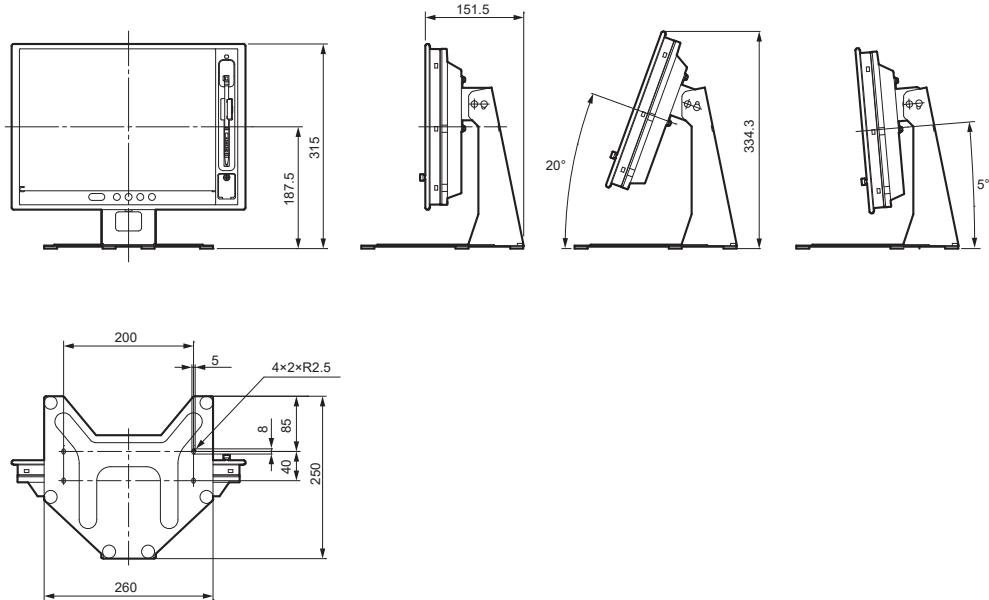
EtherCAT unit CB-NEC20E, EtherNet/IP unit CB-NEP20E, PROFINET unit CB-NPN20EA**Dedicated Mouse(OP-87506)**

Monitor (CA-MP120)/Monitor Stand (OP-87262)

● CA-MP120

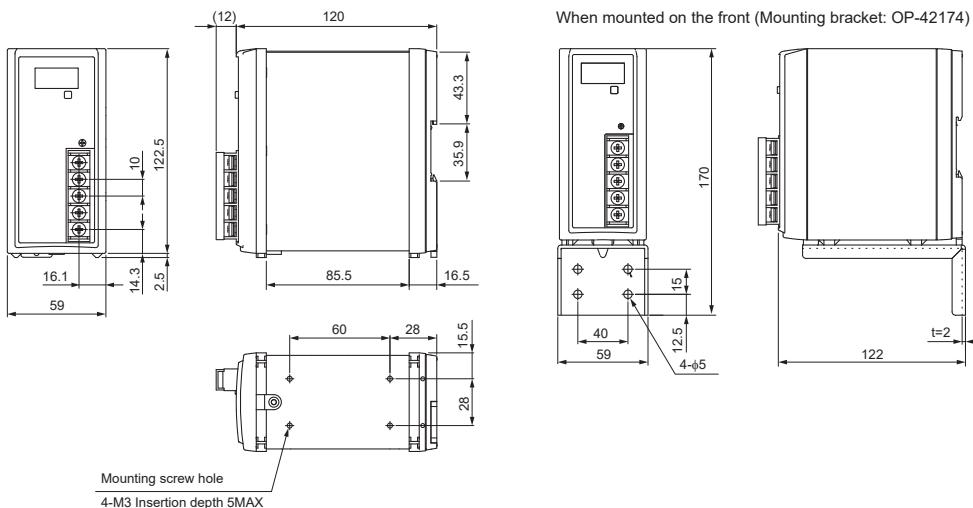


● OP-87262

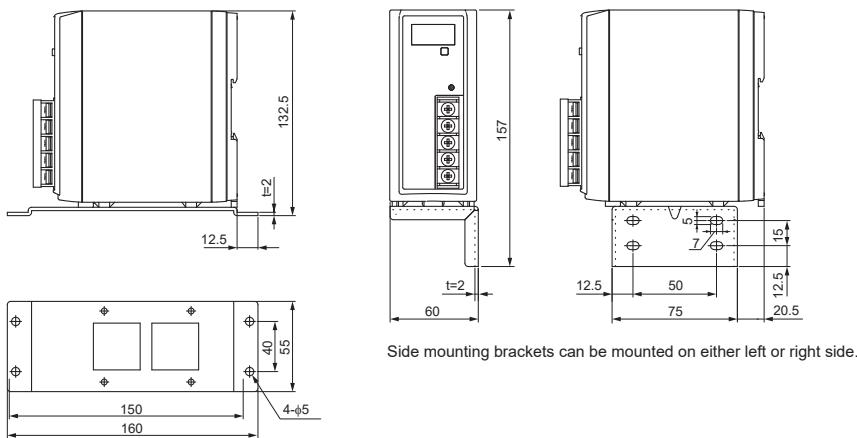


Ultra-compact switching power supply (CA-U4/U5)

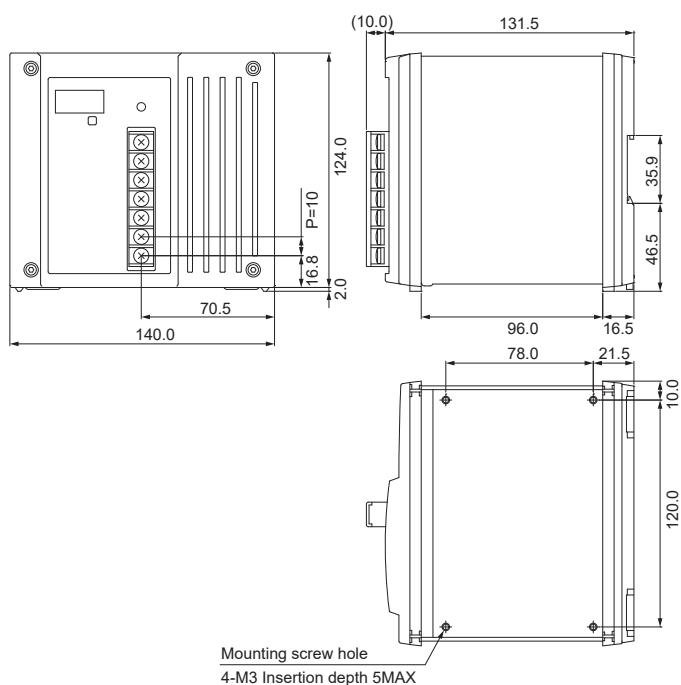
● CA-U4



Bottom mounted (Mounting bracket: OP-42175) When installing on the side (Mounting bracket: OP-51629)



● CA-U5

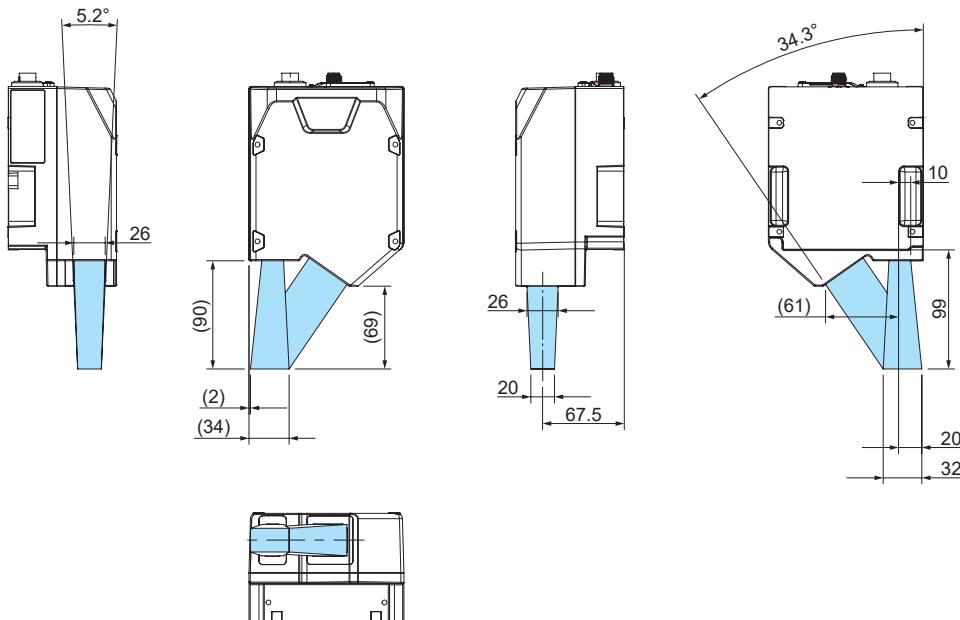


Characteristics

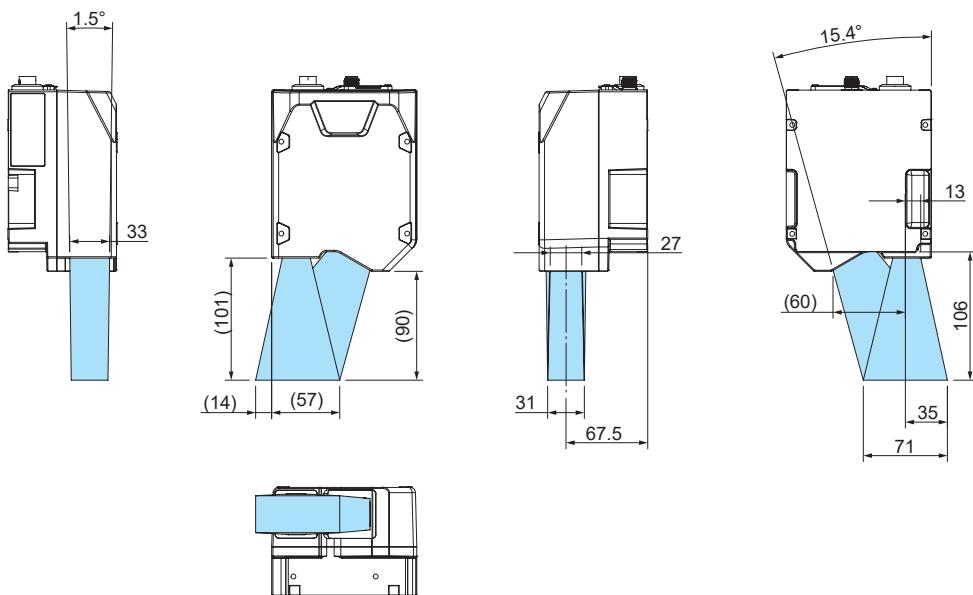
Light-axis range

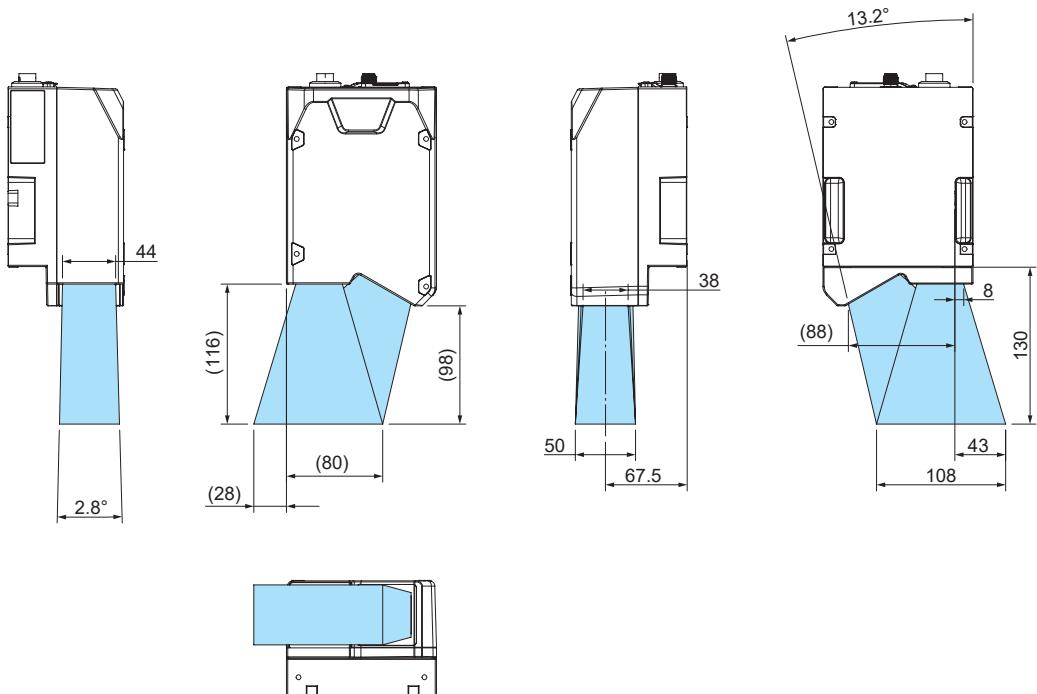
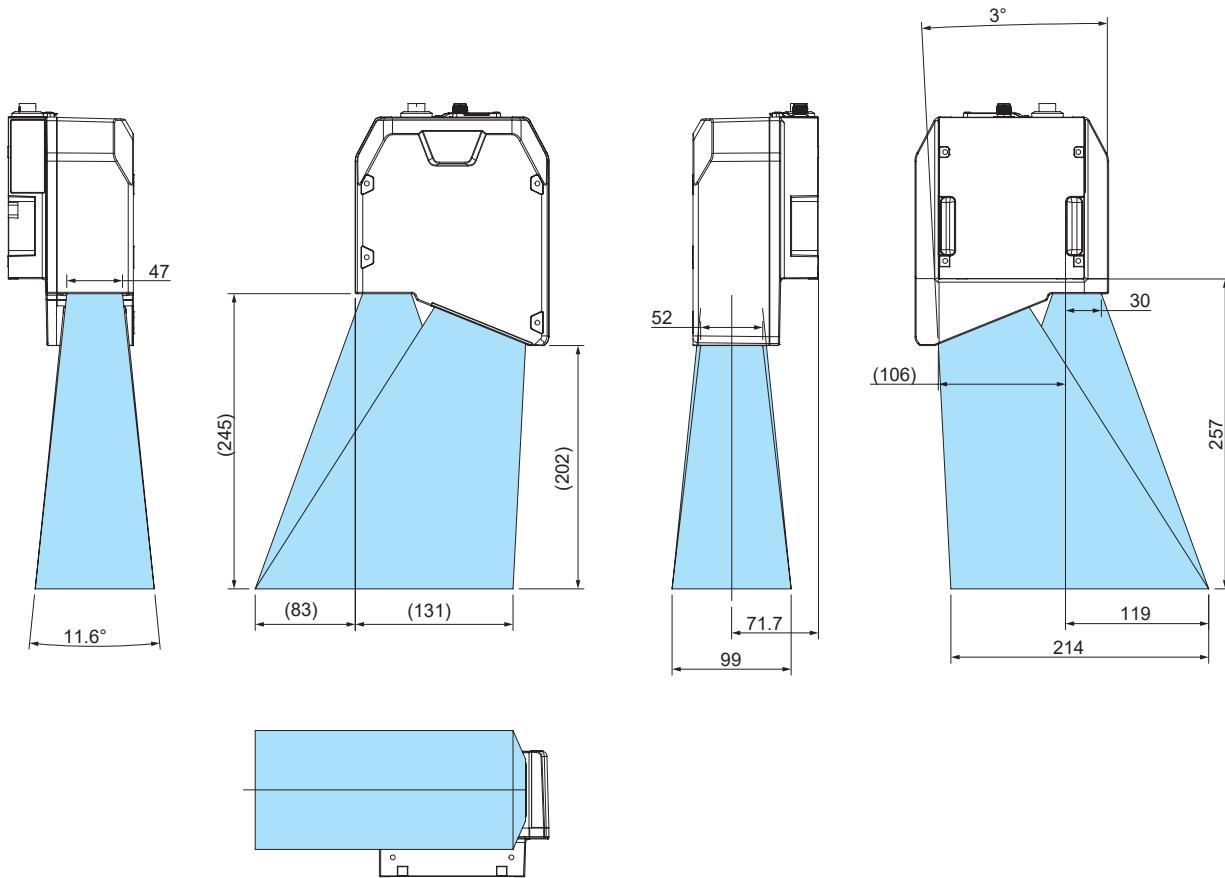
The light-axis range is the range in which measurement is affected by the blockage of the light path.

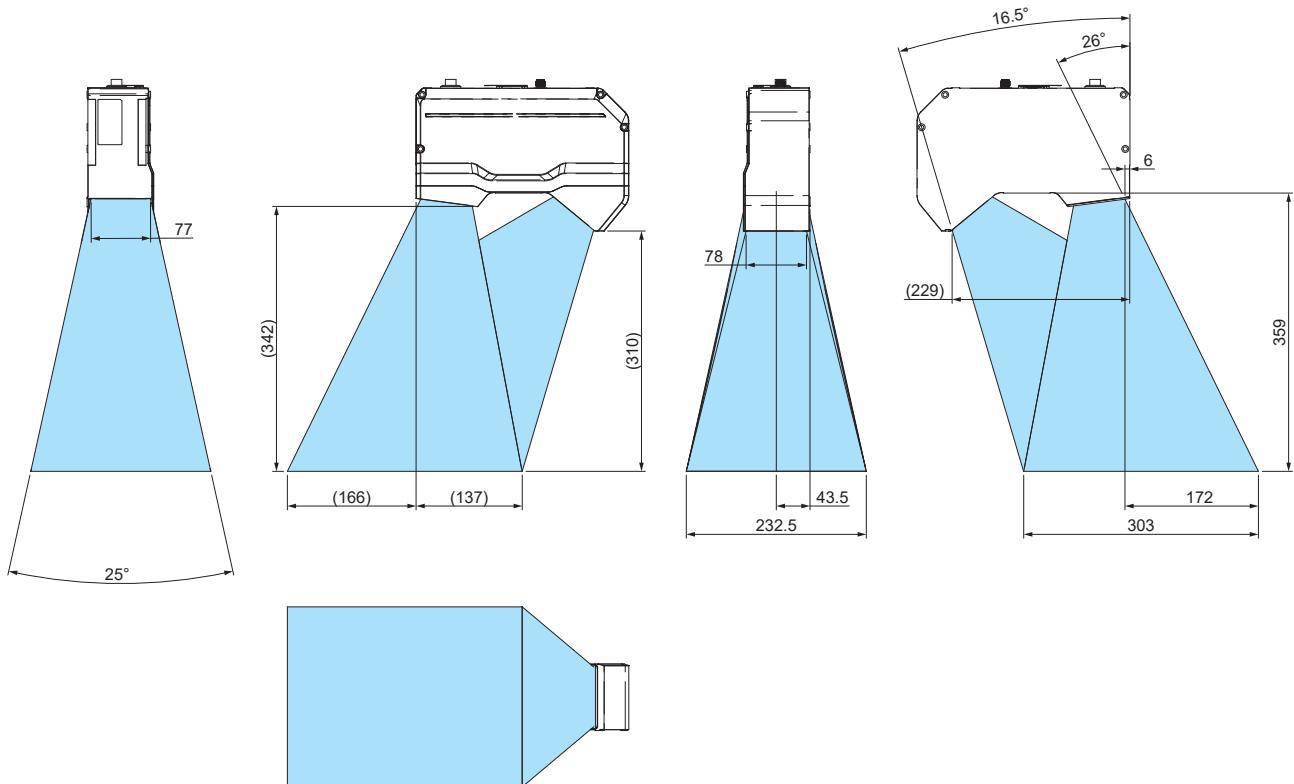
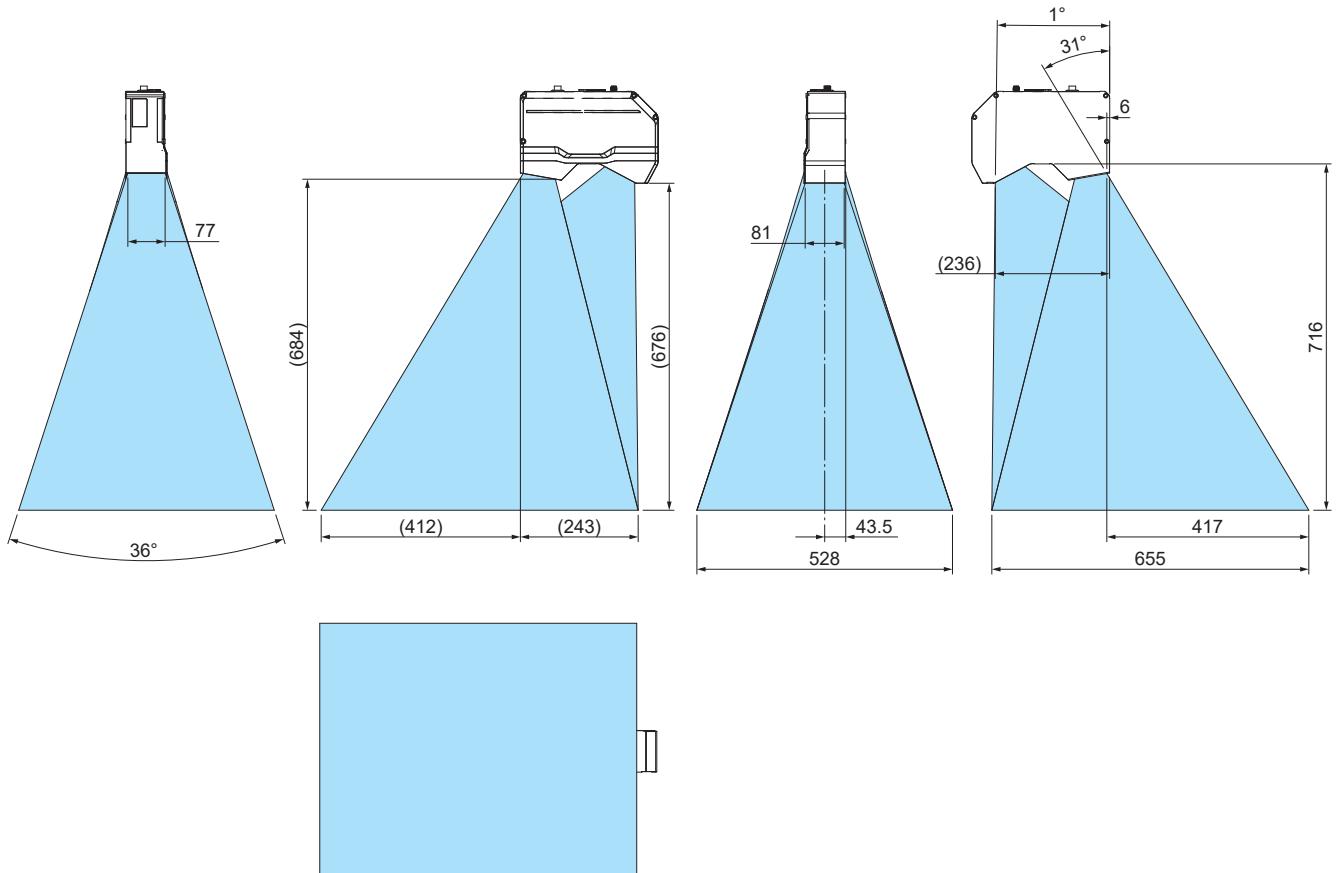
● LJ-S015

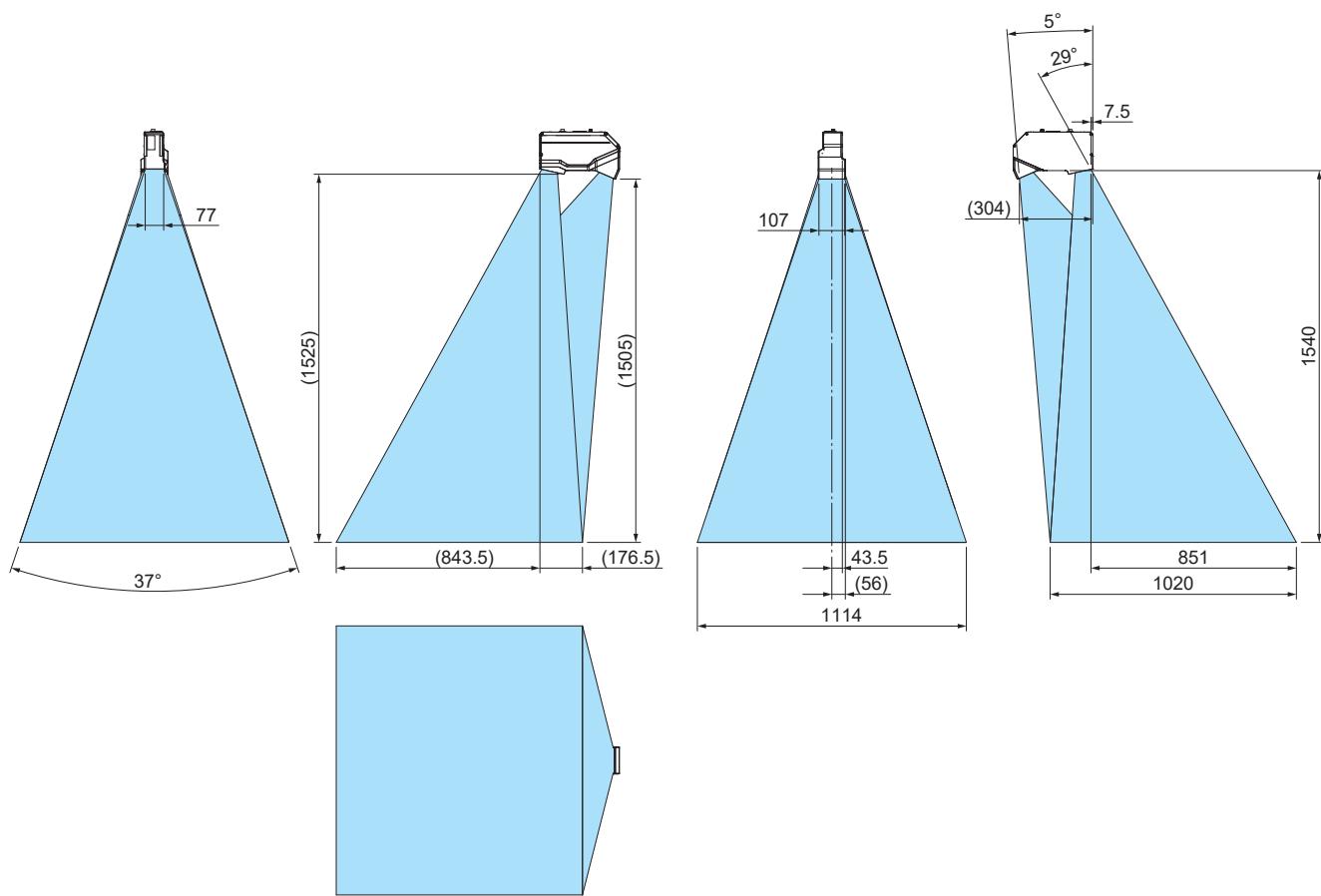


● LJ-S025



LJ-S040**LJ-S080**

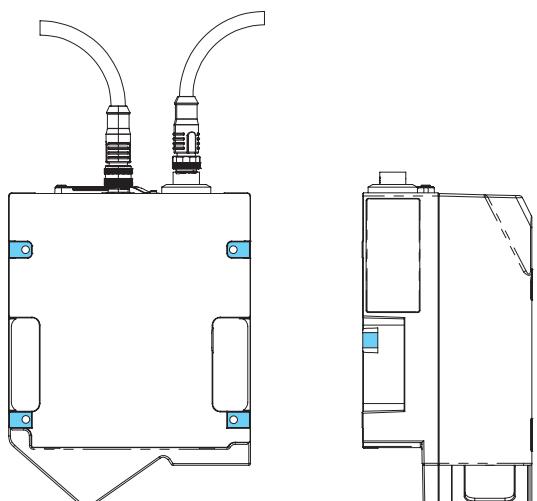
LJ-S160**LJ-S320**

LJ-S640

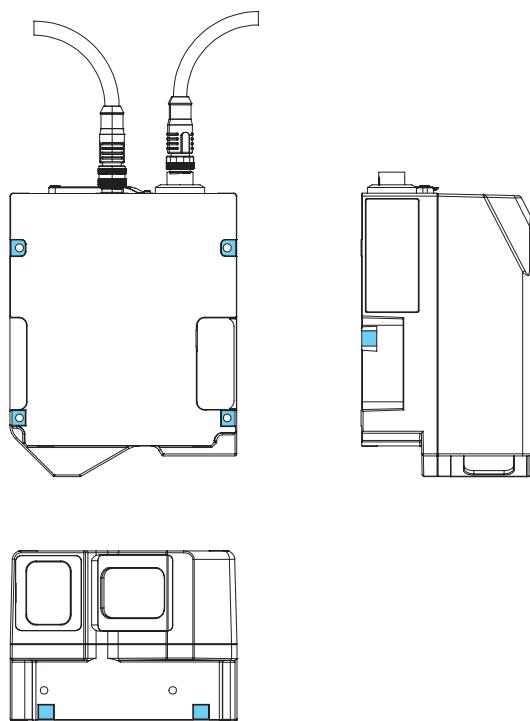
Reference plane for the head

Hatched areas (blue) are standard areas on each surface.

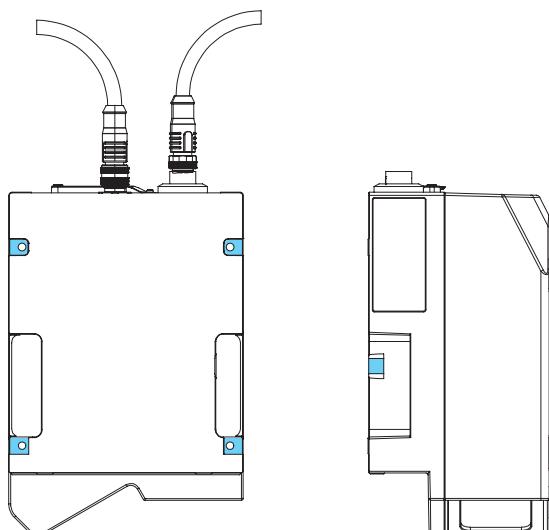
LJ-S015



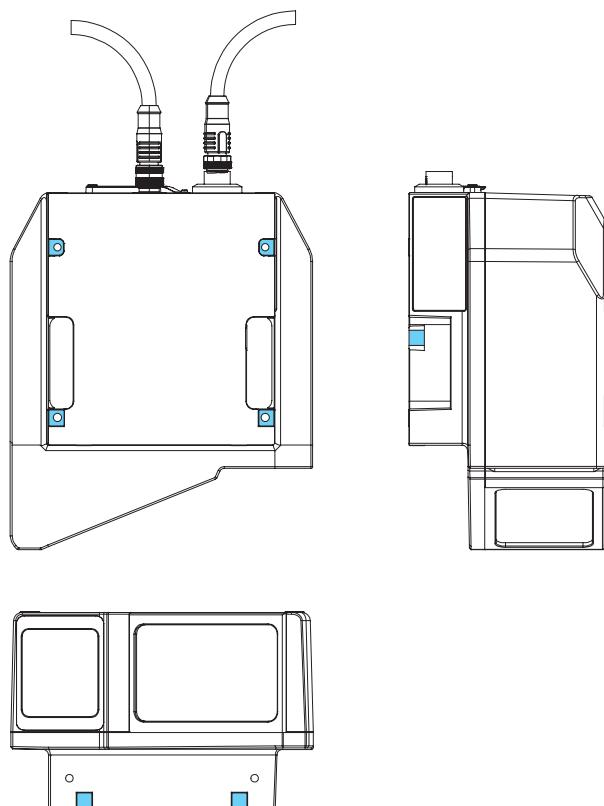
LJ-S025

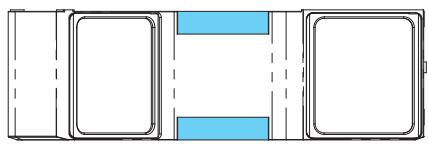
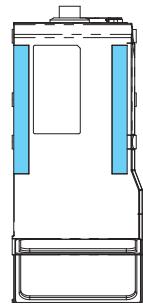
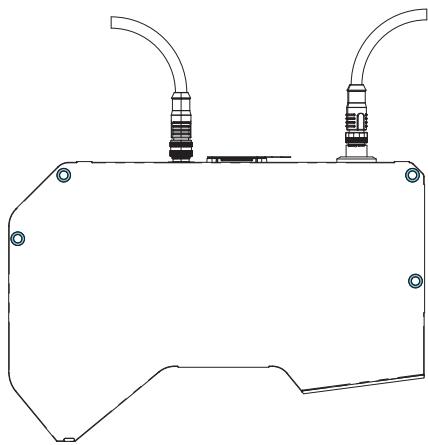
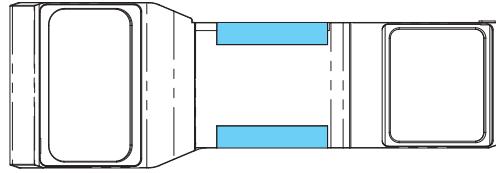
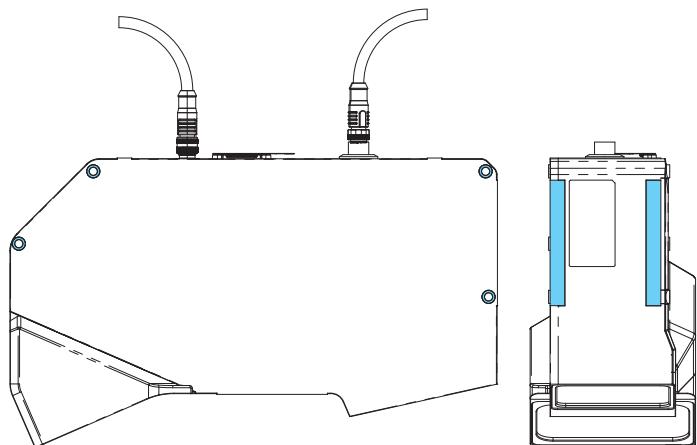
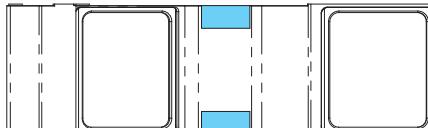
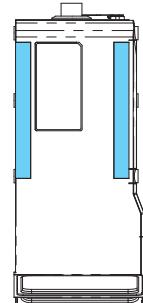
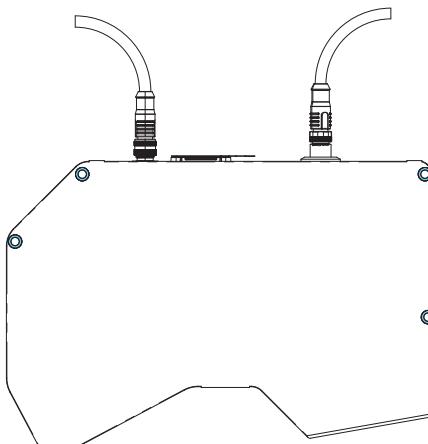


LJ-S040



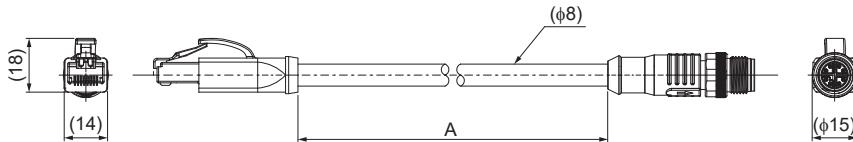
LJ-S080



LJ-S160**LJ-S640****LJ-S320**

Options

Ethernet cable for head (OP-88835/88836/88837)

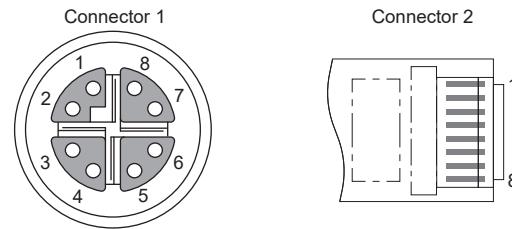


Type name	Cable length (A)	Weight
OP-88835	2m	180 g
OP-88836	5m	370 g
OP-88837	10m	700 g

Cable Specifications

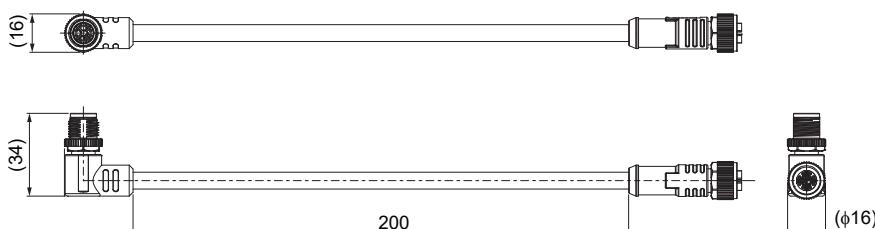
Type		OP-88835/88836/88837
Connector 1	Shape	M12X cord
	Polarity	Plug
	Number of pins	8
Connector 2	Shape	RJ45
	Polarity	Plug
	Number of pins	8
Rated voltage		DC60V
Rated current (average current)		0.6A
Protective structure (when joined)		IP67
Ambient temperature		-25°C to 75°C
Flame resistance		VW-1
AWG diameter		26
Category		Cat5e
Material	Sheath	PVC
	Mold	TPEE
	Connector 1	Brass
	Connector 2	PC
Cable color		Light blue

Pin layout

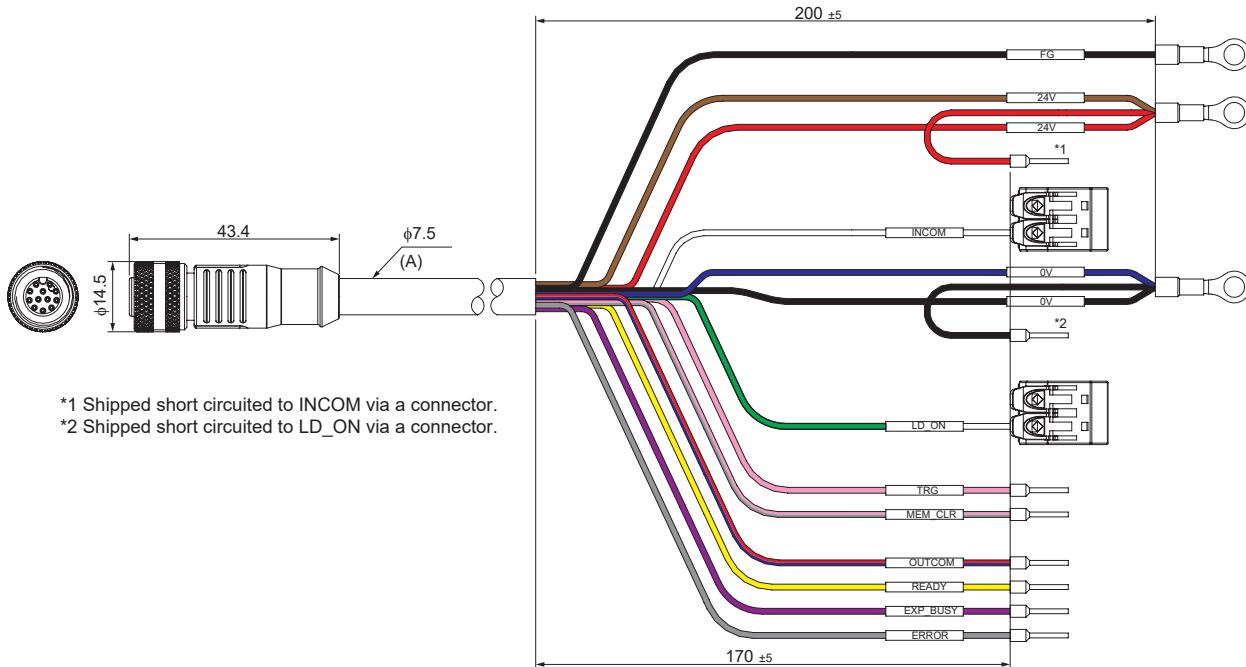


Pin no. of connector 1	AWG	Pin no. of connector 2
1	26	1
2	26	2
3	26	3
4	26	6
5	26	7
6	26	8
7	26	5
8	26	4

Ethernet cable for L-shaped head (OP-88825)



Power I/O cable for head (OP-88949/88950/88951)

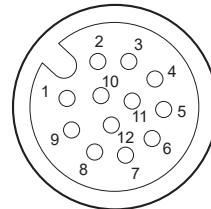


Type name	Cable length (A)	Weight
OP-88949	2m	Approx. 180g
OP-88950	5m	Approx. 430g
OP-88951	10m	Approx. 830g

Cable Specifications

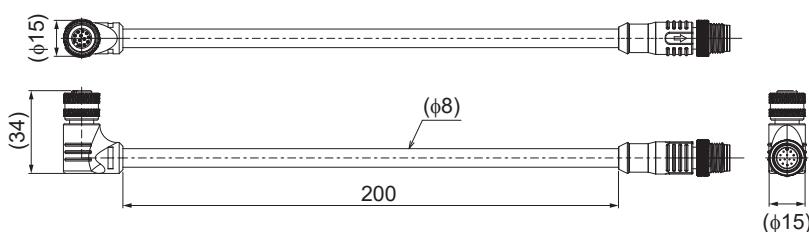
Type		OP-88949/88950/88951
Connector	Shape	M12A cord
	Polarity	Socket
	Number of pins	12
Rated voltage		DC30V
Rated current (average current)		3.2 A (AWG22) / 1.5 A (AWG26)
Protective structure (when joined)		IP67
Ambient temperature		-25°C to 75°C
Flame resistance		VW-1
AWG diameter		22/26
Material	Sheath	PVC
	Mold	TPEE
	Connector	Brass
Cable color		Black

Pin layout



Pin no. of connector 1	Color	AWG
1	Brown	22
2	Blue	22
3	White	26
4	Green	26
5	Pink	26
6	Yellow	26
7	Black	22
8	Gray	26
9	Red	22
10	Purple	26
11	Pink/Gray	26
12	Red/Blue	26

Power I/O cable for L-shaped head (OP-88826)



Others

Model name	Description
OP-87262	Monitor stand for CA-MP120
OP-42279	Pole mounting bracket for CA-MP120
OP-66842	Monitor cable (3 m)
OP-87055	Monitor cable (10 m)
CA-SD16G	SD card 16 GB (industrial specifications)
CA-SD4G	SD card 4 GB (industrial specifications)
CA-SD1G	SD card 1 GB (industrial specifications)
OP-87133	SD card 512 MB (industrial specifications)
OP-51657	Parallel connection cable (3 m)
OP-26486	D-sub9 pin connector (female)
OP-26485	D-sub25 pin connector (female)
OP-86930	D-sub 9-pin connector (MELSEC)
OP-84384	D-sub 9-pin connector (SYSMAC)
OP-26487	Serial connection cable (2.5 m, straight)
OP-66843	Ethernet cable (3 m, cross cable)
OP-66844	USB 2.0 cable (2 m)
CA-U4	Ultra-compact switching power supply (6.5 A)
CA-U5	Ultra-compact switching power supply (12.5 A)
OP-87506	Dedicated mouse
OP-88956	OP stand head adjuster
OP-88957	OP stand base panel
OP-88958	OP stand height adjustment block (1 piece)
OP-88959	OP stand height adjustment block (3 pieces)
OP-88960	OP stand attachment panel A
OP-88961	OP stand attachment panel B
OP-88956	Adjuster
OP-88957	Base plate
OP-88958	Height adjustment block (1 piece)
OP-88959	Height adjustment block (3 piece)
OP-88960	Mounting Plate A
OP-88961	Mounting Plate B
OP-89041	Mounting Plate C
OP-89042	Mounting Plate D
OP-89040	Mounting rail set

Appendix

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Calculation Overview

The operators and functions as well as the operation symbol that is supported by the calculation tool will be explained.

