Panasonic

Laser Displacement Sensor

HL-G2 Series

User's Manual

Communication Type

WUME-HLG2CM-2

2024.4 | industry.panasonic.com/

(MEMO)

Introduction

Thank you for purchasing Laser Displacement Sensor **HL-G2** Series.

Before using this product, read and understand this User's Manual. Use the product correctly and in the optimum manner.

Keep this manual in a safe location for reference whenever necessary.

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Types of Manuals

- There are different types of user's manual for the**HL-G2**series, as listed below. Refer to the appropriate manual according to your need.
- These manuals can be downloaded from our website:https://industry.panasonic.com/global/en/downloads/?tab=manual.

Type of sensor / Software name	Manual name	Manual code
Communication type HL-G2	HL-G2 Series User's Manual (Communication Type)	WUME-HLG2CM
Analog output type HL-G2	HL-G2 Series User's Manual (Analog Output Type)	WUME-HLG2AN
Tool software for the HL-G2 series HL-G2 Configuration Tool	HL-G2 Configuration Tool User's Manual	WUME-HLG2CT

Manual Configuration

Chapter 1	Before Using This Product	This chapter explains safety and handling precautions, laser safety standards, component names, and other information that should be checked before using this product.
Chapter 2	System Configuration	This chapter explains the system configuration.
Chapter 3	Installation and Setup	This chapter explains installation, connection, wiring, initial startup setting, and other work.
Chapter 4	Description of Function	This chapter explains details and settings for various functions.
Chapter 5	External Communication Control (Ethernet)	This chapter explains how to set and control the system with Ethernet communication.
Chapter 6	External Communication Control (RS-485)	This chapter explains how to set and control the system with RS-485 communication.
Chapter 7	Maintenance	This chapter explains maintenance and inspection.
Chapter 8	Troubleshooting	This chapter explains how to take action when problems occur.
Chapter 9	Specifications and Dimensions	This chapter explains the specifications and dimensions.

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1.1 Safety Precautions (Always observe)

This section explains important rules that must be observed to prevent personal injury and property damage.

■ **Safety precautions items are classified into “WARNING” and “CAUTION” depending on the level of hazard.**

⚠ **WARNING**	Risk of death or serious injury.
⚠ **CAUTION**	Risk of minor injury or property damage.

⚠ WARNING	
	• Do not use this product as a sensing device for personal protection. Using this product as a sensing device for personal protection may result in death or serious injury.
	• For sensing devices for personal protection, use products that conform to the laws and standards related to personal protection in each country, such as OSHA, ANSI, and IEC.
	• This product is intended to be used to detect target objects and is not provided with control functions that prevent accidents to ensure safety.
	• To prevent electric shock, ensure that the frame ground (F.G.) terminal of the product is grounded to a Class D ground (100 Ω or less) or higher.
	• Do not use this product in areas with inflammable gases. (Doing so may cause an explosion.)
	• Avoid observing beams continuously, particularly in a dark surrounding environment.
	• Do not stare into laser beam with an optical device such as telephoto optics.
	• Be careful not to directly stare into the laser beam emitting part or the laser beam reflected on a mirror surface.
	• Never attempt to disassemble, repair, or modify this product. This product is not equipped with function that automatically stops laser radiation when it is disassembled. Therefore, there is a risk that you may be exposed to laser radiation when the product is disassembled.
	• Do not use the product in a way that is not specified in this User’s Manual. Controlling or adjusting the product according to procedures other than those specified in this User’s Manual may lead to dangerous exposure to laser radiation.

1.2 Network Security

There is the risk of suffering following damage when using this product connected to the network.

1. Information leakage through this product
2. Illegal operations of this product by a malicious third party
3. Obstructing or stopping this product by a malicious third party

Sufficient network security measures should be taken including the following countermeasures at your own risk to prevent such damages.

- If this product is used in a system to which a PC is connected, make sure that it is periodically checked against infection by computer viruses and malware and then disinfected.
- Use this product in an environment where a LAN, VPN (Virtual Private Network), or leased line network is established.
- Use this product in an environment where only limited authorized personnel are allowed to enter.
- Use the PC connected to this product under secure conditions.

We shall not be held responsible for any damage caused by insufficient network security.

- Do not install this product and accessories such as optional cables in a place where they can be easily damaged.

- Use this product in an intranet environment.
- If this product is transferred to a third party by means of a transfer, disposal, repair, etc., there is the risk that important information saved in this product may be passed to the third party.

  The user must be responsible for handling this product and for taking necessary measures such as deleting the information before the product is transferred.
- When this product is connected to an existing LAN, incorrect settings may cause malfunction of devices on the network. Before connecting the unit to an existing LAN, consult your network administrator.

1.3 Handling Precautions

1.3.1 Explanation of Graphic Symbols

■ **In this manual, the following symbols are used to indicate safety information that must be observed.**

Stop	Indicates an action that is prohibited or a matter that requires caution.
!	Indicates an action that must be taken.
Note	Indicates details about the subject in question or information useful to remember.
1 2 Procedure	Indicates operation procedures.

1.3.2 Handling Precautions

Specifications

- This product has been developed and manufactured for industrial use only.
- Do not use this product outside the scope of the specifications. Doing so may result in accidents or failures.
  It will also significantly shorten the service life.
- Note that, if this product is used for many hours, the brightness of the display section drops over time due to aging.
- If there are objects with high reflectance around the detection point, the product may be affected by ambient leakage light.
- Specular reflection of light may prevent normal measurement if it enters the beam receiving part. Be careful when installing the product if the reflectance of the sensing objects is high.
- For high-precision sensing, perform span adjustment in the actual installation conditions.

Power Supply

- Verify that the supply voltage fluctuations are within the rating when using the product. Applying a voltage greater than the rated voltage or directly applying AC power will result in damage or burning.
- To ensure performance, use the product at least 30 minutes (warm-up time) after the power is turned ON.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- Make sure that the power supply input satisfies the following items.
  - The power supply unit must be certified for use in your region.
  - The output holding time of the power supply unit must be 20 ms or more.
  - The current capacity (recommended current capacity including starting current and external output current) of the power supply unit must be 500 mA or more, including a rated output voltage of 24 VDC ±10 % and a ripple of 0.5 V (P-P).
  - If CE marking is required, the Safety Extra Low Voltage (SELV) or Protective Extra Low Voltage (PELV) of the power supply unit must comply with the EMC Directive.

  - If UKCA marking is required, the Safety Extra Low Voltage (SELV) or Protective Extra Low Voltage (PELV) of the power supply unit must comply with the EMC Regulations.
- When using this product in a positive ground environment, do not mix positive and negative grounds. In particular, on most PCs, the 0 V and F.G. terminals are internally connected. Connecting these terminals by mistake may cause a short circuit via the 0 V of the PC, causing device damage. Note that the F.G. of the product and the internal power supply and signal lines are isolated by capacitors.

Wiring

- Before wiring work, always turn the power off.
- Do not wire in parallel with a high-voltage line or power line, or run through the same conduit. Doing so may result in malfunctioning due to induction.

Operating Environment

- This product is suitable for indoor use only.
- Do not install the sensor in the following locations.
  - Locations subject to flammable gas, corrosive gas, or excessive dust
  - Locations subject to dust, metal particles, or saline matter
  - Location around which there are combustibles
  - Atmospheres containing benzine, paint thinner, alcohol, or other organic solvents or strong alkaline substances such as ammonia or caustic soda
  - Locations subject to severe vibration or shock
  - Locations subject to direct sunlight
  - Locations subject to water, oil, or chemicals
  - Locations where load is applied to the sensor
- Use the product in an environment where the temperature ranges between -10 °C and +45 °C. Also, store the product in an environment where the temperature ranges between -20 °C and +60 °C.

  However, avoid using the product in an environment where icing may occur.
- Use and store the product in an environment where the humidity ranges between 35 % RH and 85 % RH. However, avoid using the product in an environment where dew condensation may occur due to a sudden temperature change.
- The service life of a semiconductor laser depends on the ambient operating temperature. When using the product near a heat generation part, lower the ambient temperature as much as possible by cooling, etc.
- Install this product on a surface with good heat dissipation as the product itself also generates heat. If used at an ambient temperature of 40 °C or more, the product should be installed on an aluminum or steel surface with a surface area of 200 cm^2 or more.
- Furthermore, when installing two or more of this product in parallel, provide a clearance of 20 mm or more between the products, and install each one on an aluminum or steel surface with an area of 200 cm^2 or more at the temperature of 40 °C or less.
- Performance may not be satisfactory in a strong electromagnetic field.
- Do not allow extraneous light such as sunlight or other light that has the same wavelength as the laser to directly hit the beam receiving part. In particular, if precision is required, use this product by mounting a douser or similar material.
- Keep the beam emitting and receiving parts of this product clean and free of water, oil, fingerprints, and other substances that refract light as well as dust, grit, and other objects that intercept light. When cleaning the surfaces, wipe them with a lint-free soft cloth or lens cleaning paper.

- Do not drop or subject this product to strong shocks. Doing so may result in an accident or failure.

Other Precautions

- When this product becomes unnecessary, dispose of the product properly as industrial waste in accordance with the applicable law in the country.
- When exporting the product or when taking it out of Japan, the user is required to check applicable standards, laws and regulations.

1.4 Terminology

Term	Description
Measurement display	A display that allows the user to check the measured distance (measured value) between the sensor and the sensing object
HIGH set value / LOW set value	A value (threshold) that is used to judge if a measure value falls within the predetermined range. The upper limit threshold is the "HIGH set value" and the lower limit threshold is the "LOW set value".
Teaching	A function for setting the HIGH set value / LOW set value using actual sensing objects.
Measured raw value	A measured value before moving average processing or zero setting.
Final measured value	A measured value after moving average processing or zero setting that was output after alarm processing or judgment processing.
Brightness Tuning	If the brightness of sensing objects varies, set the brightness in advance and tune the adjustment range.
Setting resolution	The minimum unit of setting that this product supports. In switch operation, values can be manipulated only up to the unit of setting resolution of the model for each distance type. For communication commands, you can set values in units of 0.1 μm regardless of the distance type, but numbers less than the setting resolution are rounded down in the actual setting.
Internal memory	Non-volatile memory that stores written data after the power is turned OFF. The "Internal memory" mentioned in "5.4 SLMP" refers to the access target in SLMP, which is not non-volatile memory.

1.5 Regulations and Standards

■ Conformity Directives and Conforming Regulations

EU Law: EMC Directive 2014/30/EU
British Legislation: EMC Regulations 2016/1091

- Applicable standards
  - EN 60825-1
  - EN 61000-6-2
  - EN 61000-6-4
- US Regulations: FDA21 CFR1040.10, and 1040.11 (Laser Notice No.56 applied)

■ Conforming standards

- USA/Canada Standards
  - UL61010-1
  - CAN/CSA-C22.2 No.61010-1
- Other standards
  - IEC 60825-1
  - JIS C 6802
  - GB 7247.1
  - KS C IEC 60825-1
  - KN 61000-6-2
  - KN 61000-6-4

Note

- For the standards in US / Canada, cTÜVus mark by a Notified Body TÜV SÜD America has been acquired.

- When using this product, be sure to check and comply with the regulations and standards applicable in the country or region where the product is used.

1.6 Conditions for Compliance with CE Marking/UKCA Marking

To use this product as a CE marking/UKCA marking compliant product, the following conditions must be met.

- The signal and power lines connected to the product must not exceed the maximum length of the optional cable available.

  CN-8E-C5 (For Ethernet communication) / Cable length 5 m

  CN-8R-C20 (For RS-485 communication) / Cable length 20 m
- If compliance with CE marking is required, SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage) power supply units that comply with the EMC Directive must be used.
- If compliance with UKCA marking is required, SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage) power supply units that comply with the EMC Regulations must be used.

1.7 Laser Safety Standards

1.7.1 IEC / EN / JIS / GB / KS

To prevent laser products from affecting their users, IEC, EN, JIS, GB, and KS standards have the following respective standards:

These standards classify laser products into classes according to the hazard level of laser, and prescribe safety and preventive measures that should be implemented for each class.

This product belongs to **Class 2 laser products** according to “Radiation safety standard of laser products” specified in IEC 60825-1:2014, EN 60825-1:2014/A11:2021, JIS C 6802:2014, GB 7247.1-2012, KS C IEC 60825-1:2014.

Explanation of hazard levels

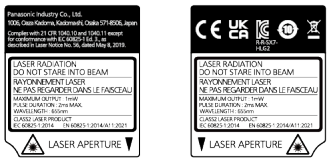
Classification	Overview of danger evaluation
Class 2	A laser that emits visible light with the wavelength range of 400 nm to 700 nm under which eyes can be protected by an aversive reaction (avoidance behavior) such as a blink.

(Note 1) When an unexpected failure occurs, dangerous radiation may be generated. Therefore, pay special attention to safety.

■ Warning label

- Based on the safety standards for laser products, FDA/IEC (EN) standard certification / identification / warning labels are affixed to both sides of this product.
- This product is shipped with JIS, GB, and KS standard warning labels. Affix appropriate labels over the FDA/IEC (EN) labels as needed.

<FDA/IEC(EN)>



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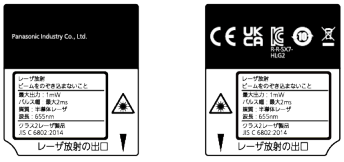

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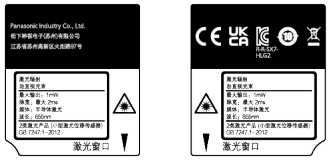

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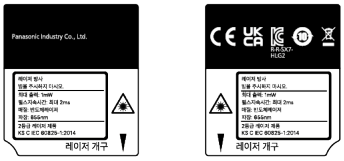

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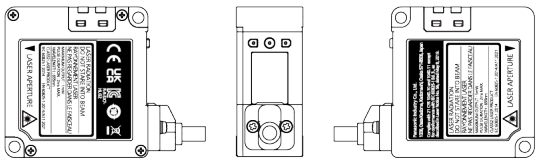


1.7.2 FDA

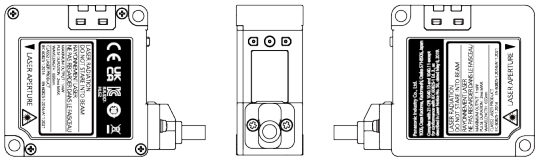
■ Exporting to the USA

If this product is incorporated into facilities or equipment to be exported to the US, it is subject to the laser regulations of the US Food and Drug Administration (FDA). To prevent laser products from affecting their users, PART1040 (Performance Standards for Light-Emitting Products) was established as one of the FDA regulations. These standards classify laser products into classes according to the hazard level of laser and prescribe safety and preventive measures that should be implemented for each class.

This product complies with the FDA regulations (FDA 21 CFR 1040.10 and 1040.11) in accordance with FDA Laser Notice No. 56, except for complying with IEC 60825-1:2014 Ed. 3. (**Class 2 laser products**)

■ Certificate / identification / warning label

＜Label position＞

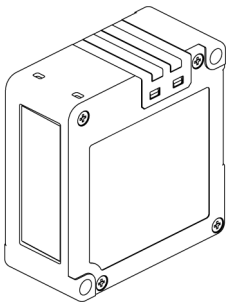


- To prevent the laser beam from directly entering your eyes, install this product so that the beam is above or below the eye level.