- "Operation Notations" (Page A-2)
- "Operation Function List" (Page A-6)
- "Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)" (Page A-28)

Operation Notations

Follow the following rules when describing an operation on the LJ-S Series.

- "Supported Character Sets" (Page A-2)
- "Operation Notations" (Page A-2)
- "Programming" (Page A-3)
- "Temporary variables" (Page A-3)
- "Expressions and Operators" (Page A-4)
- "Statements" (Page A-5)

Supported Character Sets

Calculations and scripts can be created using the following characters.

Type	Character set
Space	<Space> <TAB>
Letters	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
Numbers	0123456789
Symbol	.()[]+-*^=<>_@':%

- Spaces and tabs are identified as token (language) separators.
- Letters are case-sensitive.

Operation Notations

● Functions and lines

- Operation programs are made up of multiple lines.
- Each line can contain a set of elements for defining a single function.
- A function is the smallest unit of execution in a calculation/script.

● Comment

- Comments are indicated by a single quotation (' mark).
- Functions after a single quotation (' on the same line are ignored.

● Example

```
@a = 100 'Set initial values
'Date created:May23
```

● Line continuation

To separate a long line into several lines, use a space and an underscore ("space" + " _").

○ Example 1 (Correct)

```
IF (@a > 100) AND (@a < 200) THEN
... (omitted)
END IF
```

○ Example 2 (Correct)

```
IF (@a > 100) AND_
(@a < 200) THEN
... (omitted)
END IF
```

○ Example 3 (Error)

```
IF (@a > 100) AND
(@a < 200) THEN
... (omitted)
END IF
```

○ Example 4 (Correct)

```
@max = Max(@a, @b, @c,_
@d, @e, @f)
```

● Commentary on the example

Example 1: Processed correctly because the function is written on a single line.

Example 2: Processed correctly because the line continuation syntax is used.

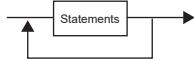
Example 3: Results in an error because the line continuation syntax is missing.

Example 4: Example of separating function arguments over two lines.

Programming

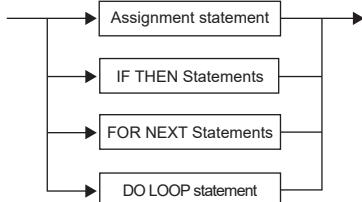
● Arithmetic expression

Arithmetic expressions are comprised of statements.



● Statements

Statements are categorized into Assignment, IF, FOR, and DO LOOP statements.



● Other

- The maximum number of characters that can be used is 5000.
- The levels of nesting allowed for parentheses, IF, FOR, and DO LOOP statements is subject to the amount of free memory. If the available memory space is exceeded, a programming error will occur when the calculation is applied, and the cursor moves to the beginning of the expression where the error occurs.

Temporary variables

Description of a string starting with [...] can treat the string as a temporary variable. By assigning a value into the temporary variable, it can be quoted again during calculation.

● Example

`@a=10`
`ANS0=20+@a`
`[ANS0] is set to a value of "30".`

○ Example (Error)

`@a_10[10] ... (1)`

● Commentary on the example

(1) cannot use arrays.

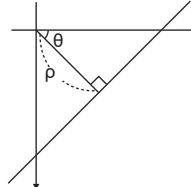
● Variable type of temporary variables

A temporary variable is fixed by the value type which is input first in the calculation. Since a temporary variable of which the type is not fixed cannot be used, be sure to input a value into the variable in advance. Six types are available; "Scalar", "Position", "Line", "Circle", "3D Position" and "Plane". Each consists of the data in the table below.

Type	Notation Method	Internal Storage Type
Scalar	Variable name	64-bit floating point number
Position	Variable name.X (X coordinate)	64-bit floating point number
	Variable name.Y (Y coordinate)	64-bit floating point number
Line*	Variable name.T(θ)	64-bit floating point number
	Variable name.RH(r)	64-bit floating point number
Circle	Variable name.CX (Center X coordinate of circle)	64-bit floating point number
	Variable name.CY (Center Y coordinate of circle)	64-bit floating point number
	Variable name.CR (circle radius)	64-bit floating point number
3D Position	Variable name.TX (X coordinate)	64-bit floating point number
	Variable name.TY (Y coordinate)	64-bit floating point number
	Variable name.TZ (Z coordinate)	64-bit floating point number
Plane**	Variable name.PPA	64-bit floating point number
	Variable name.PPB	64-bit floating point number
	Variable name.PPC	64-bit floating point number

*The following is the line-type notation.

- $RH(p)$
Length (pixels) of the perpendicular line connecting the straight line from the origin (0,0)
- $T(\theta)$
Clockwise angle where the three o'clock direction of the perpendicular line of $RH(p)$ is 0 degrees



** The following is the plane-type notation.

PPA, PPB, PPC: Value of each coefficient when a plane is expressed with $z=PPAx+PPBy+PPC$.

● Example

`@a=AsPoint(20,30)`

Since "@a" is treated as a positional variable, it is treated as "@a.X=20" and "@a.Y=30".

● Precautions for use of temporary variables

- Temporary variables cannot be referred between different calculation tools.
- Variable names have to be 32 characters or less including the @ sign.

Expressions and Operators

Mathematical operators

Mathematical operators can be used for processing numerical values. The following operators are available.

Operator	Description	Syntax	Explanation
$^$	Power	A^B	Raises A to the power of B.
$+$	Positive	$+A$	A
$-$	Negative	$-A$	Inverts the sign of A.
$*$	Multiply	$A * B$	Multiplies A by B.
$/$	Divide	A / B	Divides A by B.
MOD	Modulo	$A \text{ MOD } B$	The remainder when A is divided by B.
$+$	Add	$A + B$	Adds A and B.
$-$	Subtract	$A - B$	Subtracts B from A.

Comparison operators

Comparison operators compare scalar data and produce Boolean (true or false) results.

A true/false value of 1 indicates true and a value of 0 indicates false.

Operator	Description	Syntax	Explanation
$=$	Equal to	$A = B$	A is equal to B.
\neq	Not equal to	$A \neq B$	A is not equal to B.
$>$	Greater than	$A > B$	A is greater than B.
$<$	Less than	$A < B$	A is less than B.
\geq	Greater than or equal to	$A \geq B$	A is greater than or equal to B.
\leq	Less than or equal to	$A \leq B$	A is less than or equal to B.



Comparison operations are executed in 64-bit floating point decimal form.

Example

- If @a is equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a = @b THEN
...
END IF
- If @a is not equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a <> @b THEN
...
END IF
- If @a is greater than @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a > @b THEN
...
END IF
- If @a is less than @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a < @b THEN
...
END IF
- If @a is greater than or equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a >= @b THEN
...
END IF
- If @a is less than or equal to @b, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF @a <= @b THEN
...
END IF



Comparison operators can only be used in conditional statements (such as IF and WHILE). They cannot be processed on their own.

If a statement such as "@a=@b<>@c", 0 or 1 is used for defining @a, a programming error will occur.

To define @a, the script must be written using the IF statement as shown.

```
IF @b<>@c THEN
    @a=1
ELSE
    @a=0
ENDIF
```

Logic operators

Logic operators can be used in conditional functions for performing true/false operations. Logic operators can only be used in conditional statements (such as IF and WHILE).

The following logic operators are available.

Operator	Description	Syntax	Explanation
NOT	Logical inverse	NOT A	Inverts A.
AND	Multiplication	A AND B	Multiplies A and B.
OR	Addition	A OR B	Adds A and B.
XOR	Exclusive Addition	A XOR B	Exclusive OR of A and B

Example

- If @a is a value other than 1, the result of the statement is TRUE (1), and if it is 1, the expression is FALSE (0):
IF NOT (@a = 1) THEN
...
END IF
- If @a is greater than -1 and less than +1, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF (@a > -1) AND (@a < +1) THEN
...
END IF
- If @a is less than -1 or greater than +1, the result of the statement is TRUE (1), otherwise it is FALSE (0):
IF (@a < -1) OR (@a > +1) THEN
...
END IF
- If one of @a or @b are 0 and the other value is not 0, the result of the statement is TRUE (1)
If both @a and @b are 0 or both not 0, the result of the statement is FALSE (0):
IF (@a = 0) XOR (@b = 0) THEN

Priority of Operator

If a statement contains more than one operator, the order of execution is based on the priority of the operators.

Operators are evaluated in the following order.

- (1) Mathematical Operators
- (2) Comparison Operators
- (3) Logic Operators

The priority of operators is shown in the table below.

Operator		Description	Processing Priority
Mathematical Operators	$^$	Power	1
	$+$	Positive	2
	$-$	Negative	
	$*$	Multiply	3
	$/$	Divide	
	MOD	Modulo	4
	$+$	Add	
Comparison Operators	$-$	Subtract	5
	$=$	Equal to	
	\neq	Not equal to	
	$>$	Greater than	
	$<$	Less than	6
	\geq	Greater than or equal to	
Logic Operators	\leq	Less than or equal to	
	NOT	Logical inverse	7
	AND	Multiplication	8
	OR	Addition	9
	XOR	Exclusive Addition	10

Example

- IF @a > -1 AND @a < +1 THEN ... (1)
- ...
END IF
- IF (@a > -1) AND (@a < +1) THEN ... (2)
- ...
END IF
- @a = 1 + 2 * 3 ... (3)
- @a = 1 + (2 * 3) ... (4)
- @a = (1 + 2) * 3 ... (5)

Commentary on the example

- (1) and (2) result in being processed the same way.
- (3) and (4) result in being processed the same way.
- The result of (3) is 7.
- The result of (4) is 7.
- The result of (5) is 9.

Statements

Assignment statement

- An item (result, setting, value, etc.) can be substituted to a variable.
- The item on the right of the expression is assigned to the variable on the left of the "=" sign.
- Only items of the same type can be assigned to each other.

Syntax

variable = expression

Syntax



Example (Correct)

- Assignment of a scalar variable:
@a = @a + 1
- Assignment of the X component (scalar value) of a circle to a scalar variable:
@a = @circle.CX
- Assignment of the three scalar components of a circle (CX, CY, CR) to a circle type variable:
@circle_A = @circle

Example (Error)

- Incorrect assignment of a circle value into a scalar variable:
@a = @circle
- Incorrect assignment of a scalar value into a circle variable:
@circle = @a

IF THEN: Conditional function

Process a single set of functions as a block from multiple blocks based on the result of a conditional expression.

Syntax

```
If <conditional expressions> THEN
- statements -
[ELSE IF]
- statements -
[ELSE]
- statements -
END IF
```

Reference The parts in the [] brackets in the syntax shown above can be omitted.

Explanation

- If the result of the IF statement condition is true, execute the block after THEN and branch to END IF.
 - If false, branch to the next ELSE IF.
 - If false and ELSE IF is omitted, branch to ELSE.
 - If no ELSE IF or ELSE is programmed and the condition is FALSE, execution branches to END IF.
- If the result of the ELSE IF statement condition is true, execute the block after THEN and branch to END IF.
 - If false, branch to the next ELSE IF.
 - If false and ELSE IF is omitted, branch to ELSE.
 - If no ELSE IF or ELSE is programmed and the condition is FALSE, execution branches to END IF.
- The ELSE IF statement can be used as many times as necessary.
- The ELSE statement can only be used as the last ELSE term before END IF.

Example

```
@a = 4
IF @a < 3 THEN
  @b = 333
ELSE IF @a < 4 THEN
  @b = 444
ELSE IF @a < 5 THEN
  @b = 555
ELSE
  @b = 999
END IF
```

Example explanation

In the above example, @b is assigned the value of 555.

FOR TO: Loop with counter (specified count)

Processing a set of functions multiple times in a loop fashion (from FOR to NEXT) for a specified number of iterations.

Syntax

```
FOR <Variable> = <Initial value> TO <Final value> [STEP <increment>]
- statements -
NEXT
```

Explanation

- Before the loop is processed, an initial value is assigned to a variable, which is then incremented each time through the loop. This loop is repeated until the variable value exceeds the final value.
- STEP can be omitted (in which case the incremental value is 1).
- A loop can be exited using the EXIT FOR statement. Processing resumes at the line following the NEXT statement.
- Example
@a = 0
FOR @i = 1 TO 10
 @a = @a + @i
 IF @a > 11 THEN
 EXIT FOR
 END IF
NEXT

Commentary on the example

In the above example, the value of @a becomes 15.

DO: Conditional loop (unspecified count)

Processing a set of functions multiple times in a loop fashion (from DO to LOOP) while a conditional statement is true.

Syntax

```
• Pre-loop evaluation:  
DO WHILE <conditional expression> -statements- LOOP
• Post loop evaluation:  
DO - statements - LOOP WHILE <conditional expression>
```

Explanation

The DO statement uses pre-loop evaluation when the condition is written after the DO statement and post-loop evaluation when the condition is written after the LOOP statement.

- In the pre-loop evaluation, the loop condition must be true in order to process the functions below. When processing reaches the LOOP statement, it returns to the DO statement. If the conditional expression is false, the loop is finished and processing resumes on the line after the LOOP statement.
 - In the post loop evaluation, the statements in the loop are processed first and then the loop condition is checked. If true, processing returns to the DO statement, otherwise the loop is finished and processing resumes on the next line.
 - The loop condition can be omitted (resulting in an endless loop).
 - LOOP can be exited using the EXIT DO statement in the loop after the desired condition.
- Processing resumes on the next line after the LOOP statement DO. If WHILE is omitted the loop function must include EXIT DO.

Example

```
(Pre-loop evaluation)
@a = 0
@i = 0
DO WHILE @i < 10
  @i = @i + 10
  @a = @a + @i
LOOP ... (1)

(Post loop evaluation)
@a = 0
@i = 10
DO
  @i = @i + 1
  @a = @a + @i
LOOP WHILE @i < 10 ... (2)
```

Example explanation

- In the above example @a is assigned the value of 10.
- In the above example @a is assigned the value of 11.

Operation Function List

● Mathematical functions

Function	Description	Ref.
Abs()	Absolute value	A-8
Ave()	Average	A-8
AveR()	Average value in a set range	A-8
Ceil()	Round up	A-8
Deg()	Convert radians to degrees	A-8
Exp()	Exponential	A-8
Floor()	Round down	A-8
Hist()	Refer to the previous measurement	A-8
Int()	Convert to integer	A-9
Ln()	Natural logarithm	A-9
Log()	Common logarithm	A-9
Max()	Maximum value	A-9
MaxN()	Location of Maximum value	A-9
Min()	Minimum value	A-9
MinN()	Location of minimum value	A-9
Pi()	Circle ratio	A-10
Rad()	Convert angle to radians	A-10
Round()	Round to the nearest integer	A-10
Sqr()	Square	A-10
Sqrt()	Square root	A-10
Stdev()	Standard Deviation of a Range of Values	A-10

● Trigonometric functions

Function	Description	Ref.
Acos()	Angle formed by adjacent & hypotenuse	A-11
Asin()	Angle formed by opposite & hypotenuse	A-11
Atan()	Angle formed by opposite & adjacent	A-11
Atan2()	Angle formed by opposite & adjacent (P1/P2)	A-11
Cos()	Adjacent/Hypotenuse: Cosine	A-11
Sin()	Opposite/Hypotenuse: Sine	A-11
Tan()	Opposite/Adjacent: Tangent	A-11

● Two-dimensional geometric operation function

Function	Description	Ref.
AddVector()	Addition of two-dimensional vectors	A-12
AngC()	Center angle	A-12
Angle()	2 point angle	A-12
AngleConv()	Angle conversion	A-12
AngW()	Angle width	A-12
Circle3()	Circle detection (3 points specified)	A-13
CircleTangent()	Circular contact detection	A-13
ConvCrd()	Coordinate system conversion	A-13
ConvCrd2()	Coordinate system conversion 2	A-13
Dist()	Distance between 2 points	A-14
I2Circle()	Intersection point of two circles	A-14
I4XY()	4 point intersection	A-14
I4Line()	Intersection of quadrilateral diagonals	A-14
ILineCircle()	Circle, Straight line intersection	A-15
InnerProd()	Inner product of two-dimensional vectors	A-15
ISect()	2 straight line intersection	A-15
Line()	Line detection (2 points specified)	A-15
LLAngle()	2 straight lines angle	A-16
LnAngle()	Straight line angle	A-16
LnDist()	Point, Distance between straight lines	A-16
LnDistP()	Perpendicular vector distance from point to line	A-16
LnDistXY()	Intersection point with perpendicular	A-17
MidLine()	Bisector	A-17
MidXY()	Middle point	A-17
OuterProd()	Outer product of two-dimensional vector	A-17
Rotate()	Rotation	A-17
RotCenter()	Rotation center	A-18
SubVector()	Subtract of two-dimensional vectors	A-18
VMidLine()	Vertical bisector	A-18
AsCircle()	Circular variable substitution	A-18
CX()	Center x coordinate of circular variable	A-18
CY()	Center Y coordinate of circular variable	A-19
CR()	Radius of circular variable	A-19
C.CX	Center x coordinate of circular variable	A-19
C.CY	Center Y coordinate of circular variable	A-19
C.CR	Radius of circular variable	A-19
AsLine()	Linear type variable substitution	A-19
T()	Angle of straight linear variable	A-19
RH()	Distance from origin of linear variable	A-20
L.T	Angle of straight linear variable	A-20
L.RH	Distance from origin of linear variable	A-20
AsPoint()	Positional variable substitution	A-20
X()	X coordinate of positional variable	A-20
Y()	Y coordinate of positional variable	A-20
Q.X	X coordinate of positional variable	A-20
Q.Y	Y coordinate of positional variable	A-20

● Three-dimensional geometric operation function

Function	Description	Ref.
AddVector3D()	Addition of three-dimensional vectors	A-21
Dist3D()	Distance between 3D coordinates	A-21
I2Plane()	Intersection line of two planes	A-21
ILine3DPlane()	Intersection point of a 3D straight line and a plane	A-21
Line3DDist()	Distance between point and 3D line	A-21
Line3DDistXYZ()	A perpendicular foot from a point to a 3D straight line	A-22
LnLn3DDist()	Distance between 3D straight lines	A-22
Plane2Angle()	Angle of two planes	A-22
PlanePassPt()	Parallel Movement of Plane	A-22
PIDist()	Distance of a plane to a point	A-22
PIDistP()	Distance of a plane to a point (signed)	A-23
PIDistXYZ()	Foot of Perpendicular from Point to Plane	A-23
SubVector3D()	Subtract of three-dimensional vectors	A-23
As3DPoint()	3D positional variable substitution	A-23
TX()	X coordinate of 3D positional variable	A-23
TY()	Y coordinate of 3D positional variable	A-23
TZ()	Z coordinate of 3D position variable	A-24
T.TX	X coordinate of 3D positional variable	A-24
T.TY	Y coordinate of 3D positional variable	A-24
T.TZ	Z coordinate of 3D position variable	A-24
AsPlane()	Define Plane from A, B and C Value	A-24
PPA()	X slope of planar variable	A-24
PPB()	Y slope of planar variable	A-24
PPC()	Z-intercept of planar variables	A-24
P.PPA	X slope of planar variable	A-25
P.PPB	Y slope of planar variable	A-25
P.PPC	Z-intercept of planar variables	A-25

● Calendar functions

Function	Description	Ref.
ShiftDay()	No. Day(s) offset	A-25
ShiftMonth()	No. Month(s) offset	A-25
ShiftYear()	No. Year(s) offset	A-25

● BIT functions

Function	Description	Ref.
B_And()	Multiplication	A-26
B_Not()	Inverse	A-26
B_Or()	Addition	A-26
B_Xor()	Exclusive Addition	A-26
Bind()	Bind Bits	A-26

● Other

Function	Description	Ref.
ANS0	Operation Result 0	A-27
ANS1	Operation Result 1	A-27
ANS2	Operation Result 2	A-27

Mathematical functions

Reference The sample calculations given in the following explanations may be not be precise due to computational errors inherent with processors.

Abs(P): Absolute value

Calculates the absolute value of P.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@integer = -128  
@natural = Abs(@integer)
```

● Commentary on the example

@natural is set to a value of 128.

Ave(P0, P1, ..., Pn): Average

Calculates the average value of P0-Pn (Maximum of 40 items).

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

- An error occurs if none of the terms P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@a = 8  
@b = 9  
@c = 2  
@d = 3  
@average = Ave(@a, @b, @c, @d)
```

● Commentary on the example

@average is set to a value of 5.5.

AveR(Max, Min, P0, P1, ..., Pn): Average value in a set range

Calculates the average value of terms that fall between a specified Min-to-Max range from P0-Pn (Maximum of 40 items).

- The function will still calculate the average if the Min and Max are reversed.
- Results in 0 if none of terms P0 to Pn fall between the Min-to-Max range.

● Argument

○ Max

Maximum value. Constant, scalar variable, or a function that results in a scalar value.

○ Min

Minimum value. Constant, scalar variable, or a function that results in a scalar value.

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@max = 25  
@min = 20  
@a = 21  
@b = 26  
@c = 23  
@average = AveR(@max, @min, @a, @b, @c)
```

● Commentary on the example

@average is set to a value of 22.

Ceil(P): Round up

Rounds P up to the nearest integer.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@a = Ceil(1.5)  
@b = Ceil(-1.5)
```

● Commentary on the example

@a and @b are set to values of 2 and -1, respectively.

Deg(P): Convert radians to degrees

Converts the angle P from radians into degrees.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.
In radians.

● Return value

Scalar value (unit: degrees ($^{\circ}$)).

● Example

```
@degree = Deg(3.14)
```

● Commentary on the example

@degree is set to a value of 179.909...

Exp(): Exponential

Returns the exponential base e value (2.71828183...).

● Argument

None

● Return value

Scalar value

● Example

```
@a = Exp()
```

● Commentary on the example

@a is set to a value of 2.718...

Floor(P): Round down

Truncate the first decimal place of P.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@a = Floor(1.5)  
@b = Floor(-1.5)
```

● Commentary on the example

@a and @b are set to values of 1 and -2, respectively.

Hist(P): Refer to the previous measurement

Refer to the value of the previous measurement for P.

● Argument

○ P

Measured value or judgment value.

Reference

- When the LJ-S Series is started, the program No. is changed, or immediately after reset, the value is "0" regardless of the P value.
- Self-quotation is useful for integration of the measured values in the past. For example, when "ANS = Hist (ANS of own tool) + judgment result of measurement tool" is specified, NG count can be calculated for any measurement tool.

Int(P): Convert to integer

Truncate the first decimal place of P.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@a = Int(1.5)
@b = Int(-1.5)
```

● Commentary on the example

@a and @b are set to values of 1 and -1, respectively.

Ln(P): Natural logarithm

Calculates the natural logarithm of P.

● Argument

○ P

Scalar (larger than 0).

● Return value

Scalar value

● Causes of errors

An error occurs if the value of P is 0 or less.

● Example

```
@e = Exp()
@a = Ln(@e)
```

● Commentary on the example

@a is set to a value of 1.

Log(P): Common logarithm

Calculates the common logarithm (base 10) of P.

● Argument

○ P

Scalar (larger than 0).

● Return value

Scalar value

● Causes of errors

An error occurs if the value of P is 0 or less.

● Example

```
@a = Log(10)
```

● Commentary on the example

The value becomes @a=1.

Max(P0, P1, ..., Pn): Maximum value

Calculates the largest value in P0 - Pn (Maximum of 40 items)

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@a = 8
@b = 9
@c = 2
@d = 3
@max = Max(@a, @b, @c, @d)
```

● Commentary on the example

@max is set to a value of 9.

MaxN(P0, P1, ..., Pn): Location of maximum value

Returns the location (from 0 to n) of the largest value in P0-Pn (maximum of 40 items).

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

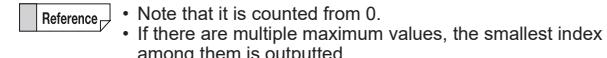
- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@a = 8
@b = 9
@c = 2
@d = 3
@maxn = MaxN(@a, @b, @c, @d)
```

● Commentary on the example

@maxn is set to a value of 1.



Min(P0, P1, ..., Pn): Minimum value

Calculates the smallest value in P0 - Pn (maximum of 40 items).

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@a = 8
@b = 9
@c = 2
@d = 3
@min = Min(@a, @b, @c, @d)
```

● Commentary on the example

@min is set to a value of 2.

MinN(P0, P1, ..., Pn): Location of minimum value

Returns the location (from 0 to n) of the smallest value in P0-Pn (maximum of 40 items).

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

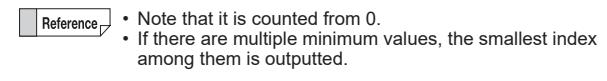
- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

```
@a = 8
@b = 9
@c = 2
@d = 3
@minn = MinN(@a, @b, @c, @d)
```

● Commentary on the example

@minn is set to a value of 2.



Pi(): Circle ratio

Returns the value of p (circular constant) in double precision.

● Argument

None

● Return value

Scalar value

 180 (deg) = n (radian).

Rad(D): Convert angle to radians

Converts the angle D from degrees to radians.

● Argument

○ D

Constant, scalar variable, or a function that results in a scalar value.
The unit is degrees (").

● Return value

Scalar value in radians

● Example

@radian = Rad(30)

● Commentary on the example

@radian is set to a value of 0.523...

Round(P): Round to the nearest integer

Rounds P up or down to the nearest integer.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

@a = Round(1.5)
@b = Round(1.4)
@c = Round(-1.4)
@d = Round(-1.5)

● Commentary on the example

@a, @b, @c and @d are set to values of 2, 1, -1 and -2, respectively.

Sqr(P): Square

Calculates P to the power of 2.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

@param = 2
@result = Sqr(@param)

● Commentary on the example

@result is set to a value of 4.

Sqrt(P): Square root

Calculates the square root of P.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

An error occurs if the value of P is negative.

● Example

@param = 256
@result = Sqrt(@param)

● Commentary on the example

@result is set to a value of 16.

Stdev(P0,P1,...,Pn): Standard deviation

Finds the standard deviation of a range of values P0 to Pn (up to 40).

● Argument

○ P0-Pn

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

- An error occurs if none of the terms from P0 - Pn are specified.
- An error occurs if P0 - Pn is more than 40 terms.

● Example

@a = 8
@b = 9
@c = 2
@d = 3
@stdev = Stdev(@a, @b, @c, @d)

● Commentary on the example

@stdev is set to a value of 3.041.

Trigonometric functions

Acos(P): Angle formed by adjacent & hypotenuse

Calculates the angle of an arc of a right-angled triangle based on (P) (adjacent/hypotenuse).

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value. Specifies a value within the range of -1 to 1.

● Return value

Scalar value (0 to 180) (Unit: degrees (°))

● Causes of errors

An error occurs if the value of P falls outside of -1.0 to +1.0.

● Example

@degree = Acos(0.5)

● Commentary on the example

@degree is set to a value of 60 (°).

Asin(P): Angle formed by opposite & hypotenuse

Calculates the angle of an arc of a right-angled triangle based on (P) (opposite/hypotenuse).

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value. Specifies a value within the range of -1 to 1.

● Return value

Scalar value (-90 to 90) (Unit: degrees (°))

● Causes of errors

An error occurs if the value of P falls outside of -1.0 to +1.0.

● Example

@degree = Asin(0.5)

● Commentary on the example

@degree is set to a value of 30 (°).

Atan(P): Angle formed by opposite & adjacent

Calculates the angle of an arc for a right-angled triangle based on (P) (opposite/adjacent).

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value (-90 to 90) (Unit: degrees (°))

● Example

@degree = Atan(1)

● Commentary on the example

@degree is set to a value of 45 (°).

Atan2(P1, P2): Angle formed by opposite &adjacent (P1/P2)

Angle formed by opposite & adjacent (P1/P2)
If P2 = 0, the function processes as follows.

- P1>0 → 90
- P1<0 → -90
- P1 = 0 @ error

● Argument

○ P1, P2

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value (-180 to 180) (Unit: degrees (°))

● Causes of errors

An error occurs if both P1 and P2 are 0.

● Example

@degree = Atan2(1, 1)

● Commentary on the example

@degree is set to a value of 45 (°).

Cos(D): Adjacent/Hypotenuse: Cosine

Calculates opposite, hypotenuse ratio for a right-angled triangle based on an arc (D) (°).

● Argument

○ D

Constant, scalar variable, or a function that results in a scalar value. The unit is degrees (°).

● Return value

Scalar value

● Example

@a = Cos(60)

● Commentary on the example

@a is set to a value of 0.5.

Sin(D): Opposite/Hypotenuse: Sine

Calculates opposite, hypotenuse ratio for a right-angled triangle based on an arc (D) (°).

● Argument

○ D

Constant, scalar variable, or a function that results in a scalar value. The unit is degrees (°).

● Return value

Scalar value

● Example

@a = Sin(30)

● Commentary on the example

@a is set to a value of 0.5.

Tan(D): Opposite/Adjacent: Tangent

Calculates opposite, adjacent ratio for a right-angled triangle based on an arc (D) (°).

● Argument

○ D

Constant, scalar variable, or a function that results in a scalar value. The unit is degrees (°).

● Return value

Scalar value

● Example

@a = Tan(45)

● Commentary on the example

@a is set to a value of 1.

Two-dimensional geometric operation function

AddVector(Q1, Q2): Addition of two-dimensional vectors

Calculate the addition value of two-dimensional vectors.

● Argument

○ Q1, Q2

Position variable or a function that results in position data.

● Return value

Positional value.

● Example

```
@vector1=AsPoint(1,1)
@vector2=AsPoint(2,2)
@resultVector = AddVector ( @vector1, @vector2 )
```

● Commentary on the example

The value of @resultVector is (3, 3).

AngC(D1, D2): Center angle

Find the center angle when viewed clockwise from angle D1 ($^{\circ}$) to angle D2 ($^{\circ}$).

● Argument

○ D1, D2

Constant, scalar variable, or a function that results in a scalar value. The unit is degrees ($^{\circ}$).

● Return value

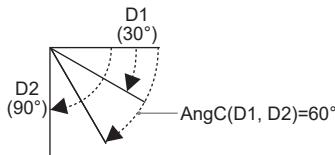
Scalar value (unit: degrees ($^{\circ}$)).

● Example

```
@degree = AngC(30, 90)
```

● Commentary on the example

The value of @degree is 60 ($^{\circ}$).



Angle (Q1, Q2): Angle of 2 points

Find the angle that the line connecting coordinates Q1 and Q2 makes with the horizontal line.

- Find the angle of Q2 centering on Q1.
- The angle is positive clockwise value against the horizontal line.

● Argument

○ Q1, Q2

Position variable or a function that results in position data.

● Return value

Scalar value (unit: degrees ($^{\circ}$)).

- Returns a value greater than -180 degrees and less than or equal to 180 degrees.

● Causes of errors

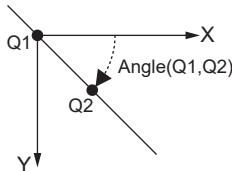
If Q1 and Q2 have the same value, the function terminates abnormally.

● Example

```
@Q1 = AsPoint(0, 0)
@Q2 = AsPoint(1, 1)
@ang = Angle(@Q1, @Q2)
```

● Commentary on the example

@ang is set to a value of 45($^{\circ}$).



AngleConv(D1, D2, P): Angle conversion

Add the angle D2 to the angle D1 and find the converted angle within the range specified by P.

- In the normal case, the angle is measured clockwise using the horizontal line at 3 o'clock as the reference line.
- Using this function, it is possible to convert to an angle based on any reference line direction.

● Argument

○ D1

Angle before conversion (unit: degree ($^{\circ}$)).

Specify constant, scalar variable, or function that results in a scalar value.

○ D2

Angle to be added (unit: degree ($^{\circ}$)).

Specify constant, scalar variable, or function that results in a scalar value.

○ P

In case of 0, it returns as an angle between -180 and 180 ($^{\circ}$).

In case of 1, it returns as an angle between 0 and 360 ($^{\circ}$).

Specify constant, scalar variable, or function that results in a scalar value.

● Return value

Angle after conversion (unit: degree ($^{\circ}$)).

Scalar value

● Causes of errors

If P is other than 0 or 1, the function terminates abnormally.

● Example

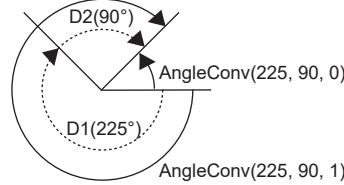
```
@after0 = AngleConv(225, 90, 0)
@after1 = AngleConv(225, 90, 1)
```

● Commentary on the example

The above is converted to an angle with the 12 o'clock direction as the reference line.

The value of @after0 is -45 ($^{\circ}$).

The value of @after1 is 315 ($^{\circ}$).



AngW(D1, D2): Angle width

Find the angle width as viewed clockwise from angle D1 ($^{\circ}$) to angle D2 ($^{\circ}$).

● Argument

○ D1, D2

Constant, scalar variable, or a function that results in a scalar value. The unit is degrees ($^{\circ}$).

● Return value

Scalar value (unit: degrees ($^{\circ}$)).

○ Example 1

```
@degree = AngW(30, 90)
```

○ Commentary of the example 1

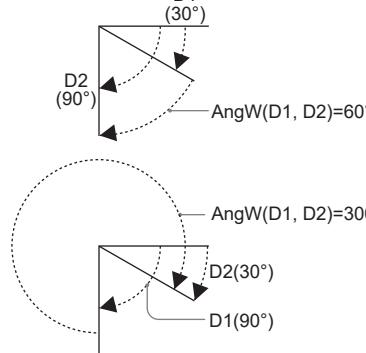
The value of @degree is 60 ($^{\circ}$).

○ Example 2

```
@degree = AngW(90, 30)
```

○ Commentary of the example 2

The value of @degree is 300 ($^{\circ}$).



Circle3(Q1, Q2, Q3): Detect Circle (3 Points)

Calculates the circle that passes through three X,Y positions (Q1, Q2, Q3).

Argument

- Q1, Q2, Q3

Position variable or a function that results in position data.

Return value

Circular value.

Causes of errors

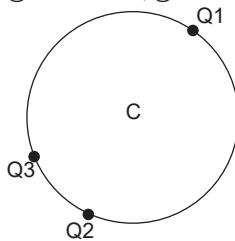
If two or more points are equal coordinates or if three points are aligned, a function terminates abnormally.

Example

```
@point0 = AsPoint(10,0)
@point1 = AsPoint(0,10)
@point2 = AsPoint(10,20)
@circle = Circle3(@point0, @point1, @point2)
```

Commentary on the example

@circle.CX = 10, @circle.CY = 10, and @circle.CR = 10.



CircleTangent(C, Q, P): Circular contact detection

Calculate tangent points (two points) drawn from point Q to circle C.

Argument

- C

Circular variable or function that returns circular value.

- Q

Position variable or a function that results in position data.

- P

Constant, scalar variable, or a function that results in a scalar value.
 • 0: Looking at point Q from circle C, return the value of the left intersection point.
 • 1: Looking at point Q from circle C, return the value of the right side intersection point.

Return value

Positional value (unit: pixel).

Causes of errors

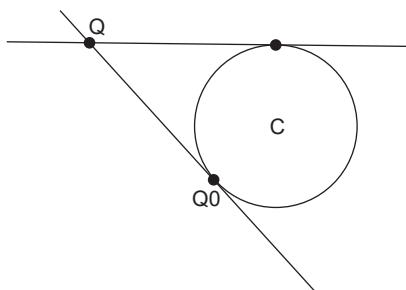
- If point Q is inside a circle, the function ends abnormally.
- If P is other than 0 or 1, the function terminates abnormally.

Example