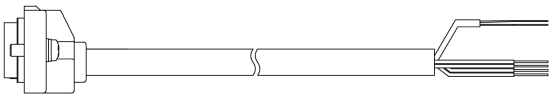
  The safety distance (nominal ocular hazard distance: NOHD) is approximately 0.4 m. Be sure to terminate the laser beam with a diffuse reflector or absorber.

1.8 Contents of Package

The following accessories are included in the product package. Before using this product, make sure that no items are missing.

Products
HL-G203B-S-MK/ 30 mm type **HL-G205B-S-MK**/ 50 mm type **HL-G208B-S-MK**/ 85 mm type **HL-G212B-S-MK**/ 120 mm type **HL-G225B-S-MK**/ 250 mm type ● Product  ● Laser warning label: JIS, GB, and KS, 1 set each ● Installation instruction (English/Japanese, Chinese/Korean): 1 volume each ● General Information for Safety, Compliance, and Instructions: 1 volume

Optional cables (sold separately, for Ethernet communication)
CN-8E-C2 / Cable length 2 m **CN-8E-C5** / Cable length 5 m ● Cable body   Two M2.6 screws are attached

Optional cables (sold separately, for RS-485 communication)
CN-8R-C2 / Cable length 2 m **CN-8R-C5** / Cable length 5 m **CN-8R-C10** / Cable length 10 m **CN-8R-C20** / Cable length 20 m ● Cable body  Two M2.6 screws are attached

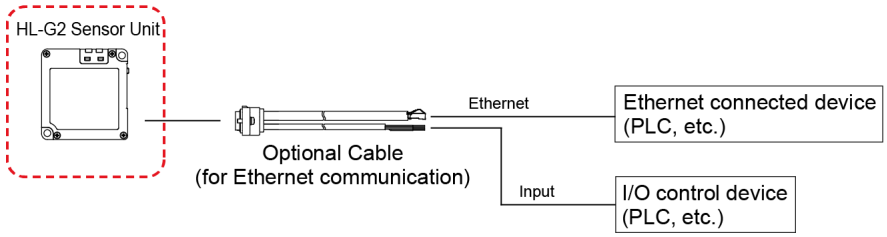
2 System Configuration

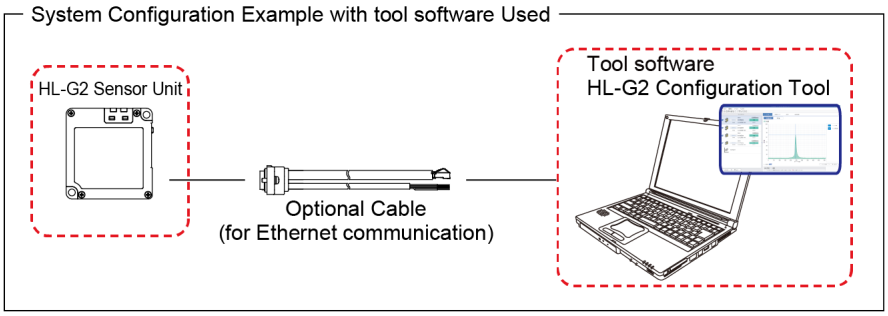
2.1 System Configuration Diagram.....2-2
2.2 Description of Parts.....2-4

2.1 System Configuration Diagram

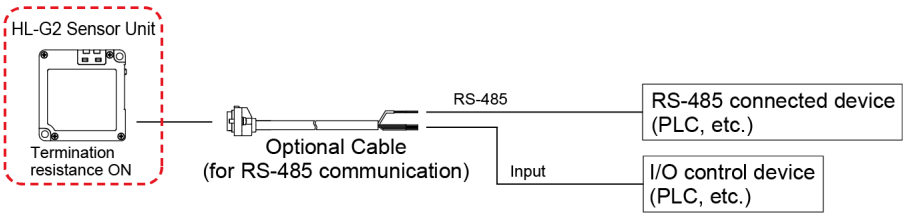
The figure below shows a system configuration and cables connecting each device.

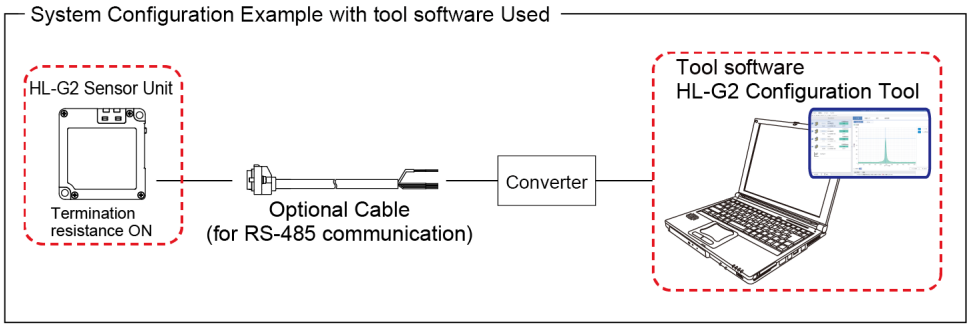
Ethernet communication





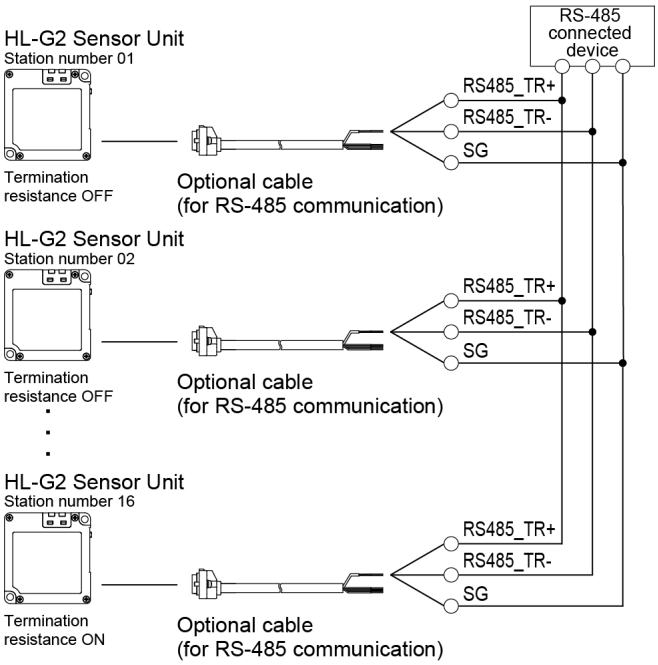
RS-485 communication





RS-485 wiring allows connection of up to 16 devices.

- This product contains built-in termination resistance. Be sure to turn ON the termination resistance on the terminal unit sensor.

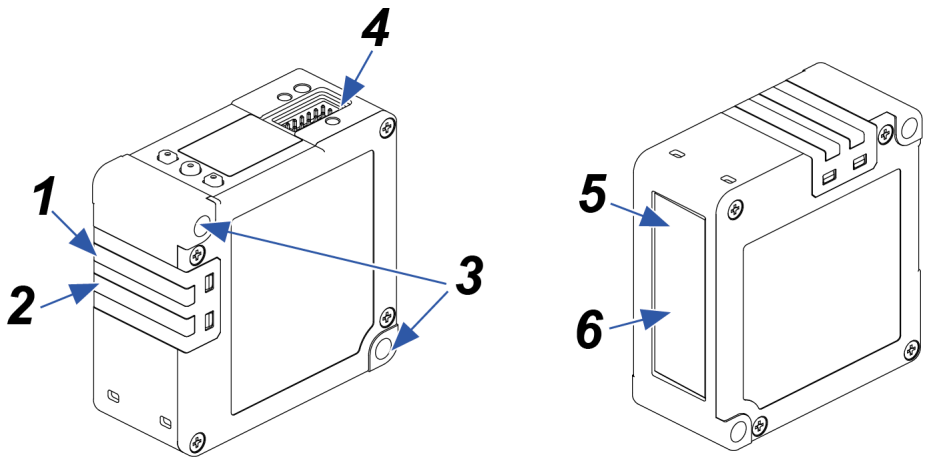


Note

- For stability of RS-485 communication, check the system operation by connecting actual devices on your own. The number of units connected, transmission distance, and transmission speed may vary depending on the connected device and transmission path.
- The maximum cable length of the optional cable (For RS-485 communication) is 20 m. It is recommended that the total cable length from the RS-485 connected device to this product be 20 m or less.
- For RS-485 wiring, use multi-point connection.

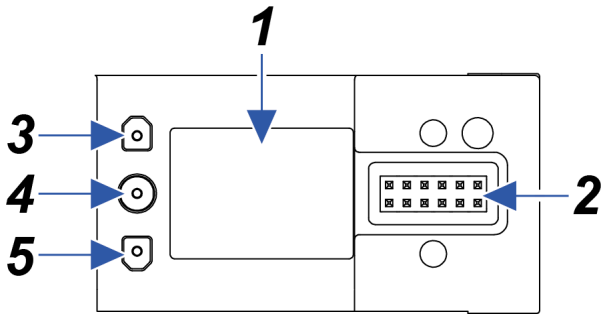
2.2 Description of Parts

■ **Sensor unit**



	Name	Function
1	Laser radiation indicator	Lit in green while laser beams are being emitted. It blinks if an error occurs.
2	Alarm indicator	Lit in orange when an measurement alarm occurs. It blinks if an error occurs.
3	Mounting hole	These hole are used to mount the sensor on machinery with M4 screws.
4	Cable connector part	Used when connecting the sensor with a optional cable.
5	Beam emitting part	This part emits laser beam.
6	Beam receiving part	This part receives the beam reflected on the measurement object.

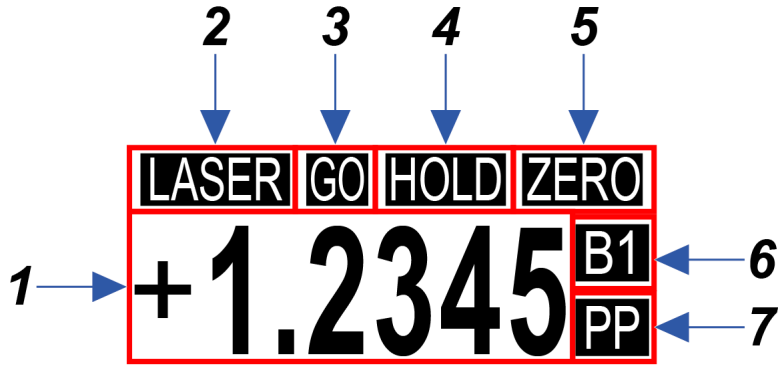
■ Operation/display section



	Name	Function
1	Display section	Displays measured values, settings, and error codes(Note 1).
2	Cable connector part	Used when connecting the sensor with a optional cable.
3	UP (DOWN) key	Used to change setting items and settings when configuring settings.
4	ENTER key	
5	DOWN (UP) key	

(Note 1) For error messages and actions to be taken, refer to "8.2 Error Messages and Action Methods".

■ **Measurement display**



	Name	Function
1	Measurement value display	The current measured value (mm) is displayed with a sign.
2	LASER icon	Displayed when the laser is turned on.
3	HI / GO / LO icons	Displayed depending on the state of the measured value judgment result. When the measured value exceeds the HIGH set value, "HI" is displayed. When the measured value falls below the LOW set value, "LO" is displayed. When the measured value is within the range of the HIGH set value / LOW set value, "GO" is displayed.
4	HOLD icon	Displayed when the laser is on hold.
5	ZERO set icon	Displayed when zero set is turned ON.
6	Bank icons	The number of currently used bank (B1 to B4) is displayed.
7	Hold mode icons	The currently selected hold mode is displayed. ● Peak Hold: P ● Bottom Hold: B ● Peak-to-Peak Hold: PP No icon is displayed when "None (Normal mode)" is set.

Note

- The display range of measured values for each distance type is as follows.

Model name	Measurement center distance	Measurement range(Note 1)	Display range(Note 2)
HL-G203B-S-MK	30 mm	±5 mm	-9.5000 to +9.5000
HL-G205B-S-MK	50 mm	±10 mm	-95.000 to +95.000
HL-G208B-S-MK	85 mm	±20 mm	-95.000 to +95.000
HL-G212B-S-MK	120 mm	±30 mm	-95.000 to +95.000
HL-G225B-S-MK	250 mm	±150 mm	-950.00 to +950.00

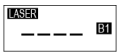
(Note 1) The measurable range from the measurement center distance. Use outside the measurement range is not recommended although the measured values will be output, since they are out of the specification range.

(Note 2) The range of values displayed on the display section.

- When the measured value is above the positive limit of the display range, "+OVER" is displayed on the display section.

- When the measured value is below the negative limit of the display range, "-OVER" is displayed on the display section.

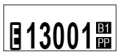
- When the measured value is indeterminate, "----" is displayed on the display section.



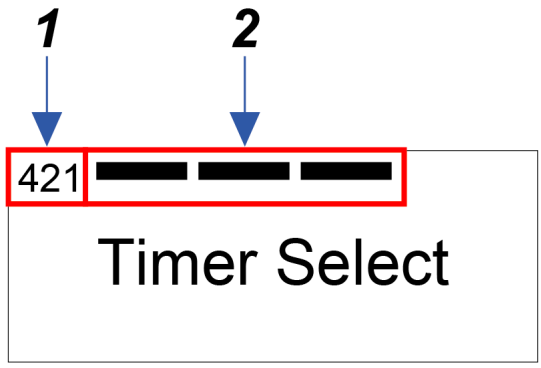
- In an alarm state, "ALARM" is displayed on the display section. (Only when the Alarm digital output setting is "Alarm")

- If an error occurs during setting or measurement, the corresponding error code will be displayed on the display section.

  For error messages and actions to be taken, refer to "8.2 Error Messages and Action Methods".



■ Setting screen (Setting mode)



	Name	Function
1	Menu number	Shows the setting item by number. Hold down the <ENTER> key for 2 seconds on the measurement display. The screen that appears after entering the Setting mode is the first level. Following this, pressing the <ENTER> key each time brings you to the second level, the third level, and so on. When the menu number is "421", the first level is 4, the second level is 2, and the third level is 1.
2	Hierarchical level display bar	Shows the hierarchal level of the setting item as bars. When three bars are displayed, the setting item is at the third level.