```
@circle = AsCircle(10, 10, 10)
@point = AsPoint(-10,10)
@tangent0 = CircleTangent(@circle, @point, 0) ... (1)
@tangent1 = CircleTangent(@circle, @point, 1) ... (2)
```

Commentary on the example

- (1) contact is (5, 18.660 ...).
 (2) contact is (5, 1.339 ...).



ConvCrd(Q1, Q2, D, P): Coordinate system conversion

Invert D ° with Q2 as the origin, and find the position of Q1 when expressed in a P-fold coordinate system (coordinate system conversion).

Argument

- Q1, Q2

Position variable or a function that results in position data.

- D

Constant, scalar variable, or a function that results in a scalar value.
 The unit is degrees (°).

- P

Constant, scalar variable, or a scalar value

Return value

Positional value (unit: pixel).

Causes of errors

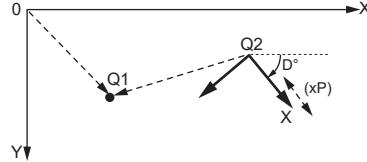
- If P = 0, the function terminates abnormally.

Example

```
@before = AsPoint(10,10 + 10 * Sqrt(2))
@origin = AsPoint(10,10)
@after = ConvCrd(@before, @origin, 45, 1)
```

Commentary on the example

@after is set to a value of (10, 10).



ConvCrd2(Q1, Q2, D, P1, P2): Coordinate system conversion 2

Convert the coordinates of the points represented in the image's coordinate system to ones viewed from an any coordinate system.

- Outputs the position of Q1 in terms of the origin set at Q2, rotated D degrees and scaled by P1.
- Converts to a right hand system or a left hand system.

Argument

- Q1

Transformation source coordinates (coordinates are expressed in transformation source coordinate system) Positional variable or function that returns a positional value.

- Q2

The origin of the coordinate system on conversion destination (coordinates are expressed on the conversion source coordinate system) Positional variable or function that returns the positional value .

- D

Rotation angle of X axis in the destination coordinate system (coordinates expressed in terms of the source coordinate system) Constant, scalar variable, or function that returns a scalar value.

- P1

Magnification of the coordinate system on conversion destination (coordinates are expressed on the conversion source coordinate system) Constant, scalar variable, or function that results in scalar value.

- P2

0 if the positive side of the Y axis faces the same way in the source and destination. 1 if the positive side of the Y axis faces in the opposite direction between the source and destination. (Constant, scalar type variable, or function that returns a scalar value.)

Return value

Positional value.

Causes of errors

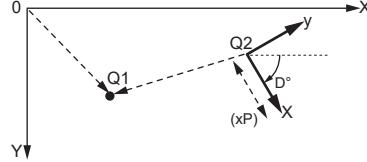
- If P = 0, the function terminates abnormally.
- An error occurs if the value of P2 is neither 0 nor 1.

Example

```
@before = AsPoint(10,10 + 10 * Sqrt(2))
@origin = AsPoint(10,10)
@after0 = ConvCrd2(@before, @origin, 45, 1, 0) ... (1)
@after1 = ConvCrd2(@before, @origin, 45, 1, 1) ... (2)
```

Commentary on the example

- (1) @after0 is set to a value of (10,10).
 (2) @after1 is set to a value of (10,-10).



Dist(Q1, Q2): Distance between 2 points

Calculates the distance between two X,Y positions Q1 and Q2.

Argument

- Q1, Q2

Position variable or a function that results in position data.

Return value

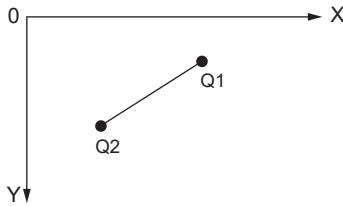
Scalar value (unit: pixel).

Example

```
@point1 = AsPoint(70,20)
@point2 = AsPoint(30,50)
@distance = Dist(@point1, @point2)
```

Commentary on the example

@distance is set to a value of 50.



I2Circle(C1, C2, P): Intersection point of two circles

Calculate the intersection point of two circles C1 and C2 (if they are in contact, the same coordinates are output for both points).

Argument

- C1, C2

Circular variable or function that returns circular value.

- P

- 0: Returns the left intersect point when looking at the line passing through the intersecting points (Q0, Q1) from the center of the circle (C1).
- 1: Looking at the straight line passing Q0 and Q1 from the center point of circle C1, return the value of the right intersection point.

Return value

Positional value (unit: pixel).

Causes of errors

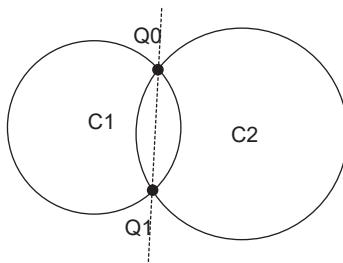
- If the circles do not intersect, the function ends abnormally.
- If P is other than 0 or 1, the function terminates abnormally.

Example

```
@circle0 = AsCircle(10, 10, 10)
@circle1 = AsCircle(20, 20, 10)
@point0 = I2Circle(@circle0, @circle1, 0) ... (1)
@point1 = I2Circle(@circle0, @circle1, 1) ... (2)
```

Commentary on the example

- (1) (20,10) is returned for a intersection point.
- (2) (10,20) is returned for a intersection point.



I4XY(Q1, Q2, Q3, Q4): 4 point intersection

Finds the intersection of diagonals from four points.

Argument

- Q1, Q2, Q3, Q4

Position variable or a function that results in position data.

Return value

Positional value.

Causes of errors

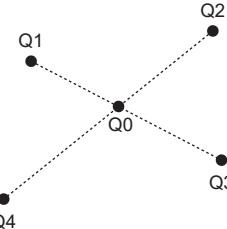
- The function terminates abnormally if Q1 and Q3 as well as Q2 and Q4 have the same coordinates.
- The function terminates abnormally because an intersection cannot be found if lines Q1Q3 and Q2Q4 are parallel.

Example

```
@p0 = I4XY(@Q1,@Q2,@Q3,@Q4)
```

Commentary on the example

The coordinates of the intersection point Q0 are returned to @ p0.



I4Line(L1, L2, L3, L4): Intersection of a quadrilateral's diagonal lines

Finds the intersection of the diagonals of a quadrilateral that is composed by four straight lines.

Argument

- L1, L2, L3, L4

Line variable or a function that results in line data.

Return value

Positional value.

Causes of errors

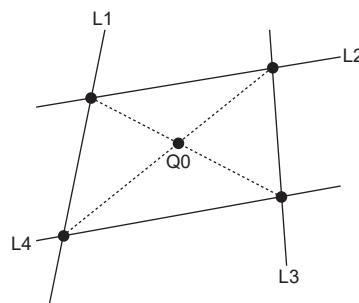
- The function terminates abnormally if at least 1 of the 4 required intersections cannot be found.
- The function terminates abnormally if diagonals cannot be found from the 4 line intersections.

Example

```
@p0 = I4Line(@L1,@L2,@L3,@L4)
```

Commentary on the example

The coordinates of the intersection point Q0 are returned to @ p0.



ILineCircle(C, L, P): Circle, straight line intersection

Calculates the two intersecting points of a circle (C) and a line (L). The points will have the same value if the circle and line are touching but not passing through each other.

● Argument

C
Circular variable or function that returns circular value.

L
Line variable or a function that results in line data.

P
Constant, scalar variable, or a function that results in a scalar value.
• 0: Looking at a straight line L from the center point of circle C, return the value of the left intersection point.
• 1: Returns the right intersect point when looking at the line (L) from the center of the circle (C).

 When line L passes through the center of circle C, it is not determined. Specification by P value is not allowed.

● Return value

Positional value (unit: pixel).

● Causes of errors

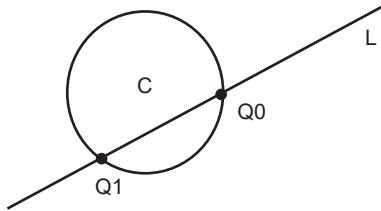
- An error occurs if the circle and line do not intersect.
- If P is other than 0 or 1, the function terminates abnormally.

● Example

```
@circle = AsCircle(10, 10, 10)
@line = AsLine(15 * Sqrt(2), 45) ... (1)
@point0 = ILineCircle(@circle, @line, 0) ... (2)
@point1 = ILineCircle(@circle, @line, 1) ... (3)
```

● Commentary on the example

- (1) straight line $y = -x + 30$ is expressed.
- (2) (20, 10) is returned for an intersection point.
- (3) (10, 20) is returned for an intersection point.



InnerProd(Q1, Q2): Inner product of two-dimensional vector

Calculates the inner product of the 2D vector consisting of Q1 and Q2.

● Argument

Q1, Q2
Position variable or a function that results in position data.

● Return value

Scalar value

● Example

```
@vector1=AsPoint(1,1)
@vector2=AsPoint(2,2)
@result = InnerProd( @vector1, @vector2 )
```

● Commentary on the example

@result is set to a value of 4 (@vector1.X * @vector2.X + @vector1.Y * @vector2.Y).

ISect(L1, L2): Intersection of 2 lines

Calculates the intersecting point of line L1 and line L2.

● Argument

L1, L2
Line variable or a function that results in line data.

● Return value

Positional value (unit: pixel).

● Causes of errors

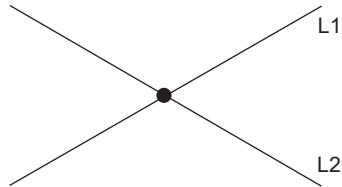
An error occurs if L1 and L2 are parallel.

● Example

```
@point0 = AsPoint(20,0)
@point1 = AsPoint(0,10)
@point2 = AsPoint(0,0)
@point3 = AsPoint(20,10)
@intersect = ISect( Line(@point0,@point1), Line(@point2,@point3))
```

● Commentary on the example

@intersect.X is 10 and @intersect.Y is 5.



Line(Q1, Q2): Create line from 2 points

Find a straight line connecting coordinates Q1 and Q2.

● Argument

Q1, Q2
Position variable or a function that results in position data.

● Return value

Line data

● Causes of errors

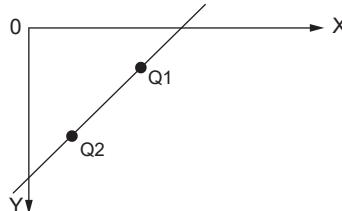
If Q1 and Q2 have the same value, the function terminates abnormally.

● Example

```
@point1 = AsPoint(50,20)
@point2 = AsPoint(20,50)
@line = Line(@point1, @point2)
```

● Commentary on the example

@line.T is set to a value of 45°, and @line.RH to 49.497.



LLAngle(L1, L2): Angle between 2 lines

Calculates the angle ($0^\circ \leq \theta < 180^\circ$) formed by lines L1 and L2 where the angle is the absolute difference of the angle formed ($-90^\circ < \theta \leq 90^\circ$) by L1 and L2 with a horizontal line.

Point If the straight line is vertical to the horizontal line, it is treated as 90° .

Argument

- L1, L2**

Line variable or a function that results in line data.

Return value

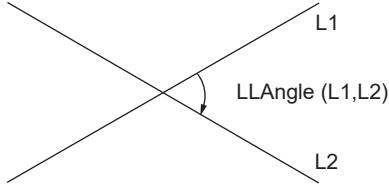
Scalar value (unit: degrees ($^\circ$)).

Example

```
@line0 = AsLine(Sqrt(3) / 2, 60)
@line1 = AsLine(0, 120)
@angle = LLAngle(@line0, @line1)
```

Commentary on the example

The value of @angle is 60° .



LnAngle(L): Angle of line to horizontal

Find the angle that the straight line L makes with the horizontal line (the angle that the straight line makes with the horizontal line is $-90^\circ < \theta \leq 90^\circ$).

Point If the straight line is vertical to the horizontal line, it is treated as 90° .

Argument

- L**

Line variable or a function that results in line data.

Return value

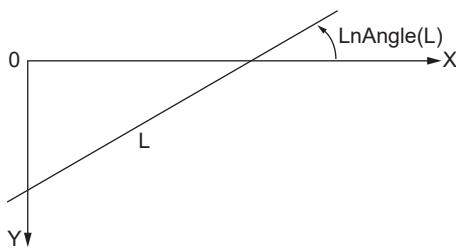
Scalar value (unit: degrees ($^\circ$)).

Example

```
@line = AsLine(Sqrt(3) / 2, 60)
@ang = LnAngle(@line)
```

Commentary on the example

@ang is set to a value of -30° .



LnDist(L, Q): Circle, distance between 2 straight lines

Calculates the perpendicular distance between line L and X,Y position Q.

Argument

- L**

Line variable or a function that results in line data.

- Q**

Position variable or a function that results in position data.

Return value

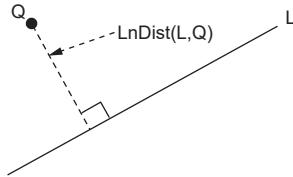
Scalar value (unit: pixel).

Example

```
@point = AsPoint(0,0)
@line = AsLine(1.5, 60)
@distance = LnDist(@line, @point)
```

Commentary on the example

@distance is set to a value of 1.5.



LnDistP(L, Q): Distance from point to line (Signed)

Signed output of LnDist. When the point Q is below the straight line L it is a positive value, and when it is above the line L it is a negative value.

Argument

- L**

Line variable or a function that results in line data.

- Q**

Position variable or a function that results in position data.

Return value

Scalar value (unit: pixel).

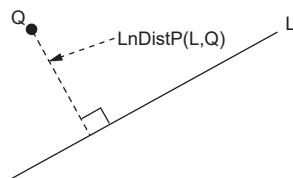
- When point Q is more on the positive side of the Y axis than line L, a positive value is returned.
- However, when line L is parallel to axis Y, it is when point Q is more on the positive side of axis X than line L that a positive value is returned.

Example

```
@point = AsPoint(0,0)
@line = AsLine(1.5, 60)
@distance = LnDistP(@line, @point)
```

Commentary on the example

@distance is set to a value of -1.5.



LnDistXY(L, Q): Intersection in respect to perpendicular

Calculates the intersecting point between the line L and the perpendicular line from X,Y position Q.

Argument

- L Line variable or a function that results in line data.

- Q Position variable or a function that results in position data.

Return value

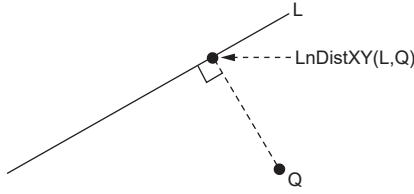
Positional value (unit: pixel).

Example

```
@point = AsPoint(10,10)
@line = AsLine(5 * Sqrt(2), 45)
@intersect = LnDistXY(@line, @point)
```

Commentary on the example

@intersect is set to a value of (5, 5).



MidLine(L1, L2, P): Bisector

Calculates two bisecting lines based on the intersection of two straight lines L1 and L2.

Argument

- L1, L2 Line variable or a function that results in line data.

- P Constant, scalar variable, or a function that results in a scalar value.
 - 0: θ component returns the median between L1 and L2.
 - 1: returns the line perpendicular to the median when 0 is specified.

Return value

Line data

Causes of errors

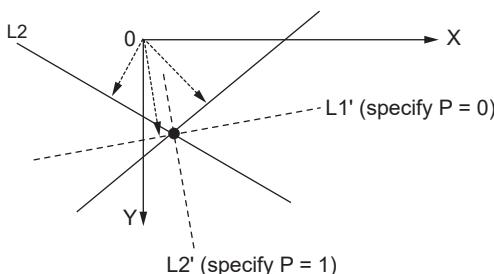
- An error occurs if L1 and L2 are parallel.
- If P is other than 0 or 1, the function terminates abnormally.

Example

```
• @Line0 = AsLine(10, 60)
• @Line1 = AsLine(0, 120)
• @line = MidLine(@Line0, @Line1, 0) ... (1)
• @line = MidLine(@Line0, @Line1, 1) ... (2)
```

Commentary on the example

- (1) It will be $\theta=90^\circ$, $p=5.7735(10/\sqrt{3})$.
- (2) It will be $\theta=0^\circ$, $p=10$.



MidXY(Q1, Q2): Midpoint

Calculates the point Q halfway between X,Y positions Q1 and Q2.

Argument

- Q1, Q2 Position variable or a function that results in position data.

Return value

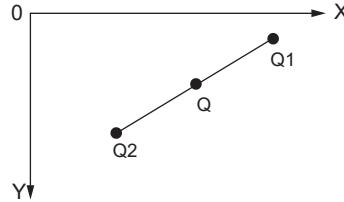
Positional value (unit: pixel).

Example

```
@point0 = AsPoint(90,20)
@point1 = AsPoint(10,80)
@mid = MidXY(@point0, @point1)
```

Commentary on the example

@mid is set to a value of (50, 50).



OuterProd(Q1, Q2): Outer product of vectors

Calculates the outer product of the 2D vector consisting of Q1 and Q2.

Argument

- Q1, Q2 Position variable or a function that results in position data.

Return value

Scalar value

Example

```
@vector1=AsPoint(1,1)
@vector2=AsPoint(2,2)
@result = OuterProd( @vector1, @vector2 )
```

Commentary on the example

The value of @result is 0 (@vector1.X * @vector2.Y - @vector1.Y * @vector2.X).

Rotate(Q1, Q2, D, P): Rotation

Rotate Q1 by D degrees centering Q2 and calculate coordinates multiplied by P.

Argument

- Q1 The rotation source coordinates. Position variable or a function that results in position data.

- Q2 Rotation center. Position variable or a function that results in position data.

- D Rotation angle. Constant, scalar variable, or a function that results in a scalar value. Clockwise is positive.

- P Magnification. Constant, scalar variable, or a function that results in a scalar value.

Return value

Positional value (unit: pixel).

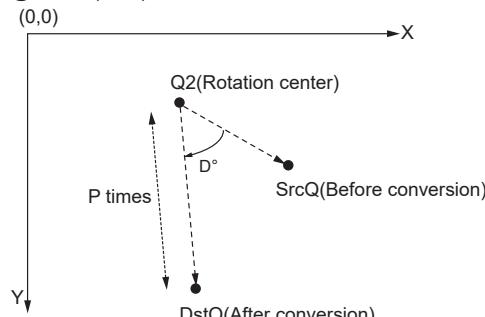
Example

```
@before = AsPoint(15,15)
@origin = AsPoint(10,10)
@after = Rotate(@before, @origin, 90, 2)
```

Commentary on the example

@After is (0, 20).

(0,0)



RotCenter(Q1, Q2, D): Rotation center

Find the rotation center coordinates when rotated D degrees from Q1 to Q2.

Argument

- Q1**
Positional variables or functions that return positional values (Coordinates before rotation).
- Q2**
Positional variables or functions that return positional values (Coordinates after rotation).
- D**
Constant, scalar variable, or a function that results in a scalar value.
The unit is degrees ($^{\circ}$)
(The rotation angle from Q1 to Q2)

Return value

Positional value.

Causes of errors

- If Q1 and Q2 have the same value, the function ends abnormally.
- If D is a multiple of 360 degrees (such as -360 degrees, 0 degrees, 360 degrees, 720 degrees, etc.), the function ends abnormally.

Example

```
@origin=RotCenter( @before, @after, 30 )
```

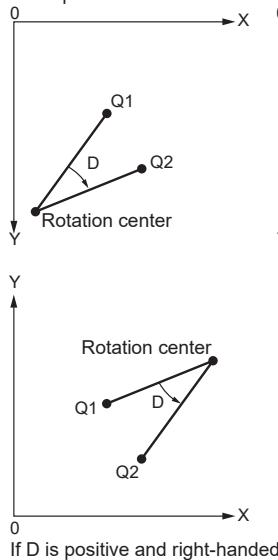
Commentary on the example

Assigns to @origin the rotation center value used for rotating the point of @before 30 degrees to move it to the coordinate of @after.



The rotation angle is positive in the direction from the X-axis to the Y-axis. Specifically, for left-handed systems, the clockwise direction relative to the center of rotation is positive (counterclockwise direction is negative), and for right-handed systems, the counterclockwise direction relative to the center of rotation is positive (clockwise direction is negative).

If D is positive and left-handed If D is negative and left-handed



If D is positive and right-handed

VMidLine(Q1, Q2): Bisector between two points

Calculates the perpendicular line that bisects the line passing through X,Y positions Q1 and Q2.

Argument

- Q1, Q2**
Position variable or a function that results in position data.

Return value

Line data

Causes of errors

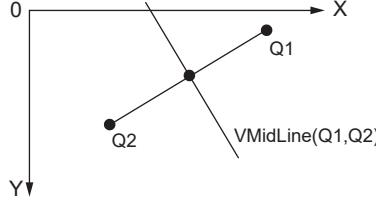
An error occurs if Q1 and Q2 are the same coordinates.

Example

```
@point0 = AsPoint(10*.Sqrt(3),0)
@point1 = AsPoint(0,10)
@line = VMidLine(@point0, @point1)
```

Commentary on the example

@line.T is set to a value of -30° , and @line.RH to 5.



AsCircle(P1, P2, P3): Define circle from single X,Y and radius values

Create a circular variable by assigning P1 as the X center coordinate of a circle, P2 as to Y center coordinate, and P3 as radius R.

Argument

- P1**
X-coordinate value of the center point (a constant, a scalar variable, or a function that returns a scalar value).
- P2**
Y-coordinate value of the center point (a constant, a scalar variable, or a function that returns a scalar value).
- P3**
Radius value (a constant, a scalar variable, or a function that returns a scalar value).

Return value

Circular value.

Example

```
@circle = AsCircle(10, 20, 30)
```

CX (C): Center X coordinate of circular variable

Extract the X coordinate of the center of the circle from the circular variable.

Argument

- C**
Circular variable or function that returns circular value.

Return value

Scalar value

Example

```
@circle = AsCircle(10, 20, 30)
@x = CX(@circle)
```

Commentary on the example

@x is set to a value of 10.

It has the same result as the following operation.
`@circle = AsCircle(10, 20, 30)`
`@x = @circle.CX`

SubVector(Q1, Q2): Subtract of 2D vectors

Calculates the vector by subtracting position vector Q2 from position vector Q1.

Argument

- Q1, Q2**
Position variable or a function that results in position data.

Return value

Positional value.

Example

```
@vector1=AsPoint(1,1)
@vector2=AsPoint(2,2)
@result = SubVector( @vector1, @vector2 )
```

Commentary on the example

@result is set to a value of (-1,-1).

CY (C): Center Y coordinate of circular variable

Extract the Y coordinate of the center of the circle from the circular variable.

● Argument

C

Circular variable or function that returns circular value.

● Return value

Scalar value

● Example

```
@circle = AsCircle(10, 20, 30)
@y = CY(@circle)
```

● Commentary on the example

@y is set to a value of 20.

 It has the same result as the following operation.


```
@circle = AsCircle(10, 20, 30)
@y = @circle.CY
```

CR (C): Radius of circular variable

Extract the circle radius from the circular variable.

● Argument

C

Circular variable or function that returns circular value.

● Return value

Scalar value

● Example

```
@circle = AsCircle(10, 20, 30)
@radius = CR(@circle)
```

● Commentary on the example

@radius is set to a value of 30.

 It has the same result as the following operation.


```
@circle = AsCircle(10, 20, 30)
@radius = @circle.CR
```

C.CX: Center X coordinate of circular variable

● Argument

None

● Return value

Scalar value

● Example: Only center X coordinate is individually updated.

```
@circle = AsCircle(10, 20, 30)
@circle.CX = 40 'Update of center X coordinates
@x = @circle.CX
```

● Commentary on the example

@x is set to a value of 40.

 It has the same result as the following operation.


```
@circle = AsCircle(10, 20, 30)
@circle.CX = 40
@x = CX(@circle) 'When using CX (C)
```

C.CY: Center Y coordinate of circular variable

● Argument

None

● Return value

Scalar value

● Example: Only center Y coordinate is individually updated.

```
@circle = AsCircle(10, 20, 30)
@circle.CY = 40 'Update of center Y coordinate
@y = @circle.CY
```

● Commentary on the example

@y is set to a value of 40.

 It has the same result as the following operation.


```
@circle = AsCircle(10, 20, 30)
@circle.CY = 40
@y = CY(@circle) 'When using CY (C)
```

CR (C): Radius of circular variable

● Argument

None

● Return value

Scalar value

● Example: Only radius value is individually updated.

```
@circle = AsCircle(10, 20, 30)
@circle.CR = 40 'Update of radius value
@radius = @circle.CR
```

● Commentary on the example

@radius is set to a value of 40.

 It has the same result as the following operation.


```
@circle = AsCircle(10, 20, 30)
@circle.CR = 40
@radius = CR(@circle) 'When using CR (C)
```

AsLine(P, D): Linear variable substitution

Assign a linear variable when expressing a straight line as $x \cos D + y \sin D = P$.

● Argument

P

Distance between origin and straight line (constant, scalar variable, or a function that results in a scalar value).

D

The clockwise angle that the perpendicular drawn straight from the origin forms with the 3 o'clock direction (unit: °) (constant, scalar variable, or a function that results in a scalar value).

● Return value

Line data

● Example

```
@line = AsLine(10, 45)
```

T (L): Angle of linear variable

Gets the clockwise angle which has the 3 o'clock direction of the perpendicular line (drawn from the origin (0,0) to the line) as 0°.

● Argument

T (Variable name)

0: 64-bit floating point number.

● Example

```
@line = AsLine(10, 45)
@theta = T(@line)
```

● Commentary on the example

@theta is set to a value of 45.

 It has the same result as the following operation.


```
@line = AsLine(10, 45)
@theta = @line.T
```

RH (L): Distance from origin of linear variable

Gets the perpendicular line length (pixel) drawn from the origin (0, 0) to the line.

● Argument

○ L

Line variable or a function that results in line data.

● Example

```
@line = AsLine(10, 45)
@rho = RH(@line)
```

● Commentary on the example

@rho is set to a value of 10.



It has the same result as the following operation.
`@line = AsLine(10, 45)`
`@rho = @line.RH`

L.T: Angle of linear variable

Gets the clockwise angle which has the 3 o'clock direction of the perpendicular line (drawn from the origin (0,0) to the line) as 0°.

● Argument

None

● Example: Only θ is individually updated.

```
@line = AsLine(10, 45)
@line.T = 30 'Update of θ
@theta = @line.T
```

● Commentary on the example

@theta is set to a value of 30.



It has the same result as the following operation.
`@line = AsLine(10, 45)`
`@line.T = 30`
`@theta = T(@line) 'When using T(L)`

L.RH: Distance from origin of linear variable

Gets the perpendicular line length (pixel) drawn from the origin (0, 0) to the line.

● Argument

None

● Example: Only ρ is individually updated.

```
@line = AsLine(10, 45)
@line.RH = 30 'Update of ρ
@rho = @line.RH
```

● Commentary on the example

@rho is set to a value of 30.



It has the same result as the following operation.
`@line = AsLine(10, 45)`
`@line.RH = 30`
`@rho = RH(@line) 'When RH(L) is used`

AsPoint(P1, P2): Positional variable substitution

Substitute position variables with P1 as X coordinate and P2 as Y coordinate.

● Argument

○ P1

The value of X coordinate (Constant, scalar variable, or a function that results in a scalar value).

○ P2

The value of Y coordinate (Constant, scalar variable, or a function that results in a scalar value).

● Return value

Positional value.

● Example

```
@point = AsPoint(10, 20)
```

X (Q): X coordinate of positional variable

Obtain the X coordinate from a positional variable.

● Argument

○ Q

Position variable or a function that results in position data.

● Example

```
@point = AsPoint(1, 2)
@x = X(@point)
```

● Commentary on the example

@x is set to a value of 1.



It has the same result as the following operation.
`@point = AsPoint(1, 2)`
`@x = @point.X`

Y (Q): Y coordinate of positional variable

Obtain the Y coordinate from a positional variable.

● Argument

○ Q

Position variable or a function that results in position data.

● Example

```
@point = AsPoint(1, 2)
@y = Y(@point)
```

● Commentary on the example

@y is set to a value of 2.



It has the same result as the following operation.
`@point = AsPoint(1, 2)`
`@y = @point.Y`

Q.X: X coordinate of positional variable

● Argument

None

● Example: Update only X coordinate individually

```
@point = AsPoint(1, 2)
@point.X = 10 'Update of X coordinate
@x = @point.X
```

● Commentary on the example

@x is set to a value of 10.



It has the same result as the following operation.
`@point = AsPoint(1, 2)`
`@point.X = 10`
`@x = X(@point) 'When X(Q) is used`

Q.Y: Y coordinate of positional variable

● Argument

None

● Example: Update only Y coordinate individually

```
@point = AsPoint(1, 2)
@point.Y = 10 'Update of Y coordinate
@y = @point.Y
```

● Commentary on the example

@y is set to a value of 10.



It has the same result as the following operation.
`@point = AsPoint(1, 2)`
`@point.Y = 10`
`@y = Y(@point) 'When Y(Q) is used`

Three-dimensional geometric operation function

AddVector3D(Q1, Q2): Addition of three-dimensional vectors

(3) Calculate the addition value of three-dimensional vectors.

● Argument

Q1, Q2

3D positional variables or functions that return 3D positional value.

● Return value

3D positional value.

● Example

```
@P1 = As3DPoint (10,10,10)
@P2 = As3DPoint (20,20,20)
@P = AddVector3D (@P1,@P2)
```

● Commentary on the example

The value of @P is (30,30,30).

Dist3D(Q1, Q2): Distance between 3D coordinates

Find distance between 3D coordinates Q1 and Q2.

● Argument

Q1, Q2

3D positional variables or functions that return 3D positional value.

● Return value

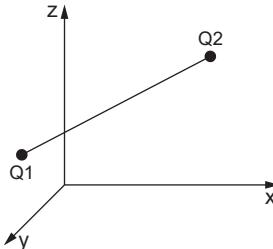
Scalar value (Unit: mm).

● Example

```
@Q1 = As3DPoint (TX1,TY1,TZ1)
@Q2 = As3DPoint (TX2,TY2,TZ2)
@distance = Dist3D(@Q1,@Q2)
```

● Commentary on the example

Distance between two points is returned to @distance.



I2Plane(A1, A2, P, V): Intersection line of two planes

Finds the line of intersection of two planes.

● Argument

A1, A2

Planar variables or functions that return planar values

P

3D positional variable (The found point on the intersection line is stored).

V

3D positional variable (The found direction vector of the intersection line is stored).

● Return value

Scalar value (0=Success).

When the error conditions are fulfilled, the function abnormally terminates, so the return value is not returned.

● Causes of errors

If the normal vectors of the two planes are parallel, the function ends abnormally.



Since the plane formula is expressed as $z = ax + by + c$, it is not possible to calculate a plane with a normal perpendicular to the Z axis.

ILine3DPlane(P, V, A): Intersection of 3D line and plane

Finds the intersection of a 3D line and a plane. The 3D line passes through 3D position P and is shown as a straight line with direction vector V.

● Argument

P

3D positional variables or functions that return 3D positional value.

V

3D positional variables or functions that return 3D positional value.

A

Planar variables or functions that return planar values

● Return value

3D positional value

● Causes of errors

- If the direction vector of the 3D line is perpendicular to the plane's normal vector, then it is a function abnormal end occurs.
- If the direction vector V is (0, 0, 0), a function abnormal end occurs.

Since the plane formula is expressed as $z = ax + by + c$, it is not possible to calculate a plane with a normal perpendicular to the Z axis.

Line3DDist(P, V, Q): Distance between point and 3D line

Finds the distance between a point and a 3D line (straight line in directional vector V passing through 3D position P).

● Argument

P

3D positional variables or functions that return 3D positional value.

V

3D positional variables or functions that return 3D positional value.

Q

3D positional variables or functions that return 3D positional value.

● Return value

Scalar value (Unit: mm).

● Causes of errors

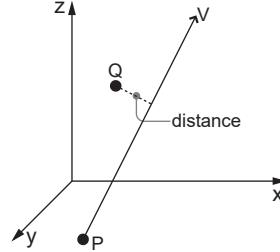
If the direction vector V is (0, 0, 0), a function abnormal end occurs.

● Example

```
@P = As3DPoint (TX1,TY1,TZ1)
@V = As3DPoint (TX2,TY2,TZ2)
@Q = As3DPoint (TX3,TY3,TZ3)
@distance = Line3DDist (@P,@V,@Q)
```

● Commentary on the example

The distance from point Q to the 3D line is returned to @distance.



Line3DDistXYZ(P, V, Q): A perpendicular foot from a point to a 3D straight line

Finds the coordinates (XYZ) for the foot of a perpendicular line dropped from a point to a 3D line (straight line in directional vector V passing through 3D position P).

Argument

- P
3D positional variables or functions that return 3D positional value.
- V
3D positional variables or functions that return 3D positional value.
- Q
3D positional variables or functions that return 3D positional value.

Return value

3D positional value.

Causes of errors

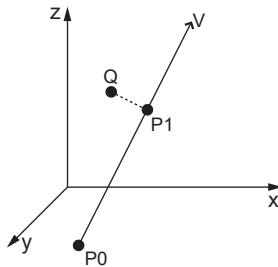
If the direction vector V is (0, 0, 0), a function abnormal end occurs.

Example

```
@P0 = As3DPoint (TX1,TY1,TZ1)
@V = As3DPoint (TX2,TY2,TZ2)
@Q = As3DPoint (TX3,TY3,TZ3)
@p1 = Line3DDistXYZ (@P0,@V,@Q)
```

Commentary on the example

The coordinates of the perpendicular line and straight line intersection P1 are returned to @p1.



LnLn3DDist(P1, V1, P2, V2): Distance between 3D straight lines

Finds the distance between two 3D lines (straight lines in directional vector V passing through 3D position P).

Argument

- P1
3D positional variables or functions that return 3D positional value.
- V1
3D positional variables or functions that return 3D positional value.
- P2
3D positional variables or functions that return 3D positional value.
- V2
3D positional variables or functions that return 3D positional value.

Return value

Scalar value (Unit: mm).

Causes of errors

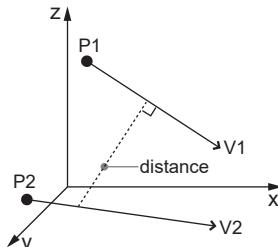
The function terminates abnormally if direction vector V1 or V2 is (0,0,0).

Example

```
@P1 = As3DPoint (TX1,TY1,TZ1)
@V1 = As3DPoint (TX3,TY3,TZ3)
@P2 = As3DPoint (TX2,TY2,TZ2)
@V2 = As3DPoint (TX4,TY4,TZ4)
@distance = LnLn3DDist (@P1,@V1,@P2,@V2)
```

Commentary on the example

The distance between the two lines is returned to @distance.



Plane2Angle(A1, A2): Angle of two planes

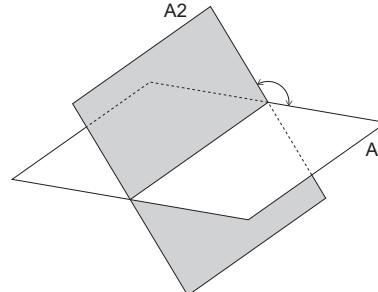
Find a plane and the angle of the plane.

Argument

- A1, A2
Planar variables or functions that return planar values

Return value

Scalar value (Unit: degree (°))



PlanePassPt(A, Q): Parallel movement of a plane

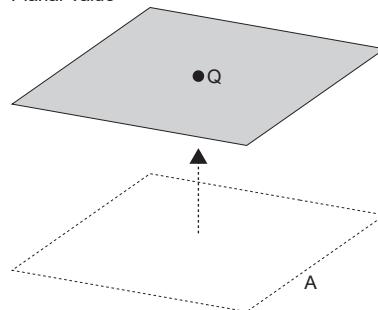
Shift a plane A to find a plane Q passing through the specified point.

Argument

- A
Planar variables or functions that return planar values
- Q
3D positional variables or functions that return 3D positional value.

Return value

Planar value



PIDist(A, Q): Distance between a plane and a point

Find distance between a plane A and 3D coordinate Q.

Argument

- A
Planar variables or functions that return planar values
- Q
3D positional variables or functions that return 3D positional value.

Return value

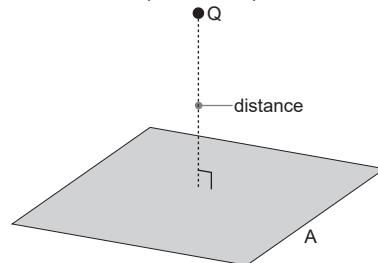
Scalar value (Unit: mm).

Example

```
@Q = As3DPoint (TX,TY,TZ)
@A = AsPlane (P1,P2,P3)
@distance = PIDist (@A, @Q)
```

Commentary on the example

Distance from a plane A to a point Q is returned to @distance.



PIDistP(A, Q): Distance between a plane and a point (signed)

Find the distance between plane A and 3D coordinates Q, and find the signed result (PIDist's signed output with positive normal vector direction).

● Argument

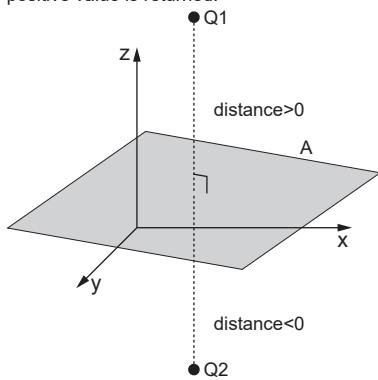
- A**
Planar variables or functions that return planar values

- Q**
3D positional variables or functions that return 3D positional value.

● Return value

Scalar value (Unit: mm).

When the point Q is on the positive side of Z-axis more than the plane A, a positive value is returned.



PIDistXYZ(A, Q): Foot of perpendicular from point to plane

Find the coordinates (XYZ) of a perpendicular foot drawn from a point to a plane.

● Argument

- A**
Planar variables or functions that return planar values

- Q**
3D positional variables or functions that return 3D positional value.

● Return value

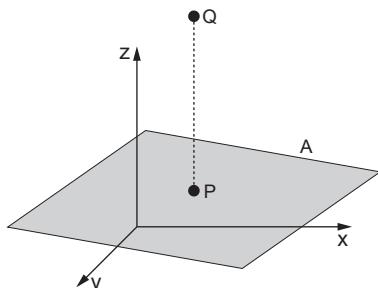
3D positional value.

● Example

```
@Q = As3DPoint(TX,TY,TZ)
@A = AsPlane(P1,P2,P3)
@p = PIDistXYZ(@A,@Q)
```

● Commentary on the example

The 3D coordinates of the perpendicular foot drawn from point Q on plane A are returned to @p. (Reference) Since the formula of the plane is expressed by $z = ax + by + c$, it is not possible to calculate a plane with a normal perpendicular to the Z axis.



SubVector3D(Q1, Q2): Subtract of 3D vectors

Finds the subtracted value of 3D vectors.

● Argument

- Q1, Q2**

3D positional variables or functions that return 3D positional value.

● Return value

3D positional value.

● Example

```
@P1 = As3DPoint(20,20,20)
@P2 = As3DPoint(10,10,10)
@P = SubVector3D (@P1,@P2)
```

● Commentary on the example

The value of @P is (10,10,10).

As3DPoint(P1, P2, P3): 3D positional variable substitution

Substitute P1, P2, and P3 into 3D position type TX, TY, and TZ.

● Argument

- P1**

The value of TX (constant, scalar variable, or a function that results in a scalar value)

- P2**

The value of TY (constant, scalar variable, or a function that results in a scalar value)

- P3**

The value of TZ (constant, scalar variable, or a function that results in a scalar value)

● Return value

3D positional value.

● Example

```
@P = As3DPoint(10,20,30)
```

● Commentary on the example

It has the same result as the following operation.

```
@P.TX = 10
@P.TY = 20
@P.TZ = 30
```

TX(T): X coordinate of 3D position variable

Obtain the X coordinate from a 3D positional variable.

● Argument

- T**

3D positional variables or functions that return 3D positional value.

● Example

```
@p = As3DPoint(10,20,30)
@tx = TX(@p)
```

● Commentary on the example

@tx is set to a value of 10.

Reference It has the same result as the following operation.
@p = As3DPoint(10,20,30)
@tx = @p.TX

TY(T): Y coordinate of 3D position variable

This function obtains the Y coordinate from a 3D position variable.

● Argument

- T**

3D positional variables or functions that return 3D positional value.

● Example

```
@p = As3DPoint(10,20,30)
@ty = TY(@p)
```

● Commentary on the example

@ty is set to a value of 20.

Reference It has the same result as the following operation.
@p = As3DPoint(10,20,30)
@ty = @p.TY

TZ(T): Z coordinate of 3D position variable

This function obtains the Z coordinate from a 3D position variable.

● Argument

T

3D positional variables or functions that return 3D positional value.

● Example

```
@p = As3DPoint(10,20,30)
@tz = TZ(@p)
```

● Commentary on the example

@tz is set to a value of 30.

Reference

It has the same result as the following operation.

```
@p = As3DPoint(10,20,30)
@tz = @p.TZ
```

T.TX: X coordinate of 3D position variable

● Argument

- None

● Example: Update only X coordinate individually

```
@p = As3DPoint(1,2,3)
@p.TX = 10 'X coordinate update
@tx = @p.TX
```

● Commentary on the example

@tx is set to a value of 10.

Reference

It has the same result as the following operation.

```
@p = As3DPoint(1,2,3)
@p.TX = 10
@tx = TX(@p) 'If TX(T) is used
```

T.TY: Y coordinate of 3D position variable

● Argument

None

● Example: Update only Y coordinate individually

```
@p = As3DPoint(1,2,3)
@p.TY = 20 'Y coordinate update
@ty = @p.TY
```

● Commentary on the example

@ty is set to a value of 20.

Reference

It has the same result as the following operation.

```
@p = As3DPoint(1,2,3)
@p.TY = 20
@ty = TY(@p) 'If TY(T) is used
```

T.TZ: Z coordinate of 3D position variable

● Argument

None

● Example: Update only Z coordinate individually

```
@p = As3DPoint(1,2,3)
@p.TZ = 30 'Z coordinate update
@tz = @p.TZ
```

● Commentary on the example

@tz is set to a value of 30.

Reference

It has the same result as the following operation.

```
@p = As3DPoint(1,2,3)
@p.TZ = 30
@tz = TZ(@p) 'If TZ(T) is used
```

AsPlane(P1,P2,P3): Define plane from A, B and C value

Substitute P1, P2 and P3 into planar A, B and C respectively.

● Argument

P1

The value of A (constant, scalar variable, or a function that results in a scalar value)

P2

The value of B (constant, scalar variable, or a function that results in a scalar value)

P3

The value of C (constant, scalar variable, or a function that results in a scalar value)

● Return value

Planar value

● Example

```
@P = AsPlane(10, 20, 30)
```

● Commentary on the example

It has the same result as the following operation.

```
@PPA = 10
```

```
@PPB = 20
```

```
@PPC = 30
```

PPA(P): X Slope of Plane Variable

Take the X slope from a planar variable.

● Argument

P

Planar variables or functions that return planar values.

● Example

```
@p = AsPlane(10,20,30)
```

```
@ppa = PPA(@p)
```

● Commentary on the example

@ppa is set to a value of 10.

Reference

It has the same result as the following operation.

```
@p = AsPlane(10,20,30)
```

```
@ppa = @p.PPA
```

PPB(P): Y Slope of Plane Variable

Take the Y slope from a planar variable.

● Argument

P

Planar variables or functions that return planar values.

● Example

```
@p = AsPlane(10,20,30)
```

```
@ppb = PPB(@p)
```

● Commentary on the example

@ppb is set to a value of 20.

Reference

It has the same result as the following operation.

```
@p = AsPlane(10,20,30)
```

```
@ppb = @p.PPB
```

PPC(P): Z Intercept of Plane Variable

Take the Z intercept from a planar variable.

● Argument

P

Planar variables or functions that return planar values.

● Example

```
@p = AsPlane(10,20,30)
```

```
@ppc = PPC(@p)
```

● Commentary on the example

@ppc is set to a value of 30.

Reference

It has the same result as the following operation.

```
@p = AsPlane(10,20,30)
```

```
@ppc = @p.PPC
```

P.PPA: X Slope of Plane Variable

● Argument

None

● Example: Update only X slope individually

```
@p = AsPlane(1,2,3)
@p.PPA = 10 'X slope update
@ppa = @p.PPA
```

● Commentary on the example

@ppa is set to a value of 10.

 It has the same result as the following operation.
 @p = AsPlane(1,2,3)
 @p.PPA = 10
 @ppa = PPA(@p) 'If PPA(P) is used

P.PPB: Y Slope of Plane Variable

● Argument

None

● Example: Update only Y slope individually

```
@p = AsPlane(1,2,3)
@p.PPB = 20 'Y slope update
@ppb = @p.PPB
```

● Commentary on the example

@ppb is set to a value of 20.

 It has the same result as the following operation.
 @p = AsPlane(1,2,3)
 @p.PPB = 20
 @ppb = PPB(@p) 'If PPB(P) is used

P.PPC: Z Intercept of Plane Variable

● Argument

None

● Example: Update only Z intercept individually

```
@p = AsPlane(1,2,3)
@p.PPC = 30 'Z intercept update
@ppc = @p.PPC
```

● Commentary on the example

@ppc is set to a value of 30.

 It has the same result as the following operation.
 @p = AsPlane(1,2,3)
 @p.PPC = 30
 @ppc = PPC(@p) 'If PPC(P) is used

Calendar functions

ShiftDay(P): No. Day(s) offset

Adds or subtracts the number of days (P) to the current date of this controller, and returns [Day].

● Argument

P

Number of days to be added or subtracted.
 (Constant, scalar variable, or a scalar value)

● Return value

Scalar value

● Causes of errors

An error occurs if the number of days P exceeds 9,999.

● Example

```
@day = ShiftDay(-1)
```

● Commentary on the example

Returns the day one day prior to the current date.

ShiftMonth(P): No. Month(s) offset

Adds or subtracts the number of days (P) to the current date of this controller, and returns [Month].

● Argument

P

Number of days to be added or subtracted.
 (Constant, scalar variable, or a scalar value)

● Return value

Scalar value

● Causes of errors

An error occurs if the number of days P exceeds 9,999.

● Example

```
@month = ShiftMonth(10)
```

● Commentary on the example

Returns the month of the date 10 days after the current date.

ShiftYear(P): No. Year(s) offset

Adds or subtracts the number of days (P) to the current date of this controller, and returns [Year].

● Argument

P

Number of days to be added or subtracted.
 (Constant, scalar variable, or a scalar value)

● Return value

Scalar value

● Causes of errors

An error occurs if the number of days P exceeds 9,999.

● Example

```
@year = ShiftYear(-365)
```

● Commentary on the example

Returns the year of the date 365 days prior to the current date.

BIT functions

B_And(P1, P2): Multiplication

Calculates the logical product of the BIT's of P1 and P2.

- The function converts P1 and P2 from a scalar value to a 4-byte integer and returns the calculated result as a scalar value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer ($= 4294967295 = 32\text{nd power of } 2 - 1$), the lower 4-bytes are used and all bits above that are ignored.

● Argument

○ P1, P2

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@param1 = 10.1
@param2 = 3.14
@result = B_And(@param1, @param2)
```

● Commentary on the example

@result is set to a value of 2.

B_Not(P): Inverse

Calculates the logical inverse of the BIT's of P.

- The function converts P from a scalar value to a 4-byte integer and returns the calculated result as a scalar value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer ($= 4294967295 = 32\text{nd power of } 2 - 1$), the lower 4-bytes are used and all bits above that are ignored.

● Argument

○ P

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@param = 10.1
@result = B_And(B_Not(@param), 15)
```

● Commentary on the example

@result is set to a value of 5.

B_Or(P1, P2): Addition

Calculates the logical sum of the BIT's of P1 and P2.

- The function converts P1 and P2 from a scalar value to a 4-byte integer and returns the calculated result as a scalar value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer ($= 4294967295 = 32\text{nd power of } 2 - 1$), the lower 4-bytes are used and all bits above that are ignored.

● Argument

○ P1, P2

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@param1 = 10.1
@param2 = 3.14
@result = B_Or(@param1, @param2)
```

● Commentary on the example

@result is set to a value of 11.

B_Xor(P1, P2): Exclusive OR

Calculates the exclusive logical OR of the BIT's of P1 and P2.

- The function converts P1 and P2 from a scalar value to a 4-byte integer and returns the calculated result as a scalar value.
- If the value specified exceeds the maximum for an unsigned 4-byte integer ($= 4294967295 = 32\text{nd power of } 2 - 1$), the lower 4-bytes are used and all bits above that are ignored.

● Argument

○ P1, P2

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Example

```
@param1 = 10.1
@param2 = 3.14
@result = B_Xor(@param1, @param2)
```

● Commentary on the example

@result is set to a value of 9.

Bind(P0, P1, P2, P3, P4, P5, P6, P7): Bind Bits

Binds the bits from P0 to P7 into an 8-bit value (P0: MSB, P7: LSB).

● Argument

○ P0 - P7

Constant, scalar variable, or a function that results in a scalar value.

● Return value

Scalar value

● Causes of errors

An error occurs if the value of P0 to P1 is neither 0 nor 1.

● Example

```
@result = Bind(0,1,0,1,0,1,0,1)
```

● Commentary on the example

@result is set to a value of 85.

Other

ANS0: Operation result 0

A scalar variable defined in advance. It is equivalent to the result data of the calculation tool.

- ANS has to be referenced in uppercase letters.
- ANS must be referred as left-hand side value.

● Example

$ANS0 = T101.RSLT.X[JGL]:AB - T100.RSLT.X[JGL]:AB$

● Commentary on the example

Puts the difference between the X coordinate measured by the tool whose tool ID is 101 and the X coordinate measured by the tool whose tool ID is 100 into ANS0.

ANS1: Operation result 1

A scalar variable defined in advance. It is equivalent to the result data of the calculation tool.

- ANS has to be referenced in uppercase letters.
- ANS must be referred as left-hand side value.

● Example

$ANS1 = T101.RSLT.Y[JGL]:AB - T100.RSLT.Y[JGL]:AB$

● Commentary on the example

Puts the difference between the Y coordinate measured by the tool whose tool ID is 101 and the Y coordinate measured by the tool whose tool ID is 100 into ANS1.

ANS2: Operation result 2

A scalar variable defined in advance. It is equivalent to the result data of the calculation tool.

- ANS has to be referenced in uppercase letters.
- ANS must be referred as left-hand side value.

● Example

$ANS2 = T101.RSLT.T[JGL]:AB - T100.RSLT.T[JGL]:AB$

● Commentary on the example

Puts the difference between the angle measured by the tool whose tool ID is 101 and the angle measured by the tool whose tool ID is 100 into ANS2.

Operation Symbol/Output Item Comparison Table (Measured Value/Judgment Value)

Reference

- ST (Reference value): Measured value for the reference image calculated during setting.
- MS (Measured value): The measured result data that is output.
- JG (Judgment value): Judgment result (OK=0, NG=1).
- AB (Absolute measured value): Measured value before specifying the origin. When Position Correction is used, it is the value before adjustment.
- HL (Upper limit): The upper limit used for judgment.
- LL (Lower limit): The lower limit used for judgment.
- Items that can use label specification are only MS (measured value) and AB (absolute measured value).
- When the output is set, the selection is automatically set to [MS]. Items for which a decimal number (with any number of digits) is listed under Format of measurement data are handled as decimal data in PLC-Link, EtherNet/IP, PROFINET, and EtherCAT. For details, check "Decimal Point" for each communication method in "Chapter 9 Communication control" (Page 9-1).
- For an item with the symbol * shown at the end, the measured value correction function is available. For details, see "Correction of measured values" (Page 5-12).

Tool: Common

Symbol	Description of measurement item selection	Form of measured data	Scaling target	Label Specification	Item ID
EXAC	Execution Count	Integer 10 digits	-	x	-
OKAC	OK Count	Integer 10 digits	-	x	-
NGAC	NG Count	Integer 10 digits	-	x	-
TERR	Execution Error	Integer 1 digits	-	x	-
TEID	Execution Error ID	Integer 7 digits	-	x	-
EXTM	Execution Time	Integer 7 digits, 3 digits after the decimal point	-	x	-

Tool: Height Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
MXX*	Max. Height X	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	8051
MXY*	Max. Height Y	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	8053
MXZ*	Max. Height Z	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8055
MXH*	Max. Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8019
MXXYZ*	Maximum Height XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MNX*	Min. Height X	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	8058
MNY*	Min. Height Y	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	8060
MNZ*	Min. Height Z	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8062
MNH*	Min. Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8020
MNXYZ*	Min. Height XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
AVZ*	Ave. Height Z	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8067
AVH*	Ave. Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8087
PMH*	Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8343
EPA	Valid Pixel Count	MS,JG,HL,LL	Integer 8 digits	-	x	8089
CONC_AR*	Concave Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	x	8022
CONV_AR*	Convex Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	x	8021
CONC_VOL*	Concave Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	x	8024
CONV_VOL*	Convex Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	x	8023
DPPABC	Plane Formula Info. XYZ of Detected Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	x	-
DPPA	X Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
DPPB	Y Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
DPPC	Z Intercept of Detected Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PPABC	Plane Formula Information XYZ of Zero Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	x	-
PPA	X Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPB	Y Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPC	Z Intercept of the Zero Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-

Tool: Trend Height

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
SGN	No. of Segments	MS	Integer 4 digits	-	✗	-
DSGN	Number of Detected Segments	MS,JG,HL,LL	Integer 4 digits	-	✗	533
NSGN	Number of NG Segments	MS,JG,HL	Integer 4 digits	-	✗	8229
CNSGN	Number of Consecutive NG Segments	MS,JG,HL	Integer 4 digits	-	✗	8230
MXX	Peak X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
MXXMX	Max. Peak X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
MXXMN	Min. Peak X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
MXY	Peak Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
MXYMX	Max. Peak Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
MXYMN	Min. Peak Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
MXZ	Peak Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MXZMX	Max. Peak Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MXZMN	Min. Peak Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MXH*	Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8019
MXHMX*	Max. Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8241
MXHMN*	Min. Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8242
MXXYZ	Peak XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MXXYZMX	Max. Peak XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MXXYZMN	Min. Peak XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MXMXSGI	Max. Peak Segment Number	MS	Integer 4 digits	-	✗	-
MNMNSGI	Min. Peak Segment Number	MS	Integer 4 digits	-	✗	-
MNX	Bottom X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
MNXMX	Max. Bottom X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
MNXMN	Min. Bottom X	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
MNY	Bottom Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
MNYMX	Max. Bottom Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
MNYMN	Min. Bottom Y	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
MNZ	Bottom Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MNZMX	Max. Bottom Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MNZMN	Min. Bottom Z	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MNH*	Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8020
MNHMX*	Max. Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8253
MNHMN*	Min. Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8254
MNXYZ	Bottom XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MNXYZMX	Max. Bottom XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MNXYZMN	Min. Bottom XYZ	MS,AB,	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MNMXSGI	Max. Bottom Segment Number	MS	Integer 4 digits	-	✗	-
MNMNSGI	Min. Bottom Segment Number	MS	Integer 4 digits	-	✗	-
AVZ	Average Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
AVZMX	Max. Average Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
AVZMN	Min. Average Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
AVH*	Average H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8087
AVHMX*	Max. Average H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8265
AVHMN*	Min. Average H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8266
AVMXSGI	Max. Average Segment Number	MS	Integer 4 digits	-	✗	-
AVMNSGI	Min. Average Segment Number	MS	Integer 4 digits	-	✗	-

Tool: Trend height

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMHIH*	Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8343
PMHIHMX*	Max. Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8348
PMHIHMN*	Min. Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	8349
PMMXSGI	Peak-to-Peak Height Maximum Segment Number	MS	Integer 4 digits	-	✗	-
PMMNSGI	Peak-to-Peak Height Minimum Segment Number	MS	Integer 4 digits	-	✗	-
EPA	Valid Pixel Count	MS,JG,HL,LL	Integer 8 digits	-	✓	8089
EPAMX	Max. Valid Pixel Count	MS,JG,HL,LL	Integer 8 digits	-	✗	8272
EPAMN	Min. Valid Pixel Count	MS,JG,HL,LL	Integer 8 digits	-	✗	8273
EPAMXSGI	Effective Pixel Number Maximum Segment number	MS	Integer 4 digits	-	✗	-
EPAMNSGI	Effective Pixel Number Minimum Segment number	MS	Integer 4 digits	-	✗	-
CONV_AR*	Convex Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✓	8021
CONV_ARMX*	Max. Convex Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	8274
CONV_ARMN*	Min. Convex Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	8275
CONV_AMXSGI	Max. Convex Area Segment Number	MS	Integer 4 digits	-	✗	-
CONV_AMNSGI	Min. Convex Area Segment Number	MS	Integer 4 digits	-	✗	-
CONC_AR*	Concave Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✓	8022
CONC_ARMX*	Max. Concave Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	8276
CONC_ARMN*	Min. Concave Area	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	8277
CONC_AMXSGI	Max. Concave Area Segment Number	MS	Integer 4 digits	-	✗	-
CONC_AMNSGI	Min. Concave Area Segment Number	MS	Integer 4 digits	-	✗	-
CONV_VOL*	Convex Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✓	8023
CONV_VOLMX*	Max. Convex Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✗	8278
CONV_VOLMN*	Min. Convex Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✗	8279
CONV_VMXSGI	Max. Convex Volume Segment Number	MS	Integer 4 digits	-	✗	-
CONV_VMNSGI	Min. Convex Volume Segment Number	MS	Integer 4 digits	-	✗	-
CONC_VOL*	Concave Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✓	8024
CONC_VOLMX*	Max. Concave Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✗	8280
CONC_VOLMN*	Min. Concave Volume	MS,JG,HL,LL	Integer 9 digits, 3 digits after the decimal point	-	✗	8281
CONC_VMXSGI	Max. Concave Volume Segment Number	MS	Integer 4 digits	-	✗	-
CONC_VMNSGI	Min. Concave Volume Segment Number	MS	Integer 4 digits	-	✗	-
DCR	Detection Circle Radius	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	545
DCD	Best Fit Circle Diameter	MS,JG,HL,LL	Integer 6 digits, 3 digits after the decimal point	-	✗	2592
DCX	Detection Circle Center X	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	X	✗	-
DCY	Detection Circle Center Y	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	Y	✗	-
DCZ	Circle Cent. Z	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	-	✗	-
DCH	Circle Cent. H	MS	Sign, Integer 6 digits, 3 digits after the decimal point	-	✗	-
DPPABC	Plane Formula Info. XYZ of Detected Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	✗	-
DPPA	X Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✗	-
DPPB	Y Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✗	-
DPPC	Z Intercept of Detected Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PPABC	Plane Formula Information XYZ of Zero Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	✓	-
PPA	X Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✓	-
PPB	Y Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✓	-
PPC	Z Intercept of the Zero Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
SGCX	Segment Center X	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	X	✓	-
SGCY	Segment Center Y	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	Y	✓	-
SGCXY	Segment Center XY	MS,AB,	Sign, Integer 6 digits, 3 digits after the decimal point	-	✓	-

Tool: Trend height

Tool: Profile Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMSR[J].HGT	Height	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8920
PMSR[J].DIFF	Height Difference	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	1642
PMSR[J].DHGTR	Step: Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].DHGTM	Step: Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].POS	Position	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	8923
PMSR[J].POSXYZ	Position XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].POSX	Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].POSY	Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
PMSR[J].POSZ	Position ZD	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].CTR	Center Position	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	8924
PMSR[J].CTRXYZ	Center Position XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].CTRX	Center Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].CTRY	Center Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
PMSR[J].CTRZ	Center Position Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].CPOS1	Center Position: Position (1)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].CPOS2	Center Position: Position (2)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].WID	Width	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	8927
PMSR[J].WPOSR	Width: Position (1)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].WPOSM	Width: Position (2)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[J].HANG	Angle from Horizontal	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	8930
PMSR[J].LLANG	Angle Between Two Straight Lines	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	8931
PMSR[J].LLANGR	Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PMSR[J].LLANGM	Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PMSR[J].PRAD	Radius of Circle	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8934
PMSR[J].ZAR	Cross-section Area	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	9425
PMSR[J].LAR	Cross-section Area Surrounded by a Straight Line	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8935
PMSR[J].DLAR	Cross-section Area Surrounded by Two Straight Lines	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8936
PMSR[J].PPDST	Points Distance	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8937
PMSR[J].LPDST	Point/Line Distance	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8938
PMSR[J].PCNT	Count	MS,JG,HL,LL	Integer 5 digits	-	x	9062
PMSR[J].STG	Amount of Defects	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	1627
PMSR[J].STD	Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[J].PRMTR	Profile length	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	10714
PMSR[J].LPDST	Throat Thickness	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8938
PMSR[J].PPDST	Leg length	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8937
PMSR[J].LPDST	Undercut	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8938
PMSR[J].LLANG	Overlap	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	8931
PMSR[J].LLANGR	Base metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PMSR[J].LLANGM	Approximate straight line of bead surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PPABC	Plane Formula Information XYZ of Zero Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	x	-
PPA	X Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPB	Y Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPC	Z Intercept of the Zero Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-

Specify the value of the item ID added that of the label multiplied by 1000000 as the parameter of the DW/DR command for height, step, position, center position, width, angle of horizontal, angle between two straight lines, radius of circle, cross-section area, cross-section area surrounded by a straight line, cross-section area surrounded by two straight lines, point-to-point distance, point-to-line distance, defect detection, count, profile length, throat thickness, leg length, undercut and overlap.

Example: When accessing the judgment condition of label 5 of height (Item ID: 8920)

The parameter specification is "8920 + 5 * 1000000 = 5008920".

Tool: Continuous Profile Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PROFN	Number of the Profiles	MS	Integer 5 digits	-	x	-
VPROFN	Number of the Effective Profiles	MS,JG,HL,LL	Integer 5 digits	-	x	9955
NPROFN	Number of the NG Profiles	MS,JG,HL	Integer 5 digits	-	x	9236
CNPROFN	Consecutive NG Profile Count	MS,JG,HL	Integer 5 digits	-	x	9237
PROFJG[]	Per Profile Judgment Value		Integer 1 digits	-	✓	-
VPROF[]	Per Profile Effective Invalid		Integer 1 digits	-	✓	-
DC1PROFIDX[]	(Condition 1) Result Display Profile Number	MS	Integer 5 digits	-	✓	-
DC2PROFIDX[]	(Condition 2) Result Display Profile Number	MS	Integer 5 digits	-	✓	-
DC3PROFIDX[]	(Condition 3) Result Display Profile Number	MS	Integer 5 digits	-	✓	-
DC4PROFIDX[]	(Condition 4) Result Display Profile Number	MS	Integer 5 digits	-	✓	-
PMSR[],PRERR[]	Profile Measurement Presence or Absence of Errors	MS	Integer 1 digits	-	✓	-
PMSR[],ITEMJG	Overall Judgment Value		Integer 1 digits	-	x	-
PMSR[],HGT[]	Height	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8920
PMSR[],MXHGT	Height (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNHGT	Height (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVHGT	Height (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DVHGT	Height (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1HGT[]	(Condition 1) Height	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2HGT[]	(Condition 2) Height	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3HGT[]	(Condition 3) Height	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4HGT[]	(Condition 4) Height	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DIF[]	Height Difference	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	1642
PMSR[],DHGTR[]	Step: Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DHGTM[]	Step: Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],MXDIFF	Step (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNDIFF	Step (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVDIFF	Step (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DVDIFF	Step (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1DIF[]	(Condition 1) Step	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC1DHGTR[]	(Condition 1) Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC1DHGTM[]	(Condition 1) Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2DIF[]	(Condition 2) Step	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2DHGTR[]	(Condition 2) Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2DHGTM[]	(Condition 2) Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3DIF[]	(Condition 3) Step	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3DHGTR[]	(Condition 3) Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3DHGTM[]	(Condition 3) Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4DIF[]	(Condition 4) Step	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4DHGTR[]	(Condition 4) Reference Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4DHGTM[]	(Condition 4) Measurement Height	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],POS[]	Position	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	8923
PMSR[],POSXYZ[]	Position XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],POSX[]	Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],POSY[]	Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
PMSR[],POSZ[]	Position ZD	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],MXPOS	Position (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],MXPOSXYZ	Position (Maximum) XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MXPOSX	Position (Maximum) X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],MXPOSY	Position (Maximum) Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
PMSR[],MXPOSZ	Position (Maximum) Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNPOS	Position (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],MNPOSXYZ	Position (Minimum) XTZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNPOSX	Position (Minimum) X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],MNPOSY	Position (Minimum) Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
PMSR[],MNPOSZ	Position (Minimum) Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVPOS	Position (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],DVPOS	Position (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],DC1POS[]	(Condition 1) Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC2POS[]	(Condition 2) Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC3POS[]	(Condition 3) Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC4POS[]	(Condition 4) Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],CTR[]	Center Position	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	8924
PMSR[],CTRXYZ[]	Center Position XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],CTRX[]	Center Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-

Tool: Continuous Profile Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMSR[J].CTRY[]	Center Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
PMSR[J].CTRZ[]	Center Position Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].CPOS1[]	Position1	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].CPOS2[]	Position2	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].MXCTR	Center Position (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].MXCTXYZ	Center Position (Maximum) XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].MXCTRX	Center Position (Maximum) X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].MXCTRY	Center Position (Maximum) Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
PMSR[J].MXCTRZ	Center Position (Maximum) Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].MNCTR	Center Position (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].MNCTXYZ	Center Position (Minimum) XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].MNCTRX	Center Position (Minimum) X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].MNCTRY	Center Position (Minimum) Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
PMSR[J].MNCTRZ	Center Position (Minimum) Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].AVCTR	Center Position (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].DVCTR	Center Position (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].DC1CTR[]	(Condition 1) Center Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC1CPOS1[]	(Condition 1) Center Position: Position (1)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC1CPOS2[]	(Condition 1) Center Position: Position (2)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2CTR[]	(Condition 2) Center Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2CPOS1[]	(Condition 2) Center Position: Position (1)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2CPOS2[]	(Condition 2) Center Position: Position (2)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3CTR[]	(Condition 3) Center Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3CPOS1[]	(Condition 3) Center Position: Position (1)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3CPOS2[]	(Condition 3) Center Position: Position (2)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4CTR[]	(Condition 4) Center Position	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4CPOS1[]	(Condition 4) Center Position: Position (1)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4CPOS2[]	(Condition 4) Center Position: Position (2)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].WID[]	Width	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	8927
PMSR[J].WPOSR[]	Width: Position 1	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].WPOSM[]	Width: Position 2	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].MXWID	Width (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].MNWID	Width (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].AVWID	Width (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].DVWID	Width (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	X	✗	-
PMSR[J].DC1WID[]	(Condition 1) Width	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC1WPOSR[]	(Condition 1) Width: Reference Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC1WPOSM[]	(Condition 1) Width: Measurement Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2WID	(Condition 2) Width	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2WPOSR[]	(Condition 2) Width: Reference Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC2WPOSM[]	(Condition 2) Width: Measurement Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3WID	(Condition 3) Width	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3WPOSR[]	(Condition 3) Width: Reference Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC3WPOSM[]	(Condition 3) Width: Measurement Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4WID	(Condition 4) Width	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4WPOSR[]	(Condition 4) Width: Reference Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].DC4WPOSM[]	(Condition 4) Width: Measurement Position	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[J].HANG[]	Angle from Horizontal	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	8930
PMSR[J].MXHANG	Angle of Horizontal (Maximum)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].MNHANG	Angle of Horizontal (Minimum)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].AVHANG	Angle of Horizontal (Average)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].DVHANG	Angle from Horizontal (3σ)	MS	Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].DC1HANG[]	(Condition 1) Angle of Horizontal	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2HANG[]	(Condition 2) Angle of Horizontal	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3HANG[]	(Condition 3) Angle of Horizontal	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4HANG[]	(Condition 4) Angle of Horizontal	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].LLANG[]	Angle Between Two Straight Lines	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	8931
PMSR[J].LLANGR[]	Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].LLANGM[]	Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].MXLLANG	Angle Between Two Straight Lines (Maximum)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].MNLLANG	Angle Between Two Straight Lines (Minimum)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
PMSR[J].AVLLANG	Angle Between Two Straight Lines (Average)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-

Tool: Continuous Profile Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMSR[J].DVLLANG	Angle Between Two Straight Lines (3σ)	MS	Integer 3 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DC1LLANG[J]	(Condition 1) Angle Between Two Straight Lines	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC1LLANGR[J]	(Condition 1) Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC1LLANGM[J]	(Condition 1) Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2LLANG[J]	(Condition 2) Angle Between Two Straight Lines	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2LLANGR[J]	(Condition 2) Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2LLANGM[J]	(Condition 2) Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3LLANG[J]	(Condition 3) Angle Between Two Straight Lines	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3LLANGR[J]	(Condition 3) Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3LLANGM[J]	(Condition 3) Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4LLANG[J]	(Condition 4) Angle Between Two Straight Lines	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4LLANGR[J]	(Condition 4) Reference Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4LLANGM[J]	(Condition 4) Measurement Angle	MS	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].PRAD[J]	Radius of Circle	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8934
PMSR[J].MXPRAD	Circle Radius (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].MNPRAD	Circle Radius (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].AVPRAD	Circle Radius (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DVPRAD	Circle Radius (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DC1PRAD[J]	(Condition 1) Circle Radius	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2PRAD[J]	(Condition 2) Circle Radius	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3PRAD[J]	(Condition 3) Circle Radius	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4PRAD[J]	(Condition 4) Circle Radius	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].ZAR[J]	Cross-section Area	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	9425
PMSR[J].MXZAR	Cross-section Area (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].MNZAR	Cross-section Area (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].AVZAR	Cross-section Area (average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DVZAR	Cross-section Area (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DC1ZAR[J]	(Condition 1) Cross-section Area	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2ZAR[J]	(Condition 2) Cross-section Area	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3ZAR[J]	(Condition 3) Cross-section Area	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4ZAR[J]	(Condition 4) Cross-section Area	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].LAR[J]	Cross-section Area Surrounded by a Straight Line	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8935
PMSR[J].MXLAR	Cross-section Area Surrounded by a Straight Line (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].MNLAR	Cross-section Area Surrounded by a Straight Line (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].AVLAR	Cross-section Area Surrounded by a Straight Line (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DVLAR	Cross-section Area Surrounded by a Straight Line (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DC1LAR[J]	(Condition 1) Cross-section Area Surrounded by a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2LAR[J]	(Condition 2) Cross-section Area Surrounded by a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3LAR[J]	(Condition 3) Cross-section Area Surrounded by a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4LAR[J]	(Condition 4) Cross-section Area Surrounded by a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DLAR[J]	Cross-section Area Surrounded by Two Straight Lines	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8936
PMSR[J].MXDLAR	Cross-section Area Surrounded by Two Straight Lines (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].MNDLAR	Cross-section Area Surrounded by Two Straight Lines (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].AVDLAR	Cross-section Area Surrounded by Two Straight Lines (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DVDLAR	Cross-section Area Surrounded by Two Straight Lines (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].DC1DLAR[J]	(Condition 1) Cross-section Area Surrounded by Two Straight Lines	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC2DLAR[J]	(Condition 2) Cross-section Area Surrounded by Two Straight Lines	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC3DLAR[J]	(Condition 3) Cross-section Area Surrounded by Two Straight Lines	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].DC4DLAR[J]	(Condition 4) Cross-section Area Surrounded by Two Straight Lines	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[J].PPDST[J]	Points Distance	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8937
PMSR[J].MXPPDST	Point-to-point Distance (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].MNPPDST	Point-to-Point Distance (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-
PMSR[J].AVPPDST	Point-to-Point Distance (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	×	-

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMSR[],DVPPDST	Point-to-Point Distance (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1PPDST[]	(Condition 1) Point-to-Point Distance	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2PPDST[]	(Condition 2) Point-to-Point Distance	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3PPDST[]	(Condition 3) Point-to-Point Distance	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4PPDST[]	(Condition 4) Point-to-Point Distance	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],LPDST[]	Point/Line Distance	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8938
PMSR[],MXLPDST	Distance Between a Point and a Straight Line (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNLPDST	Distance Between a Point and a Straight Line (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVLPDST	Distance Between a Point and a Straight line (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DVLPDST	Distance Between a Point and a Straight Line (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1LPDST[]	(Condition 1) Distance Between a Point and a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2LPDST[]	(Condition 2) Distance Between a Point and a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3LPDST[]	(Condition 3) Distance Between a Point and a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4LPDST[]	(Condition 4) Distance Between a Point and a Straight Line	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],PCNT[]	Count	MS,JG,HL,LL	Integer 5 digits	-	✓	9062
PMSR[],MXPCNT	Count (Maximum)	MS,JG	Integer 5 digits	-	x	-
PMSR[],MNPCNT	Count (Minimum)	MS,JG	Integer 5 digits	-	x	-
PMSR[],AVPCNT	Count (average)	MS,JG	Integer 5 digits	-	x	-
PMSR[],DVPCNT	Count (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1PCNT[]	(Condition 1) Count	MS,JG	Integer 5 digits	-	x	-
PMSR[],DC2PCNT[]	(Condition 2) Count	MS,JG	Integer 5 digits	-	x	-
PMSR[],DC3PCNT[]	(Condition 3) Count	MS,JG	Integer 5 digits	-	x	-
PMSR[],DC4PCNT[]	(Condition 4) Count	MS,JG	Integer 5 digits	-	x	-
PMSR[],STG[]	Amount of Defects	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	1627
PMSR[],STD[]	Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],MXSTG	Defect Amount (Maximum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNSTG	Defect Amount (Minimum)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVSTG	Defect Amount (Average)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DVSTG	Defect Amount (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1STG[]	(Condition 1) Defect Amount	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC1STD[]	(Condition 1) Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2STG[]	(Condition 2) Defect Amount	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2STD[]	(Condition 2) Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3STG[]	(Condition 3) Defect Amount	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC3STD[]	(Condition 3) Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4STG[]	(Condition 4) Defect Amount	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC4STD[]	(Condition 4) Distance from Model Line	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],PRMTR[]	Profile length	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	10714
PMSR[],MXPRMTR	Profile Length (Max.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],MNPRMTR	Profile Length (Min.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],AVPRMTR	Profile Length (Average)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],DVPRMTR	Profile length (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	X	x	-
PMSR[],DC1PRMTR[]	(Condition 1) Profile Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC2PRMTR[]	(Condition 2) Profile Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC3PRMTR[]	(Condition 3) Profile Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],DC4PRMTR[]	(Condition 4) Profile Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
PMSR[],LPDST[]	Throat Thickness	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8938
PMSR[],MXLPDST	Throat Thickness (Max.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNLPDST	Throat Thickness (Min.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],AVLPDST	Throat Thickness (Average)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DVLPDST	Throat Thickness (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],DC1LPDST[]	(Condition 1) Throat Thickness	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2LPDST[]	(Condition 2) Throat Thickness	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2LPDST[]	(Condition 3) Throat Thickness	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],DC2LPDST[]	(Condition 4) Throat Thickness	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
PMSR[],PPDST[]	Leg length	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8937
PMSR[],MXPPDST	Leg Length (Max.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
PMSR[],MNPPDST	Leg Length (Min.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	x	✓
PMSR[],AVPPDST	Leg Length (Average)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	✓	x	✓
PMSR[],DVPPDST	Leg Length (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	✓	x	✓

Tool: Continuous Profile Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
PMSR[.DC1PPDST]	(Condition 1) Leg Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2PPDST]	(Condition 2) Leg Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC3PPDST]	(Condition 3) Leg Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2PPDST]	(Condition 4) Leg Length	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.LPDST]	Undercut	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	8938
PMSR[.MXLPDST]	Undercut (Max.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.MNLPDST]	Undercut (Min.)	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.AVLPDST]	Undercut (Average)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.DVLPDST]	Undercut (3σ)	MS	Integer 5 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.DC1LPDST]	(Condition 1) Undercut	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2LPDST]	(Condition 2) Undercut	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC3LPDST]	(Condition 3) Undercut	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2LPDST]	(Condition 4) Undercut	MS,JG	Sign, Integer 5 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.LLANG]	Overlap	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	8931
PMSR[.LLANGR]	Base metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.LLANGM]	Approximate straight line of bead surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.MXLLANG]	Overlap (Max.)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.MNLLANG]	Overlap (Min.)	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.AVLLANG]	Overlap (Average)	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.DVLLANG]	Overlap (3σ)	MS	Integer 3 digits, 3 digits after the decimal point	✓	✗	✓
PMSR[.DC1LLANG]	(Condition 1) Overlap	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC1LLANGR]	(Condition 1) Base Metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC1LLANGM]	(Condition 1) Approximate Straight Line of Bead Surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2LLANG]	(Condition 2) Overlap	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2LLANGR]	(Condition 2) Base Metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC2LLANGM]	(Condition 2) Approximate Straight Line of Bead Surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC3LLANG]	(Condition 3) Overlap	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC3LLANGR]	(Condition 3) Base Metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC3LLANGM]	(Condition 3) Approximate Straight Line of Bead Surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC4LLANG]	(Condition 4) Overlap	MS,JG	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC4LLANGR]	(Condition 4) Base Metal	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC4LLANGM]	(Condition 4) Approximate Straight Line of Bead Surface	MS	Sign, Integer 3 digits, 3 digits after the decimal point	✓	✓	✓
PMSR[.DC1PRERR]	(Condition 1) Profile Measurement Error		Integer 3 digits	-	✓	-
PMSR[.DC2PRERR]	(Condition 1) Profile Measurement Error		Integer 3 digits	-	✓	-
PMSR[.DC3PRERR]	(Condition 1) Profile Measurement Error		Integer 3 digits	-	✓	-
PMSR[.DC4PRERR]	(Condition 1) Profile Measurement Error		Integer 3 digits	-	✓	-
PPABC	Plane Formula Information XYZ of Zero Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	✗	-
PPA	X Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✗	-
PPB	Y Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	✗	-
PPC	Z Intercept of the Zero Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-

Tool: Continuous Profile Measurement

Specify the value of the item ID added that of the label multiplied by 1000000 as the parameter of the DW/DR command for height, step, position, center position, width, angle of horizontal, angle between two straight lines, radius of circle, cross-section area, cross-section area surrounded by a straight line, cross-section area surrounded by two straight lines, point-to-point distance, point-to-line distance, defect detection, count, profile length, throat thickness, leg length, undercut and overlap.

Example: When accessing the judgment condition of label 5 of height (Item ID: 8920)

The parameter specification is "8920 + 5 * 1000000 = 5008920".

Tool: Free/Arranged Multi-Point Height Measurement

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
MXXMX	Max. Peak X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
MXXMN	Min. Peak X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
MXYMX	Max. Peak Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
MXYMN	Min. Peak Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
MXZMX	Max. Peak Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MXZMN	Min. Peak Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MXHMX*	Max. Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8241
MXHMN*	Min. Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8242
MXXYZMX	Max. Peak XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MXXYZMN	Min. Peak XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MNXMX	Max. Bottom X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
MNXMN	Min. Bottom X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
MNYMX	Max. Bottom Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
MNYMN	Min. Bottom Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
MNZMX	Max. Bottom Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MNZMN	Min. Bottom Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MNHMX*	Max. Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8253
MNHMN*	Min. Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8254
MNXYZMX	Max. Bottom XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
MNXYZMN	Min. Bottom XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
AVZMX	Max. Average Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
AVZMN	Min. Average Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
AVHMX*	Max. Average H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8265
AVHMN*	Min. Average H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8266
PMHMX*	Max. Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8348
PMHMH*	Min. Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	8349
EPAMX	Max. Valid Pixel Count	MS	Integer 8 digits	-	x	-
EPAMN	Min. Valid Pixel Count	MS	Integer 8 digits	-	x	-
CONC_ARMX*	Max. Concave Area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	8276
CONC_ARMN*	Min. Concave Area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	8277
CONV_ARMX*	Max. Convex Area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	8274
CONV_ARMN*	Min. Convex Area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	8275
CONC_VOLMX*	Max. Concave Volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	x	8280
CONC_VOLMN*	Min. Concave Volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	x	8281
CONV_VOLMX*	Max. Convex Volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	x	8278
CONV_VOLMN*	Min. Convex Volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	x	8279
DPPABC	Plane Formula Info. XYZ of Detected Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	x	-
DPPA	X Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
DPPB	Y Slope of Detected Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
DPPC	Z Intercept of Detected Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
PPABC	Plane Formula Information XYZ of Zero Plane	MS,AB	Sign, Integer 3 digits, 6 digits after the decimal point	-	x	-
PPA	X Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPB	Y Slope of the Zero Plane	MS,AB	Sign, Integer 1 digits, 6 digits after the decimal point	-	x	-
PPC	Z Intercept of the Zero Plane	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
DPRPT	Angle created by detected plane and zero plane	MS	Integer 2 digits, 3 digits after the decimal point	-	x	-
RGNJG[]	Region [] - Judgment Value for Each Region	MS	Integer 1 digits	-	✓	-
RGNERR[]	Region [] - Error Information for Each Region	MS	Integer 1 digits	-	✓	-
MXX[]	Region [] - Peak X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
MXY[]	Region [] - Peak Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
MXZ[]	Region [] - Peak Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MXH[]*	Region [] - Peak H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8019
MXXYZ[]	Region [] - Peak XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MNX[]	Region [] - Bottom X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
MNY[]	Region [] - Bottom Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
MNZ[]	Region [] - Bottom Z	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
MNH[]*	Region [] - Bottom H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8020
MNXYZ[]	Region [] - Bottom XYZ	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
AVZ[]	Region [] - Ave. Height Z	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
AVH[]*	Region [] - Ave. Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8087
PMH[]*	Region [] - Peak-to-Peak Height H	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	8343
EPA[]	Region [] - Valid Pixel Count	MS	Integer 8 digits	-	✓	-
CONV_AR[]*	Region [] - Convex area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	✓	8021
CONC_AR[]*	Region [] - Concave area	MS,JG,HL,LL	Sign, Integer 6 digits, 3 digits after the decimal point	-	✓	8022
CONV_VOL[]*	Region [] - Convex volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	✓	8023
CONC_VOL[]*	Region [] - Concave volume	MS,JG,HL,LL	Sign, Integer 9 digits, 3 digits after the decimal point	-	✓	8024

Tool: Free/Arranged Multi-Point Height Measurement

Tool: Area

With or without/distinction on the area of the specified color (black and white) and inspection for defects/stains on the black or white area.