■ Setting items corresponding to menu numbers

Menu number	Hierarchical level display bar (Number of bars)	Setting item	Reference page
1	1	Bank	"4.2 Bank Switching"
2	1	Sensing	"4.3 Sensing Setting"
3	1	Judgment	"4.4 Judgment Setting"
4	1	Output	"4.5 Output Setting"
5	1	Input	"4.6 Input Setting"
6	1	Alarm	"4.7 Alarm Setting"
7	1	Ethernet	"5.1 Ethernet Communication Setting"
8	1	RS-485	"6.1 RS-485 Communication Setting"
9	1	System	"4.8 System Setting"
21	2	Sampling Frequency	"4.3.1 Sampling Frequency"
22	2	Average Times	"4.3.2 Average Times"
23	2	Brightness Tuning	"4.3.3 Brightness Tuning"
24	2	Hold Mode	"4.3.4 Hold Mode"
25	2	±Inversion	"4.3.5 Inversion of Measured Value"
26	2	Span	"4.3.6 Span"
27	2	Offset	"4.3.7 Offset"

Menu number	Hierarchical level display bar (Number of bars)	Setting item	Reference page
31	2	HIGH Set Value	"4.4.1 HIGH Set Value"
32	2	LOW Set Value	"4.4.2 LOW Set Value"
33	2	Hysteresis	"4.4.3 Hysteresis"
34	2	Teaching Mode	"4.4.4 Teaching Mode"
35	2	Tolerance	"4.4.5 Tolerance"
42	2	Output Delay Timer	–
52	2	Laser Stop	"4.6.1 Laser Stop"
53	2	Trigger Mode	"4.6.2 Trigger Mode"
62	2	Alarm Digital Output	"4.7.2 Alarm Digital Output"
63	2	Alarm Delay Count	"4.7.1 Alarm Delay Count"
71	2	IP Address	"5.2.1 Modbus TCP Setting Method" "5.3.1 EtherNet/IP Setting Method" "5.4.1 SLMP Setting Method"
72	2	Subnet Mask	
73	2	Default Gateway	
74	2	Port No.(Tool)	
75	2	Port No.(Modbus)	
76	2	Port No.(SLMP)	
77	2	Network No./Node No.	
78	2	MAC Address	
81	2	Termination Resistance	"6.2 Connection and Setting Method"
82	2	Device Address	
83	2	Comm Speed(bps)	
84	2	Parity/Stop Bit	
91	2	Display Digit	"4.8.1 Display Digit"
92	2	ECO Mode	"4.8.2 ECO Mode"
93	2	Display Inversion	"4.8.3 Display Inversion"
94	2	Language	"4.8.4 Language Setting"
95	2	Comm Reset	"4.8.5 Resetting Communication Settings"
96	2	Initialize	"4.8.6 Settings Initialization"
421	3	Timer Select	"4.5.1 Output Delay Timer Selection"
422	3	Timer Setting	"4.5.2 Output Delay Timer Setting"

(MEMO)

3 Installation and Setup

3.1 Flow of Operations up to Measurement Startup 3-2
3.2 Sensor Installation 3-3
3.3 Sensor Installation Direction and Angle 3-4
3.4 Optional Cable Connection Method 3-7
3.5 Functions and Wiring of I/O Lines 3-9
3.5.1 Grounding 3-12
3.5.2 Precautions for positive ground environment 3-12
3.6 Initial Startup Settings 3-13

3.1 Flow of Operations up to Measurement Startup

This section explains the flow of operations up to measurement startup by using workpiece detection mode as an example.

1. Before power ON

Check package contents and confirm that all parts are complete.
Prepare either CN-8E-C□ (For Ethernet communication) or CN-8R-C□ (For RS-485 communication) according to the communication method to set up.

2. Installation and wiring

Install this product and connect the optional cables according to the installation and wiring methods.

1. "3.2 Sensor Installation"
2. "3.3 Sensor Installation Direction and Angle"
3. "3.4 Optional Cable Connection Method"

3. Initial setup

Turn the power ON and perform the initial setup.

1. "3.6 Initial Startup Settings"

4. Communication settings

Perform communication settings.
Set up one of the following according to the communication method to use.

1. Ethernet communication: "5.1.1 Connection and Setting Method"
2. RS-485 communication: "6.2 Connection and Setting Method"

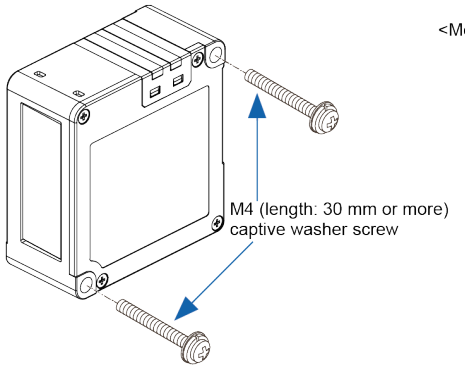
5. Setting up the functions

Perform the necessary function settings according to your environment.
"4.1 List of Functions"

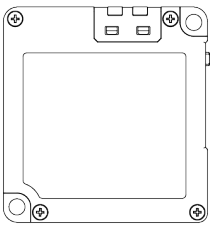
3.2 Sensor Installation

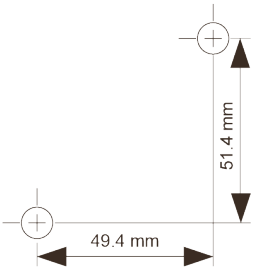
1 2 Procedure

1. When installing this product, use M4 captive washer screws (to be prepared separately). (Tightening torque: 0.8 N·m or less)



<Mounting hole positional dimensions>





- Carefully handle the sensor so that no force is applied around the connector of the optional cable. Do not bend the cable close to the connector. Doing so may cause disconnection.
- Do not bend the optional cable to a radius of 50 mm or less.

- To prevent the sensor from falling due to screw loosening, take preventive measures such as using captive washer screws depending on the usage environment.
- Install the sensor so that the beam emitting part and beam receiving part surfaces are set in parallel with the measurement object.

3.3 Sensor Installation Direction and Angle

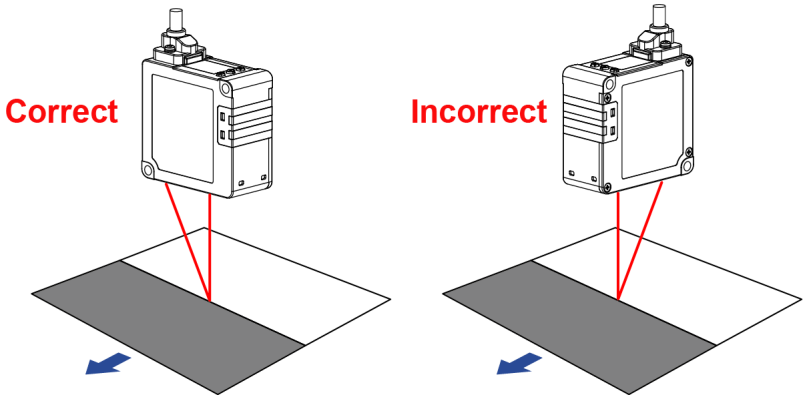
To stabilize measurement (including the reduction of measurement errors), install the sensor considering the installation direction depending on the operating environment.

Install the sensor so that the beam emitting part and beam receiving part surfaces are set in parallel with the measurement object.

■ Installation Direction

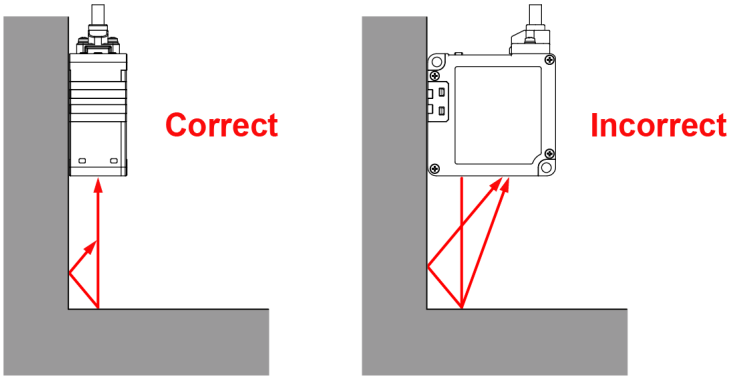
- When the material or color of the measurement object largely varies

  To measure moving objects with significant differences in material or color, installing the sensor as shown in the figure below minimizes the measurement error.



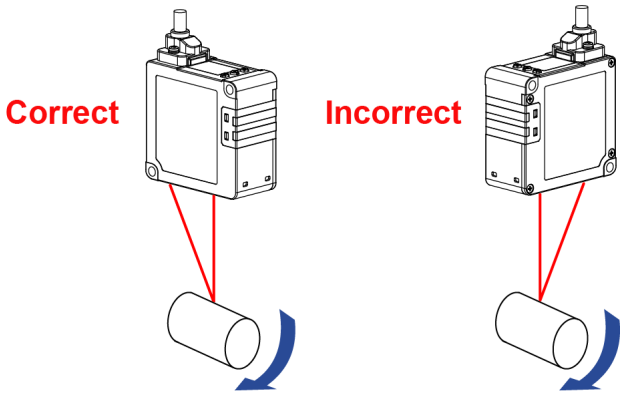
- When installing the sensor head on a wall surface

  To prevent entry of multiple reflections from the wall surface into the beam receiving part, install the sensor as shown in the figure below. If the wall surface is highly reflective, it is effective to make it matte black.



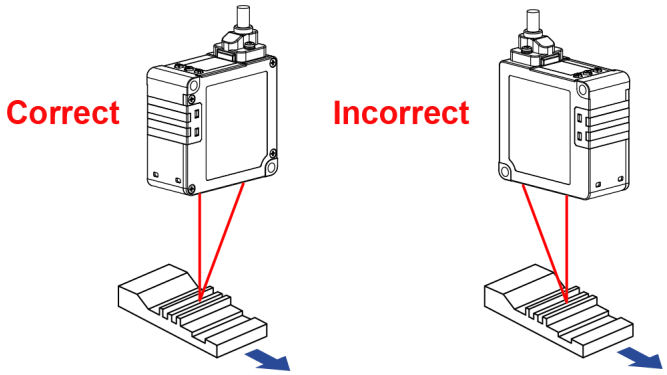
- When the measurement object rotates

  To measure rotating objects, installing the sensor as shown in the figure below minimizes the effects of vertical vibration, misalignment, etc.



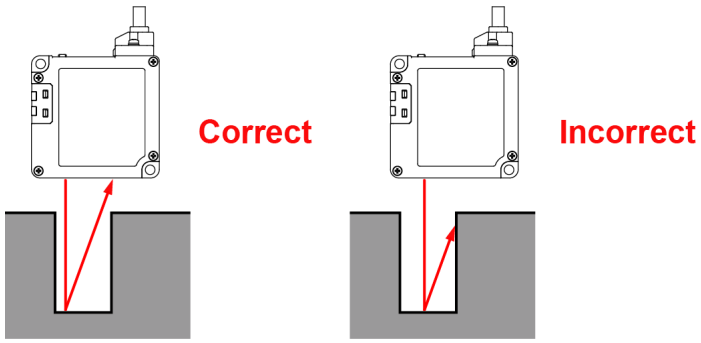
- When there are level differences on the surface of the measurement object

  To measure moving objects with level differences on the surface, installing the sensor as shown in the figure below minimizes the effect of the level edges.



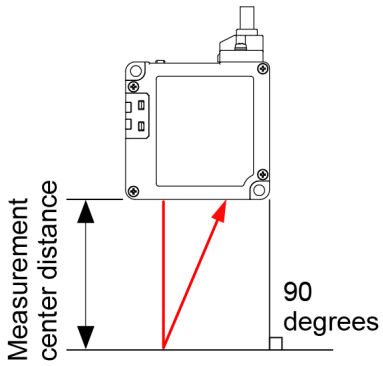
- When measuring a concave part

  To measure objects in a narrow space or hole, install the sensor so that the light path from the beam emitting part to the beam receiving part is not blocked.



■ Installation Angle

Install the sensor so that the beam emitting part and beam receiving part surfaces are set at 90 degrees (parallel) with the measurement object.



<Reference>

Model No.	Measurement center distance	Measurement range
HL-G203B-S-MK	30 mm	±5 mm
HL-G205B-S-MK	50 mm	±10 mm
HL-G208B-S-MK	85 mm	±20 mm
HL-G212B-S-MK	120 mm	±30 mm
HL-G225B-S-MK	250 mm	±150 mm

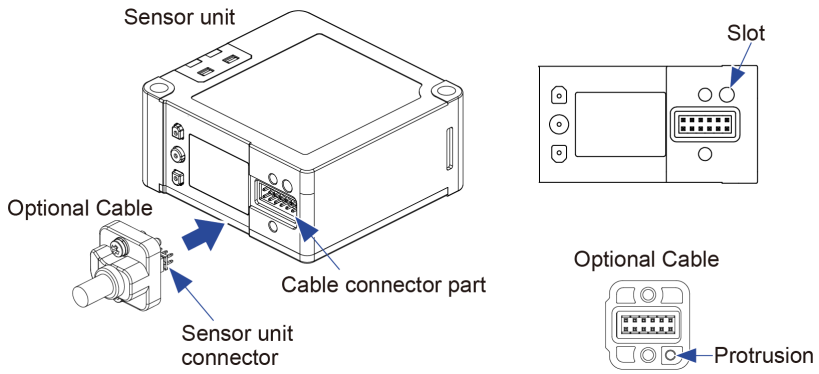
3.4 Optional Cable Connection Method

- When using the optional cable, confirm that there is no foreign matters in the connector part before using the cable.
- Always grasp the connector body when connecting or disconnecting the connector. Wires may break if excessive stress is applied to the cable.
- Insert the connector all the way in and tighten the M2.6 screws to this product before using it. If the connectors are not completely connected, the sensor unit may become damaged.

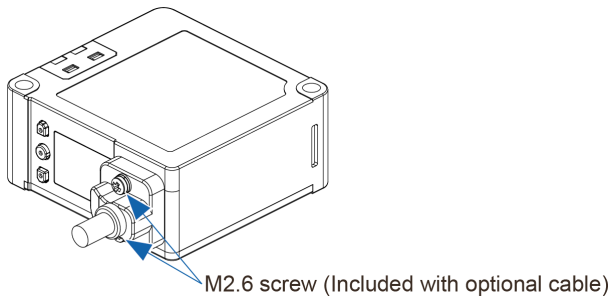
- Do not insert the connector at an angle. Otherwise, connector pins may be bent.

Procedure

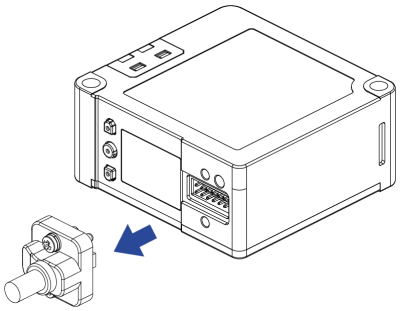
1. Insert the sensor unit connection connector on the optional cable into the sensor unit cable connector.
   When doing this, insert the protrusions on the sensor unit connector on the communication cable into the holes on the connector for the sensor unit connection cable.



2. Tighten the two M2.6 screw. Tighten the two M2.6 screw. (Tightening toque 0.23 to 0.3 N·m)



3. When removing the connecting cable from the sensor, loosen the two M2.6 screws, hold the connector part of the cable, and pull out the cable.