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
AR	Area	MS,JG,HL,LL	Integer 8 digits	-	✗	105

Tool: Pattern Search

With or without on the shading pattern/distinction, shading pattern position (position/inclination), shading pattern position (dimensions and geometric shape), shading pattern quantity, position adjustment with the shading pattern

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Quantity	MS,JG,HL,LL	Integer 2 digits	-	✗	90
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
	XY Position/Angle (Cannot be used in calculation)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
C	Match %	MS,JG,HL,LL	Integer 2 digits, 3 digits after the decimal point	-	✓	89

Tool: ShapeTrax3A

With or without on the outline pattern/distinction, outline pattern position (position/inclination), outline pattern position (dimensions and geometric shape), outline pattern quantity, position correction with the outline pattern

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Quantity	MS,JG,HL,LL	Integer 4 digits	-	✗	90
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
	XY Position/Angle (Cannot be used in calculation)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
C	Match %	MS,JG,HL,LL	Integer 2 digits, 3 digits after the decimal point	-	✓	89
s	Scale	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	✓	1759
QZ1	Number of Feature Pixels 1	MS,JG,HL,LL	Integer 6 digits	-	✓	9458
QZ2	Number of Feature Pixels 2	MS,JG,HL,LL	Integer 6 digits	-	✓	9459

Tool: PatternTrax

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Quantity	MS,JG,HL,LL	Integer 4 digits	-	x	90
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	83
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
XYT	XY Position/Angle (Cannot be used in calculation)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
C	Match %	MS,JG,HL,LL	Integer 2 digits, 3 digits after the decimal point	-	✓	89

Tool: Edge Position

Edge position (position/inclination), edge position in the circumferential direction, edge position (dimensions and geometric shape), number of edges, edge position correction

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Number of Edges	MS,JG,HL,LL	Integer 4 digits	-	x	90
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
P	Distance	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
I	Intensity	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-

Tool: Edge Angle

Edge Inclination

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
T	Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	84
N	Number of Edges	MS,JG,HL,LL	Integer 4 digits	-	x	90
X	Center X	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y	Center Y	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY	Center XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
X1	Position1X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Position 1 Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Position 1XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
P1	Distance 1	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I1	Intensity 1	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
X2	Position 2X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y2	Position 2Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY2	Position 2XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
P2	Distance 2	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I2	Intensity 2	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-

Tool: Edge Width

Edge Width

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Number of Pairs	MS	Integer 1 digits	-	x	-
W*	Edge Width	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	x	97
X1	Position1X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Position 1 Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Position 1XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
T1	Angle 1	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
P1	Distance 1	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I1	Intensity 1	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
X2	Position 2X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y2	Position 2Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY2	Position 2XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
T2	Angle 2	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
P2	Distance 2	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I2	Intensity 2	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-

Tool: Edge Pitch

Center Pitch, Gap Pitch

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Number of Pitches	MS,JG,HL,LL	Integer 4 digits	-	✗	90
WH	Pitch (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	99
WL	Pitch (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	100
WA	Pitch (Ave)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	-
W*	Pitch	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	97
X1	Position1X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
Y1	Position 1 Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
XY1	Position 1XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T1	Angle 1	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
P1	Distance 1	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
I1	Intensity 1	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
X2	Position 2X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
Y2	Position 2Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
XY2	Position 2XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T2	Angle 2	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
P2	Distance 2	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
I2	Intensity 2	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-

Tool: Edge Pairs

Pair Pitch

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Number of Pairs	MS,JG,HL,LL	Integer 4 digits	-	✗	90
WH	Pair Width (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	99
WL	Pair Width (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	100
WA	Pair Width (Ave)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	-
W*	Pair Width	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	97
X1	Position1X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
Y1	Position 1 Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
XY1	Position 1XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T1	Angle 1	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
P1	Distance 1	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
I1	Intensity 1	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
X2	Position 2X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
Y2	Position 2Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
XY2	Position 2XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T2	Angle 2	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
P2	Distance 2	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
I2	Intensity 2	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-

Tool: Defect

Inspection for number of defects or total defect area, inspection for defects on each defect group

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
SL	Level of Defects Detected	MS	Integer 3 digits	-	✗	-
TSA	Total Amount of Defects	MS,JG,HL,LL	Integer 8 digits	-	✗	374
X	Position X	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
Y	Position Y	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
N	Number of Groups	MS,JG,HL,LL	Integer 2 digits	-	✗	90
GSA	Amount of Defects	MS,JG,HL,LL	Integer 8 digits	-	✓	377
GX	Center of Gravity X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	378
GY	Center of Gravity Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	379
GXY	Center of Gravity XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-

Tool: Blob

Position of cluster (position/inclination), position of cluster (dimensions and geometric shape), quantity of clusters, position correction with the center of gravity of cluster

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
N	Number of Labels	MS,JG,HL,LL	Integer 4 digits	-	✗	90
X	Center of Gravity X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
XH	Center of Gravity X (Max)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	294
XL	Center of Gravity X (Min)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	295
Y	Center of Gravity Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
YH	Center of Gravity Y (Max)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	296
YL	Center of Gravity Y (Min)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	297
XY	Center of Gravity XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Major Axis Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
TH	Major Axis Angle (Max)	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	298
TL	Major Axis Angle (Min)	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	299
	Center of Gravity XY/Major Axis Angle (Cannot be used in calculation)	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
AR	Area	MS,JG,HL,LL	Integer 8 digits	-	✓	105
ARH	Area (Max)	MS,JG,HL,LL	Integer 8 digits	-	✗	306
ARL	Area (Min)	MS,JG,HL,LL	Integer 8 digits	-	✗	307
FX	Blob X Feret Diameter	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	106
FXH	Feret Diameter X (Max)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	300
FXL	Feret Diameter X (Min)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	301
FY	Feret Diameter Y	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	107
FYH	Feret Diameter Y (Max)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	302
FYL	Feret Diameter Y (Min)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	303
CL	Blob Perimeter Result	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	108
CLH	Perimeter (Max)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	308
CLL	Perimeter (Min)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	✗	309
CD	Roundness	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	✓	109
CDH	Roundness (Max)	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	✗	304
CDL	Roundness (Min)	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	✗	305
MAA	Major Axis	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	1890
MAAH	Major Axis (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1896
MAAL	Major Axis (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1897
MIA	Minor Axis	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	1891
MIAH	Minor Axis (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1898
MIAL	Minor Axis (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1899
RTO	Aspect Ratio	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✓	1892
RTOH	Aspect Ratio (Max)	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✗	1900
RTOL	Aspect Ratio (Min)	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✗	1901
MAA2	Equivalent Oval Major Axis	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	1893
MAA2H	Equivalent Oval Major Axis (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1902
MAA2L	Equivalent Oval Major Axis (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1903
MIA2	Equivalent Oval Minor Axis	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	1894
MIA2H	Equivalent Oval Minor Axis (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1904
MIA2L	Equivalent Oval Minor Axis (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	1905
RTO2	Equivalent Oval Aspect Ratio	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✓	1895
RTO2H	Equivalent Oval Aspect Ratio Max.	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✗	1906
RTO2L	Equivalent Oval Aspect Ratio Min.	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✗	1907

Tool: Grayscale Blob

Inspection for defects/stains using the contrast difference with the background, position of the dark (light) cluster, number of dark (light) clusters, quantity of clusters, position correction of the dark (light) cluster center of gravity

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
DIL	Level of Contrast Detected	MS	Integer 8 digits	-	×	-
BLV	Reference Gray Level	MS	Integer 8 digits	-	×	-
TAR	Total Area	MS,JG,HL,LL	Integer 8 digits	-	×	2446
N	Number of Labels	MS,JG,HL,LL	Integer 4 digits	-	×	90
XY	Center of Gravity XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
X	Center of Gravity X	ST,MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
XH	Center of Gravity X (Max)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	×	294
XL	Center of Gravity X (Min)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	×	295
Y	Center of Gravity Y	ST,MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
YH	Center of Gravity Y (Max)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	×	296
YL	Center of Gravity Y (Min)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	×	297
T	Major Axis Angle	ST,MS,AB,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
TH	Major Axis Angle (Max)	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	×	298
TL	Major Axis Angle (Min)	MS,JG,HL,LL	Sign, Integer 3 digits, 3 digits after the decimal point	-	×	299
AR	Area	MS,JG,HL,LL	Integer 8 digits	-	✓	105
ARH	Area (Max)	MS,JG,HL,LL	Integer 8 digits	-	×	306
ARL	Area (Min)	MS,JG,HL,LL	Integer 8 digits	-	×	307
VOL	Volume	MS,AB,JG,HL,LL	Integer 10 digits, 3 digits after the decimal point	-	✓	2447
VOLH	Volume (Max.)	MS,AB,JG,HL,LL	Integer 10 digits, 3 digits after the decimal point	-	×	2451
VOLL	Volume (Min.)	MS,AB,JG,HL,LL	Integer 10 digits, 3 digits after the decimal point	-	×	2452
BOW	Light-dark	MS	Integer 1 digits	-	✓	-
AVI	Average Level of Contrast	MS,JG,HL,LL	Integer 3 digits	-	✓	2448
AVIH	Average Level of Contrast (Max.)	MS,JG,HL,LL	Integer 3 digits	-	×	2453
AVIL	Average Level of Contrast (Min.)	MS,JG,HL,LL	Integer 3 digits	-	×	2454
MXI	Max. Level of Contrast	MS,JG,HL,LL	Integer 3 digits	-	✓	2449
MXIH	Max. Level of Contrast (Max.)	MS,JG,HL,LL	Integer 3 digits	-	×	2455
MXIL	Max. Level of Contrast (Min.)	MS,JG,HL,LL	Integer 3 digits	-	×	2456
FX	Blob X Feret Diameter	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	106
FXH	Feret Diameter X (Max)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	300
FXL	Feret Diameter X (Min)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	301
FY	Feret Diameter Y	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	107
FYH	Feret Diameter Y (Max)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	302
FYL	Feret Diameter Y (Min)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	303
CL	Blob Perimeter Result	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	✓	108
CLH	Perimeter (Max)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	308
CLL	Perimeter (Min)	MS,AB,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	L	×	309
CD	Roundness	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	✓	109
CDH	Roundness (Max)	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	×	304
CDL	Roundness (Min)	MS,JG,HL,LL	Integer 1 digits, 3 digits after the decimal point	-	×	305
MAA	Major Axis	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	✓	1890
MAAH	Major Axis (Max)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1896
MAAL	Major Axis (Min)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1897
MIA	Minor Axis	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	✓	1891
MIAH	Minor Axis (Max)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1898
MIAL	Minor Axis (Min)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1899
RTO	Aspect Ratio	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✓	1892
RTOH	Aspect Ratio (Max)	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	×	1900
RTOL	Aspect Ratio (Min)	MS,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	×	1901
MAA2	Equivalent Oval Major Axis	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	✓	1893
MAA2H	Equivalent Oval Major Axis (Max)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1902
MAA2L	Equivalent Oval Major Axis (Min)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1903
MIA2	Equivalent Oval Minor Axis	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	✓	1894
MIA2H	Equivalent Oval Minor Axis (Max)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1904
MIA2L	Equivalent Oval Minor Axis (Min)	MS,AB,JG,HL,LL	Integer 5 digits, 3 digits after the decimal point	L	×	1905
RTO2	Equivalent Oval Aspect Ratio	MS,LG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	✓	1895
RTO2H	Equivalent Oval Aspect ratio (Max.)	MS,LG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	×	1906
RTO2L	Equivalent Oval Aspect ratio (Min.)	MS,LG,HL,LL	Integer 5 digits, 3 digits after the decimal point	-	×	1907

Tool: Profile Position

Position and angle of line to horizontal, position of circle center, edge position (position/inclination), line detection, detect circle, tip position (dimensions and geometric shape), position adjustment with the position and angle of the line, position correction of circle center

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
SGN	No. of Segments	MS	Integer 4 digits	-	✗	-
DSGN	Number of Detected Segments	MS,JG,HL,LL	Integer 4 digits	-	✗	533
N	Number of Edges	MS	Integer 4 digits	-	✓	-
NHI	No. of Edges (Max)	MS	Integer 4 digits	-	✗	-
NLO	No. of Edges (Min)	MS	Integer 4 digits	-	✗	-
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
XHI	Position X (Max)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	598
XLO	Position X (Min)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	599
XA	Position X (Ave)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
YHI	Position Y (Max)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	600
YLO	Position Y (Min)	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	601
YA	Position Y (Ave)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
XYHI	Position XY (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
XYLO	Position XY (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
XYA	Position XY (Ave)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
T	Angle	ST,MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
THI	Angle (Max)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
TLO	Angle (Min)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	-
P*	Distance	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	91
PHI	Distance (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	110
PLO	Distance (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	111
PA	Distance (Ave)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	-
RW	Radius	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	541
RWHI	Radius (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	112
RWLO	Radius (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	113
RWA	Radius (Ave)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✗	-
I	Intensity	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
IHI	Intensity (Max)	MS	Integer 3 digits, 3 digits after the decimal point	-	✗	-
ILO	Intensity (Min)	MS	Integer 3 digits, 3 digits after the decimal point	-	✗	-
DCX	Detection Circle Center X	ST,MS,JG,HL,LL,AB	Sign, Integer 6 digits, 3 digits after the decimal point	X	✗	546
DCY	Detection Circle Center Y	ST,MS,JG,HL,LL,AB	Sign, Integer 6 digits, 3 digits after the decimal point	Y	✗	547
DCXY	Detection Circle Center XY	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	-	✗	-
DCR	Detection Circle Radius	MS,HL,LL,AB	Integer 6 digits, 3 digits after the decimal point	L	✗	545
DCD	Best Fit Circle Diameter	MS,HL,LL,AB	Integer 6 digits, 3 digits after the decimal point	L	✗	2592
DLT	Best Fit Line Angle	ST,MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✗	640
DLX	Line Center X	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
DLY	Line Center Y	ST,MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
DLXY	Line Center XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
DLX1	Line X1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
DLY1	Best Fit Line Y1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
DLXY1	Best Fit Line XY1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
DLX2	Best Fit Line X2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✗	-
DLY2	Best Fit Line Y2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✗	-
DLXY2	Best Fit Line XY2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✗	-
MXSGI	Max. Segment Number (Cannot be used with output settings)	MS	Integer 4 digits	-	✗	-
MNSGI	Min. Segment Number (Cannot be used with output settings)	MS	Integer 4 digits	-	✗	-

Tool: Profile Width

Width (max./min.), diameter (max./min.), width between peaks

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
SGN	No. of Segments	MS	Integer 4 digits	-	x	-
DSGN	Number of Detected Segments	MS,JG,HL,LL	Integer 4 digits	-	x	533
N	Number of Pairs	MS	Integer 4 digits	-	✓	-
NHI	No. of Pairs (Max)	MS	Integer 4 digits	-	x	-
NLO	No. of Pairs (Min)	MS	Integer 4 digits	-	x	-
W*	Edge Width	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	97
WHI*	Edge Width (Max)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	x	604
WLO*	Edge Width (Min)	MS,JG,HL,LL,AB	Integer 5 digits, 3 digits after the decimal point	L	x	605
WA	Edge Width (Ave)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
PMHI*	Max. P-P Width	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	x	2718
PMLO*	Min. P-P Width	MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	L	x	2719
X1	Position1X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
X1HI	Position 1X (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X1LO	Position 1X (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X1PHI	Peak Position 1X (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X1PLO	Peak Position 1X (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Position 1 Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
Y1HI	Position 1Y (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y1LO	Position 1Y (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y1PHI	Peak Position 1Y (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y1PLO	Peak Position 1Y (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Position 1XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
XY1HI	Position 1XY (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY1LO	Position 1XY (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY1PHI	Peak Position 1XY (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY1PLO	Peak Position 1XY (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
T1	Angle 1	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
T1HI	Angle 1 (max)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
T1LO	Angle 1 (min)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
P1	Distance 1	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
P1HI	Distance 1 (max)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
P1LO	Distance 1 (min)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I1	Intensity 1	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
I1HI	Intensity1 (Max)	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
I1LO	Intensity1 (Min)	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
X2	Position 2X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
X2HI	Position 2X (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X2LO	Position 2X (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X2PHI	Peak Position 2X (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
X2PLO	Peak Position 2X (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
Y2	Position 2Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
Y2HI	Position 2Y (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y2LO	Position 2Y (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y2PHI	Peak Position 2Y (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
Y2PLO	Peak Position 2Y (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
XY2	Position 2XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
XY2HI	Position 2XY (Max)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY2LO	Position 2XY (Min)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY2PHI	Peak Position 2XY (Max.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
XY2PLO	Peak Position 2XY (Min.)	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
T2	Angle 2	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
T2HI	Angle 2 (max)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
T2LO	Angle 2 (min)	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
P2	Distance 2	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	✓	-
P2HI	Distance 2 (max)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
P2LO	Distance 2 (min)	MS,AB	Integer 5 digits, 3 digits after the decimal point	L	x	-
I2	Intensity 2	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
I2HI	Intensity2 (Max.)	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
I2LO	Intensity2 (Min.)	MS	Integer 3 digits, 3 digits after the decimal point	-	x	-
MXSGI	Maximum Segment No. (Cannot be used with output settings)	MS	Integer 4 digits	-	x	-
MNSGI	Minimum segment No. (Cannot be used with output settings)	MS	Integer 4 digits	-	x	-

Tool: Profile Defect

Burr/flaw on the line, Burr/flaw on the circle, Burr/flaw on the curve

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
SGN	No. of Segments	MS	Integer 4 digits	-	x	-
DSGN	Number of Detected Segments	MS,JG,HL,LL	Integer 4 digits	-	x	533
STN	Fault Count	MS,JG,HL,LL	Integer 4 digits	-	x	1609
TSTG	Total Amount of Defects	MS,JG,HL,LL	Integer 7 digits, 3 digits after the decimal point	-	x	1612
TSTL	Defect Amplitude Level	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
TSTW	Total Number of Defected Segments	MS	Integer 4 digits	-	x	-
STG[st]	Amount of Defects	MS,JG,HL,LL	Integer 7 digits, 3 digits after the decimal point	-	✓	1627
STGHI	Amount of Defects (Max.)	MS,JG,HL,LL	Integer 7 digits, 3 digits after the decimal point	-	x	1628
STGLO	Amount of Defects (Min.)	MS,JG,HL,LL	Integer 7 digits, 3 digits after the decimal point	-	x	1629
STL[st]	Defect Level	MS	Integer 5 digits, 3 digits after the decimal point	-	✓	-
STLHI	Defect Level (Max.)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
STLLO	Defect Level (Min.)	MS	Integer 5 digits, 3 digits after the decimal point	-	x	-
STW[st]	Number of Detected Segments	MS	Integer 4 digits	-	✓	-
STWHI	Number of Defected Segments (Max.)	MS	Integer 4 digits	-	x	-
STWLO	Number of Defected Segments (Min.)	MS	Integer 4 digits	-	x	-
STX[st]	Defect Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	1613
STXHI	Defect Position X (Max.)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	1614
STXLO	Defect Position X (Min.)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	1615
STY[st]	Defect Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	1616
STYHI	Defect Position Y (Max.)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	1617
STYLO	Defect Position Y (Min.)	MS,JG,HL,LL	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	1618
STXY[st]	Defect Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
STT[st]	Defect Angle	ST,MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
STTX[st]	Defect Vertex Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
STTY[st]	Defect Vertex Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
STTXY[st]	Defect Vertex Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
STBX1[st]	Defect Bend Position X1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
STBY1[st]	Defect Bend Position Y1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
STBXY1[st]	Defect Bend Position XY1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
STBX2[st]	Defect Bend Position X2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
STBY2[st]	Defect Bend Position Y2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
STBXY2[st]	Defect Bend Position XY2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
STSN[st]	No. of the Segment That Was First Defected	MS	Integer 4 digits	-	✓	-
STTN[st]	No. of the Segment with a Defected Vertex	MS	Integer 4 digits	-	✓	-
STEN[st]	No. of the Segment with a Terminated Defect	MS	Integer 4 digits	-	✓	-
BMN	Number of Reference Model Lines	MS	Integer 1 digits	-	x	-
BLX1	Reference Line X1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
BLY1	Reference Line Y1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
BLXY1	Reference Line XY1	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
BLX2	Reference Line X2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
BLY2	Reference Line Y2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
BLXY2	Reference Line XY2	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
BLX	Reference Line Center X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	x	-
BLY	Reference Line Center Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	x	-
BLXY	Reference Line Center XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	x	-
BLT	Reference Line Angle	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
BCR	Reference Circle Radius	MS,AB	Integer 6 digits, 3 digits after the decimal point	L	x	-
BCX	Reference Circle Center X	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	X	x	-
BCY	Reference Circle Center Y	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	Y	x	-
BCXY	Reference Circle Center XY	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	-
BER1	Reference Oval Radius 1	MS,AB	Integer 6 digits, 3 digits after the decimal point	L	x	-
BER2	Reference Oval Radius 2	MS,AB	Integer 6 digits, 3 digits after the decimal point	L	x	-
BEX	Reference Oval Center X	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	X	x	-
BEY	Reference Oval Center Y	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	Y	x	-
BEXY	Reference Oval Center XY	MS,AB	Sign, Integer 6 digits, 3 digits after the decimal point	-	x	-
BET	Rotation Angle of Reference Oval	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	x	-
BFX	Reference Position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
BFY	Reference Position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
BFXY	Reference Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
DIFF	Subtraction	MS	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
N	Number of Edges	MS	Integer 4 digits	-	✓	-
X	Edge position X	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	-
Y	Edge position Y	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	-
XY	Edge position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Edge Angle	MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-

Tool: Intensity

With or Without/Distinction on the Contrast Pattern

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
DA	Average Intensity	ST,MS,JG,HL,LL	Integer 3 digits, 3 digits after the decimal point	-	x	182
DD	Intensity Deviation	ST,MS,JG,HL,LL	Integer 3 digits, 3 digits after the decimal point	-	x	184
DH	Max. Intensity	ST,MS,JG,HL,LL	Integer 3 digits	-	x	187
DL	Min. Intensity	ST,MS,JG,HL,LL	Integer 3 digits	-	x	188

Tool: OCR

Character Recognition

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
STR1	Recognized String	JG	Integer 1 digits	-	x	-
RCG_CHR	Recognized Character	MS,JG	Integer 3 digits	-	✓	-
JG_CHR	Judged Character	MS	Integer 3 digits	-	✓	-
VR_STR	Collated String	JG	Integer 1 digits	-	✓	-
VR_CHR[]	Collated String	MS	Integer 2 digits	-	✓	-
CHR1	First Character Candidate	MS	Integer 3 digits	-	✓	-
CHR2	Second Character Candidate	MS	Integer 3 digits	-	✓	-
CRR1	Recognizability of First Candidate	MS	Integer 2 digits	-	✓	-
CRR2	Recognizability of Second Candidate	MS	Integer 2 digits	-	✓	-
STBL	Stability	MS	Integer 2 digits	-	✓	-
GDEV	Intensity Deviation	MS	Integer 2 digits	-	✓	-
CCN1	Number of Segmented Characters	MS	Integer 2 digits	-	x	-
L1CRR1_H	Recognizability (Max.)	MS,JG,LL	Integer 2 digits	-	x	1383
L1CRR1_L	Recognizability (Min.)	MS,JG,LL	Integer 2 digits	-	x	1384
L1STBL_H	Stability (Max.)	MS,JG,LL	Integer 2 digits	-	x	1385
L1STBL_L	Stability (Min.)	MS,JG,LL	Integer 2 digits	-	x	1386
	Judged Character (Cannot be used in calculation)	MS	String	-	x	-

Tool: OCR2

Character Recognition

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
STR1	Recognized String	JG	Integer 1 digits	-	x	-
RCG_CHR	Recognized Character	MS,JG	Integer 3 digits	-	✓	-
JG_CHR	Judged Character	MS	Integer 3 digits	-	✓	-
VR_STR	Collated String	JG	Integer 1 digits	-	✓	-
VR_CHR[]	Collated String	MS	Integer 2 digits	-	✓	-
CHR1	First Character Candidate	MS	Integer 3 digits	-	✓	-
CHR2	Second Character Candidate	MS	Integer 3 digits	-	✓	-
CRR1	Recognizability of First Candidate	MS	Integer 2 digits	-	✓	-
CRR2	Recognizability of Second Candidate	MS	Integer 2 digits	-	✓	-
VR_CPLC1[]	No. of the First Registered Dictionary Candidate	MS	Integer 3 digits	-	✓	-
VR_CPLC2[]	No. of the Second Registered Dictionary Candidate	MS	Integer 3 digits	-	✓	-
STBL	Stability	MS	Integer 2 digits	-	✓	-
GDEV	Intensity Deviation	MS	Integer 2 digits	-	✓	-
CCN1	Number of Segmented Characters	MS,JG,HL,LL	Integer 2 digits	-	x	1399
L1CRR1_H	Recognizability (Max.)	MS,JG,LL	Integer 2 digits	-	x	1383
L1CRR1_L	Recognizability (Min.)	MS,JG,LL	Integer 2 digits	-	x	1384
L1STBL_H	Stability (Max.)	MS,JG,LL	Integer 2 digits	-	x	1385
L1STBL_L	Stability (Min.)	MS,JG,LL	Integer 2 digits	-	x	1386
	Judged Character (Cannot be used in calculation)	MS	String	-	x	-

Tool: 1D Code Reading

1D Code Reader

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
ID_LEN	Length of Data Read	MS,JG,HL,LL	Integer 3 digits	-	✓	2006
ID_DATA	Data Read	MS	Integer 3 digits	-	✓	-
ID_STR	String of the Data Read (Cannot be used in calculation)	MS	128 digits	-	✓	-
X	Position X	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	X	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, Integer 5 digits, 3 digits after the decimal point	Y	✓	83
XY	Position XY	MS,AB	Sign, Integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Detected Angle	MS,JG,HL,LL,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	84
XYT	Position XY/Detected Angle (Cannot be used in calculation)	MS	Sign, integer 5 digits, integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_LEN1	Segmented Data Length 1	MS	Integer 3 digits	-	✓	-
ID_LEN2	Segmented Data Length 2	MS	Integer 3 digits	-	✓	-
ID_LEN3	Segmented Data Length 3	MS	Integer 3 digits	-	✓	-
ID_LEN4	Segmented Data Length 4	MS	Integer 3 digits	-	✓	-
ID_LEN5	Segmented Data Length 5	MS	Integer 3 digits	-	✓	-
ID_LEN6	Segmented Data Length 6	MS	Integer 3 digits	-	✓	-
ID_LEN7	Segmented Data Length 7	MS	Integer 3 digits	-	✓	-
ID_LEN8	Segmented Data Length 8	MS	Integer 3 digits	-	✓	-
ID_DATA1	Segmented Data 1	MS	Integer 3 digits	-	✓	-
ID_DATA2	Segmented Data 2	MS	Integer 3 digits	-	✓	-
ID_DATA3	Segmented Data 3	MS	Integer 3 digits	-	✓	-
ID_DATA4	Segmented Data 4	MS	Integer 3 digits	-	✓	-
ID_DATA5	Segmented Data 5	MS	Integer 3 digits	-	✓	-
ID_DATA6	Segmented Data 6	MS	Integer 3 digits	-	✓	-
ID_DATA7	Segmented Data 7	MS	Integer 3 digits	-	✓	-
ID_DATA8	Segmented Data 8	MS	Integer 3 digits	-	✓	-
ID_STR1	Segmented Data String 1 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR2	Segmented Data String 2 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR3	Segmented Data String 3 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR4	Segmented Data String 4 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR5	Segmented Data String 5 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR6	Segmented Data String 6 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR7	Segmented Data String 7 (Cannot be used in calculation)	MS	128 digits	-	✓	-
ID_STR8	Segmented Data String 8 (Cannot be used in calculation)	MS	128 digits	-	✓	-
MSIZE	Detection Code Resolution	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_CCLR	Printing Color	MS	Integer 1 digits	-	✓	-
ID_CDT	Code angle	ST,MS,AB	Sign, Integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_CDL	Code Data Length	MS	Integer 4 digits	-	✓	-
STB	Reading Stability	MS	Integer 1 digits	-	✓	-
ID_ERR	Reading Error	MS	Integer 1 digits	-	✓	-
ID_ERSN	Cause of Reading Error	MS	Integer 1 digits	-	✓	-
M_IDX	Collation Match No.	MS	Integer 2 digits	-	✓	-
M_DATA1	Collation Pattern 1	MS	Integer 3 digits	-	✓	-
M_DATA2	Collation Pattern 2	MS	Integer 3 digits	-	✓	-
M_DATA3	Collation Pattern 3	MS	Integer 3 digits	-	✓	-
M_DATA4	Collation Pattern 4	MS	Integer 3 digits	-	✓	-
M_DATA5	Collation Pattern 5	MS	Integer 3 digits	-	✓	-
M_DATA6	Collation Pattern 6	MS	Integer 3 digits	-	✓	-
M_DATA7	Collation Pattern 7	MS	Integer 3 digits	-	✓	-
M_DATA8	Collation Pattern 8	MS	Integer 3 digits	-	✓	-
M_DATA9	Collation Pattern 9	MS	Integer 3 digits	-	✓	-
M_DATA10	Collation Pattern 10	MS	Integer 3 digits	-	✓	-

Tool: 1D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
M_DATA11	Collation Pattern 11	MS	Integer 3 digits	-	✓	-
M_DATA12	Collation Pattern 12	MS	Integer 3 digits	-	✓	-
M_DATA13	Collation Pattern 13	MS	Integer 3 digits	-	✓	-
M_DATA14	Collation Pattern 14	MS	Integer 3 digits	-	✓	-
M_DATA15	Collation Pattern 15	MS	Integer 3 digits	-	✓	-
M_DATA16	Collation Pattern 16	MS	Integer 3 digits	-	✓	-
M_STR1	Collation Pattern String 1 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR2	Collation Pattern String 2 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR3	Collation Pattern String 3 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR4	Collation Pattern String 4 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR5	Collation Pattern String 5 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR6	Collation Pattern String 6 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR7	Collation Pattern String 7 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR8	Collation Pattern String 8 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR9	Collation Pattern String 9 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR10	Collation Pattern String 10 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR11	Collation Pattern String 11 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR12	Collation Pattern String 12 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR13	Collation Pattern String 13 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR14	Collation Pattern String 14 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR15	Collation Pattern String 15 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR16	Collation Pattern String 16 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_RSLT	Collocation Result	JG	Integer 1 digits	-	✓	-
M_RSLT1	Collocation Result 1	MS	Sign, integer 3 digits	-	✓	-
M_RSLT2	Collocation Result 2	MS	Sign, integer 3 digits	-	✓	-
M_RSLT3	Collocation Result 3	MS	Sign, integer 3 digits	-	✓	-
M_RSLT4	Collocation Result 4	MS	Sign, integer 3 digits	-	✓	-
M_RSLT5	Collocation Result 5	MS	Sign, integer 3 digits	-	✓	-
M_RSLT6	Collocation Result 6	MS	Sign, integer 3 digits	-	✓	-
M_RSLT7	Collocation Result 7	MS	Sign, integer 3 digits	-	✓	-
M_RSLT8	Collocation Result 8	MS	Sign, integer 3 digits	-	✓	-
M_RSLT9	Collocation Result 9	MS	Sign, integer 3 digits	-	✓	-
M_RSLT10	Collocation Result 10	MS	Sign, integer 3 digits	-	✓	-
M_RSLT11	Collocation Result 11	MS	Sign, integer 3 digits	-	✓	-
M_RSLT12	Collocation Result 12	MS	Sign, integer 3 digits	-	✓	-
M_RSLT13	Collocation Result 13	MS	Sign, integer 3 digits	-	✓	-
M_RSLT14	Collocation Result 14	MS	Sign, integer 3 digits	-	✓	-
M_RSLT15	Collocation Result 15	MS	Sign, integer 3 digits	-	✓	-
M_RSLT16	Collocation Result 16	MS	Sign, integer 3 digits	-	✓	-
BC_ALL	BC Overall Grade	MS,JG,LL	Sign, integer 1 digit	-	✗	-
BC_DEC	Result of BC Decoding (DEC)	MS	Sign, integer 1 digit	-	✗	-
BC_EDG	Number of BC Edges (EDGE)	MS	Sign, integer 1 digit	-	✗	-
BC_SC	BC Symbol Contrast (SC)	MS	Sign, integer 1 digit	-	✗	-
BC_MINR	BC Minimum reflectance (MINR)	MS	Sign, integer 1 digit	-	✗	-
BC_MINE	BC Minimum edge contrast (MINE)	MS	Sign, integer 1 digit	-	✗	-
BC_MOD	BC Modulation (MOD)	MS	Sign, integer 1 digit	-	✗	-
BC_QZ	BC Minimum quiet zone (QZ)	MS	Sign, integer 1 digit	-	✗	-
BC_DCD	Degree of Ease in BC Decoding (DCD)	MS	Sign, integer 1 digit	-	✗	-
BC_DEF	BC defect (DEF)	MS	Sign, integer 1 digit	-	✗	-
BC_WNR	BC Wide to Narrow Ratio (WNR)	MS	Sign, integer 1 digit	-	✗	-
BC_CGAP	Gap between BC Characters (CGAP)	MS	Sign, integer 1 digit	-	✗	-
BC_EDG_VAL	Number of BC Edges (EDGE) (Evaluated Value)	MS	Sign, Integer 1 digits, 2 digits after the decimal point	-	✗	-

Tool: 1D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
BC_SC_VAL	BC Symbol Contrast (SC) (Evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_MINR_VAL	BC Minimum reflectance (MINR) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_MINE_VAL	BC Minimum edge contrast (MINE) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_MOD_VAL	BC Modulation (MOD) (Evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_QZ_VAL	BC Minimum Quiet Zone (QZ) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_DCD_VAL	Degree of Ease in BC Decoding (DCD) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_DEF_VAL	BC Defect (DEF) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_WNR_VAL	BC Wide to Narrow Ratio (WNR) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_CGAP_VAL	Gap Between BC Characters (CGAP) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-

Tool: 1D Code Reading

Tool: 2D Code Reading

2D Code Reader

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
ID_LEN	Length of Data Read	MS,JG,HL,LL	Integer 3 digits	-	✓	2006
ID_DATA	Data Read	MS	Integer 3 digits	-	✓	-
ID_STR	String of the Data Read (Cannot be used in calculation)	MS	512 digits	-	✓	-
CC1D_LEN	Length of Data Read (Combined Symbols of the 1D Part)	MS	Integer 3 digits	-	✓	-
CC1D_DATA	Data Read (Combined Symbols of the 1D Part)	MS	Integer 3 digits	-	✓	-
CC1D_ID_STR	String of the Data Read (Combined Symbols of the 1D Part)	MS	128 digits	-	✓	-
CC2D_LEN	Length of Data Read (Combined Symbols of the 2D Part)	MS	Integer 3 digits	-	✓	-
CC2D_DATA	Data Read (Combined Symbols of the 2D Part)	MS	Integer 3 digits	-	✓	-
CC2D_ID_STR	String of the Data Read (Combined Symbols of the 2D Part)	MS	512 digits	-	✓	-
X	Position X	ST,MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	✓	82
Y	Position Y	ST,MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	✓	83
XY	Position XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
T	Detected Angle	MS,JG,HL,LL,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	✓	84
XYT	XY Position/Detected Angle (Cannot be used in calculation)	MS	Sign, integer 5 digits, integer 3 digits, 3 digits after the decimal point	-	✓	-
CC1D_X	Position X (Combined Symbols of the 1D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC1D_Y	Position Y (Combined Symbols of the 1D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC1D_XY	Position XY (Combined Symbols of the 1D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC1D_T	Detected Angle (Combined Symbols of the 1D Part)	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	✓	-
CC1D_XYT	XY Position/Detected Angle (Combined Symbols of the 1D Part) (Cannot be used in calculation)	MS	Sign, integer 5 digits, integer 3 digits, 3 digits after the decimal point	-	✓	-
CC2D_X	Position X (Combined Symbols of the 2D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC2D_Y	Position Y (Combined Symbols of the 2D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC2D_XY	Position XY (Combined Symbols of the 2D Part)	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	✓	-
CC2D_T	Detected Angle (Combined Symbols of the 2D Part)	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	✓	-
CC2D_XYT	XY Position/Detected Angle (Combined Symbols of the 2D Part) (Cannot be used in calculation)	MS	Sign, integer 5 digits, integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_LEN1	Segmented Data Length 1	MS	Integer 3 digits	-	✓	-
ID_LEN2	Segmented Data Length 2	MS	Integer 3 digits	-	✓	-
ID_LEN3	Segmented Data Length 3	MS	Integer 3 digits	-	✓	-