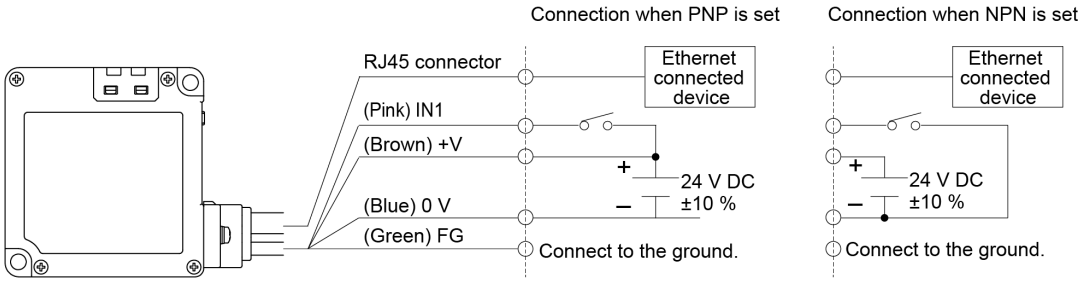


3.5 Functions and Wiring of I/O Lines

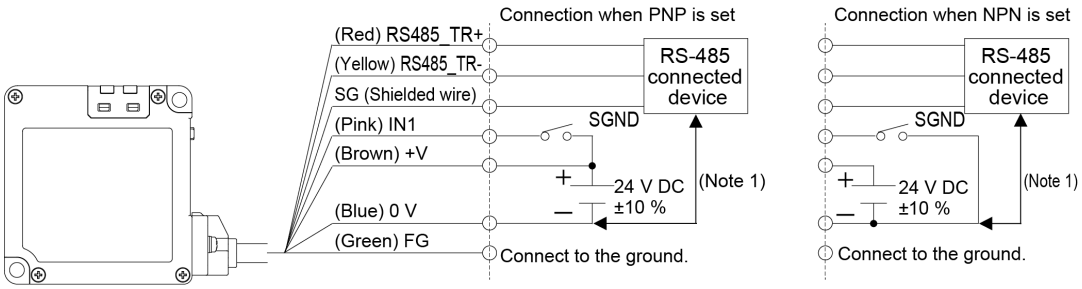
Two types of optional cables are available. Select CN-8E-C□ for Ethernet communication. Select CN-8R-C□ for RS-485 communication.

- Before wiring, always turn the power OFF.
- Be sure to use the specified optional cables.
- Be sure to insulate the ends of leads that are not used.
- Always run the Ethernet type cable through a duct or secure the cable with clamps. Failure to do so may affect the contact state of the connectors due to vibration or impact, resulting in malfunction.

■ CN-8E-C□ (For Ethernet communication)



■ CN-8R-C□(For RS-485 communication)



(Note 1) The sensor unit power supply (0 V) and SG (shield line) terminals of this product are internally connected.

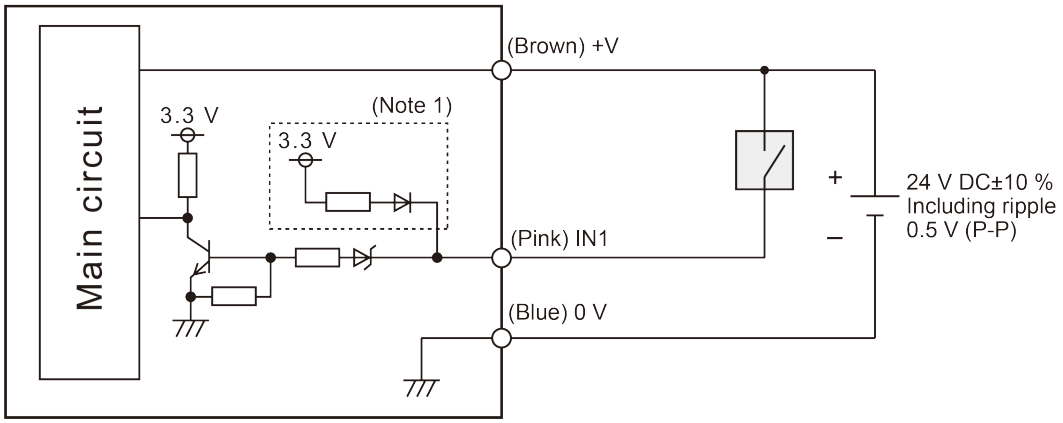
When connecting the sensor to a non-insulated RS-485 connected device, make sure that no potential difference is created between the power supply (0V) for the sensor and the GND of the RS-485 device power supply.

Failure to do so may cause failure or malfunction of the connected device or this product.

■ I/O circuit diagram

When PNP is set

HL-G2

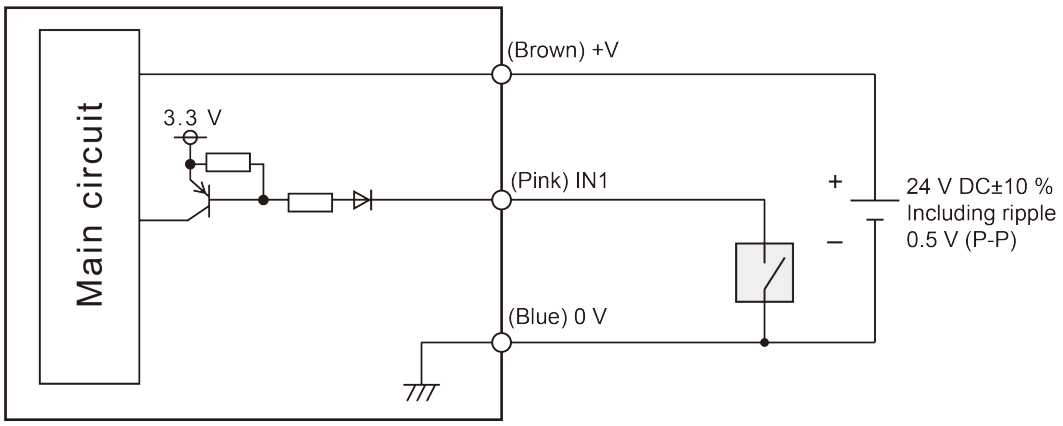


(Note 1) This product operates as a normal PNP input sensor according to the PNP input specifications. However, due to the effect of the NPN/PNP switching circuit, 3.3 V is applied from the input to the outside when PNP is set. Therefore, if the input is shorted to 0 V in the PNP setting, a current of approximately 1 mA will flow to the outside.

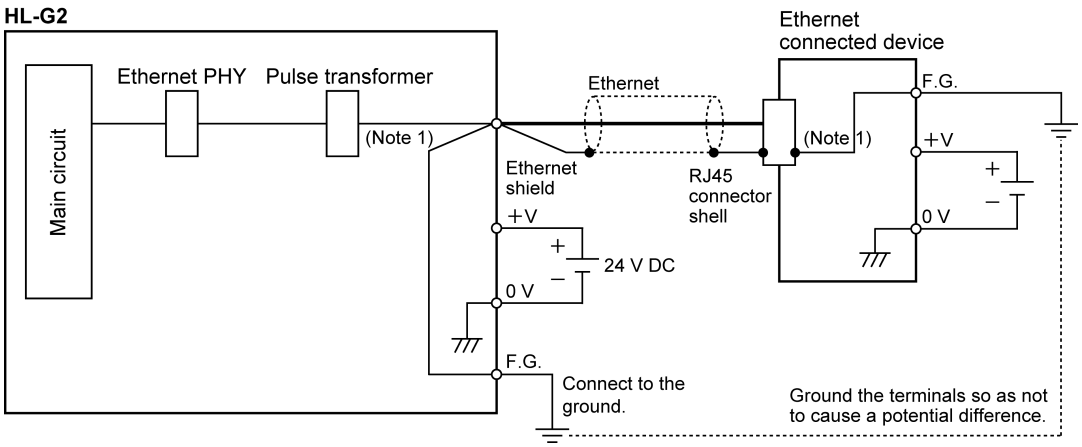
Although this does not cause the product to fail, note that it allows a current to flow to the connected device.

When NPN is set

HL-G2



■ Ethernet Circuit Diagram

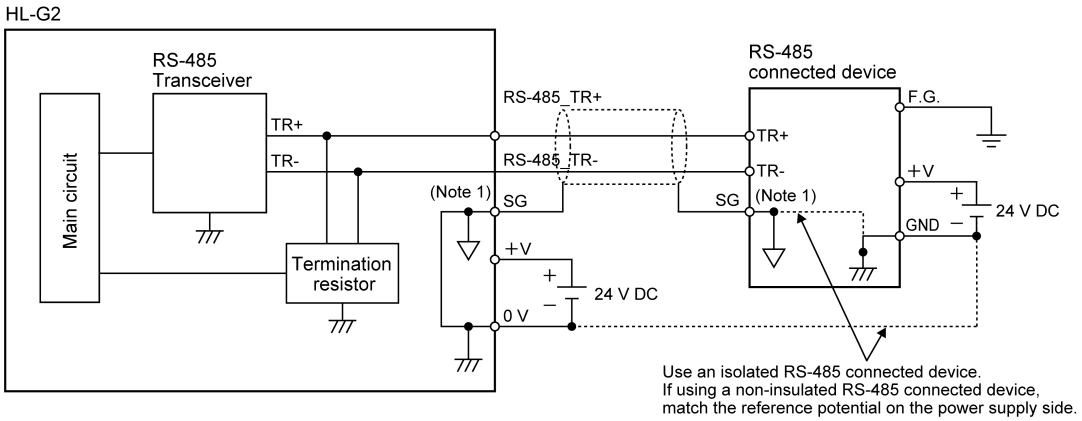


(Note 1) The F.G. terminal and Ethernet shield of this product and the RJ45 connector shell are internally connected.

If there is a potential difference between the F.G. of this product and the F.G. of the Ethernet-connected device, an overcurrent may flow between the F.G. terminals of each other, causing a failure. Ground this product so as not to cause a potential difference between the F.G. of the product and the F.G. of the Ethernet-connected device.

Also note that, if signal lines other than the ground line are incorrectly wired to the F.G., an overcurrent may flow, causing a failure.

■ RS-485 circuit diagram



(Note 1) The 0 V and SG terminals of this product are internally connected.

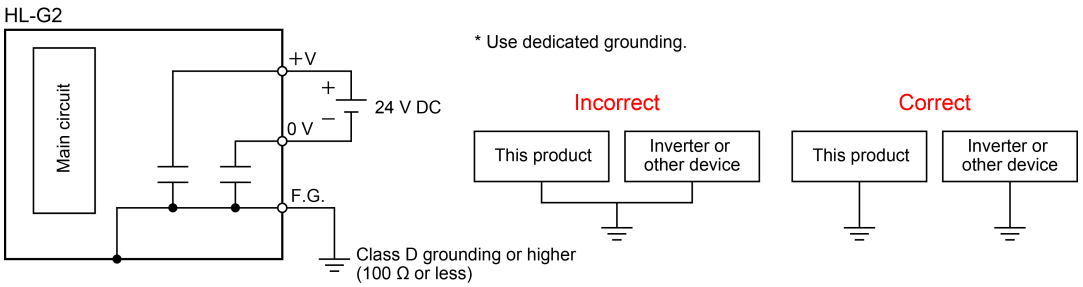
If there is a potential difference between the sensor unit power supply (0 V) and the GND of the RS-485 connected device power supply, an overcurrent may flow between the 0 V and SG terminals, causing a failure. To avoid this, use an insulated RS-485 connected device or match the potential of the sensor unit power supply (0 V) with that of the GND of the RS-485 connected device power supply.

Note also that, if signals with a potential difference are incorrectly wired between the 0 V and SG terminals, an overcurrent may flow, causing a failure.

3.5.1 Grounding

- The power supply (+V, 0 V) and F.G. terminals of this product are isolated by capacitors.
- The F.G. terminal and metal housing of this product are internally connected.

  To prevent electric shock and malfunction due to noise, use dedicated grounding with a resistance of 100 Ω or less (Class D or higher) and avoid common grounding with other devices.
- The point of grounding should be as close to this product as possible. The ground wire should be as short as possible.



3.5.2 Precautions for positive ground environment

The 0 V and SG terminals of this product are internally connected. In addition, the F.G. terminal and Ethernet shield of this product and the RJ45 connector shell are internally connected.

Connecting the product to a PC or other device in which the F.G. and GND terminals are internally connected may cause a short circuit in the power supply (24 VDC) via the PC, SG terminal, or Ethernet shield, resulting in a failure.

Note the following wiring precautions when using the product in a positive ground environment.

- Do not ground the F.G. of a PC or other device in which the F.G. and GND terminals are internally connected.

  The internal connection state varies depending on the device. For details, refer to the instruction manual of the device that you use.
- Do not ground the +V terminal of this product.
- To connect the power supply (24 VDC) for the connected device to the positive ground, prepare a separate power supply (DC24V) for this product and insulate this product.

  Also, connect input lines other than for Ethernet and the RS-485 line (including the SG terminal) to a connected device with insulated I/O.

3.6 Initial Startup Settings

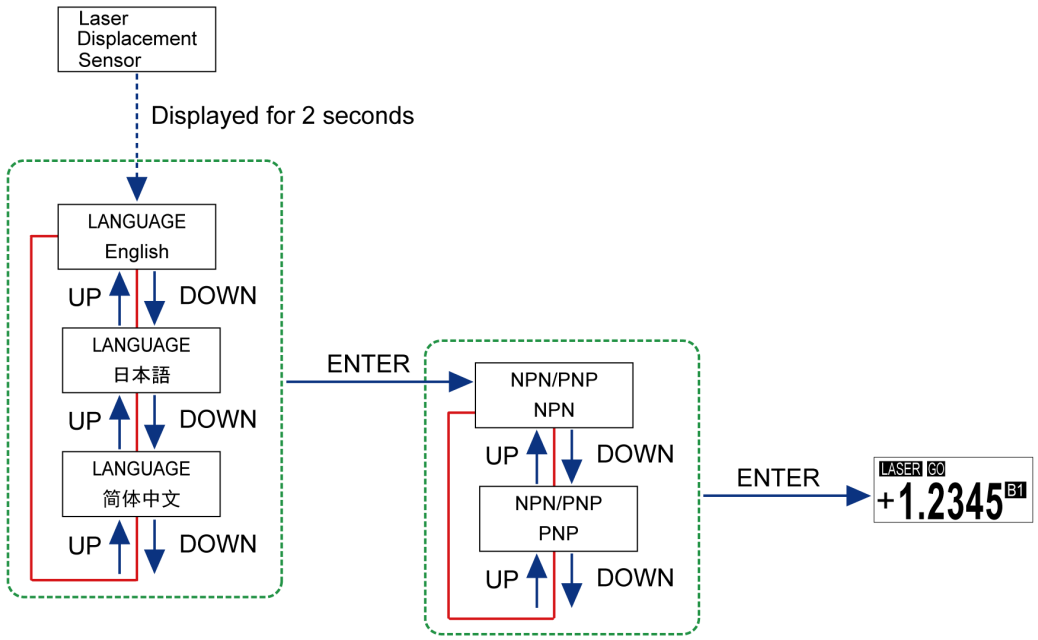
■ Overview

After turning on the power supply for the first time or executing "Set value initialization", perform the language and NPN/PNP settings.

Procedure

1. When the power supply is turned on, the startup screen is displayed for two seconds and then the language setting screen is displayed.
2. Press the<UP>or<DOWN>key to select Japanese, English, or Chinese and then press the<ENTER>key.
3. The NPN/PNP setting screen is displayed. Select either NPN or PNP and press the <ENTER> key.
4. When the NPN/PNP setting is complete, the display changes to the measurement display.