Tool: 2D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
ID_LEN4	Segmented Data Length 4	MS	Integer 3 digits	-	✓	-
ID_LEN5	Segmented Data Length 5	MS	Integer 3 digits	-	✓	-
ID_LEN6	Segmented Data Length 6	MS	Integer 3 digits	-	✓	-
ID_LEN7	Segmented Data Length 7	MS	Integer 3 digits	-	✓	-
ID_LEN8	Segmented Data Length 8	MS	Integer 3 digits	-	✓	-
ID_DATA1	Segmented Data 1	MS	Integer 3 digits	-	✓	-
ID_DATA2	Segmented Data 2	MS	Integer 3 digits	-	✓	-
ID_DATA3	Segmented Data 3	MS	Integer 3 digits	-	✓	-
ID_DATA4	Segmented Data 4	MS	Integer 3 digits	-	✓	-
ID_DATA5	Segmented Data 5	MS	Integer 3 digits	-	✓	-
ID_DATA6	Segmented Data 6	MS	Integer 3 digits	-	✓	-
ID_DATA7	Segmented Data 7	MS	Integer 3 digits	-	✓	-
ID_DATA8	Segmented Data 8	MS	Integer 3 digits	-	✓	-
ID_STR1	Segmented Data String 1 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR2	Segmented Data String 2 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR3	Segmented Data String 3 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR4	Segmented Data String 4 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR5	Segmented Data String 5 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR6	Segmented Data String 6 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR7	Segmented Data String 7 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_STR8	Segmented Data String 8 (Cannot be used in calculation)	MS	512 digits	-	✓	-
ID_CSIZ	Detection Code Resolution	MS	Integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_UECR	Rate of Unused Error Correction	MS	Integer 3 digits	-	✓	-
ID_CNR	Number of Cell Rows	MS	Integer 3 digits	-	✓	-
ID_CNC	Number of Cell Columns	MS	Integer 3 digits	-	✓	-
ID_CCLR	Printing Color	MS	Integer 1 digits	-	✓	-
ID_MRI	With or Without Mirror Effect	MS	Integer 1 digits	-	✓	-
ID_CDT	Code angle	ST,MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	✓	-
ID_CDL	Code Data Length	MS	Integer 4 digits	-	✓	-
ID_ERR	Reading Error	MS	Integer 1 digits	-	✓	-
ID_ERSN	Cause of Reading Error	MS	Integer 1 digits	-	✓	-
CC_HGAP	Length of lateral dislocation in the combined symbols	MS	Sign, integer 3 digits, 3 digits after the decimal point	-	✓	-
M_IDX	Collation Match No.	MS	Integer 2 digits	-	✓	-
M_DATA1	Collation Pattern 1	MS	Integer 3 digits	-	✓	-
M_DATA2	Collation Pattern 2	MS	Integer 3 digits	-	✓	-
M_DATA3	Collation Pattern 3	MS	Integer 3 digits	-	✓	-
M_DATA4	Collation Pattern 4	MS	Integer 3 digits	-	✓	-
M_DATA5	Collation Pattern 5	MS	Integer 3 digits	-	✓	-
M_DATA6	Collation Pattern 6	MS	Integer 3 digits	-	✓	-
M_DATA7	Collation Pattern 7	MS	Integer 3 digits	-	✓	-
M_DATA8	Collation Pattern 8	MS	Integer 3 digits	-	✓	-
M_DATA9	Collation Pattern 9	MS	Integer 3 digits	-	✓	-
M_DATA10	Collation Pattern 10	MS	Integer 3 digits	-	✓	-
M_DATA11	Collation Pattern 11	MS	Integer 3 digits	-	✓	-
M_DATA12	Collation Pattern 12	MS	Integer 3 digits	-	✓	-
M_DATA13	Collation Pattern 13	MS	Integer 3 digits	-	✓	-
M_DATA14	Collation Pattern 14	MS	Integer 3 digits	-	✓	-
M_DATA15	Collation Pattern 15	MS	Integer 3 digits	-	✓	-
M_DATA16	Collation Pattern 16	MS	Integer 3 digits	-	✓	-
M_STR1	Collation Pattern String 1 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR2	Collation Pattern String 2 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR3	Collation Pattern String 3 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR4	Collation Pattern String 4 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR5	Collation Pattern String 5 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR6	Collation Pattern String 6 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR7	Collation Pattern String 7 (Cannot be used in calculation)	MS	128 digits	-	✓	-

Tool: 2D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
M_STR8	Collation Pattern String 8 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR9	Collation Pattern String 9 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR10	Collation Pattern String 10 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR11	Collation Pattern String 11 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR12	Collation Pattern String 12 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR13	Collation Pattern String 13 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR14	Collation Pattern String 14 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR15	Collation Pattern String 15 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_STR16	Collation Pattern String 16 (Cannot be used in calculation)	MS	128 digits	-	✓	-
M_RSLT	Collocation Result	JG	Integer 1 digits	-	✓	-
M_RSLT1	Collocation Result 1	MS	Integer 3 digits	-	✓	-
M_RSLT2	Collocation Result 2	MS	Integer 3 digits	-	✓	-
M_RSLT3	Collocation Result 3	MS	Integer 3 digits	-	✓	-
M_RSLT4	Collocation Result 4	MS	Integer 3 digits	-	✓	-
M_RSLT5	Collocation Result 5	MS	Integer 3 digits	-	✓	-
M_RSLT6	Collocation Result 6	MS	Integer 3 digits	-	✓	-
M_RSLT7	Collocation Result 7	MS	Integer 3 digits	-	✓	-
M_RSLT8	Collocation Result 8	MS	Integer 3 digits	-	✓	-
M_RSLT9	Collocation Result 9	MS	Integer 3 digits	-	✓	-
M_RSLT10	Collocation Result 10	MS	Integer 3 digits	-	✓	-
M_RSLT11	Collocation Result 11	MS	Integer 3 digits	-	✓	-
M_RSLT12	Collocation Result 12	MS	Integer 3 digits	-	✓	-
M_RSLT13	Collocation Result 13	MS	Integer 3 digits	-	✓	-
M_RSLT14	Collocation Result 14	MS	Integer 3 digits	-	✓	-
M_RSLT15	Collocation Result 15	MS	Integer 3 digits	-	✓	-
M_RSLT16	Collocation Result 16	MS	Integer 3 digits	-	✓	-
ISO_ALL	ISO overall grade	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_DEC	Result of ISO Decoding (DEC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_SC	ISO Symbol Contrast (SC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_MOD	ISO Modulation (MOD)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_RM	ISO reflectance margin (RM)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_FPD	ISO fixed pattern damage (FPD)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_AN	ISO non-uniformity in the axis (AN)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_GN	ISO non-uniformity in the grid (GN)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_UEC	ISO unused error correction (UEC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_FID	ISO format information damage (FID)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_VID	ISO model number information damage (VID)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_PGH	ISO print expansion/contraction-horizontal (PGH)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_PGV	ISO print expansion/contraction-vertical (PGV)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_ALL	AIM overall grade	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_DEC	Result of AIM Decoding (DEC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_CC	AIM cell contrast (CC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_CM	AIM cell modulation (CM)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_RM	AIM reflectance margin (RM)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_FPD	AIM fixed pattern damage (FPD)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_AN	AIM non-uniformity in the axis (AN)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_GN	AIM non-uniformity in the grid (GN)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_UEC	AIM unused error correction (UEC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_FID	AIM format information damage (FID)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_VID	AIM model number information damage (VID)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_PGH	AIM print expansion/contraction-horizontal (PGH)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
AIM_PGV	AIM print expansion/contraction-vertical (PGV)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
SAE_ALL	SAE overall grade	MS,JG,LL	Sign, integer 1 digit	-	✗	-
SAE_QZ	SAE Minimum quiet zone (QZ)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
SAE_SC	SAE Symbol Contrast (SC)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
SAE_AD	SAE angle distortion (AD)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
SAE_MF	SAE module fill (MF)	MS,JG,LL	Sign, integer 1 digit	-	✗	-
ISO_SC_VAL	ISO Symbol Contrast (SC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	✗	-

Tool: 2D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
ISO_AN_VAL	ISO non-uniformity in the axis (AN) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ISO_GN_VAL	ISO non-uniformity in the grid (GN) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ISO_UEC_VAL	ISO unused error correction (UEC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ISO_FID_VAL	ISO format information damage (FID) (evaluated value)	MS	Sign, integer 1 digit, 1 digits after the decimal point	-	×	-
ISO_VID_VAL	ISO model number information damage (VID) (evaluated value)	MS	Sign, integer 1 digit, 1 digits after the decimal point	-	×	-
ISO_PGH_VAL	ISO print expansion/contraction-horizontal (PGH) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ISO_PGV_VAL	ISO print expansion/contraction-vertical (PGV) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_CC_VAL	AIM cell contrast (CC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_AN_VAL	AIM non-uniformity in the axis (AN) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_GN_VAL	AIM non-uniformity in the grid (GN) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_UEC_VAL	AIM unused error correction (UEC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_FID_VAL	AIM format information damage (FID) (evaluated value)	MS	Sign, integer 1 digit, 1 digits after the decimal point	-	×	-
AIM_VID_VAL	AIM model number information damage (VID) (evaluated value)	MS	Sign, integer 1 digit, 1 digits after the decimal point	-	×	-
AIM_PGH_VAL	AIM print expansion/contraction-horizontal (PGH) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
AIM_PGV_VAL	AIM print expansion/contraction-vertical (PGV) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
SAE_SC_VAL	SAE Symbol Contrast (SC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
SAE_AD_VAL	SAE angle distortion (AD) (evaluated value)	MS	Sign, integer 2 digit	-	×	-
SAE_MF_VAL	SAE module fill (MF) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_ALL	ST overall grade	MS,JG,LL	Sign, integer 1 digit	-	×	-
ST_DEC	Result of ST Decoding (DEC)	MS	Sign, integer 1 digit	-	×	-
ST_EDG	Number of ST Edges (EDGE)	MS	Sign, integer 1 digit	-	×	-
ST_SC	ST Symbol Contrast (SC)	MS	Sign, integer 1 digit	-	×	-
ST_MINR	ST Minimum reflectance (MINR)	MS	Sign, integer 1 digit	-	×	-
ST_MINE	ST Minimum edge contrast (MINE)	MS	Sign, integer 1 digit	-	×	-
ST_MOD	ST Modulation (MOD)	MS	Sign, integer 1 digit	-	×	-
ST_QZ	ST Minimum quiet zone (QZ)	MS	Sign, integer 1 digit	-	×	-
ST_DCD	Degree of ease in ST decoding (DCD)	MS	Sign, integer 1 digit	-	×	-
ST_DEF	ST defect (DEF)	MS	Sign, integer 1 digit	-	×	-
ST_CY	ST valid code word rate (CY)	MS	Sign, integer 1 digit	-	×	-
ST_CPQ	ST code word printing Corrective patch quality (CPQ)	MS	Sign, integer 1 digit	-	×	-
ST_UEC	ST unused error correction (UEC)	MS	Sign, integer 1 digit	-	×	-
ST_EDG_VAL	Number of ST Edges (EDGE) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_SC_VAL	ST Symbol Contrast (SC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_MINR_VAL	ST Minimum reflectance (MINR) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_MINE_VAL	ST Minimum edge contrast (MINE) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_MOD_VAL	ST Modulation (MOD) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_QZ_VAL	ST Minimum quiet zone (QZ) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_DCD_VAL	Degree of ease in ST decoding (DCD) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_DEF_VAL	ST defect (DEF) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_CY_VAL	ST valid code word rate (CY) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_CPQ_VAL	ST code word printing Corrective patch quality (CPQ) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
ST_UEC_VAL	ST unused error correction (UEC) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	×	-
BC_DEC	Result of BC Decoding (DEC)	MS	Sign, integer 1 digit	-	×	-
BC_EDG	Number of BC Edges (EDGE)	MS	Sign, integer 1 digit	-	×	-
BC_SC	BC Symbol Contrast (SC)	MS	Sign, integer 1 digit	-	×	-
BC_MINR	BC Minimum reflectance (MINR)	MS	Sign, integer 1 digit	-	×	-
BC_MINE	BC Minimum edge contrast (MINE)	MS	Sign, integer 1 digit	-	×	-

Tool: 2D Code Reading

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
BC_MOD	BC Modulation (MOD)	MS	Sign, integer 1 digit	-	x	-
BC_QZ	BC Minimum quiet zone (QZ)	MS	Sign, integer 1 digit	-	x	-
BC_DCD	Degree of Ease in BC Decoding (DCD)	MS	Sign, integer 1 digit	-	x	-
BC_DEF	BC defect (DEF)	MS	Sign, integer 1 digit	-	x	-
BC_EDG_VAL	Number of BC Edges (EDGE) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_SC_VAL	BC Symbol Contrast (SC) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_MINR_VAL	BC Minimum reflectance (MINR) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_MINE_VAL	BC Minimum edge contrast (MINE) (evaluated value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_MOD_VAL	BC Modulation (MOD) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_QZ_VAL	BC Minimum Quiet Zone (QZ) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_DCD_VAL	Degree of Ease in BC Decoding (DCD) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-
BC_DEF_VAL	BC Defect (DEF) (Evaluated Value)	MS	Sign, integer 1 digit, 2 digits after the decimal point	-	x	-

Tool: 2D Code Reading

Tool: Points Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
XP*	Distance X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2574
YP*	Distance Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2575
X1	Best Fit Point 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Best Fit Point 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Best Fit Point 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
X2	Best Fit Point 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y2	Best Fit Point 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY2	Best Fit Point 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Point/Line Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
X1	Best Fit Point X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Best Fit Point Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Best Fit Point XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L2T	Best Fit Line Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L2X	Best Fit Line X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L2Y	Best Fit Line Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L2XY	Best Fit Line XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Lines Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L2T	Best Fit Line 2 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L2X	Best Fit Line 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L2Y	Best Fit Line 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L2XY	Best Fit Line 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Point/Circle Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
XP*	Distance X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2574
YP*	Distance Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2575
X1	Best Fit Point X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Best Fit Point Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Best Fit Point XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C2X	Detection Circle Center X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
C2Y	Detection Circle Center Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
C2XY	Detection Circle Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C2R	Detection Circle Radius	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-
C2D	Best Fit Circle Diameter	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-

Tool: Line/Circle Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C2X	Detection Circle Center X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
C2Y	Detection Circle Center Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
C2XY	Detection Circle Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C2R	Detection Circle Radius	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-
C2D	Best Fit Circle Diameter	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-

Tool: Circles Distance

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
P*	Distance	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	91
XP*	Distance X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2574
YP*	Distance Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	2575
C1X	Best Fit Circle 1 Center X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
C1Y	Best Fit Circle 1 Center Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
C1XY	Best Fit Circle 1 Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C1R	Best Fit Circle 1 Radius	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-
C1D	Best Fit Circle 1 Diameter	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-
C2X	Best Fit Circle 2 Center X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
C2Y	Best Fit Circle 2 Center Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
C2XY	Best Fit Circle 2 Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
C2R	Best Fit Circle 2 Radius	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-
C2D	Best Fit Circle 2 Diameter	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	x	-

Tool: Line Passing Two Points

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
DLT	Best Fit Line Angle	MS,JG,HL,LL,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	640
DLX	Best Fit Line X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
DLY	Best Fit Line Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
DLXY	Best Fit Line XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
X1	Best Fit Point 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y1	Best Fit Point 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY1	Best Fit Point 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
X2	Best Fit Point 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y2	Best Fit Point 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY2	Best Fit Point 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-

Tool: Bisection of Two Lines

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
DLT	Median Angle	MS,JG,HL,LL,AB	Sign, integer 2 digits, 3 digits after the decimal point	-	×	640
DLX	Median X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
DLY	Median Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
DLXY	Median XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
L2T	Best Fit Line 2 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	-
L2X	Best Fit Line 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
L2Y	Best Fit Line 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
L2XY	Best Fit Line 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-

Tool: Angle Formed by Two Lines

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
T	Angle	MS,JG,HL,LL	Sign, integer 3 digits, 3 digits after the decimal point	-	×	84
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
L2T	Best Fit Line 2 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	-
L2X	Best Fit Line 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
L2Y	Best Fit Line 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
L2XY	Best Fit Line 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-

Tool: Line/V-Line Intersection

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
X	Intersection X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	82
Y	Intersection Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	83
XY	Intersection XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	×	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
X2	Best Fit Point 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y2	Best Fit Point 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY2	Best Fit Point 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-

Tool: Two Lines Intersection

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
X	Intersection X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	82
Y	Intersection Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	83
XY	Intersection XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L2T	Best Fit Line 2 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L2X	Best Fit Line 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L2Y	Best Fit Line 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L2XY	Best Fit Line 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Center of Quadrangle

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
X	Center X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	82
Y	Center Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	83
XY	Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L1T	Best Fit Line 1 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L1X	Best Fit Line 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L1Y	Best Fit Line 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L1XY	Best Fit Line 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L2T	Best Fit Line 2 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L2X	Best Fit Line 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L2Y	Best Fit Line 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L2XY	Best Fit Line 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L3T	Best Fit Line 3 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L3X	Best Fit Line 3X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L3Y	Best Fit Line 3Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L3XY	Best Fit Line 3XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
L4T	Best Fit Line 4 Angle	MS,AB	Sign, integer 3 digits, 3 digits after the decimal point	-	x	-
L4X	Best Fit Line 4X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
L4Y	Best Fit Line 4Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
L4XY	Best Fit Line 4XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Midpoint of Points

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
X	Midpoint X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	82
Y	Midpoint Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	83
XY	Midpoint XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
X1	Best Fit Point 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y1	Best Fit Point 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY1	Best Fit Point 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-
X2	Best Fit Point 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	x	-
Y2	Best Fit Point 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	x	-
XY2	Best Fit Point 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	x	-

Tool: Circle Passing Three Points

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
DCX	Detection Circle Center X	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	546
DCY	Detection Circle Center Y	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	547
DCXY	Detection Circle Center XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
DCR	Detection Circle Radius	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	×	545
DCD	Best Fit Circle Diameter	MS,JG,HL,LL,AB	Sign, integer 5 digits, 3 digits after the decimal point	L	×	2592
X1	Best Fit Point 1X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y1	Best Fit Point 1Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY1	Best Fit Point 1XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
X2	Best Fit Point 2X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y2	Best Fit Point 2Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY2	Best Fit Point 2XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-
X3	Best Fit Point 3X	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	X	×	-
Y3	Best Fit Point 3Y	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	Y	×	-
XY3	Best Fit Point 3XY	MS,AB	Sign, integer 5 digits, 3 digits after the decimal point	-	×	-

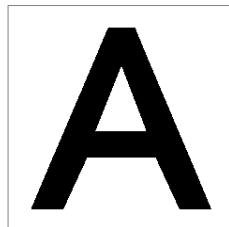
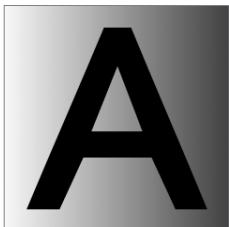
Tool: Calculation

Symbol	Description of measurement item selection	Description of separation/selection	Form of measured data	Scaling target	Label Specification	Item ID
ANS0	Operation Result 0	MS,JG,HL,LL	Sign, integer 11 digits, 3 digits after the decimal point	-	×	975
ANS1	Operation Result 1	MS,JG,HL,LL	Sign, integer 11 digits, 3 digits after the decimal point	-	×	2511
ANS2	Operation Result 2	MS,JG,HL,LL	Sign, integer 11 digits, 3 digits after the decimal point	-	×	2512
ERRC	Error Code		Integer 7 digits	-	×	-
ERRL	Error Line		Integer 7 digits	-	×	-

Pre-processing filter for contrast images

Binary

Performs binary processing.

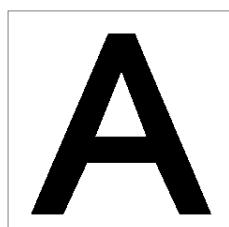


Move [LO] and [UP] with a mouse for adjustment.
Brightness between [LO] and [UP] becomes "white".

- Auto Set**
[LO] and [UP] are automatically set from distribution on the graph.

Contrast Conversion

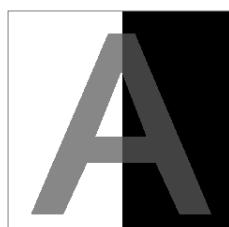
Adjusts brightness of the overall image.



- Offset**
When the value is increased, the image becomes bright. When decreased, the image becomes dark.
- Span**
When the value is increased, the contrast becomes strong. When decreased, the contrast becomes weak.

Contrast Expansion

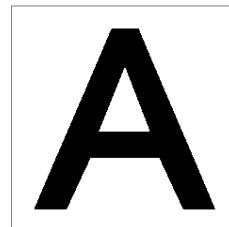
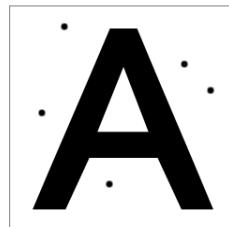
Improves the image contrast by correcting the brightness distribution in the image.



- Expansion Width**
Adjusts the intensity of the contrast expansion. Increasing this value will expand the brightness distribution correction width.
- Noise Cut**
Reduces the noise. Noise occurs especially in the dark areas of the image. Increasing the value will reduce the noise, but the image may become less sharp.

Expand

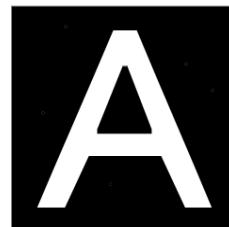
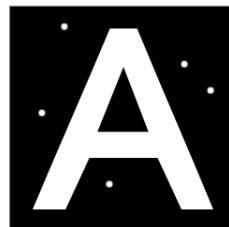
Removes dark noise by adjusting pixels to the highest grayscale intensity from a group of pixels.



- Processing Shape**
Specifies the filter processing shape.
- Size**
Sets the filter size. The greater the size, the stronger the filter effect.
- Direction**
Selects the direction of expansion.
- Count**
Changes the number of times the filter is applied.
- Border**
Select the check box when processing including information outside the border.

Shrink

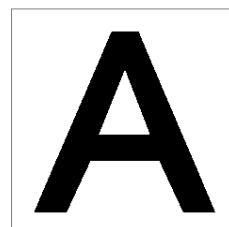
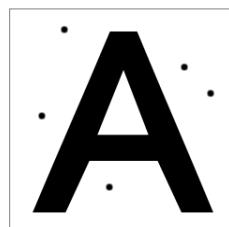
Removes bright noise by adjusting pixels to the lowest grayscale intensity from a group of pixels.



- Processing Shape**
Specifies the filter processing shape.
- Size**
Sets the filter size. The greater the size, the stronger the filter effect.
- Direction**
Selects the direction of shrink.
- Count**
Changes the number of times the filter is applied.
- Border**
Select the check box when processing including information outside the border.

Remove Dark Noise

Removes dark noise by close processing (expansion → shrink).



- Processing Shape**
Specifies the filter processing shape.
- Size**
Sets the filter size. The greater the size, the stronger the filter effect.
- Direction**
Selects the direction of expansion and shrink.
- Count**
Changes the number of times the filter is applied.
- Border**
Select the check box when processing including information outside the border.

Remove Bright Noise

Removes bright noise by open processing (shrink → expansion).



Processing Shape

Specifies the filter processing shape.

Size

Sets the filter size. The greater the size, the stronger the filter effect.

Direction

Selects the direction of expansion and shrink.

Count

Changes the number of times the filter is applied.

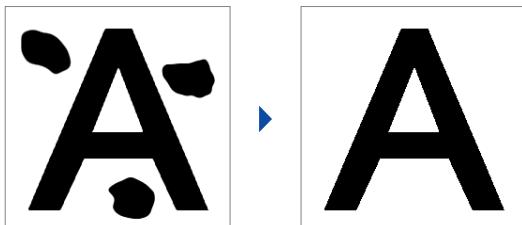
Border

Select the check box when processing including information outside the border.

Noise Isolation

Extracts or removes clusters of bright or dark pixels.

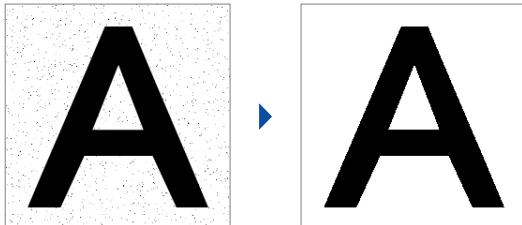
Removes dark noise by adjusting pixels to the highest grayscale intensity from a group of pixels.



"Remove or extract bright or dark pixel block with noise isolation filter" (Page A-65)

Median

Removes noise yet maintains definition by taking the median (most common) intensity across a group of pixels.



Processing Shape

Specifies the filter processing shape.

Size

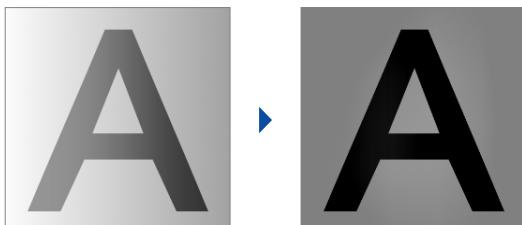
Sets the filter size. The greater the size, the stronger the filter effect.

Count

Changes the number of times the filter is applied.

Shading Correction

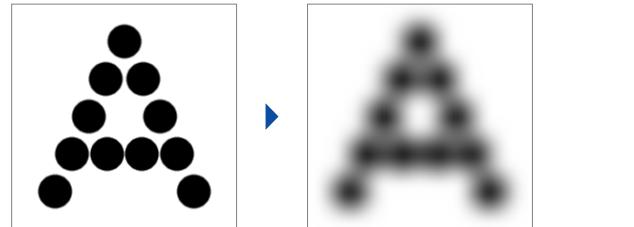
Using this filter leaves areas where there is a sharp contrast while removing smooth change in contrast for the rest of the background.



"Remove shading with a real-time shading correction filter" (Page A-63)

Blur

Blurs the image.



Intensity

Sets the level for blur. The larger the value is, the stronger blur is.

Direction

Selects the direction of blur processing.

Average

Removes noise by taking the average intensity across a group of pixels.

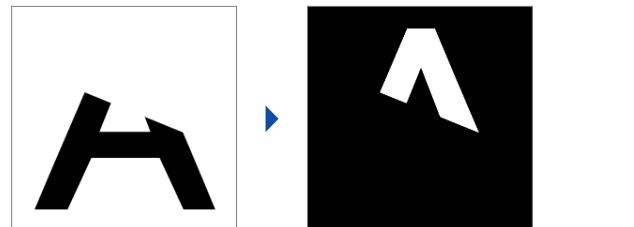


Count

Changes the number of times the filter is applied.

Subtraction

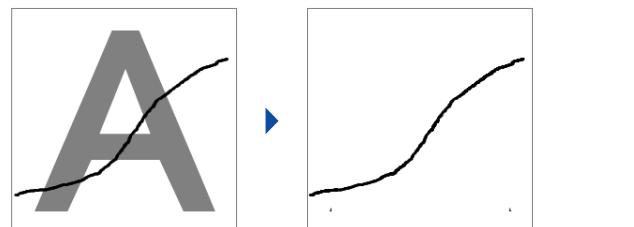
Outputs the image for tone difference obtained by overlapping the reference image with the current image.



"Extract chips and dirts with subtraction filters" (Page A-61)

Image Extraction

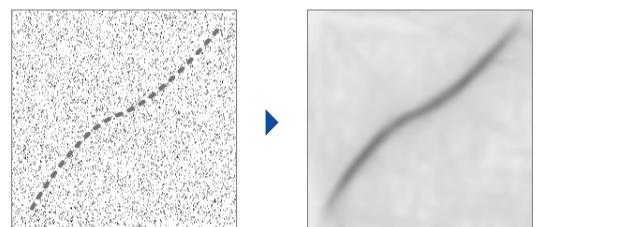
The background of a target can be removed with the Image Extraction filter, by subtracting the current image from a processed version.



"Remove background information with the Image Extraction filter" (Page A-62)

Scratch Defect Extraction

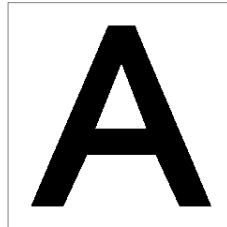
Extracts only linear defects by removing the shading variation in the background.



"Emphasizing only linear defects with a scratch defect extraction filter" (Page A-64)

Preserve Intensity

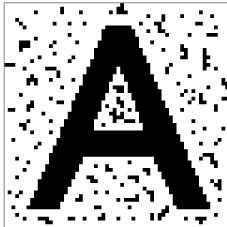
Adjusts brightness according to the intensity on the reference image.



"Reduce the effect of illuminance variation with the illumination correction filter" (Page A-62)

Blob Filter

Extracts the desired target by processing the binary image.



Detection Color

Selects which blobs ("White" or "Black") in the binarized image are to be set as targets for processing.

Detection Count

Specify the maximum number of blobs to be detected.

Low Area Filter

Blobs smaller than the specified lower limit will not be detected. Increase the value in case an unnecessary noise component is counted.

Fill Holes

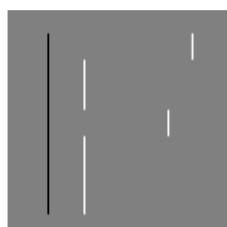
Fill the inside of the blob with the detection color.

Active border

Excludes the blobs on the frame border of the inspection region. Setting to ON removes the background from the inspection region.

Sobel X

Extracts the border of shading variation in the horizontal (X) direction.

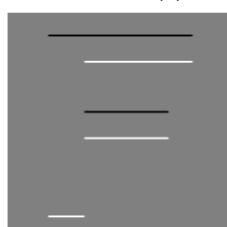


Count

Changes the number of times the filter is applied.

Sobel Y

Extracts the border of shading variation in the vertical (Y) direction.

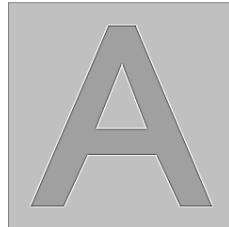


Count

Changes the number of times the filter is applied.

Sharpen

Enhances regions where there is a change in intensity.



Count

Changes the number of times the filter is applied.

Prewitt

It is the edge extraction processing that composes the results of shading variation extraction done individually in the X and Y directions.



Count

Changes the number of times the filter is applied.

Sobel

Extracts low-contrast shading variation and emphasizing it rather stronger than Prewitt.



Count

Changes the number of times the filter is applied.

Roberts

It has a little weaker extraction in X and Y directions than Prewitt, but is suitable for extraction of shading variation in oblique directions.



Count

Changes the number of times the filter is applied.

Laplacian

Extracts edge uniformly without depending on the direction.



Count

Changes the number of times the filter is applied.

Filter Details

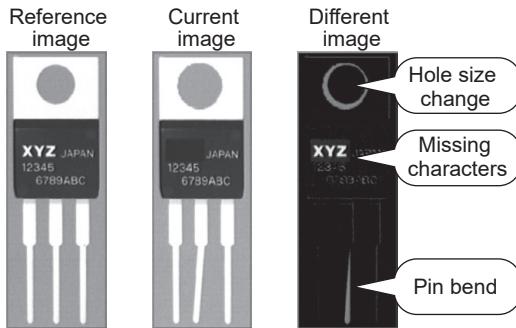
Extract chips and dirts with subtraction filters

About the Subtraction filters

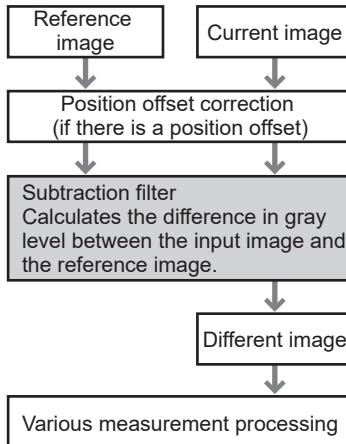
Using a subtraction filter makes possible to output a difference image of gradation differences obtained by overlaying the reference image and the input image. This is useful when you want to extract only the changed parts from the original reference image, such as dirt, chipping, and deformation.

Using it with a "Defect" (Page 5-63) tool and Position Correction to expand the function to detect defects and dirt.

Example



The process of the Subtraction filters



Operation Flow

1 Set a tool to apply the Subtraction filters.

Here the damage tool is used as example.
For details, see "Defect" (Page 5-63).

2 Add the "Subtraction" filters to a tool desired to apply.

Add the "Subtraction" on a "Image Enhance" screen.

3 Set details of the Subtraction filters.

Masking

Cancel noisy difference information occurs near the outline due to the error of the reference image and the input image. Set between 0 and 9 (default: 2) times. The higher the frequency, the higher the control effect, but the lower the sensitivity to subtle changes.

Tone Extraction

Select change direction of concentration to be reflected to the difference image.

Bright & Dark (default setting)

Changes in the light direction and dark direction to the reference image are reflected in the difference image.

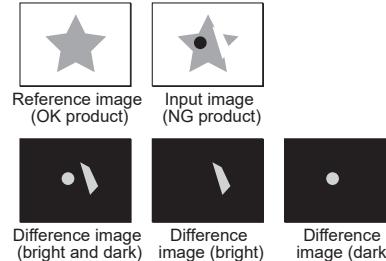
Bright

Reflect only changes in the light direction to the reference image to the difference image.

Dark

Reflect only changes in the dark direction to the reference image to the difference image.

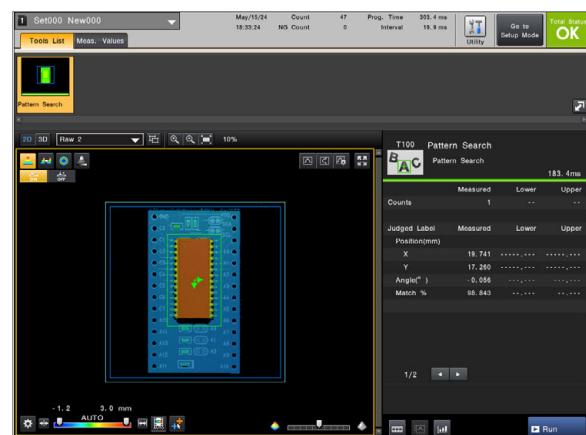
Changes of the difference image by extraction color setting



4 After completing the settings, select [OK].

5 Set a pattern search tool to use as a Position Correction tool.

Position of the detection target on the reference image and the input image is wrong, it is reflected to the Subtraction filters. To prevent this problem, it needs Position Correction with a pattern search tool etc.
For details, see "Pattern Search" (Page 5-44).



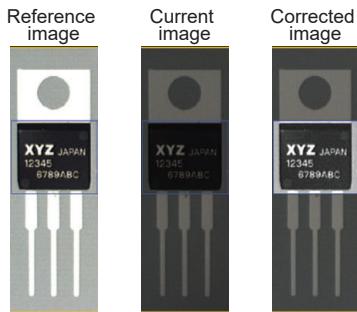
6 Specify the pattern search tool set Position Correction in procedure 5 as correction source, the defect tool as correction destination.

For details, see "Position Correction Settings" (Page 3-34).

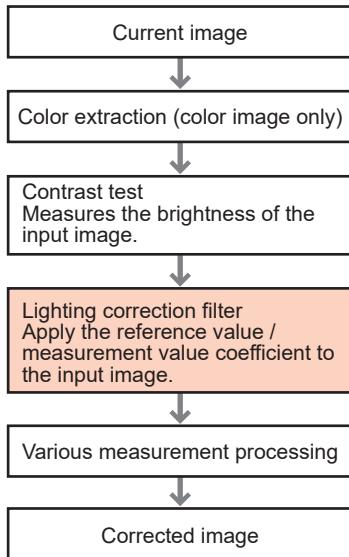
Reduce the effect of illuminance variation with the illumination correction filter

By using the illumination correction filter to correct the intensity of the reference image as a reference, it is possible to reduce the variation in height and brightness of the input image.

Example



Lighting correction process



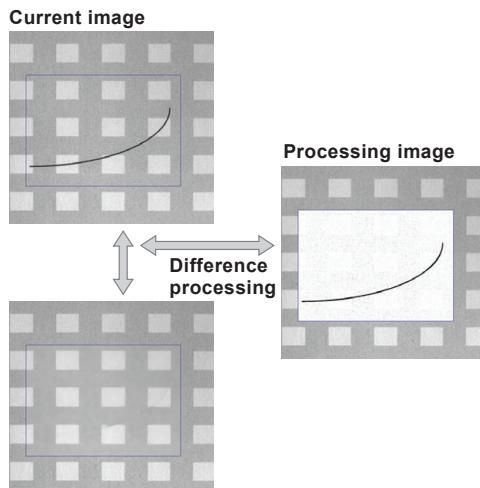
Operation Flow

- 1 Set "Shading inspection" tool to measure the reference value.**
The correction will be stable on setting the measurement area to a place of intermediate brightness (around an average intensity value of 128).
- 2 Set "Lightning correction" filters to a tool desired to apply the lightning correction.**
Add "Lightning correction" on the [Image Enhance] screen.
- 3 Select a "Shading inspection" tool as the reference in the [Shading Check for Reference] column**
- 4 After completing the settings, click [OK].**

Remove background information with the Image Extraction filter

Remove background information to calculate the difference between the input image and the internally processed image created from the input image. It is convenient to extract the target of the relatively small area such as a point and thin line from varying background.

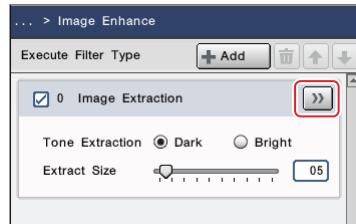
Example



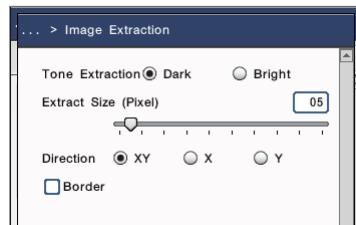
Internally processed image (not displayed)
It is created by applying expansion and contraction processing to each input image on each image processing.

Change filter settings

- 1 Click after adding the [Image Extraction] filter to a tool desired to apply processing.**



- 2 Specify [Dark] or [Bright] in the [Tone Extraction] column, extraction size (2-pixel steps, initial setting: 5) in the range of 3-39 pixels in the [Extract Size] column, processing direction (X, Y, XY).**



Out-of-area reference of the real-time difference filter

It is possible to specify the processing method in an area boundary on creating innerly processed image as the reference.

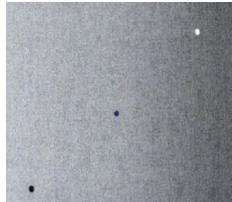
- ON**
Create a processed image by referring to the gradation outside the area.
- OFF (default setting)**
Creates a processed image with the gradation outside the area as the same as the area boundary.

Remove shading with a real-time shading correction filter

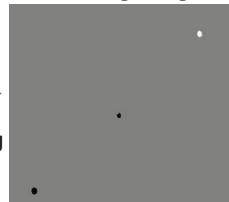
Calculate the difference of the input image and innerly processed image created from the input image to remove slow contrast change of background (shading). Remove contrast change of varying background to extract the only part of sharp contrast change. It is also possible to use the average and median intensity values in the area to uniformly correct the overall contrast of the image.

Example

Current image



Processing image



Difference processing

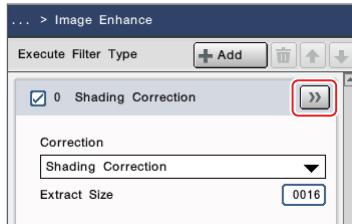


Internally processed image (not displayed)

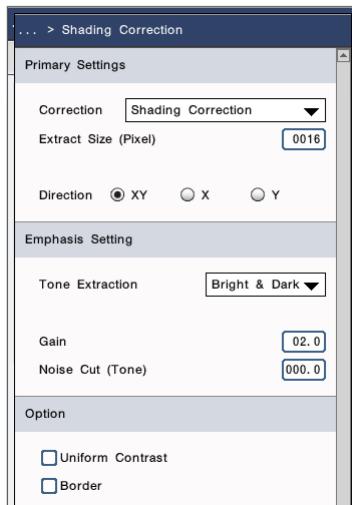
We estimate subtle gradation of background from input image and remove minute defects.

Change filter settings

- Click after adding the [Shading Correction] filter to a tool desired to apply processing.



- Change the settings as required.



Correction

The real-time contrast correction filter calculate the difference of the input image and slow contrast change of background removing sharp change as innerly processed image. Here, specify the type of internally processed image that is used for this process.

Average

Regarding the average intensity value within the entire measurement area as the reference value, the image is corrected by calculating the difference from the input image.

Correction by Median

Regarding the intermediate intensity value within the entire measurement area as the reference value, the image is corrected by calculating the difference from the input image.

Shading Correction (default setting)

Regarding the shading surface estimated based on the extraction size as the reference surface, the image is corrected by calculating the difference from the input image.

Shading Correction (HSP)

Partially suppressing the effect of shading removal to correct faster than [Shading Correction]. The correction result is different to [Shading Correction].

Extract Size (pixel)

When [Shading Correction] or [Shading Correction (HSP)] is selected in [Correction], specify the size (4 to 200; initial setting value: 16) of the defect (black point, white point, damage, etc.) to be extracted, as well as the processing direction (X, Y, XY).

The smaller the extraction size, the better the followability to finer shading (but the processing time will be longer).

Direction

Select the processing direction (X, Y, XY) of the filter when [Shading Correction] or [Shading Correction (HSP)] is selected in [Correction]. (Initial setting value: XY)

Tone Extraction

Select the color you want to extract as a defect.