Setting method



(MEMO)

4 Description of Functions

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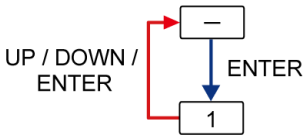
4.1 List of Functions

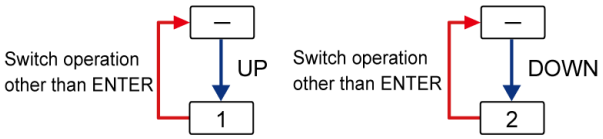
The items that can be set on the measurement display are as follows.

■ Received light intensity monitor



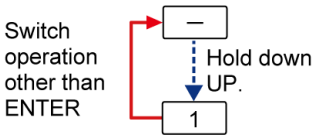
No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	Received light intensity monitor	Receive Light 500	The peak intensity of received light (range: 0 to 1023) of the received light waveform. When the measured value is indeterminate, ---- is displayed.	-

■ HIGH set value setting / LOW set value setting



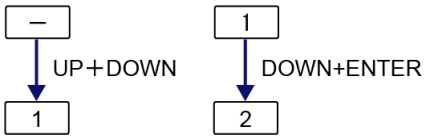
No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	HIGH set value setting	HIGH Set Value + 10.000	Used to make fine adjustment of the HIGH set value.	"4.4.1 HIGH Set Value"
2	LOW set value setting	LOW Set Value - 10.000	Used to make fine adjustment of the LOW set value.	"4.4.2 LOW Set Value"

■ 1-point / 2-point / 3-point teaching



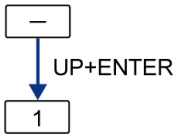
No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	1 point / 2 points / 3 points teaching	Set 1st Target Push ENTER SW +1.2345	Perform teaching using the method set in**Teaching type**under**Judgment setting**.	"4.9 1 point/2 points/3 points Teaching"

■ Zero setting ON / Zero setting OFF



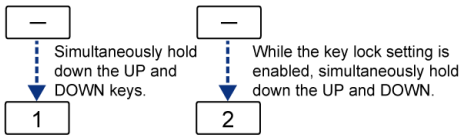
No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	Zero setting ON	LASER CO ZERO 0.0000 B1	This function is used to forcibly set the measured value to "0". You can use the function to adjust the reference point when this product has been replaced or when the workpiece has been changed.	"4.10 Zero Setting"
2	Zero setting OFF	LASER CO +1.2345 B1	Used to clear the zero setting.	"4.10 Zero Setting"

■ Measured value resetting



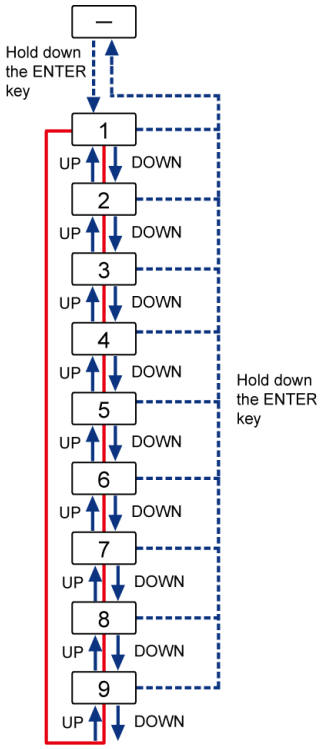
No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	Reset	LASER ---- B1	Used to reset the moving average data of the measured value or the value held by the hold function.	"4.11 Measured Value Resetting"

■ Key lock

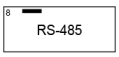
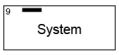


No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER CO +1.2345 B1	-	-
1	Key lock	KEY LOCK ON	Used to disable key operations.	"4.12.1 Key Lock Setting"
2	Key lock OFF	KEY LOCK OFF	Used to release the key lock setting.	"4.12.2 Key Lock OFF"

■ Setting mode



No.	Setting item	Display section	Description of Functions	Reference page
-	Measurement display	LASER +1.2345	-	-
1	Bank switching	1 — Bank	Used to switch over the bank to be used.	"4.2 Bank Switching"
2	Sensing setting	2 — Sensing	This is a function setting that is used to control the received light intensity of the sensor and to facilitate stable with accuracy.	"4.3 Sensing Setting"
3	Judgment setting	3 — Judgment	This is a function setting related to judgment results of the measured value.	"4.4 Judgment Setting"
4	Output setting	4 — Output	This is a function setting related to output operation.	"4.5 Output Setting"
5	Input setting	5 — Input	This is a function setting related to input operation.	"4.6 Input Setting"
6	Alarm setting	6 — Alarm	This is a function setting related to output when an alarm occurs.	"4.7 Alarm Setting"
7	Ethernet communication setting	7 — Ethernet	This is a function setting related to Ethernet communication.	"5.1.1 Connection and Setting Method"

No.	Setting item	Display section	Description of Functions	Reference page
8	RS-485 communication setting		This is a function setting related to RS-485 communication.	"6.2 Connection and Setting Method"
9	System setting		This includes system settings such as language setting and initialization.	"4.8 System Setting"

4.2 Bank Switching

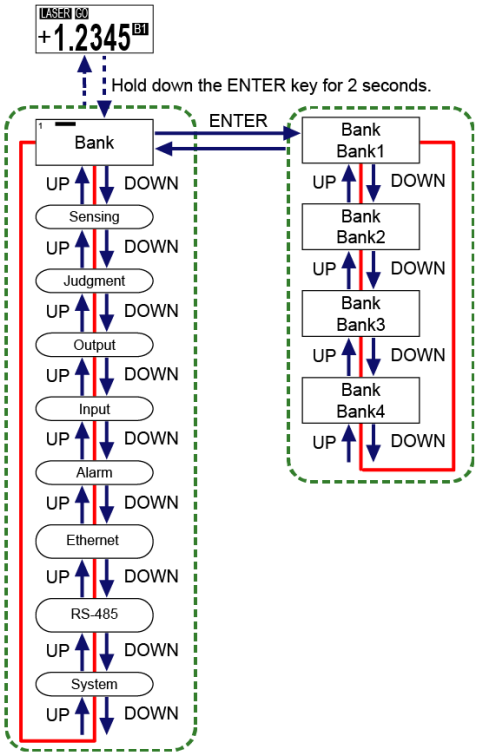
■ Overview

This product has four banks, Bank 1 to Bank 4, in order to hold some setting values.

By switching the bank to use, you can easily apply the settings when needed depending on the measurement object.

For details on the set values to be held in the banks, refer to "Types of setting items read from banks".

■ Setting method



The set values held in the specified bank will be applied.

Whenever you change the settings thereafter, the new set values will be held in the bank.

Note

- The number of currently used bank is displayed on the measurement display.

- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Bank	Bank 1	Bank 1
	Bank 2	
	Bank 3	
	Bank 4	

■ Types of setting items read from banks

Major setting item	Setting item
Sensing setting	Sampling frequency
	Average times
	Brightness tuning
	Hold mode
	Span
	Offset
Judgment setting	HIGH set value / LOW set value
	Hysteresis
	Teaching mode
	Tolerance
Output setting	Output Delay Timer selection
	Output delay timer setting
Input setting	Trigger mode
Alarm setting	Alarm digital output
	Alarm delay count
System setting	Display Digit
Others	Zero set setting
	Zero set correction value

■ Bank copy

You can copy the settings saved in a bank to another bank using communication commands for the external host device.

The copied settings will be retained even when the power is turned OFF.

When using communication commands, the following combinations of copy source and copy destination banks are available.

Set value for bank copy	Copy source bank	Copy destination bank
0	BANK1	BANK2
1	BANK1	BANK3
2	BANK1	BANK4
3	BANK2	BANK1
4	BANK2	BANK3
5	BANK2	BANK4
6	BANK3	BANK1
7	BANK3	BANK2
8	BANK3	BANK4
9	BANK4	BANK1
10	BANK4	BANK2
11	BANK4	BANK3

Note

- The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

4.3 Sensing Setting

■ Overview

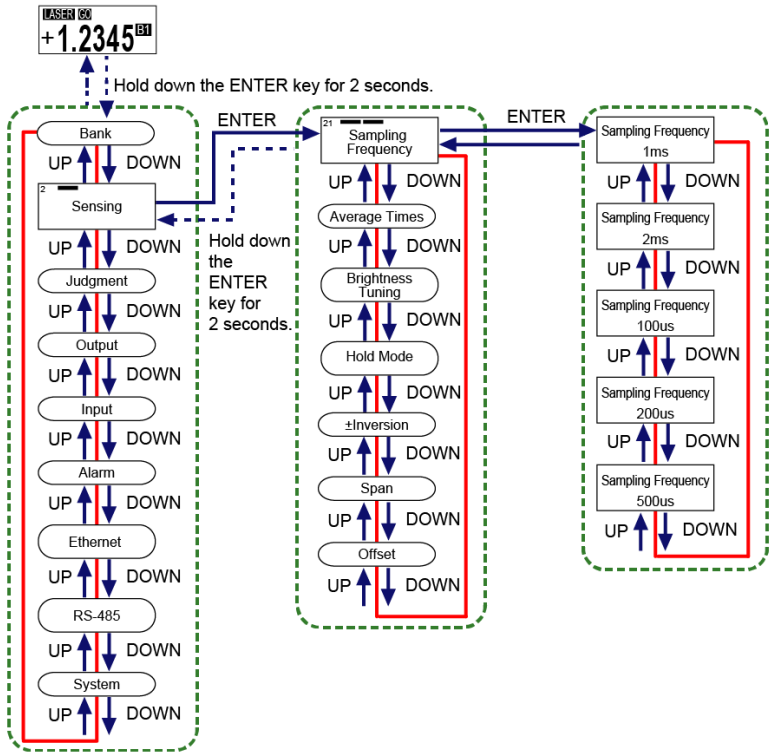
This is a function setting that is used to control the received light intensity of this product and perform calculations on the output measurement values to ensure accurate and stable measurement.

4.3.1 Sampling Frequency

■ Overview

You can change the sampling frequency according to the moving speed of the object.

■ Setting method



Note

- When measuring an object with extremely small intensity of received light such as black rubber, lengthen the sampling cycle to receive sufficient light intensity so as to achieve stable measurement.
- Depending on measurement objects, the measurement range may become narrow.
- The displayed unit “ms” stands for milliseconds, and “us” stands for microseconds.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

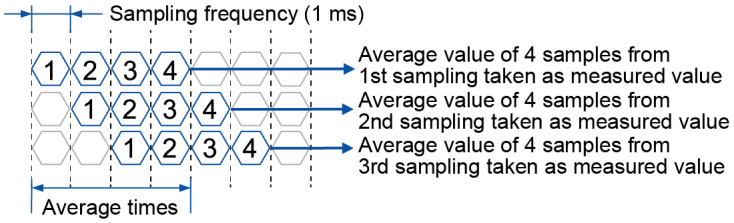
Setting item	Set value	Default value
Sampling Frequency	100 µs	1 ms
	200 µs	
	500 µs	
	1 ms	
	2 ms	

4.3.2 Average Times

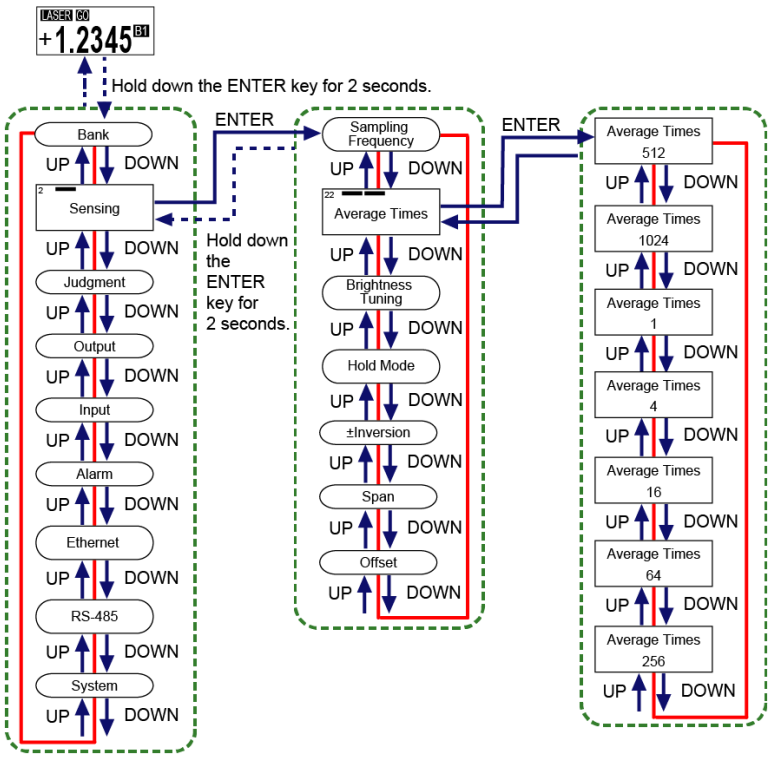
■ Overview

Set the number of moving averages used to calculate measured values.
This setting is used to stabilize fluctuating measured values.

When the average count is set to 4
(Sampling cycle: 1 ms)



■ Setting method



Note

- Setting the average count to a small value enables the sensor to respond to momentary changes. Setting the average count to a large value enables the sensor to suppress the effect of momentary changes.
- When the average count is changed, the measured value is set to an indeterminate state until values are accumulated to reach the average count again.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value (times)	Default value (times)
Average Times	1	512
	4	
	16	
	64	
	256	
	512	
	1024	

4.3.3 Brightness Tuning

■ Overview

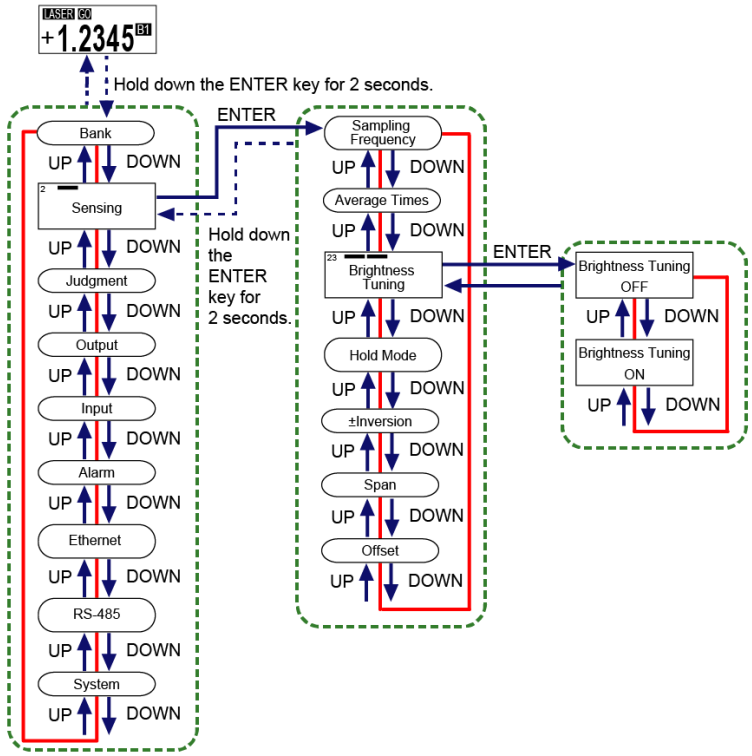
Depending on the workpiece to be measured, you can change the beam brightness adjustment method.

When measuring two workpieces with large brightness difference, use the brightness tuning which may stabilize the measurement accuracy.

To select the brightness tuning, sensing objects with different brightness are required.

Adjustment method	Operation
Auto mode	The laser beam brightness is automatically adjusted. (Set value: OFF)
Brightness tuning	If the brightness of sensing objects varies, set the brightness in advance and tune the adjustment range. This allows a faster adjustment than the auto mode. (Set value: ON)

■ Setting method



Note

- If the sampling cycle is changed after execution of brightness tuning, tuning must be made again.
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Brightness Tuning	OFF	OFF
	ON	

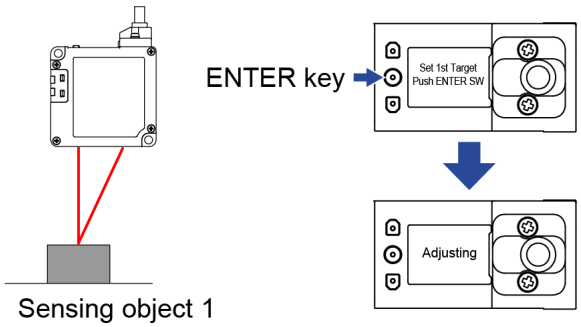
■ Brightness Tuning Procedure

When selecting Brightness tuning, both the bright portion and dark portion of the sensing object need to be registered in this product in advance.

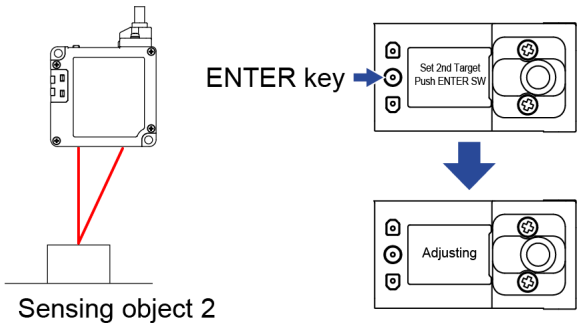
Follow the procedure below to configure the settings.

1 2 Procedure

1. Prepare two workpieces with different brightness and turn ON Brightness Tuning.
2. Confirm that a message saying"Set 1st Target - Push ENTER SW"is displayed on the display section and then set the 1st workpiece and press the<ENTER>key.
   When the<ENTER>key is pressed,"Adjusting"is displayed on the display section.

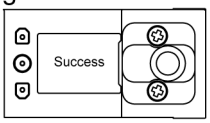


3. Confirm that a message saying"Set 2nd Target and Push ENTER SW"is displayed on the display section and then set the 2nd workpiece and press the<ENTER>key.
   When the<ENTER>key is pressed,"Adjusting"is displayed on the display section.



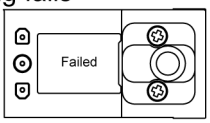
4. When the Brightness Tuning has succeeded, "Success" is displayed on the display section.

When the brightness tuning is successful



5. When the Brightness Tuning has failed, "Failed" is displayed on the display section. Perform brightness adjustment using two workpieces again.

When brightness tuning fails



- In the following case, teaching cannot be started.
  - Hold mode is set to other than "None (Normal mode)".

Note

- In the following cases, Brightness Tuning will fail.
  - Alarm state
  - Indeterminate state
  - Hold state (In this case, the state changes to indeterminate state after execution of tuning.)
  - When optimal intensity of received light could not be obtained stably for a certain period of time
- Measuring another workpiece with significantly different reflectance from either of the two registered workpieces may cause an alarm due to saturation or lack of the received light intensity, or incorrect measurement due to a malfunction of the brightness adjustment.

  To measure three or more workpieces with different reflectance, use Auto mode.

Brightness tuning using external communication

This section describes how to execute brightness tuning using communication commands from an external host device.

- During the execution of brightness tuning using communication commands, do not write data to other setting information.

- Execute brightness tuning on the measurement display.

Procedure

1. Using a communication command from an external host device, set "Brightness Tuning" to "1: ON".
2. Confirm that "Brightness Tuning execution state" is set to "1: 1st point being executed".
3. Insert the 1st sensing object and set "Brightness Tuning 1st point setting" to "0: Execute". "Brightness Tuning execution state" changes to "2: 2nd point being executed".
4. Insert the 2nd sensing object and set "Brightness Tuning 2nd point setting" to "0: Execute".
5. If the brightness tuning is "successful", "Brightness Tuning execution state" changes to "3: Success".
6. If the brightness tuning "fails", "Brightness Tuning execution state" changes to "4: Failed". Perform brightness adjustment using two sensing objects again.

Note

- Screen transition by operating switches on this product is not possible during the execution of brightness tuning using communication commands.
- The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

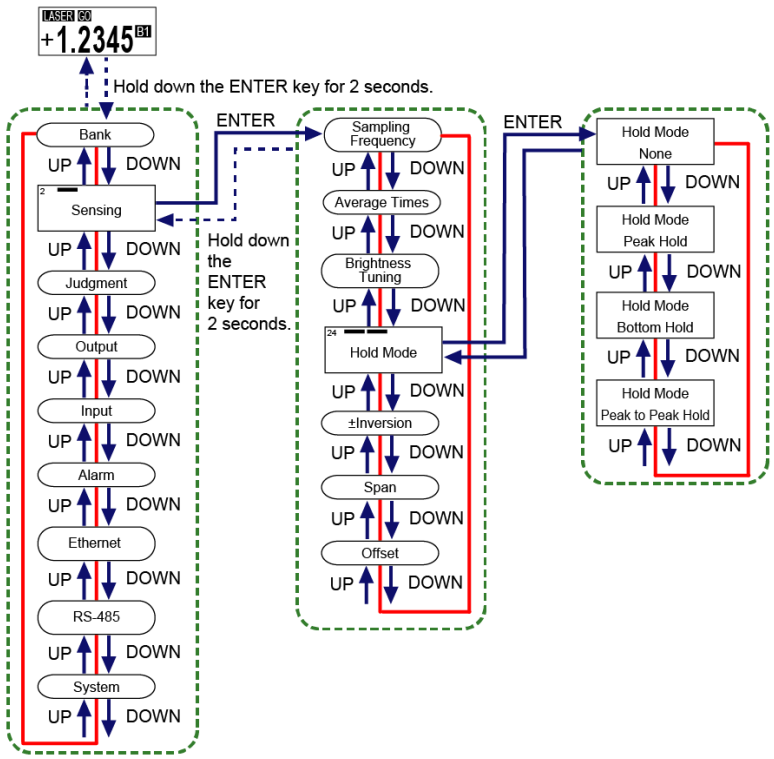
Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

4.3.4 Hold Mode

■ Overview

Set a method to hold the measured value according to the measuring method of sensing objects.

■ Setting method



Note

- There is a dependency between hold mode and trigger mode. When "None (Normal mode)" is selected in Hold mode, Trigger mode can be set to "Hold" or "One Shot".
- When other than "None (Normal mode)" is selected in Hold mode, Trigger mode can be set to "Hold" only.
- When "One Shot" is selected in Trigger Mode, setting Hold mode to other than "None (Normal mode)" automatically changes the mode to "Hold". For detailed setting procedure, refer to "4.6.2 Trigger Mode".
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Hold mode	None (Normal mode)	None (Normal mode)
	Peak Hold	
	Bottom Hold	

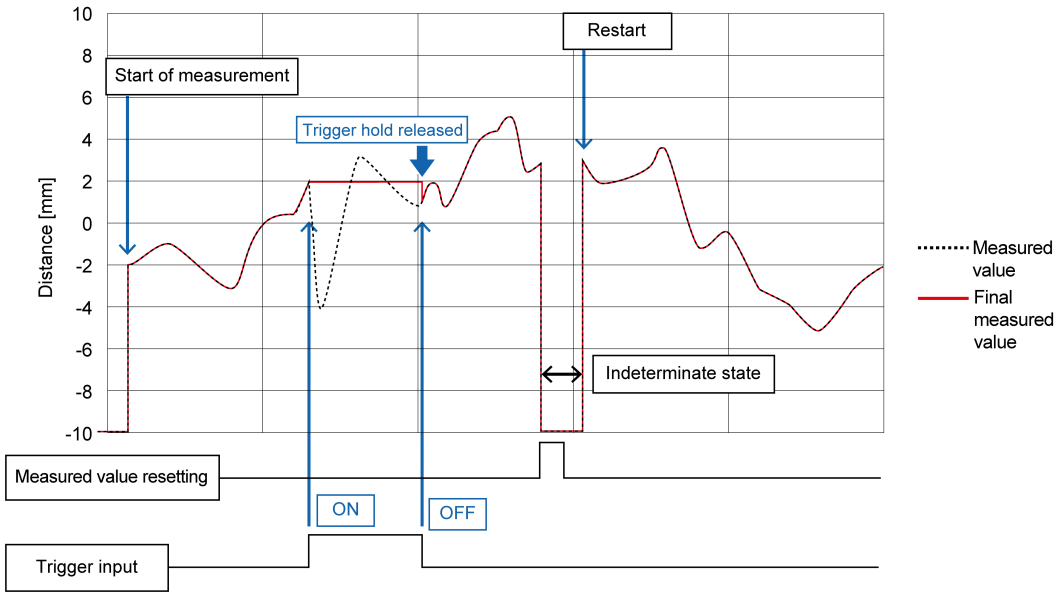
Setting item	Set value	Default value
	Peak to Peak Hold	

■ Timing chart

The diagram shown in the following explanation shows an example where"Hold"is set in the trigger mode.

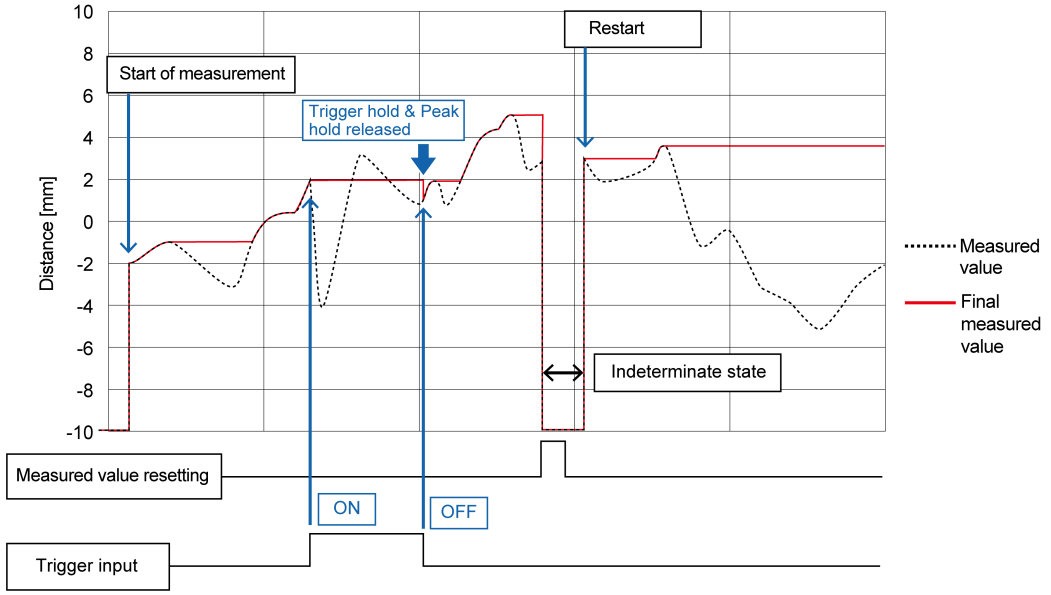
None (Normal mode)

When the trigger input turns ON, the measured value is held. When the trigger input turns OFF, the hold state is released, and the value is updated and output as necessary.



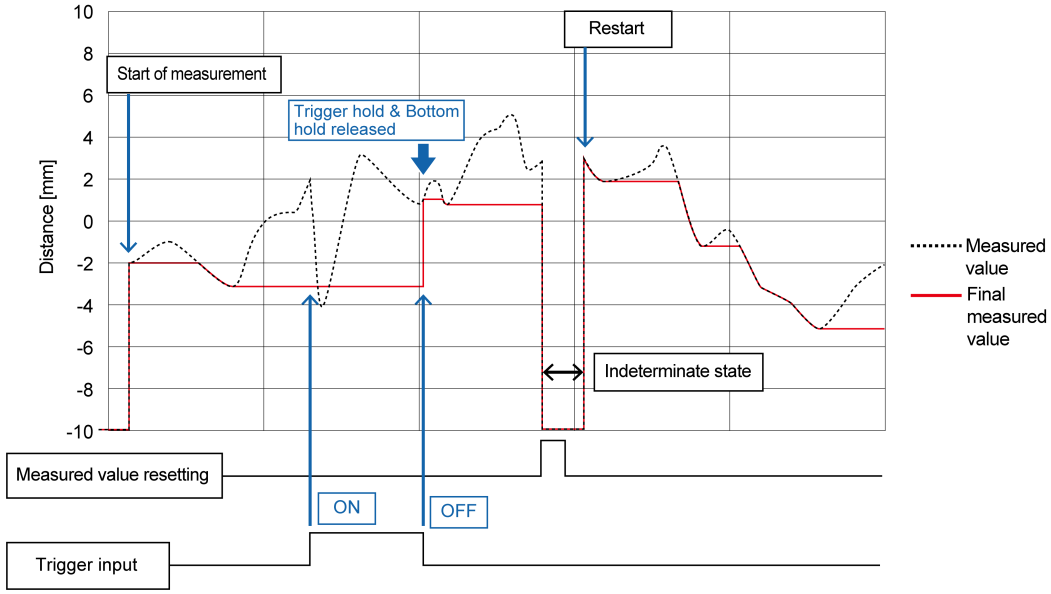
Peak Hold

Used to update and output the maximum value of the measured values as needed. During the period from when the trigger input turns ON to when it turns OFF, the maximum value data is held.



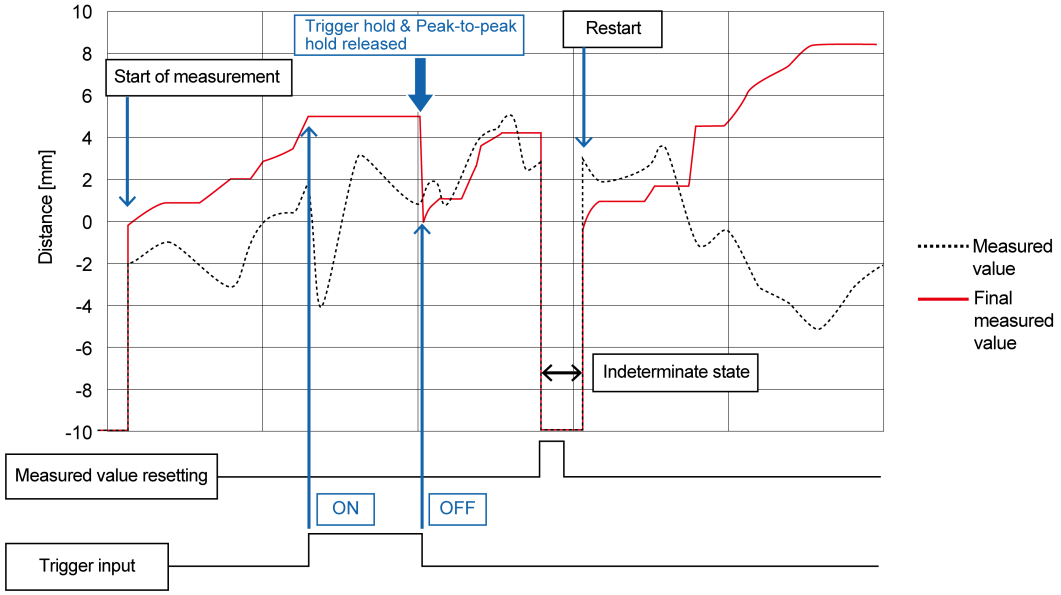
Bottom Hold

Used to update and output the minimum value of the measured values as needed. During the period from when the trigger input turns ON to when it turns OFF, the minimum value data is held.