Bright

Select to extract only defects that are brighter than the background.

Dark

Select to extract only defects that are darker than the background.

Bright & Dark (default setting)

Select to extract both bright and dark defects.

Individual

Select when extracting defects by setting the extraction sensitivity separately for the contrast.

Gain

Set the gain to the corrected image (0 to 10.0, initial setting value: 2.0). If you want to increase the contrast, set a larger number.

Noise cut (Tone)

Remove minute noise components of background (0 to 255, Initial setting value: 0.0). Noise below the specified gradation is removed.

Uniform Contrast

Put check if intensity changes of background are large and you want more uniformity. It also has the effect of maintaining the contrast of the filtered image when the background brightness changes.

OFF (default setting)

Contrast equalization is not performed.

ON

Contrast equalization is performed.

Border

When [Shading Correction] or [Shading Correction (HSP)] is selected in [Correction], check and select whether to process with reference to the image outside the measurement area.

OFF (default setting)

Process without referencing an image outside of the region.

ON

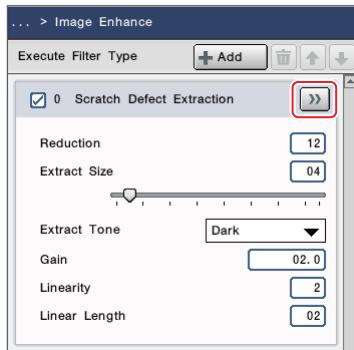
Refer to and process images outside the area.

- After completing the settings, click [OK].

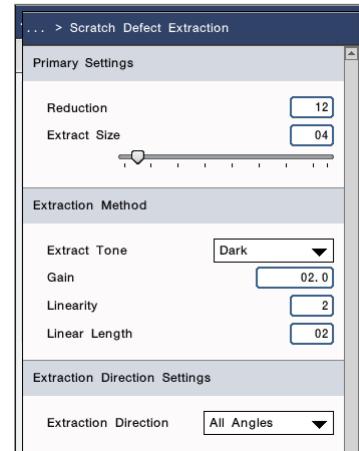
Emphasizing only linear defects with a scratch defect extraction filter

Generate a reduced image from the input image for speed and noise removal, and create a background image that represents the gradual shading of the background. A pretreatment that emphasizes only the linear defects is applied to the background-removed image from which the background image and the original reduced image have been obtained by calculate the difference of the background image and the original reduced image.

- Click  after adding the "Scratch Defect Extraction" filter to a tool desired to apply processing.



- Change the settings as required.



● Reduction

Increasing the extraction reduction degree improves processing speed but makes it difficult to extract thin line defects.

● Extract Size

Increasing the value makes it easier to extract thick line defects.

● Extraction Tone

Select the color you want to extract as a line defect.

Bright

Extract only line defects that are brighter than the background.

Dark

Extract only line defects that are darker than the background.

Bright & Dark

Extract both bright and dark line defects.

● Gain

Enlarging the gain increases the contrast of the image. Contrast enhancement is performed on the background-removed image.

● Linearity

If the line defect you want to extract is linear, increase the value. The smaller the value, the easier it is to extract line defects with large curvature.

● Linear Length

Increasing the value makes it easier to extract long line defects. If you want to extract short line defects, decrease the value.

● Extraction direction

Specify the direction of the line defect you want to extract.

All Angles

Line defects in all directions are to be extracted.

Specify Angle

The processing speed is improved by limiting the direction of extracted line defects. The direction is specified by the reference angle and the angle range.

● Starting Angle

Specify the range of the direction of the line defect that you want to extract, using a combination of "starting angle ± angle range".

● Angle Range

Specify the range of the direction of the line defect that you want to extract, using a combination of "starting angle ± angle range".

- After completing the settings, click [OK].

Remove or extract bright or dark pixel block with noise isolation filter

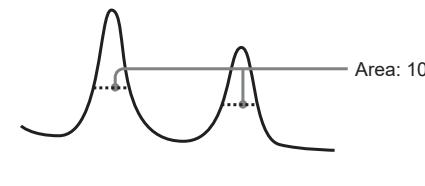
A reduced image is generated from the input image for speeding up and noise removal, and the graduation value of the target tone is converted according to the set area value. A block below the specified area will be processed.

Example

Example 1

- Process Type: Remove
- Target Tone: Bright
- Area: 10
- Image profile

Before processing



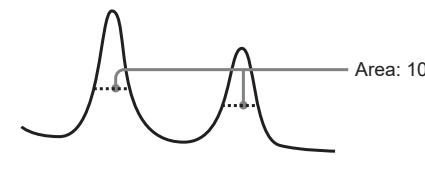
After processing



Example 2

- Process Type: Extraction
- Target Tone: Bright
- Area: 10
- Image profile

Before processing

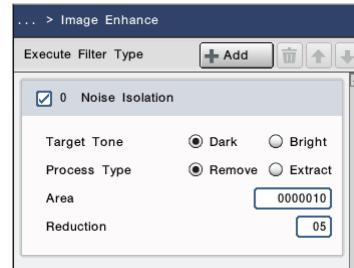


After processing



Change filter settings

- 1 Add the "Noise Isolation" filter to the tool that you want to process.
- 2 Change the settings as required.



Target Tone

A block of pixels of a specified color is to be processed.

Bright

A block of bright pixels is to be processed.

Dark

A block of dark pixels is to be processed.

Process Type

Choose how to handle the target block.

Remove

Remove the processing target block.

Extract

Extract only the processing target block.

Area

A block equal to or less than the specified area is considered to be processed.

Reduction degree

Increasing the reduction degree reduces the calculation accuracy of the area to be processed, but improves the processing speed.

- 3 After completing the settings, click [OK].

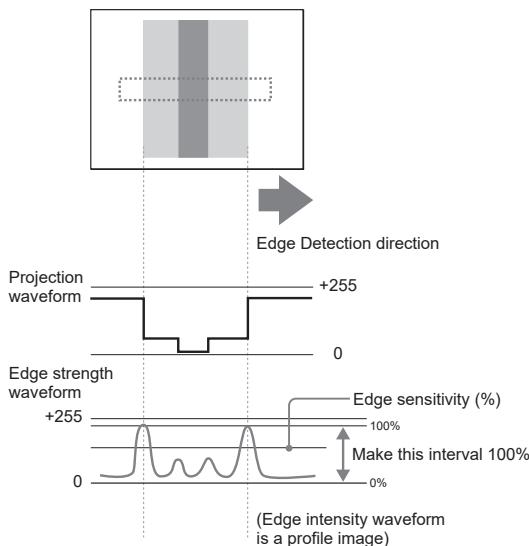
Technical Explanation

What is an edge?

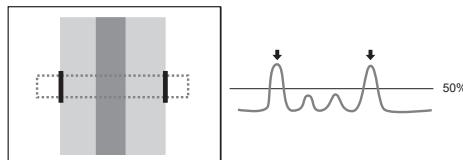
The machine's edge processing is to detect the boundaries of the measurement area. Edge detection is performed not by the absolute value of intensity, but by the amount of change in the average intensity, which is projection processing within the measurement area perpendicular to the edge detection direction. This amount of change is called edge strength.

Edge Sensitivity

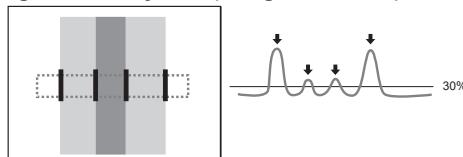
The rate at which an edge is recognized as the maximum edge intensity value (where the contrast change is the largest) of 100%, is called the edge sensitivity. Edge detection is stabilized even if there is a lighting change in the entire image by specifying the edge sensitivity (edge recognition reference) relative to the maximum edge intensity in addition to detecting the edge by the amount of change in intensity.



Edge Sensitivity 50% (2 edges detected)

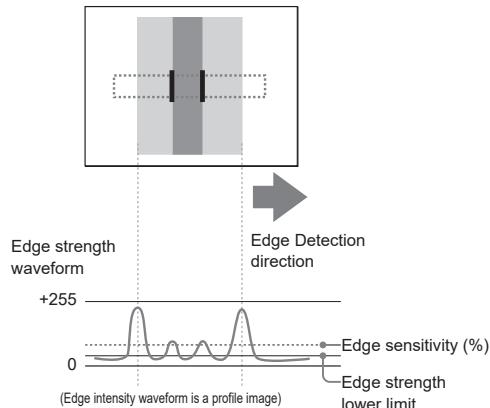


Edge Sensitivity 30% (4 edges detected)



Edge strength lower limit

The lower limit of detection for this differential waveform is called the edge strength lower limit, which is the lower limit for recognizing edges (see also the figure below). If it falls below the lower limit of edge strength, it is not recognized as an edge.



Difference between edge sensitivity and edge strength lower limit

While the edge sensitivity specifies with relative value regarding the maximum value of edge strength as 100%, the lower limit of edge strength differs in that it specifies the absolute value of edge strength.

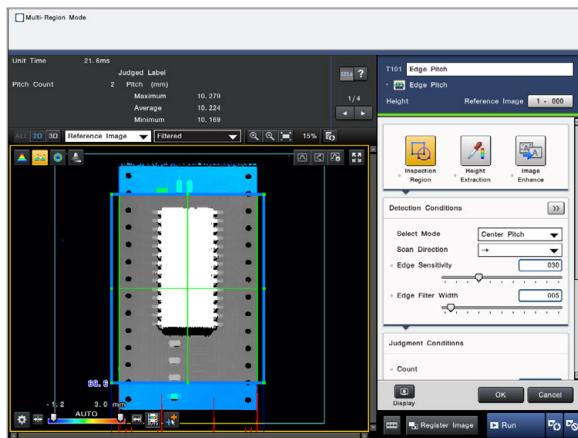
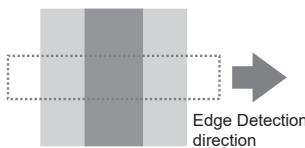
How to check edge strength

It is possible to check the maximum edge strength value in the measurement area by the numbers of the edge strength waveform displayed on the "Edge detection condition setting" screen.

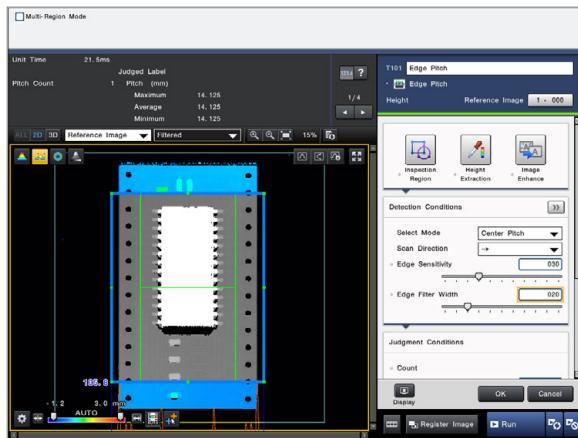
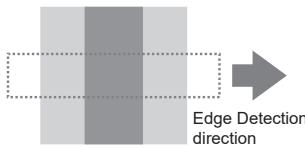
Filter width

By setting the filter width, it is possible to average the edge strength waveform. If the noise component causes false detection of an edge, it is possible to reduce false detection by increasing the filter width and averaging the noise component. Also, if you want to detect a gentle edge, such as when the measurement work is inclined, it is possible to easily detect a wide range of intensity changes as an edge by increasing the filter width.

● At the time of filter width initialization (filter width = 5)



● After changing the filter width setting (filter width = 20)

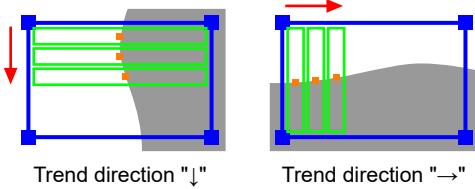


What is trend edge measurement?

In trend edge measurement, the edge detection segment is scanned in the specified direction in the measurement area, and the edge position of each segment is measured. As multiple edge position information can be measured in one measurement area, it is possible to calculate the average, maximum and minimum of the whole, and to detect circles and straight lines based on the detection position. It is also possible to determine defects based on the detected circle or straight line.

Trend Direction

Select the moving direction of the segment to detect the edge.
Select with "↑" or "→" (when the area is rectangular).

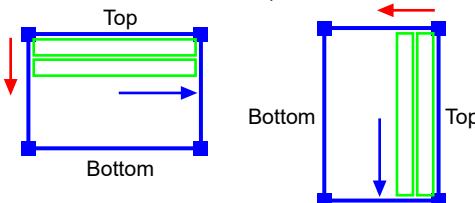


Trend direction "↓"

Trend direction "→"

- If the area is a rotating rectangle

The direction is fixed from the top to the bottom.



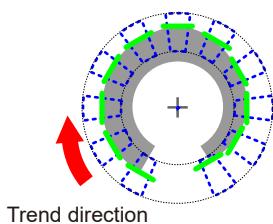
Top

Bottom

Top

- If the area is a circle or arc

It will be fixed clockwise.



Scan Direction

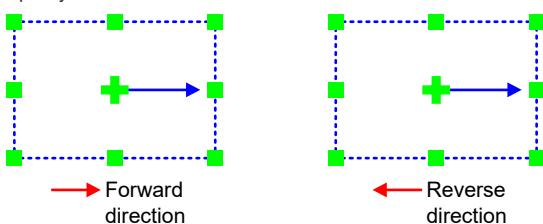
Specify the direction to scan the edge in the area (segment).

- If the area is rectangular

Specify with "↑", "↓", "←" and "→".

- If the area is a rotating rectangle

Specify "Forward" or "Reverse".



Forward direction

Reverse direction



Selectable one is perpendicular direction to the trend direction.

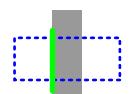
- If the area is a circle or arc

Select from "Center to Out" or "Out to Center" of the area.

Edge Direction

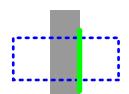
Specify the light level change for edge detection.

"Day→Night"



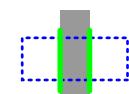
Edge Detection direction

"Night→Day"



Edge Detection direction

"Both directions"



Edge Detection direction

Edge Sensitivity (%)

Specify the percentage of edge recognition while regarding maximum edge strength as 100%.

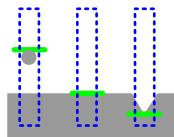
For details, see □ "What is an edge?" (Page A-66).

Segment Size

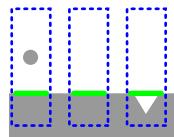
Specify the size of the segment to detect the edge.

When the size is increased, small changes cannot be detected, but they are less susceptible to noise.

Size (Small)



Size (large)

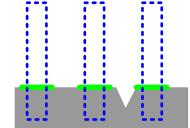


If you want to keep the segment size small and reduce the effects of noise, use preprocessing.

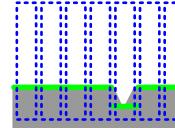
Segment Shift

Specifies how much the segment that detects the edge moves in the trend direction. The smaller the movement amount, the longer the processing time, but it is possible to measure points more finely.

Amount of movement "Large"



Amount of movement "Small"



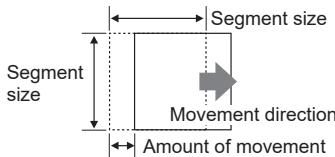
Maximum number of segments

Specifies the maximum number of segments that can be detected.

As increasing the maximum number of segments consumes resource memory, you may not be able to add tools. In that case, check whether there is a tool that unnecessarily increases the maximum number of segments.

What is a defect measurement?

In the defect tool, the measurement segment moves in the measurement area in the specified detection direction by the specified movement amount, and measures the average intensity in the segment.



Difference between defect level and area

The difference between the maximum intensity and the minimum intensity in the total 4 segments, including the current segment, to be compared in detection direction becomes the "defect level" of the current segment. In the following example, the defect level's max. intensity of 120 (current segment + position 3) - the min. intensity of 80 (current segment + position 1) = 40 (defect level).

(1) Current segment (Average concentration 95)



(2) Current segment + 1 (Average concentration 80)



(3) Current segment + 2 (Average concentration 1000)



(4) Current segment + 3 (Average concentration 120)



If the "defect level" exceeds the set threshold, it is determined that the current segment is defective and is added to the "defect area" measurement value (defect area measurements are the number of segments determined to be defective).

Example: In the case of detecting chipping or burrs of the outline part by limiting the detection direction

By limiting the detection direction and scanning along the contour, you can detect only chips and burrs without misdetecting the contour.

What is the defect grouping function?

The defect grouping function in the defect tool (page 5-63) is a function to measure continuous small areas detected as segments as one group.

In normal defect detection, among the multiple (number indicated as total defect area) segments detected above the defect level threshold in the measurement area, the one with the highest difference in intensity (the defect level) is detected as the defect position. On the other hand, the defect grouping function treats and processes continuous segments exceeding the defect level threshold as a group.

It is effective when detecting the position of damage or dirt larger than the segment size, or detecting a condition (such as a stain) where the defect area is large enough that the intensity difference within defect (not along the border) is not detected.

When detecting the position

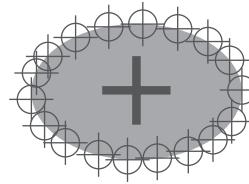
Defect grouping "OFF"

Detects the position of the segment with the most intensity difference on the boundary of damages and dirt.



Defect grouping "ON"

It is possible to group surrounding segments and output the coordinates of the center of gravity.

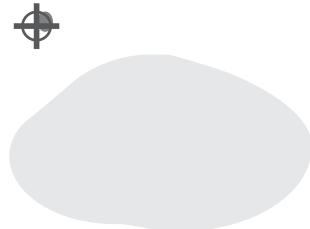


[Reference] The detection segment in the above figure is an image (different from the actual display). For segment distribution, check [Contrast] from the VIEW bar.

When detecting large defects such as stains

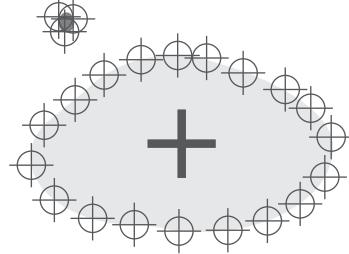
Defect grouping "OFF"

Detects the position of the segment with the most intensity difference in the measurement area.



Defect grouping "ON"

The number of segments exceeding the defect level at the border (of lower contrast defects) can be detected.



[Reference]

- The detection segment in the above figure is an image (different from the actual display). For segment distribution, check [Contrast] from the VIEW bar.
- The defect grouping function is disabled when "Circumferential" in the measurement area and "Circular direction" or "Radial direction" is selected as the detection direction.

Supplementary Explanation of Recognition Category Tool

ASCII code table (hexadecimal/decimal notation)

When the recognition character of recognition category tool is referred to by calculation, ASCII code value of each character is returned. ASCII code value (hex number, decimal number) is as follows.

		()	+	-	.	/	:
Symbol	Hex number	28	29	2B	2D	2E	2F	3A
	Decimal number	40	41	43	45	46	47	58

	0	1	2	3	4	5	6	7	8	9	
Numbers	Hex number	30	31	32	33	34	35	36	37	38	39
	Decimal number	48	49	50	51	52	53	54	55	56	57

	A	B	C	D	E	F	G	H	I	J	K	L	M	
Letters	Hex number	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D
	Decimal number	65	66	67	68	69	70	71	72	73	74	75	76	77
	N	O	P	Q	R	s	T	U	V	W	X	Y	Z	
	Hex number	4E	4F	50	51	52	53	54	55	56	57	58	59	5A
	Decimal number	78	79	80	81	82	83	84	85	86	87	88	89	90
	a	b	c	d	e	f	g	h	i	j	k	l	m	
Letters	Hex number	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D
	Decimal number	97	98	99	100	101	102	103	104	105	106	107	108	109
	n	o	p	q	r	s	t	u	v	w	x	y	z	
	Hex number	6E	6F	70	71	72	73	74	75	76	77	78	79	7A
	Decimal number	110	111	112	113	114	115	116	117	118	119	120	121	122

	SPACE	
Other	Hex number	20
	Decimal number	32

 For Kanji data, the shift JIS 2-byte code value is returned.

Set conversion table to determine encrypted date and time information by built-in calendar (Date Encryption Settings)

When using the "Date Encryption Settings" to inspect the printed contents for the date and time encrypted, create a conversion table that supports the judgment string linked to the built-in calendar to be encrypted. By using this conversion table, it becomes possible to work with the built-in calendar even when the judgment string is encrypted, so it is possible to judge the encrypted date and time printing as same as a normal character string.

1 Select [Conversion Settings] in [Judgment Condition] of OCR tool or OCR2 tool and select [Date Encryption Settings].

[Conversion Settings] can be selected only when the date and time or calculation result is specified in the judgment string.

2 Select the tab to be converted.

Year Encrypted Table Settings (eYear)
When performing the judgment corresponding to the date and time encryption, set the date and time encryption tolerance (eYear) to the judged string and then set the conversion table.
Register the replacement character strings every year after specification of the table number.
Set the auto input setting to execute the auto input, and replacement character strings can be specified at

eYear
eMonth
eDay
eHour
eMinute
Shift

Table No.: eYear 0

Year	Replacement String
□ 00	<input type="text"/>
□ 01	<input type="text"/>
□ 02	<input type="text"/>
□ 03	<input type="text"/>
□ 04	<input type="text"/>

Select All Deselect All Clear

- eYear: Year
- eMonth: Month
- eDay: Day
- eHour: Hour
- eMinute: Minute
- Shift: Shift

3 Specify the table number (0 to 9).

You can create up to 10 tables. If you are using encryption patterns that the detection target is different, it is useful to switch and manage conversion tables.

Date Encryption Settings

Year Encrypted Table Settings (eYear)
When performing the judgment corresponding to the date and time encryption, set the date and time encryption tolerance (eYear) to the judged string and then set the conversion table.
Register the replacement character strings every year after specification of the table number.
Set the auto input setting to execute the auto input, and replacement character strings can be specified at

eYear
eMonth
eDay
eHour
eMinute
Shift

Table No.: eYear 0

Year	Replacement String
□ 00	<input type="text" value="AA"/>
□ 01	<input type="text"/>
□ 02	<input type="text"/>
□ 03	<input type="text"/>
□ 04	<input type="text"/>

Select All Deselect All Clear Input Setting Auto Input

4 Create a conversion table.

Register replacement string for each replacement source number (YYMMDDHHMMSS).

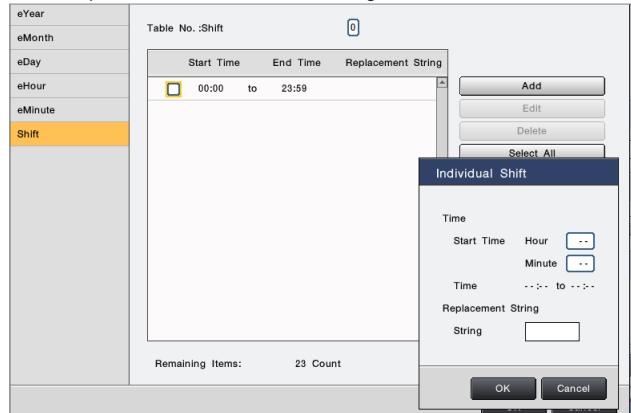
For example, if October 14, 2012 is printed as BC (year) JM (month) BE (day), specify as follows.

Conversion unit specified in step 2	Replace source	Replacement string
Year	12	BC
Month	10	JM
Day	14	BE

By using [Input setting], you can specify replacement characters for each number at once.

○ If you selected [Shift] in step 2

Select "Add" on the conversion table creation screen, and register the time zone and replacement character string as a set on the [Individual Shift] screen. Up to 24 sets of divisions can be registered for each table.



5 After completing the settings, click [OK].

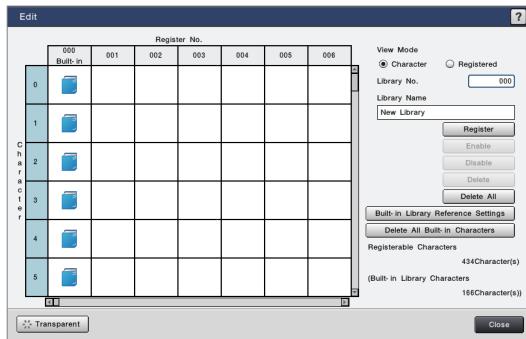
Register the character pattern used for character recognition in the library

You can register some symbols such as alphanumeric characters and dots.

1 In [Library Settings] of the OCR tool or OCR2 tool, select [Edit].

The [Edit] screen is displayed.

[Reference] In the case of a library created with the OCR2 tool, the headings of the table are displayed in light blue for the character types for which the built-in library characters are registered.



To change the format of the list

You can change the display format in [View Mode].

- Character: A list of registered characters is displayed in a matrix.
- Registered: Registration state of all character types is shown in a list.

To switch the library to register

Specify the library number you want to register in [Library No.] (000 to 999: However, the number of dictionaries that can be created may be limited depending on the remaining amount of internal memory).

To change the library name

Select [Library Name] and enter a name of your choice (up to 30 full-pitch or 60 half-pitch).

To check the image for registration

Click [Transparent] to make the setting screen transparent. Click [Transparent] again to return to the original state.

2 Click [Register].

The [Select Register Mode] screen is displayed.



3 Select the image to be registered as a library in the VIEW bar.

- Reference Image: Displays the reference image.
- Current Image: Displays the input image from the head.
- Image strip: Displays the image remaining in the image strip.

4 Select the library registration method and extraction method, and register the library.

There are two ways to register a library:

Each

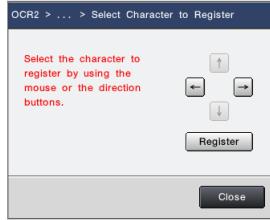
Register the library while specifying the character type of the cut out character one by one.

Batch

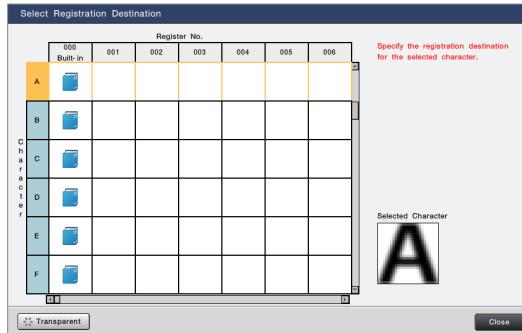
Performs library registration of characters to be cut out with a string all at once.

○ When [Each] is selected

Select the extracted character from the screen and click [Register], [Select Character to Register] screen is displayed.



Please select a character type to register characters, then register.



Repeat this operation until the required character type is registered.

[Reference] Click [Transparent] to make the setting screen transparent. Click [Transparent] again to restore the original state.

○ When selecting [Batch]

The [Batch] screen is displayed.



Enter the text of the currently cut out character string and register it.

5 When registration is complete, click [Close].

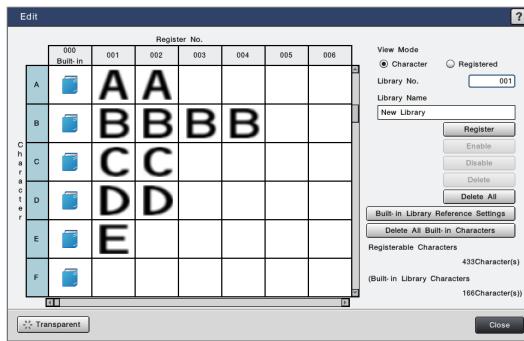
Return to the [Edit] screen.

If necessary, you can check the registration status of the library.

Switch between [Character] and [Registered] and check.

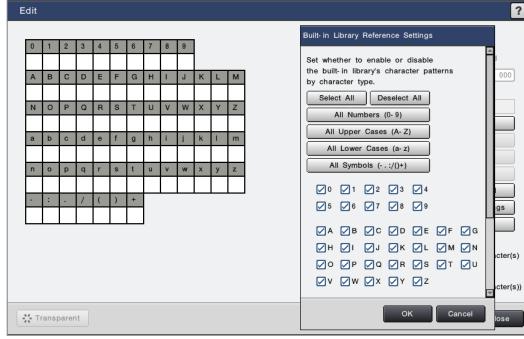
○ Character

Data registered for each character type is displayed.



○ Registered

If registered for each character type, it will be displayed with a check.

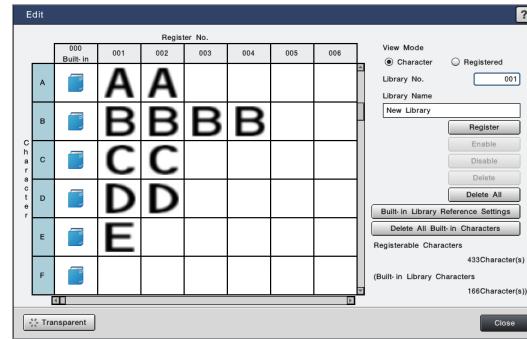


Reference Click [Transparent] to make the setting screen transparent.
Click [Transparent] again to restore the original state.

Edit/delete registered library data

You can edit/delete registered library data according to the following procedure.

1 Perform the necessary operations on the [Edit] screen.



● Enable/Disable

Temporarily enable/disable the selected character pattern. The invalid character is displayed with ×, but the data itself is not deleted, so it can be turned back later.

● Delete

Deletes the selected character pattern or character type.

● Delete all

Deletes all character patterns registered in the selected library number.

● Built-in Library Reference Settings (when using OCR2 tool)

Set the built-in library to valid/invalid for each character type in the selected library.

● Delete All Built-in Characters (when using the OCR2 tool)

Deletes all registered characters in the built-in library from the character patterns registered in the selected library number.



If you delete all built-in library characters, you cannot restore the built-in library characters to the specified library. If you want to use a library that contains built-in library characters, you need to create the library again.

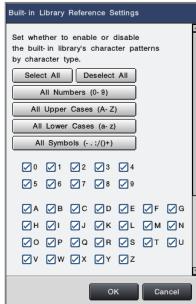
2 When editing is complete, click [Close].

Change the reference setting of characters registered in the built-in library (when using the OCR2 tool)

For characters registered in the built-in library, you can set whether to reference when recognizing characters for each character type.

1 On the [Edit] screen, click [Built-in Library Reference Settings].

[Built-in Library Reference Settings] screen is displayed.



2 Check the character type to refer to at the time of character recognition. Uncheck the character types that you do not refer to.

- **Check box for each character type**

The character type with a check is referenced at the time of character recognition.

- **Select All**

Click to select the check boxes for all character types.

- **Deselect All**

Click to clear the check boxes for all character types.

- **All Numbers**

Every time you click, it switches reference/non-reference for all numbers.

- **All Upper Cases**

Every time you click, it switches reference/non-reference for all upper case letters.

- **All Lower Cases**

Every time you click, it switches reference/non-reference for all lowercase letters.

- **All Symbols**

Every time you click, it switches reference/non-reference for all symbols.

3 When editing is complete, click [OK].

Saved File Types

The file types and data contents saved by the operation of this machine are as follows.



- The number of measurements used for the file name is reset when the power is turned on, when the RESET operation is performed, when the inspection setting is switched, and returns to the initial value.
- Images that have been saved after being thinned cannot be reloaded on this unit. When using archived images on this machine, set the file format to "BMP", "JPG" or "PNG" in the saved image export of "Image Output" (Page 6-19) or "Image Strip Settings" (Page 7-29).

	File Name	Contained Data
Output File	<ul style="list-style-type: none"> • YYMMDD_HHMMSS_{Number of measurements}_Image name_Total judgment.bmp (/jpg /png) • Serial Number_Designated Character_Image Name_Total judgment.bmp (/jpg /png) 	<ul style="list-style-type: none"> • Captured image data saved with <input type="checkbox"/> "Image Output" (Page 6-19) (24-bit color (height image) or 8-bit grayscale (grayscale image) of bitmap or JPEG format or 16-bit grayscale (height image) or 8-bit grayscale (grayscale image) of PNG format). • If it is not thinned out, you can load it into this machine again. • You can select from 3 patterns in <input type="checkbox"/> "Image Output" (Page 6-19) for naming rules for file names.
	<ul style="list-style-type: none"> • YYMMDD_HHMMSS.bmp (/jpg /png) • Serial number_Specified character.bmp (/jpg /png) 	<ul style="list-style-type: none"> • Display screen data saved by screen capture (1024x768 dots, 24-bit color of bitmap or JPEG format or PNG format). • You can select from 2 patterns in <input type="checkbox"/> "Image Capture Settings" (Page 8-13) for file names.
	YYMMDD_HHMMSS.csv	<ul style="list-style-type: none"> • Output data log such as measurement results (comma separated text data) • The contents set in the output setting of the SD card 2 will be recorded, and the file name will be automatically assigned by YYMMDD_HHMMSS when the file was created. • The file name is reset when the power is turned on, when the RESET operation is performed, when the inspection setting is switched, when it is switched by the OW command, and another file is created at the first data writing time after reset.
	YYMMDD_HHMMSS_{SD card number}_Inspection setting number_dat.csv	Measurement data such as measurement name and measurement result (number of measurement / statistical target item / individual judgment) saved in measurement value list of statistics (text data separated by comma)
	YYMMDD_HHMMSS_{SD card number}_Inspection setting number_stat.csv	Number of measurements saved in process monitor of statistics / Measurement data such as yield / Cpk / Cpu / Cpl (comma separated text data)
	YYMMDD_HHMMSS_{number of measurements}_Image Name_Total Determination.bmp (/jpg /png)	<ul style="list-style-type: none"> • Archived image data saved in saved image export of <input type="checkbox"/> "Image Strip Settings" (Page 7-29) (24-bit color (height image) or 8-bit grayscale (grayscale image) of bitmap or JPEG format or 16-bit grayscale (height image) or 8-bit grayscale (grayscale image) of PNG format). • If it is not thinned out, you can load it into this machine again.
Output File	YYMMDD_HHMMSS_{Number of measurements}_Image Name_Total Determination.bmp (/png)	<ul style="list-style-type: none"> • Archived image data stored when the saved image export is checked in the export of inspection settings (24-bit color (height image) or 8-bit grayscale (grayscale image) of bitmap or 16-bit grayscale (height image) or 8-bit grayscale (grayscale image) of PNG format). • The data can be loaded on the controller again.
	rs_232c_YYMMDD_HHMMSS_SD card number_Inspection setting number.log	Communication log data (text data) saved in <input type="checkbox"/> "RS-232C Monitor" (Page 7-13)
	Ethernet_YYMMDD_HHMMSS_SD card number_inspection setting number.log	Communication log data (text data) saved in <input type="checkbox"/> "Ethernet Monitor" (Page 7-14)
Configuration file (do not rename the file)	env.dat	Configuration data for this machine (binary data in dedicated format)
	Inspect.dat	Individual inspection setting data for this machine (binary data in dedicated format)
	ref1_Reference image number.bmp (/jpg /png)	Reference image data of this machine (24-bit color (height image) or 8-bit grayscale (grayscale image) of bitmap or JPEG format or 16-bit grayscale (height image) or 8-bit grayscale (grayscale image) of PNG format).
	dic dictionary number.dat	Dictionary data for this machine's OCR2/OCR tool (binary data in dedicated format)
	STF.tbd	Feature data created with the feature drawing tool of the ShapeTrax3A tool of this machine (binary data of dedicated format)
	RGN_SHP.dat	The shape region data set in Shape Region.

Remedy when the screen display is slow

Perform recalculations manually

● Recalculation settings

The display screen may take a while to be updated when tool editing starts or the parameters are changed.

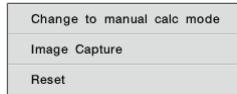
Tool editing can be done efficiently by changing the recalculation setting to Manual.

- Automatic (initial value): The display screen is updated automatically.
- Manual: The display screen is updated when "Recalculate" is clicked.

● Operation Flow

1 In Setup Mode, right click and hold.

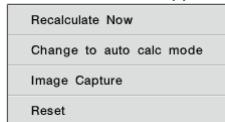
The context menu appears.



2 Select [Change to manual calc mode].

3 Right click and hold to recalculate.

The context menu appears.



4 Click [Recalculate Now] to perform the recalculation.

5 To return to automatic recalculation, click [Change to auto calc mode].



An icon in the top right corner of the data screen shows whether automatic or manual recalculation is currently set. You can click this icon to change the setting.

- Automatic:
- Manual:

Error Message

System error

Errors that occur on the controller include hardware errors such as head connection errors and software errors such as incorrect settings. While the controller operates in Run mode, any error occurrence can be detected via the ERROR terminal which turns ON in the event of an error.

● Head Settings

Error Number	Error Messages	Cause	Remedy
10001	The head cannot be recognized. Turn off the controller and check the connection of the head.	An error occurred in the connection with the head.	<ul style="list-style-type: none"> After turning on the power, check that the head has not been removed. Check that the head is properly connected. Make sure that the head cable is not disconnected. Use a head cable that supports the head to connect.
10004	An internal device error has occurred on the head *. (Detail code: 0x ****)	An error occurred in the internal device of the head.	If it does not operate normally even after the power is turned on again, the head may be broken. Contact your local KEYENCE office.
10005	An internal error occurred at the head *. (Detail code: 0x ****)	An internal error occurred at the head.	If it does not operate normally even after the power is turned on again, the head may be broken. Contact your local KEYENCE office.
10006	An input unit device error has occurred. (Detail code: 0x ****)	An error occurred in the internal device of the input unit.	If it does not operate normally even after the power is turned on again, the input unit may be broken. Contact your local KEYENCE office.
10007	An error occurred in the input unit. (Detail code: 0x ****)	An internal error has occurred in the input unit.	If it does not operate normally even after the power is turned on again, the input unit may be broken. Contact your local KEYENCE office.
10008	The line scan period is too fast. Check the setting list.	Trigger Pass is generated.	Increase the fastest line scan period in the head setting or lower the moving speed of the workpiece.
10009	The head * cannot be recognized. (Detailed code: 0x ****)Turn off the controller and check the connection of the head.	An error occurred in the connection with the head.	<ul style="list-style-type: none"> After turning on the power, check that the head has not been removed. Check that the head is properly connected. Make sure that the head cable is not disconnected.
10010	A timeout error has occurred on Head *. (Detail code: 0x ****)	A head processing timeout occurred.	Change the detection mode settings in the head settings.
14127	The following items do not match the head settings. Model/head type	A different type of head is connected to the head set in the head setting of the inspection setting.	Check the model of the connected head.
14128	The following items do not match the head settings. • Head luminance output type	A type of head different from the head setting (luminance output) of the inspection setting is connected.	Check the model of the connected head.
14129	The following items do not match the head settings. • Number of heads	The head setting (number of heads) of the inspection setting is different from the number of heads connected.	Check the number of heads connected.
14130	The error below has occurred. • Unrecognized head is connected.	A head not compatible with the controller is connected.	Check the model of the connected head.
14132	The error below has occurred. • No head is connected. After turning off the power, connect the head, then turn on the power again.	The head is not connected to the controller.	Check the connection between the controller and the head.
14133	The error below has occurred. • Connect the head to the Head A port. After turning off the power, connect the head, then turn on the power again.	The head is not connected to the connector of the head A.	After turning off the power, connect the head to the connector of head A, and then turn on the power again.
14134	The error below has occurred. • Connect a head that is the same model as head A and head B. After turning off the power, connect the head, then turn on the power again.	A head that is a different model from head A and head B is connected.	Connect a head that is the same model as head A and head B.