Peak to Peak Hold

Used to update and output the value obtained by subtracting the minimum value from the maximum value as needed. During the period from when the trigger input turns ON to when it turns OFF, the value when ON is input is held.



Note

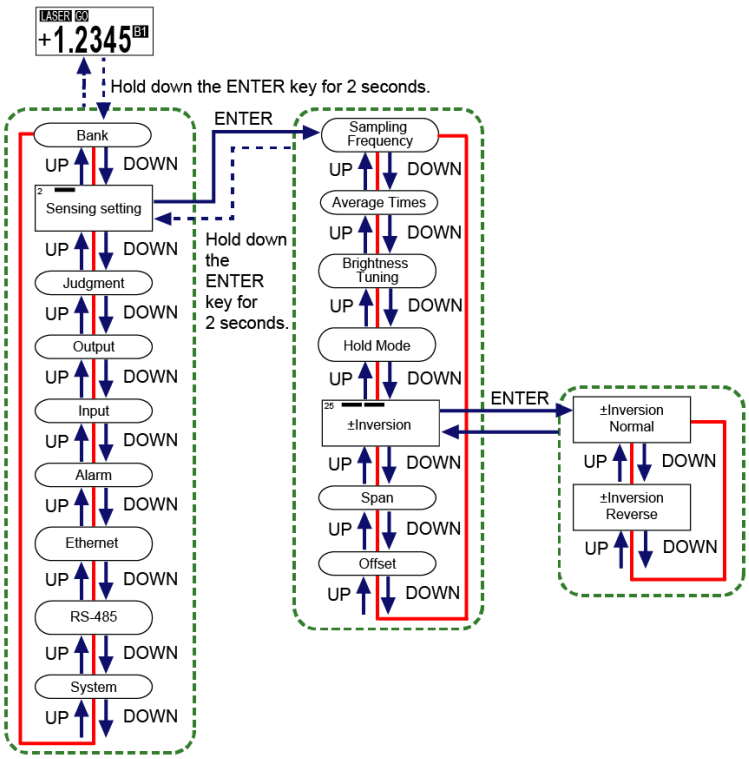
- In the following cases, the held value is initialized.
  - When the trigger input is turned OFF
  - When Measured value resetting is executed
  - When a setting change is made to cause the measured value to be in an indeterminate state
  - When "All Areas" is executed in Settings initialization

4.3.5 Inversion of Measured Value

■ Overview

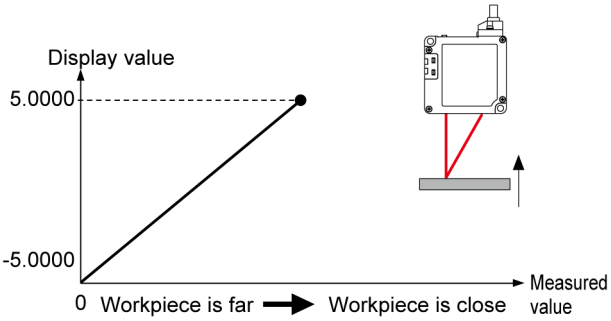
This is a function that reverses the positive / negative direction of the measured value. When set to "Reverse", only the positive/negative sign of the measured value is reversed.

■ Setting method

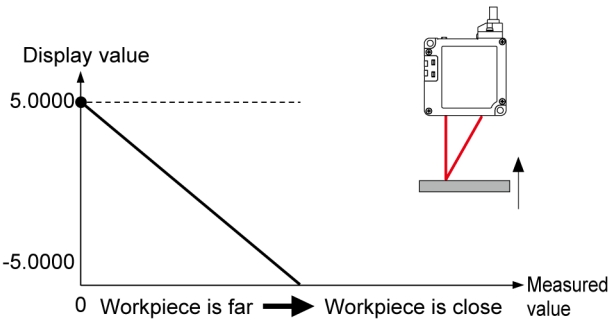


Note

- When set to "Normal", the measured value increases as the workpiece comes closer to this product.



- When set to "Reverse", the measured value decreases as the workpiece comes closer to this product.



- For the HIGH and LOW measurement values and the zero set correction value, changing the Inversion of Measured Value setting does not change the positive/negative sign.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
±Inversion	Normal	Normal
	Reverse	

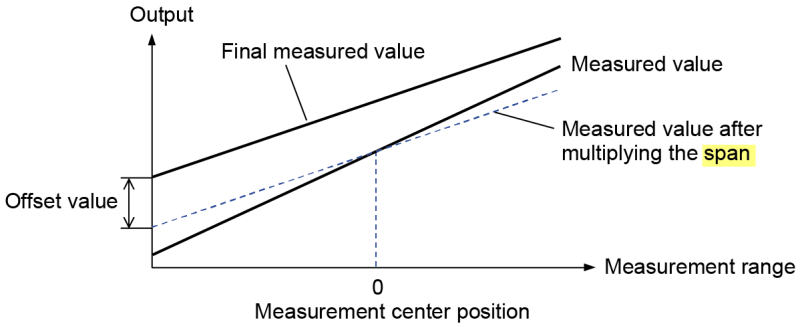
4.3.6 Span

■ Overview

This is a function that multiplies a span (factor) to the measured value after zero setting and outputs the result.

By adding an optionally set value as the offset, the value is output as the final measured value.

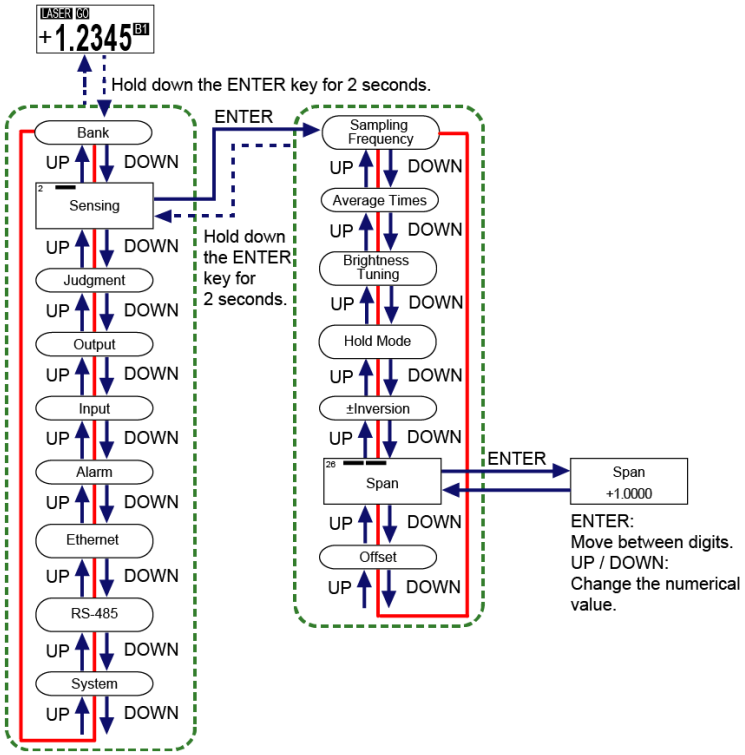
Final measured value = Span (factor) × Measured value (after zero setting) + Offset



Note

- For details on zero setting and offset, refer to"4.10 Zero Setting"and"4.3.7 Offset".

■ Setting method



Note

- The set value can be set in increments of 0.0001.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

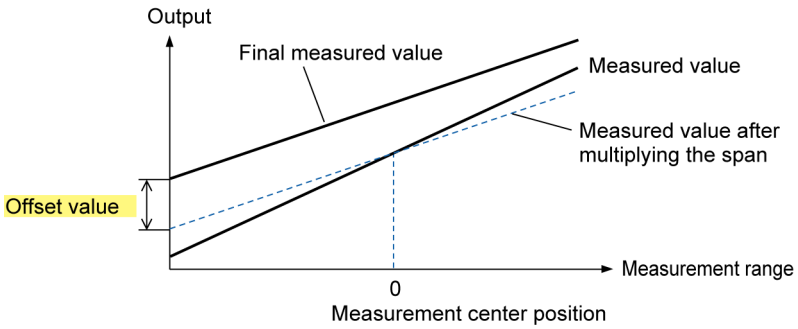
Setting item	Set value	Default value
Span	+0.1000 to +9.9999	+1.0000

4.3.7 Offset

■ Overview

This function is used to add or subtract an optional value to/from the measured value.
By multiplying a span (factor) to the measured value after zero setting and by adding an optionally set value as the offset, the value is output as the final measured value.

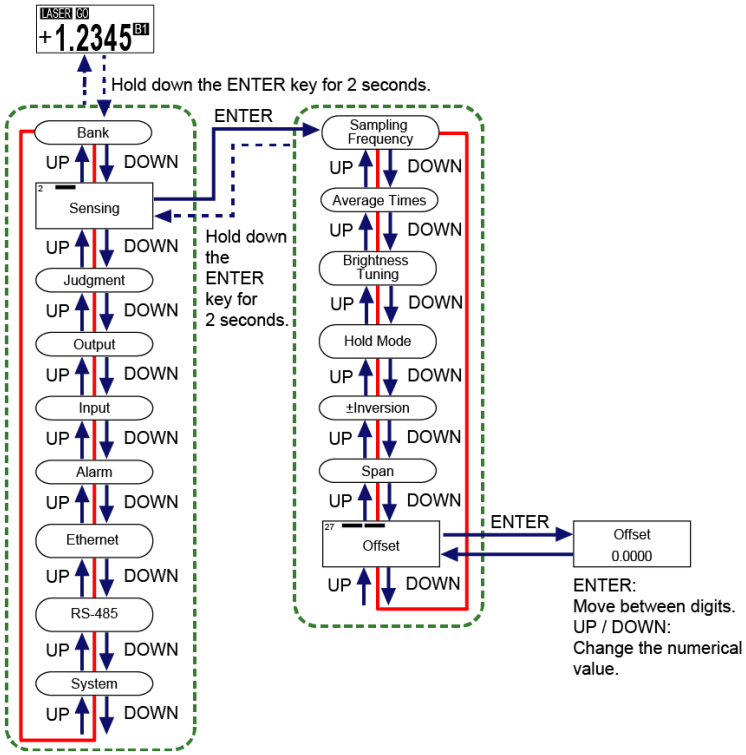
Final measured value = Span (factor) × Measured value (after zero setting) + Offset



Note

- For details on zero setting and span, refer to"4.10 Zero Setting"and"4.3.6 Span".

■ Setting method



Note

- The setting range varies depending on the distance type of this product.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit (sign).
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Distance type	Set value (mm)	Default value (mm)	Setting resolution (μm)
Offset	30 mm	-9.5000 to +9.5000	0.0000	0.1
	50 mm	-95.000 to +95.000		1
	85 mm			
	120 mm			
	250 mm	-950.00 to +950.00		10

4.4 Judgment Setting

■ Overview

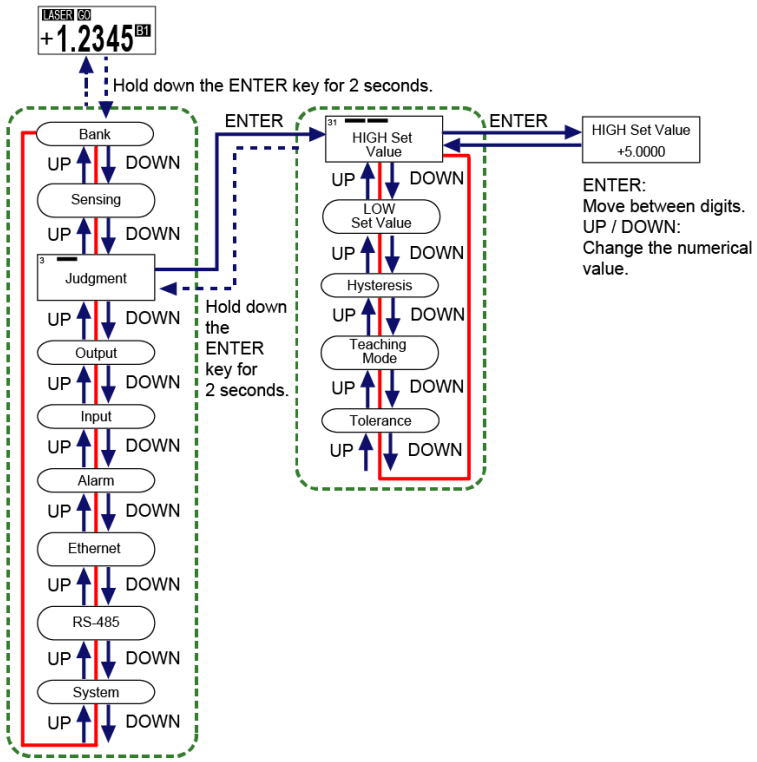
This is a function setting related to judgment results of the measured value.

4.4.1 HIGH Set Value

■ Overview

This function allows you to optionally set the upper limit value (HIGH set value) used to judge the measured value.
If the measured value exceeds the HIGH set value, the judgment is output as HIGH.

■ Setting method



- Be sure to set a HIGH set value that is greater than the LOW set value. If the value is not greater than the LOW set value, an error will occur.
- Set this so that the difference between the HIGH and LOW set values is more than twice the hysteresis. If set to not more than twice the hysteresis, an error will occur.

Note

- You can set HIGH and LOW set values by teaching.
  For details, refer to "4.4.4 Teaching Mode".
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.
- In internal processing, comparisons are performed in units of 0.01 μm or less. (Common to all distance types)

Setting item	Distance type	Set value (mm)	Default value (mm)	Setting resolution (μm)
HIGH set value	30 mm	-9.5000 to +9.5000	+5.0000	0.1
	50 mm	-95.000 to +95.000	+10.000	1
	85 mm		+20.000	
	120 mm		+30.000	
	250 mm	-950.00 to +950.00	+150.00	10

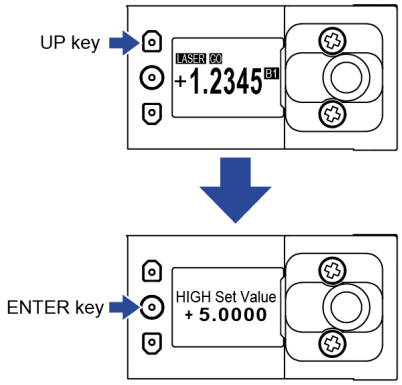
Setting a"HIGH set value"directly during measurement

■ Overview

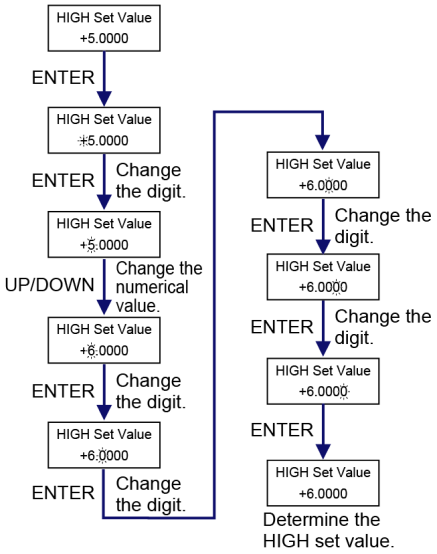
In addition to the method described in HIGH Set Value, you can also set a HIGH set value directly from the measurement display during measurement.