● System File

Error Number	Error Messages	Cause	Remedy
11001	Unable to load the selected program setting file.	The program file that corresponds to the last saved program No. (or the program No. selected using the mouse) does not exist.	Change the program number to a working program.
		The program file for the specified program could not be found when changing or reloading programs.	Change the program number to a working program.
11002	Failed to load because the image memory of the program setting is beyond the size.	The image memory for the program file loaded at startup is full.	<ul style="list-style-type: none"> • Change to a different program file. • Correct the program to reduce the size of its data.
		The program being loaded exceeds the available image memory.	<ul style="list-style-type: none"> • Change to a different program file. • Correct the program to reduce the size of its data.
11003	Failed to load the system setting.	The system settings file used at startup cannot be found on the SD card 1.	Before powering up the controller, make sure the system settings file exists on the SD card.
		The system settings loaded at startup is from a incompatible version.	Create a compatible version of the system settings file.
		The system settings file has a checksum error.	Use a different system settings file.
		The system settings file loaded at startup is damaged.	Use a different system settings file.
11004	Unable to load the program setting file due to unsupported version.	The program loaded at startup is an incompatible version.	Change the program to a different working program.
		The program being loaded is an incompatible version.	Create a compatible version of the program file.
11005	Unable to load the program setting file due to checksum errors.	The program loaded at startup has a checksum error.	Change the program to a different working program.
		The program being loaded has a checksum error.	Recreate the program file.
11006	Unable to load the program setting file due to damage.	The program loaded at startup is damaged.	Change the program to a different working program.
		The program being loaded is damaged.	Recreate the program file.
11011	Failed to load because the resource memory of the program setting is beyond the size.	Resource memory is full in the program setting file loaded at startup.	<ul style="list-style-type: none"> • Change to a different program file. • Correct the program setting such that it does not exceed the available resource memory. • Change to a different program file. • Correct the program setting such that it does not exceed the available resource memory.
		The program being loaded exceeds the available resource memory.	<ul style="list-style-type: none"> • Change to a different program file. • Correct the program setting such that it does not exceed the available resource memory. • Change to a different program file. • Correct the program setting such that it does not exceed the available resource memory.

● SD card

Error Number	Error Messages	Cause	Remedy
12001	Failed to access the SD card 1.	A problem occurred while trying to access SD card 1. There is a problem with access to SD card 1.	<ul style="list-style-type: none"> From the [Manage Files] menu, run the [Check] utility on SD card 1. If the error persists, format the SD card 1. (Note, this will erase all contents on SD card 1.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged.
		The controller could not recognize the format of SD card 1.	<ul style="list-style-type: none"> From the [Manage Files] menu, run the [Check] utility on SD card 1. If the error persists, format the SD card 1. (Note, this will erase all contents on SD card 1.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged.
		An unsupported SD card is being used.	The functionality and performance when using commercially available (non-industrial rated) SD cards is not guaranteed
		The destination file is set to read-only.	Disable the read-only setting on the destination file, or delete it.
12002	Failed to access the SD card 2.	A problem occurred while trying to access SD card 2.	<ul style="list-style-type: none"> From the [Manage Files] menu, run the [Check] utility on SD card 2. If the error persists, format the SD card 2. (Note, this will erase all contents on SD card 2.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged.
		The controller could not recognize the format of SD card 2.	<ul style="list-style-type: none"> From the [Manage Files] menu, run the [Check] utility on SD card 2. If the error persists, format the SD card 2. (Note, this will erase all contents on SD card 2.) If the problem cannot be resolved by any of these remedies, the SD card may be damaged.
		An unsupported SD card is being used.	The functionality and performance when using commercially available (non-industrial rated) SD cards is not guaranteed
		The destination file is set to read-only.	Disable the read-only setting on the destination file, or delete it.
12003	SD card 1 is full.	There is not enough free space on SD card 1.	Make space available by deleting or moving unnecessary files on SD card 1.
12004	SD card 2 is full.	There is not enough free space on SD card 2.	Make space available by deleting or moving unnecessary files on SD card 2.
12005	Insert SD card 1.	No SD card in SD1 slot.	Properly insert an SD card into the SD1 slot.
		An unsupported SD card is being used.	The functionality and performance when using commercially available (non-industrial rated) SD cards is not guaranteed
12006	Insert SD card 2.	No SD card in SD2 slot.	Properly insert an SD card into the SD2 slot.
		After executing [Remove SD Card2], no SD card has been reinserted into SD2 slot.	If the SD card is already inserted, remove it first, and then insert it again.
		An unsupported SD card is being used.	The functionality and performance when using commercially available (non-industrial rated) SD cards is not guaranteed
12007	Cannot find SD card 1. Be sure to keep the SD card 1 inserted during the power on.	SD card 1 was removed while the power was ON.	Do not remove SD card 1 while the power was ON. Removing an SD card while it is being accessed may damage the SD card and the data saved on it.
12008	Execute the eject operation before removing the SD card 2. The SD card and files may be damaged.	The SD card 2 was removed without using the [Remove SD Card2] function.	Execute the [Remove SD Card2] function before removing the SD card 2. Removing an SD card while it is being accessed may damage the SD card and the data saved on it.
12009	SD card 1 is write-protected.	The write-protect switch on SD card 1 is enabled.	Disable the write-protect switch on SD card 1.
12010	SD card 2 is write-protected.	The write-protect switch on SD card 2 is enabled.	Disable the write-protect switch on SD card 2.
12012	Unable to export to SD card 2 due to a full output buffer.	SD card 2 output buffer is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the SD card 2. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.

Error Number	Error Messages	Cause	Remedy
12014	The firmware SD card is not inserted. Please turn off the power and reboot after having inserted the firmware SD card.	No firmware SD card is in the slot.	Please turn off the power and reboot after having inserted the firmware SD card.
12101	Connect the USB HDD.	No USB HDD is connected to the USB HDD connector.	Connect correctly a USB HDD to the USB HDD connector.
		A USB HDD that is incompatible with this controller is being used.	Do not use a USB HDD that is incompatible with this controller. Doing so may result in data loss or setting data damage. For the specifications of the USB HDD that can be used with this controller, see □ "Supported USB HDD" (Page 2-8).
12102	Failed to access the USB HDD.	<ul style="list-style-type: none"> • A problem occurred while trying to access USB HDD. • There is a problem with access to the USB HDD. • A USB HDD that is incompatible with this controller is being used. • The destination file is set to read-only. 	<ul style="list-style-type: none"> • If the error persists, format the USB HDD. (Note, this will erase all contents on the USB HDD.) • If the problem cannot be resolved, the USB HDD may be damaged. Contact your local KEYENCE office.
12103	Unable to export to the USB HDD due to a full output buffer.	The output buffer for output the USB HDD is full.	Reduce the amount of data to be output to the USB HDD so the data is output at a faster rate than it builds up. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.
12104	The USB HDD is full.	There is not enough free space on the USB HDD.	Make space available by deleting or moving unnecessary files.
12105	The USB HDD is write-protected.	The write-protect switch on the USB HDD is enabled.	Disable the write-protect switch on the USB HDD.
12106	Execute the Remove USB HDD operation before removing the USB HDD. The USB HDD and files may be damaged.	The USB HDD was removed without using the [Remove USB HDD] function.	Execute the [Remove USB HDD] function before removing the USB HDD. Removing the USB HDD while it is being accessed may damage the USB HDD and the data saved on it.
12107	An unsupported USB device was connected. Please remove the connected USB device.	A device other than mass storage class devices, such as a mouse, is connected to the USB 3.0 connector.	Remove the connected device.
12108	The format of the USB HDD is incorrect. Perform format with the memory utility of the file management.	The controller could not recognize the format of the USB HDD.	Format the USB HDD. (Note, this will erase all contents on the USB HDD.)

● PC Program

Error Number	Error Messages	Cause	Remedy
13001	Failed in the communication with the PC Program.	An error occurred with the Ethernet communication when the data is output to a PC program.	<ul style="list-style-type: none"> • Make sure the Ethernet cable is connected to the controller and the PC/PLC. • Make sure the LAN cable is not disconnected. • Check the Ethernet cable type (cross, straight). • Check whether the PC at the other end of the connection is ready to transmit/receive data. • Check that the correct PC program is running on the PC and that the PC is connected to the controller.
13002	Unable to output to PC Program due to a full output buffer.	The controller output buffer for outputting to PC Programs is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the PC Program. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.

● RS-232C

Error Number	Error Messages	Cause	Remedy
13101	An RS-232C communication time out error has occurred.	RS-232C communication has been down for 60 or more seconds when data output via the RS-232C is specified in the output settings.	<ul style="list-style-type: none"> • Make sure flow control is not set to [CTS/RTS] in the RS-232C settings. • Make sure the serial cable is not disconnected.
13102	Unable to output to RS-232C due to a full output buffer.	The controller output buffer for outputting via the RS-232C port is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the RS-232C. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.

● Ethernet

Error Number	Error Messages	Cause	Remedy
13201	Ethernet cable is not connected.	An error occurred with the Ethernet cable when data output via the Ethernet is specified in the output settings.	<ul style="list-style-type: none"> • Make sure the Ethernet cable is connected to the controller and the PC/PLC. • Make sure the LAN cable is not disconnected. • Check the Ethernet cable type (cross, straight). • Make sure the orange LED indicator (connection) of the Ethernet connector is lit.
13202	An Ethernet communication time out error has occurred.	Ethernet communication has been down for 10 or more seconds when data output via the Ethernet is specified in the output settings.	<ul style="list-style-type: none"> • Check whether the PC/PLC at the other end of the connection is ready to transmit/receive data. • Check that the communication software for Ethernet is running on the PC/PLC and that the PC/PLC is connected with the controller.
13203	Failed in the Ethernet (Non-Procedural) communication.	An error occurred with the Ethernet communication when data output via Ethernet is specified in the output settings.	<ul style="list-style-type: none"> • Check whether the PC/PLC at the other end of the connection is ready to transmit/receive data. • Check that the communication software for Ethernet is running on the PC/PLC and that the PC/PLC is connected with the controller.
13204	Unable to output to Ethernet due to a full output buffer.	The controller output buffer for outputting via the Ethernet port is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the Ethernet. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.

● PLC-Link

Error Number	Error Messages	Cause	Remedy
13301	Failed to establish a link with the PLC.	An error occurred in the connection with the PLC when the [PLC-Link (RS-232C)] or [PLC-Link (Ethernet)] function was enabled.	<ul style="list-style-type: none"> Check the connection with the PLC and the settings of the PLC. If PLC-Link is not used, change communication mode to [Disable PLC-Link]. If the error message displayed after a trigger input, check that the data memory destination specified is in the range that meets the PLC format.
13302	Unable to output to the PLC-Link due to a full output buffer.	The controller output buffer for outputting via PLC-Link is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the PLC-Link. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.
13303	The delay of the handshake control causes skipping of the PLC communication result output.	As the amount of data output overflows the buffer, data output is suspended partially.	<ul style="list-style-type: none"> Check that handshake is controlled properly. Clear the data in the output buffer using the TEST terminal (bit) or reset input.

● Terminal I/O

Error Number	Error Messages	Cause	Remedy
13401	Unable to make the terminal output due to a full output buffer.	The output buffer for output via the terminal is full.	Reduce the amount of data to be output through the parallel/terminal outputs, so the data is output at a faster rate than it builds up. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.
13402	The delay of the handshake control causes skipping of the I/O terminal output.	As the amount of data output overflows the buffer, data output is suspended partially.	<ul style="list-style-type: none"> Check that handshake is controlled properly. Clear the data in the output buffer using the TEST terminal (bit) or reset input.

● FTP/VNC

Point

- The FTP command "APPE" is used to output data to the FTP server on this controller. If your FTP server does not support the "APPE" command, data cannot be outputted.
- If there is a firewall on the FTP server or on the network path to the FTP server, it may fail to connect. If this is the case, you will need to take measures such as disabling the firewall. Please check with your network administrator or PC manufacturer for details.

Error Number	Error Messages	Cause	Remedy
13501	Failed to connect to FTP server.	The FTP server is not operating.	Make sure the PC and FTP server on the NAS device (network archived storage) are configured and operating correctly.
		An error occurred in the LAN connection with the FTP server.	<ul style="list-style-type: none"> Make sure the LAN cable is connected to the controller and the PC or the NAS device (network archived storage) running the FTP server. Make sure the LAN cable is not disconnected. Check the LAN cable type (cross, straight). Make sure the orange LED indicator (connection) of the Ethernet connector is lit.
		The IP address for the FTP server is incorrect.	Check the IP address settings specified in the FTP settings.
13502	Failed to login to FTP server.	The user ID and/or password for logging in to the FTP server is incorrect.	Make sure the user name and password specified in the FTP settings matches the same settings defined in the FTP server software.
13503	Timeout error occurred during output to FTP server.	The controller logged in and began writing a file but was unable to complete the process within the specified time.	<ul style="list-style-type: none"> Check the connection between the controller and the FTP server. Make sure the FTP server is operating correctly.
13504	Failed to output the file to FTP server.	The controller was able to log into the FTP server, but was not able to create a file.	<ul style="list-style-type: none"> Make sure the user account has write privileges on the FTP server. Check the remaining capacity of the FTP server. Check the connection between the controller and the FTP server. Make sure the FTP server is operating correctly.
13505	VNC connection is not acknowledged.	The remote desktop connection is used from the data collection application. The VNC connection is used from the touch panel display. The number of VNC clients being connected from a PC has reached the upper limit (4).	<ul style="list-style-type: none"> Cancel the VNC connection from the touch panel display. Cancel the other connected VNC client connection.
13506	The specified VNC version is not supported.	An unsupported protocol version has been selected.	Use VNC clients with protocol versions 3.4 or higher.
13507	VNC authentication failed.	Password authentication failed.	Check whether or not the password that is set at the controller and VNC client is correct.
13508	The specified VNC pixel format is not supported.	An unsupported pixel format has been selected.	Select either full color or 16-bit color for the pixel format.
13509	The specified VNC encode type is not supported.	An unsupported encoding type has been selected.	Select either Textile or Raw as the encoding type.
13510	FTP output failed due to a full buffer.	The output buffer for output via FTP is full.	Reduce the amount of data to be output, so that the data for each measurement is output at a slower rate than they are output to the FTP. Or, extend the time between triggers/processing to allow for data to be output. Note: Results data is not written when the buffer is full.

● EtherNet/IP

Error Number	Error Messages	Cause	Remedy
13601	EtherNet/IP communication failed.	An error occurred in the EtherNet/IP communication connection when [EtherNet/IP] was set in the global settings.	<ul style="list-style-type: none"> Check the EtherNet/IP connection status and settings. If EtherNet/IP is not used, return the communication mode to [Disable EtherNet/IP].
13602	EtherNet/IP output failed due to a full buffer.	The buffer for output via EtherNet/IP is full.	Reduce the amount of data to be output so that the data for each measurement is output at a slower rate than it is output to EtherNet/IP. Or, extend the time between triggers. Note: Result data is not written when the output buffer is full.
13603	The delay of the handshake control causes skipping of the EtherNet/IP communication result output.	As the amount of data output overflows the buffer, data output is suspended partially.	<ul style="list-style-type: none"> Check that handshake is controlled properly. Clear the data in the output buffer using the TEST terminal (bit) or reset input.
13604	The EtherNet/IP unit cannot be recognized.	The EtherNet/IP unit is not recognized, and the controller cannot use EtherNet/IP communication.	<ul style="list-style-type: none"> Make sure the EtherNet/IP unit is installed correctly. Make sure the EtherNet/IP unit is not damaged. Do not connect/disconnect the EtherNet/IP unit while the controller and unit are powered on.
13605	Non-supported EtherNet/IP unit.	An EtherNet/IP expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.

● PROFINET

Error Number	Error Messages	Cause	Remedy
13701	PROFINET communication failed.	An error occurred in the PROFINET communication connection when [PROFINET] was set in the global settings.	<ul style="list-style-type: none"> Check the PROFINET connection status and settings. If PROFINET is not used, return the communication mode to [Disable PROFINET].
13702	PROFINET output failed due to a full buffer.	The buffer for output via PROFINET is full.	Reduce the amount of data to be output so that the data for each measurement is output at a slower rate than it is output to PROFINET. Or, extend the time between triggers. Note: Result data is not written when the output buffer is full.
13703	The delay of the handshake control causes skipping of the PROFINET communication result output.	As the amount of data output overflows the buffer, data output is suspended partially.	<ul style="list-style-type: none"> Check that handshake is controlled properly. Clear the data in the output buffer using the TEST terminal (bit) or reset input.
13705	Non-supported PROFINET unit.	A PROFINET expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.

● EtherCAT

Error Number	Error Messages	Cause	Remedy
13801	EtherCAT communication failed.	Cyclic communication was interrupted. (When recovery is possible, recovery occurs automatically.)	<ul style="list-style-type: none"> Check that the Ethernet cable is connected correctly. Check whether both the controller and the master side were restarted after the communication settings were updated. Change the cyclic communication cycle and timeout time on the PLC side. With the factory default, ERROR output is not set. Set this on the "ERROR Output Settings" screen (page 8-18).
13802	EtherCAT output failed due to a full buffer.	The buffer for output via EtherCAT is full.	Change the update time on the PLC so the data from the tool is output via EtherCAT at a faster rate than it builds up. Or, extend the time between triggers. Note: Result data is not written when the output buffer is full.
13803	The delay of the handshake control causes skipping of the EtherCAT communication result output.	With the EtherCAT handshake ON, a delayed handshake caused results output via EtherCAT to be skipped.	Change the RPI setting so the data from the tool is output via EtherCAT at a faster rate than it builds up. Or, extend the time between triggers. Note: Output does not occur when the output buffer is full.
13804	The EtherCAT unit cannot be recognized.	The EtherCAT unit is not recognized, and the controller cannot use EtherCAT communication.	<ul style="list-style-type: none"> Make sure the EtherCAT unit is installed correctly. Make sure the EtherCAT unit is not damaged. Do not connect/disconnect the EtherCAT unit while the controller and unit are powered on.
13805	Non-supported EtherNet/IP unit.	An EtherNet/IP expansion unit that cannot be used with the controller is connected.	Contact your local KEYENCE office.

● Processing Memory

Error Number	Error Messages	Cause	Remedy
14001	Insufficient processing memory.	Processing memory space available is insufficient.	<ul style="list-style-type: none"> The processing memory is consumed in every operation such as measurement/mask region adding, pattern region as well as subtraction filter and dictionary data setting. Delete unnecessary region and data or reduce the size of shape and the number of registrations.

● Firmware

Error Number	Error Messages	Cause	Remedy
14301	The controller was booted using an unsupported firmware. Please turn off the power once and then update the firmware.	The controller was started with the firmware version that was not supported by the controller.	Update the firmware to one that is supported by the controller.
14302	The file update is not supported for the controller. Please remove the SD card 2 and check the file for updating.	The controller was started with an unsupported update file added to the SD card 2.	Replace the file with an update file that is supported for the controller, and then start the controller.
14303	Failed to load the file for updating.	<ul style="list-style-type: none"> A problem has occurred while trying to access SD card 2. The file update is collapsed. An SD card 2 was inserted during startup. 	<ul style="list-style-type: none"> Format the SD card 2. (Note, this will erase all contents on SD card 2.) Copy again the update file to the SD card 2. Start the controller with the SD card 2 including the update file.
14503	The internal temperature of the controller is high. As this may cause a breakdown, please check the installation status and ambient temperature.	The controller is improperly installed, or the ambient temperature has exceeded the rated value (e.g.: Ventilation holes are blocked).	<ul style="list-style-type: none"> Check if the installation direction and place follow the instruction manual. Check if the ambient temperature exceeds the rated value. If no fan unit is used, consider using a fan unit.
14504	The system has been stopped because the controller internal temperature exceeded the specified value. Turn off the controller and check the installation status and ambient temperature.	The controller is improperly installed, or the ambient temperature has exceeded the rated value (e.g.: Ventilation holes are blocked).	<ul style="list-style-type: none"> Check if the installation direction and place follow the instruction manual. Check if the ambient temperature exceeds the rated value. If no fan unit is used, consider using a fan unit.
14505	Cannot detect fan rotation. The fan unit may be damaged.	The fan in the fan unit is not rotating.	Do not replace the fan unit.
14506	Overcurrent was detected on the connected USB device. Please check the device connected to the USB.	<ul style="list-style-type: none"> A device that consumes large current (the maximum standard is USB2.0: 500 mA, USB3.0: 900 mA) is connected to the USB host. The cable is short-circuited. 	<ul style="list-style-type: none"> Check the energy consumption of the device to connect. Make sure the serial cable is not short-circuited.
14507	The connected extension unit is configured incorrectly. Turn off the controller and check the configuration of the extension unit.	An extension unit that cannot be used with the controller is connected. Too many extension units are connected.	Check the configuration of the extension unit.

Typical errors

General

Error Number	Error Messages
30001	The operation failed due to insufficient image memory.
30002	The operation failed due to insufficient resource memory.
30003	Insufficient processing memory.
30004	The operation is currently unavailable. Retry execution.
30005	There is a cycle in the dependency between the tools.
30006	IP address collision has occurred between the controller and other system on the network.
30007	There is some tool causing the setting error due to insufficient object memory. Check the setting error list.
30008	Invalid controller ID
30009	The specified program setting cannot be read. Create a new program setting or switch to another.
30010	Failed in updating the reference value.
30011	The currently selected language is not supported in an old version program setting. Change the program setting to the latest version.
30012	Failed to verify connection with the connected device.

File Access

Error Number	Error Messages
30101	Cannot find SD card 2.
30102	Failed to access the SD card 2.
30103	SD card 2 is write-protected.
30104	SD card 2 is full.
30105	Insert SD card 2.
30106	Cannot find SD card 1.
30107	Failed to access the SD card 1.
30108	SD card 1 is write-protected.
30109	SD card 1 is full.
30110	Insert SD card 1.
30111	SD card 1 is write-protected.
30112	SD card 2 is write-protected.
30113	The character that cannot be input is included.
30114	The folder is invalid.
30115	The position for space or period is invalid.
30116	Copy failure
30117	SD Card is full.
30118	Delete failure
30119	This is a read-only file or folder. Cannot rename.
30120	Failed to save file(s).
30121	Failed to save file(s) due to write protection.
30122	Files cannot be copied to the same folder.
30123	Failed to move file(s) due to write protection.
30124	Files cannot be moved within the same folder.
30125	Failed to delete file(s) due to write protection.
30126	Failed to be renamed.
30127	Failed to rename file or folder due to write protection.
30128	The identical file or folder exists. Failed to be renamed.
30129	Failed to create the new folder.
30130	Failed to create the new folder due to write protection.
30131	The folder with the same name already exists. Failed to create the new folder.
30132	The specified folder is not found and the new folder cannot be created.
30133	Unable to open the file or folder.
30134	Failed to check SD card 1.

Error Number	Error Messages
30135	Failed to format SD card 1.
30136	Failed to check SD card 2.
30137	Failed to format SD card 2.
30138	SD card (1-2) is checked. Broken files were found and converted to FILEXXX.CHK.
30139	The file name is too long.
30140	Failed to format the USB HDD.
30141	Cannot recognize the USB HDD.
30142	A USB HDD is not connected.

Program Operation

Error Number	Error Messages
30201	Copy failure
30202	Failed to copy file(s) due to write protection on the copying destination.
30203	Delete failure
30204	No deletion can be made because the specified SD card is write-protected.
30205	Failed to add new.
30206	SD card (1-2) is write-protected.
30207	No folder name is set.
30208	No program setting is selected.
30209	Destination folder already exists. Delete the file with the same type as the one to be copied, then copy the file. Accept?
30210	Failed to copy file(s) due to write protection on the saving destination.
30211	Save failed.
30212	No files selected
30213	Load failed.
30214	Failed to copy file(s) due to write protection on the loading destination.
30215	Failed to edit the name.
30216	Failed to change programs.
30217	Failed to save settings.
30218	Failed to change to the latest version due to failure in saving settings.

● Tool Operation

Error Number	Error Messages
30301	Paste Failure Cancel pasting.
30303	The operation failed due to insufficient resource.

● Global Settings

Error Number	Error Messages
30401	Failed to save the profile data.
30402	The duplicated address with that of the controller is specified. Modify the address or cancel the change.
30403	The IP address is the same as the PLC's IP address. Modify the address or cancel the change.
30404	A port number that overlaps with a non-procedural command / result output or PC application has been specified. Modify the port number or cancel the change.
30405	The port number is already assigned as the VNC port number. Modify the port number or cancel the change.
30406	Duplicate IP address of the FTP is specified. Modify the address or cancel the change.
30407	The IP address setting is invalid. Modify the address, or cancel setting. The IP address and subnet mask are set to invalid values. Change the values.
30408	The PROFINET device name total length must be 1 to 240 characters long.
30409	The label length must be 1 to 63 characters long.
30410	The PROFINET device name can use only [a] to [z] (lower case alphabet), [0] to [9] (number), [-] (hyphen) and [.] (period).
30411	Labels must not start with [-] (hyphen).
30412	Labels must not end with [-] (hyphen).
30413	The first label should have the form \"port-xyz\" or \"port-xyz-abcde\". a,b,c,d,e,x,y,z cannot be made up of numerical values [0 to 9].
30414	The PROFINET device name should not be in the form of IP-address.
30415	Labels should not start with [xn-].
30416	Duplicate IP address of the SNTP is specified. Modify the address or cancel the change.

● Head Settings

Error Number	Error Messages
30501	Failed to save the profile data.
33201	An error has occurred in the specialized encoder. Check the wiring and restart the specialized encoder.
33202	The communication setting of RS-232C cannot be changed because the PLC-link (RS-232C) is enabled.

● Preprocessing

Error Number	Error Messages
30601	Failed auto setting. Resolve the setting error(s) and retry.
30602	You cannot select it for the copy destination because the random setting is enabled.

● Output Settings

Error Number	Error Messages
30701	Output Buffer Overflows. Review Settings.
30702	Setting data cannot be reflected due to insufficient resource memory.
30703	Too much output data.

● Statistics

Error Number	Error Messages
30801	Data is not accumulated for saving.

● Archive Setting

Error Number	Error Messages
30901	With the current head model settings, <ul style="list-style-type: none"> • Storage condition of archived images: Total Status NG • Image Output Condition: Cannot be set to frequent output.

● Adjustment Navigation

Error Number	Error Messages
31001	Cannot execute end processing. Retry execution.
31002	Cannot execute end roll-back. Retry execution.
31003	The NG archive images needed for adjustment have not been stored.
31004	There is no tools that need adjustment.
31005	As the write-protect switch on SD Card 1 is enabled, the tool settings have failed to backup. Tool adjustment has stopped. Back up of tool settings failed. Tool adjustment has stopped.
31006	As there is not enough free space on SD card 1,
31007	Since SD card 1 cannot be accessed, the tool settings have failed to backup. Tool adjustment has stopped.
31008	As the write-protect switch on SD Card 2 is enabled, the tool settings have failed to backup. Tool adjustment has stopped.
31009	As there is not enough free space on SD card 2, the tool settings have failed to backup. Tool adjustment has stopped.
31010	Since SD card 2 cannot be accessed, the tool settings have failed to backup. Tool adjustment has stopped.
31011	As the write-protect switch on SD card 1 is enabled, the tool settings have failed to roll back.
31012	As there is not enough free space on SD card 1, the tool settings have failed to roll back.
31013	Since SD card 1 cannot be accessed, the tool settings have failed to roll back.
31014	As the write-protect switch on SD card 2 is enabled, the tool settings have failed to roll back.
31015	As there is not enough free space on SD card 2, the tool settings have failed to roll back.
31016	Since SD card 2 cannot be accessed, the tool settings have failed to roll back.
31017	As the write-protect switch on SD card 1 is enabled, the backup file could not be deleted.
31018	As there is not enough free space on SD card 1, the backup file could not be deleted.
31019	Since SD card 1 cannot be accessed, the backup file could not be deleted.
31020	As the write-protect switch on SD card 2 is enabled, the backup file could not be deleted.
31021	As there is not enough free space on SD card 2, the backup file could not be deleted.
31022	Since SD card 2 cannot be accessed, the backup file could not be deleted.
31023	You cannot adjust XXX with adjustment navigation.
31024	It cannot be adjusted as there is a cycle in the dependency between the source correction tools for Position Correction.
31026	Failed to roll back due to insufficient resource memory. Discard the current adjustments and return to the tool options for the adjustment target.
31027	Insufficient processing memory. Adjust the setting so that the work memory usage does not exceed 100%.
31028	The adjustment navigation failed to start. Retry adjustment navigation.

● Security Settings

Error Number	Error Messages
31101	Intended to detect by the unauthorized controller.
31102	Input the password containing at least 4 characters.
31103	Password not set. Set Password.
31104	The current controller ID in use is not found in the program setting. Unavailable at the next loading. Accept?
31105	Confirmation password is incorrect. Re-enter password.
31106	Old password is incorrect. Re-enter password.
31107	Password is incorrect. Re-enter password.
31108	Password is not entered. Enter Password.

● Image Strip

Error Number	Error Messages
31201	Cannot find SD card 1. Failed to update the images on the image strip.
31202	Cannot find SD card 2. Failed to update the images on the image strip.
31203	Failed to connect to FTP server. Failed to update the images on the image strip.
31204	Failed to login to FTP server. Failed to update the images on the image strip.
31205	Failed to obtain the file list. The FTP server is not supported. Failed to update the images on the image strip.
31206	Timeout error occurred during communication with the FTP server. Failed to update the images on the image strip.
31207	The file name is too long. Failed to update the images on the image strip.
31208	No image found Failed to update the images on the image strip.
31209	File is not found. Failed to update the images on the image strip.
31210	Cannot find SD card 1. Failed to read the images on the image strip.
31211	Cannot find SD card 2. Failed to read the images on the image strip.
31212	Failed to connect to FTP server. Failed to read the images on the image strip.
31213	Failed to login to FTP server. Failed to read the images on the image strip.
31214	Failed to obtain the file list. The FTP server is not supported. Failed to read the images on the image strip.
31215	Timeout error occurred during communication with the FTP server. Failed to read the images on the image strip.
31216	The file name is too long. Failed to read the images on the image strip.
31217	No image found Failed to read the images on the image strip.
31218	File is not found. Failed to read the images on the image strip.
31219	Cannot find SD card 1. Failed the batch test.
31220	Cannot find SD card 2. Failed the batch test.
31221	Failed to connect to FTP server. Failed the batch test.
31222	Failed to login to FTP server. Failed the batch test.
31223	Failed to obtain the file list. The FTP server is not supported. Failed the batch test.
31224	Timeout error occurred during communication with the FTP server. Failed the batch test.
31225	The file name is too long. Failed the batch test.
31226	No image found Failed the batch test.
31227	File is not found. Failed the batch test.
31228	Failed to connect to FTP server.
31229	Failed to login to FTP server.
31230	Failed to obtain the file list. The FTP server is not supported.
31231	Timeout error occurred during communication with the FTP server.
31232	No image found
31233	File is not found.
31234	No images to be saved.
31235	No tools for testing.

Error Number	Error Messages
31236	No images on the image strip.
31237	Copy failure
31238	Delete failure
31239	Failed to connect to FTP server.
31240	The folder name is too long. Rename the folder within XXX characters.
31241	The tool cannot be edited because the setting is not completed.
31242	The batch test failed to start. Retry the processing.
31243	An error has occurred in the file access. Failed to update the images on the image strip.
31244	An error has occurred in the file access. Failed to read the images on the image strip.
31245	An error has occurred in the file access. Failed the batch test.
31246	Archived image export function is already in use. Cannot execute.
31247	A USB HDD is not connected. Failed to update the images on the image strip.
31248	A USB HDD is not connected. Failed to read the images on the image strip.

● Edit Operation Screen

Error Number	Error Messages
31301	Operation screen cannot be deleted due to unassigned account. Check the operation screen setting.
31302	Operation screen cannot be changed due to unassigned account. Check the operation screen setting.

● Custom Menu

Error Number	Error Messages
31401	Registered custom menus are full. No more menus are registered.
31402	Invalid setting items. No edition accepted.
31403	Insufficient memory prevents from editing the custom menu.

● OCR, OCR2

Error Number	Error Messages
32101	The SD card is write-protected.
32102	The dictionary file space has been exceeded. Cannot register.
32103	Failed to save dictionary.
32104	The specified item cannot be added due to the cyclic dependency.
32105	The dictionary file format is invalid. Do you wish to delete the file?
32106	The dictionary file format is invalid. Cannot register.
32107	The dictionary file is write-protected.
32108	The dictionary file could not be deleted.
32109	The starting time has not been set.
32110	The starting time overlaps with other shifts.
32111	The number of characters that can be registered per character has been exceeded. Cannot register.
32112	Failed to create dictionary.
32113	Failed to save dictionary.
32114	The specified dictionary file cannot be used with the OCR tool.

● 1D code reader/2D code reader

Error Number	Error Messages
32200	<p>Failed auto tuning. Make sure that the code set in "Code Type" is capturing correctly, then redo the auto tuning, or adjust manually. It is recommended for the code resolution to be XXX pixels or more when capturing images.</p>

● ShapeTrax3A

Error Number	Error Messages
32401	Failed to save the feature data.
32402	Failed to load feature data.
32403	Failed shape fit.
32404	The features that can be added is full. No more additions.
32405	The reference image could not be filled in due to complexities.
32406	<p>If the bounding rectangle containing the pattern area and the rotation feature area exceeds 2432 pixels in width or 2050 pixels in height, the broad search mode needs to be enabled. Are you sure you want to enable the broad search mode? When enabled, the image reduction and feature reduction are set to 4 or more.</p>

● Shape Region

Error Number	Error Messages
34200	Failed to save the shape region data.

Execution Error

This section shows the list of error numbers that are output when a measurement tool execution error occurs.

Error Number	Error Messages	Remarks
20001	The current image could not be calculated due to complexities.	If there are too many blob and defect results detected.
20002	The measured area is all out of the image range.	The area is completely out with the defect tool.
20003	Detect line failed.	The dimensions/geometry, trend edge position or edge angle tool failed to detect lines.
20004	Detect circle failed.	The dimensions/geometry or trend edge position tool failed to detect circles.
20005	Detect point failed.	The dimensions/geometry tool failed to detect points.
20006	Failed to measure the size and shape.	The dimensions/geometry tool failed to measure the size and shape of detected results.
20007	An invalid operation was performed.	The calculation tool cannot be executed. See the calculation execution errors (ERRC) for details.
20008	The timeout error has occurred.	Timeout has occurred with the ShapeTrax3A tool, PatternTrax tool, 1D code reader tool and the 2D code reader tool.
20009	The dictionary data has not been registered.	The dictionary data has not been registered by the OCR or OCR2 tools.
20010	There are no valid segments.	The area is smaller than the segment size with the defect tool.
20011	Failed to detect reference model line.	The trend edge defect tool cannot detect the reference model line because it occurs in the area setting that does not exceed the image size and because the number of detected segments is too small.
20015	Tuning parameter is invalid.	A code resolution of 0 occurs when the code type details are not set.
20017	Pattern detection failed.	The measurement tool cannot be executed due to error occurrences such as insufficient memory space.
20020	Failed in height extraction/height binarization.	Height information used for plane detection cannot be acquired, such as when all extraction areas are covered with a mask for height extraction/height binarization.
20021	It is impossible to measure.	All the measured areas are covered with invalid pixels or a mask area using the height measurement and trend height measurement tools.
20022	Failed to calculate the zero plane.	The zero plane cannot be calculated correctly during the calculation of the zero plane.
20023	The current image could not be calculated due to complexities.	Occurs when too many results are detected internally by the blob filter of the preprocessing.
20024	Failed to detect plane.	The height measurement and trend height measurement tools failed to detect planes.
20025	Failed to generate an inspection region.	When the generation of the inspection region failed in the tool that is referring to an image region generator tool.
20031	Failed to generate profile.	The area is outside the image or the profile generation has failed.
20032	Failed to measure profile.	The calculation of the measurement result failed after the measurement target was obtained.
20033	Failed in tracking.	Detection failed in the reference source while using "refer to other position measurement (1 point)" or "refer to other position measurement (2 points)" in each measurement item.
20034	It is impossible to measure.	The valid profile data is not within the measurement range.
20035	Failed to detect reference model line.	The reference model line cannot be detected due to the number of scans being too low.
20036	All the set items cannot be measured.	The profile itself is generated but it cannot be measured for all measurement items.
20037	The first candidate cannot be found.	The first candidate was not found when the setting was put on "An error occurs when the first candidate is not found."
20099	Tool execution error has occurred.	The measurement tool cannot be executed due to error occurrences such as insufficient memory space.

● List of calculation tool execution error codes (ERRC)

When a calculation tool execution error (20007) occurs, more detailed error status is output as a calculation error code (ERRC). The list is shown below.

Error Number	Error Messages
1000	Division by 0 was performed.
1002	Exceeding the 64-bit floating is detected during the operation.
2020	Failed to acquire the system variable.
2030	Failed to acquire the values of setting and measurement.
4000	Max function abnormally terminated.
4001	Min function abnormally terminated.
4002	Ave function abnormally terminated.
4003	Abs function abnormally terminated.
4004	Sqr function abnormally terminated.
4005	Sqrt function abnormally terminated.
4006	AveR function abnormally terminated.
4007	Int function abnormally terminated.
4008	Floor function abnormally terminated.
4009	Round function abnormally terminated.
4010	Ceil function abnormally terminated.
4011	MaxN function abnormally terminated.
4012	MinN function abnormally terminated.
4019	Log function abnormally terminated.
4022	Exp function abnormally terminated.
4023	Ln function abnormally terminated.
4024	Cos function abnormally terminated.
4025	Acos function abnormally terminated.
4026	Sin function abnormally terminated.
4027	Asin function abnormally terminated.
4028	Tan function abnormally terminated.
4029	Atan function abnormally terminated.
4030	Atan2 function abnormally terminated.
4031	AngC function abnormally terminated.
4032	AngW function abnormally terminated.
4033	Rad function abnormally terminated.
4034	Deg function abnormally terminated.
4035	Pi function abnormally terminated.
4036	B_And function abnormally terminated.
4037	B_Or function abnormally terminated.
4038	B_Xor function abnormally terminated.
4039	B_Not function abnormally terminated.
4040	Bind function abnormally terminated.
4041	Dist function abnormally terminated.
4042	Line function abnormally terminated.
4043	ISect function abnormally terminated.
4044	LnDist function abnormally terminated.
4045	LnDistP function abnormally terminated.
4046	LnDistXY function abnormally terminated.
4047	Angle function abnormally terminated.
4048	AngleConv function abnormally terminated.
4049	LnAngle function abnormally terminated.
4050	LLAngle function abnormally terminated.
4051	ConvCrd function abnormally terminated.
4052	MidXY function abnormally terminated.
4053	VMidLine function abnormally terminated.
4054	Circle3 function abnormally terminated.
4056	I2Circle function abnormally terminated.
4057	CircleTangent function abnormally terminated.
4058	ILineCircle function abnormally terminated.
4060	MidLine function abnormally terminated.
4061	ConvCrd2 function abnormally terminated.

Error Number	Error Messages
4062	Rotate function abnormally terminated.
4064	ShiftYear function abnormally terminated.
4065	ShiftMonth function abnormally terminated.
4066	ShiftDay function abnormally terminated.
4067	AsPoint function abnormally terminated.
4068	AsLine function abnormally terminated.
4069	AsCircle function abnormally terminated.
4073	RotCenter function abnormally terminated.
4074	InnerProd function abnormally terminated.
4075	OuterProd function abnormally terminated.
4076	AddVector function abnormally terminated.
4077	SubVector function abnormally terminated.
4100	As3DPoint function abnormally terminated.
4101	AsPlane function abnormally terminated.
4110	Dist3D function abnormally terminated.
4112	PlanePassPt function abnormally terminated.
4113	PIDist function abnormally terminated.
4115	PIDistP function abnormally terminated.
4119	Stdev function abnormally terminated.
4127	I4XY function abnormally terminated.
4128	I4Line function abnormally terminated.
4129	AddVector3D function abnormally terminated.
4130	SubVector3D function abnormally terminated.
4131	ILine3DPlane function abnormally terminated.
4132	I2Plane function abnormally terminated.
4133	Line3DDist function abnormally terminated.
4134	Line3DDistXYZ function abnormally terminated.
4135	PIDistXYZ function abnormally terminated.
4136	LnLn3DDist function abnormally terminated.
4137	Plane2Angle function abnormally terminated.
5000	Timeout has occurred.

Revision history

Revision history	Edition number	Revision details
July 2024	Official release	
December 2024	Revised 1st edition	

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