1 2 Procedure

1. Press the <UP> key in the measurement display, and HIGH set value is displayed at the top of the display and a set threshold value is displayed at the bottom.



2. Press the <ENTER> key to change the set value. Pressing the <UP>/<DOWN> key increases or decreases the value with the sign changed as needed. Pressing the <ENTER> key moves the digit position, and then pressing the <ENTER> key at the last digit determines the change to the set value.



Note

- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit (sign).

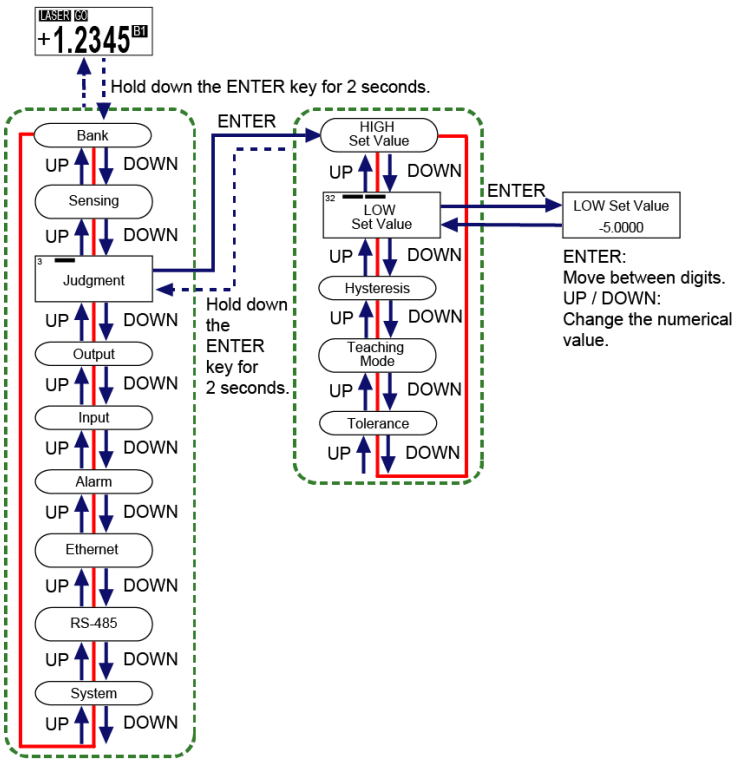
4.4.2 LOW Set Value

■ Overview

This function allows you to optionally set the lower limit value (LOW set value) used to judge the measured value.

If the measured value falls below the LOW set value, the judgment is output as LOW.

■ Setting method



- Be sure to set a LOW set value that is smaller than the HIGH set value. If the value is not smaller than the HIGH set value, an error will occur.
- Set this so that the difference between the HIGH and LOW set values is more than twice the hysteresis. If set to not more than twice the hysteresis, an error will occur.

Note

- You can set HIGH and LOW set values by teaching.
  For details, refer to "4.4.4 Teaching Mode".
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.
- In internal processing, comparisons are performed in units of 0.01 μm or less. (Common to all distance types)

Setting item	Distance type	Set value (mm)	Default value (mm)	Setting resolution (µm)
LOW set value	30 mm	-9.5000 to +9.5000	-5.0000	0.1
	50 mm	-95.000 to +95.000	-10.000	1
	85 mm		-20.000	
	120 mm		-30.000	
	250 mm	-950.00 to +950.00	-150.00	10

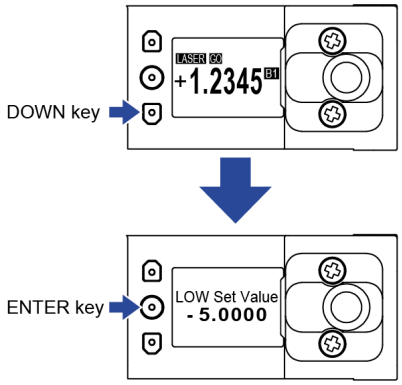
Setting a"LOW set value"directly during measurement

■ Overview

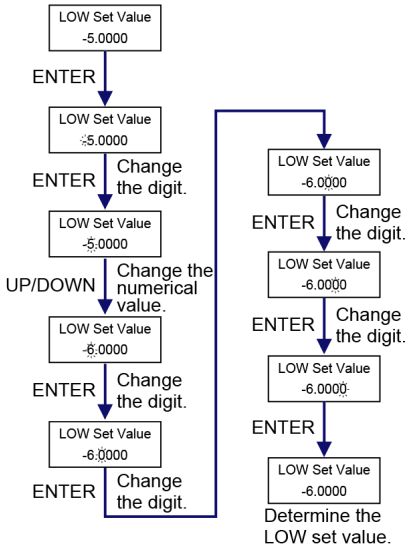
In addition to the method described in LOW Set Value, you can also set a LOW set value directly from the measurement display during measurement.

1 2 Procedure

1. Press the <DOWN> key in the measurement display, and LOW set value is displayed at the top of the display and a set value is displayed at the bottom.



2. Press the <ENTER> key to change the set value. Pressing the <UP>/<DOWN> key increases or decreases the value with the sign changed as needed. Pressing the <ENTER> key moves the digit position, and then pressing the <ENTER> key at the last digit determines the change to the set value.



Note

- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit (sign).

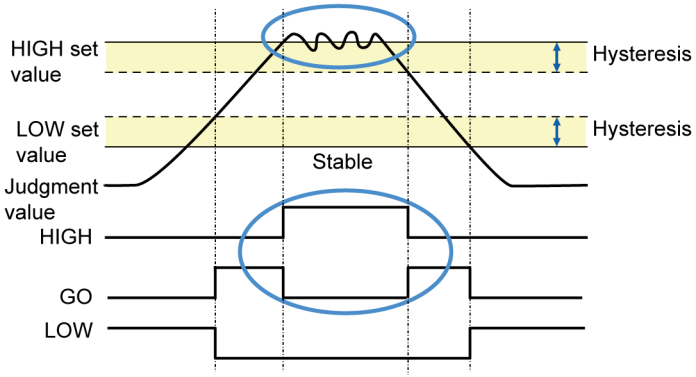
4.4.3 Hysteresis

■ Overview

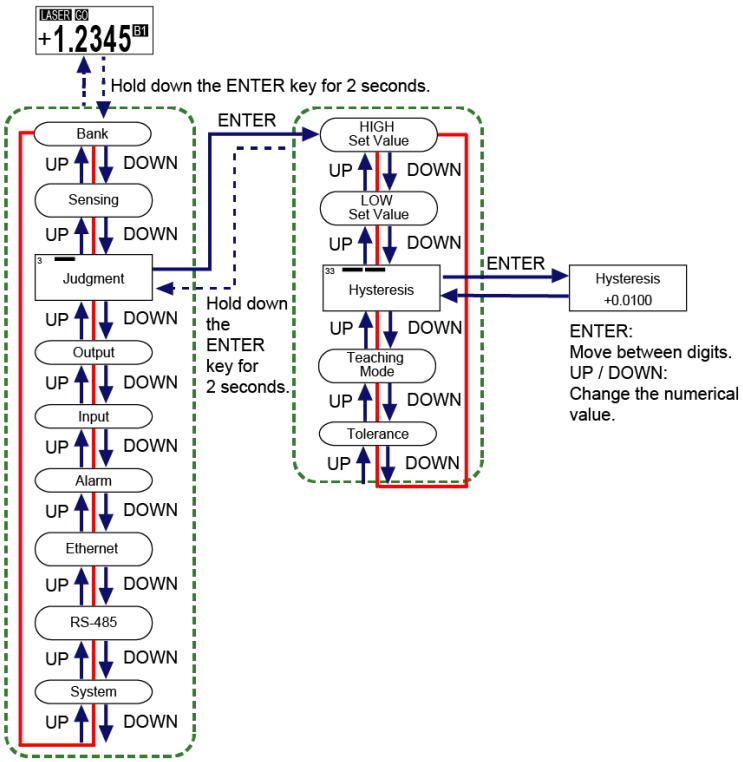
If the sensing object vibrates in the vicinity of the HIGH set value / LOW set value, the final measured value may fluctuate, resulting in unstable operation.

When a sensing workpiece is located near the HIGH set value / LOW set value, increasing the value of hysteresis makes output operations stable.

Fluctuates in the vicinity of HIGH set value or LOW set value.



■ Setting method



- Set this so that the difference between the HIGH and LOW set values is more than twice the hysteresis. If set to not more than twice the hysteresis, an error will occur.

Note

- The hysteresis setting range varies depending on the distance type of this product.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Distance type	Set value (mm)	Default value (mm)	Setting resolution (μm)
Hysteresis	30 mm	0 to +9.5000	+0.0100	0.1
	50 mm	0 to +95.000	+0.020	1
	85 mm		+0.040	
	120 mm		+0.060	
	250 mm	0 to +950.00	+0.30	10

4.4.4 Teaching Mode

■ Overview

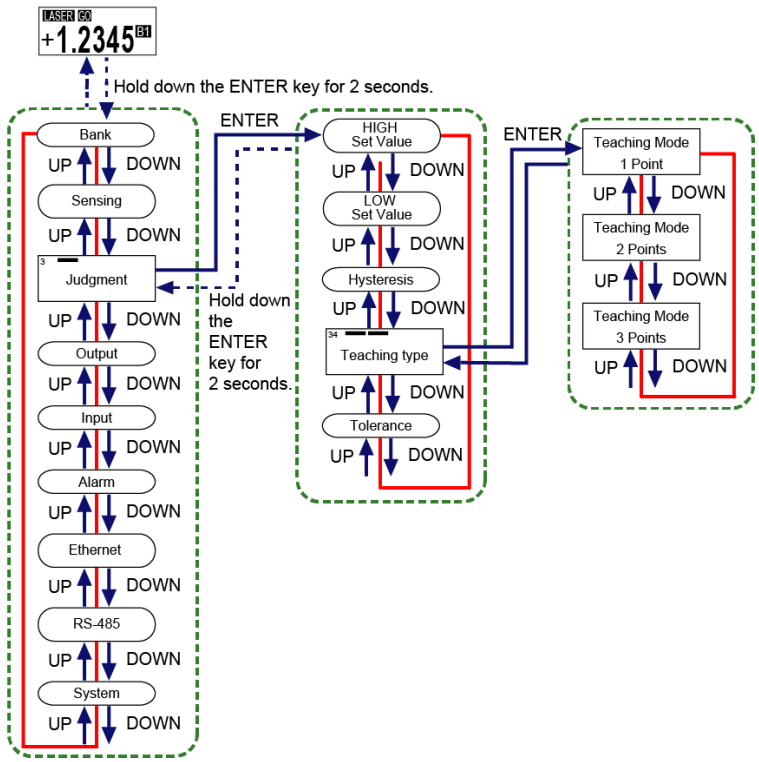
By teaching using a sensing object, you can automatically set HIGH and LOW set values.
You can select the teaching method from one of the following three types.

Set value	Operation	Reference page
1 point teaching	This method is to perform 1-point teaching on the distance from the reference plane of a sensing object and to set HIGH set value / LOW set value.	"4.9.1 1 point Teaching"
2 points teaching	This method is to perform teaching on the reference planes of two sensing objects and set the HIGH set value / LOW set value based on the measured results.	"4.9.2 2 points Teaching"
3 points teaching	This method is to perform teaching on the reference planes of sensing objects 1, 2, and 3 and set the HIGH set value / LOW set value based on the measured results.	"4.9.3 3 points Teaching"

Note

- For details on various teaching methods, refer to"4.9 1 point/2 points/3 points Teaching".

■ Setting method



Setting item	Set value	Default value
Teaching Mode	1 point	1 point
	2 points	
	3 points	

Note

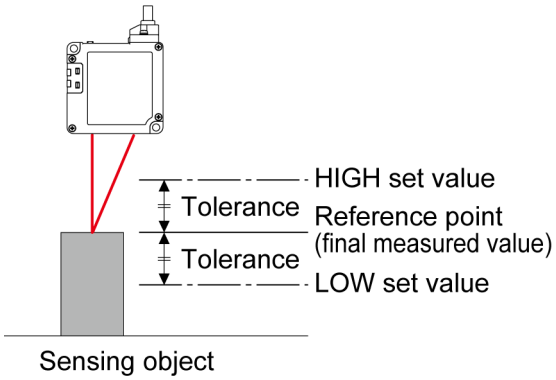
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

4.4.5 Tolerance

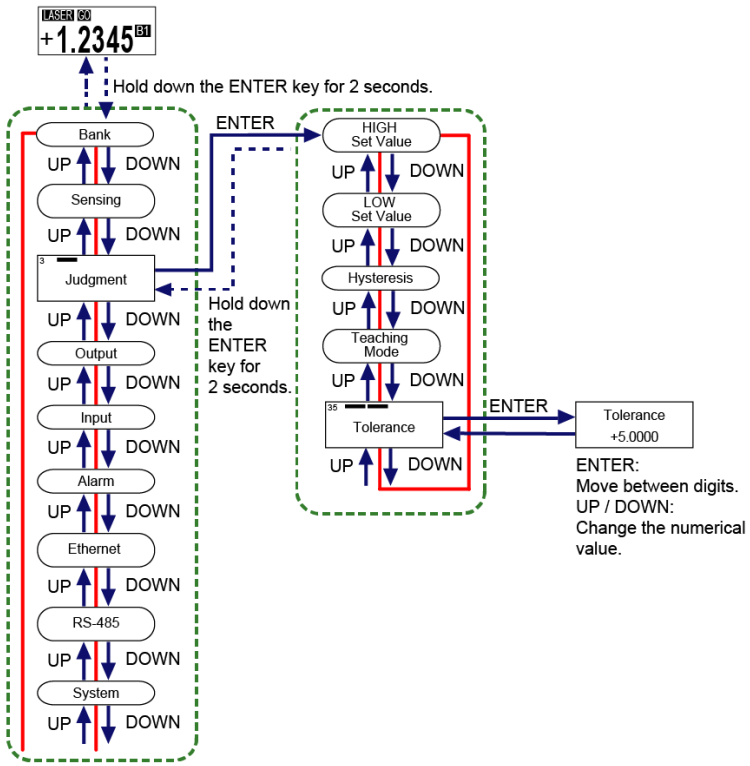
■ Overview

When 1-point teaching is performed, the measured value of the master workpiece plus the tolerance can be set as the HIGH set value and the measured value of the master workpiece minus the tolerance can be set as the LOW set value.

This is valid only when 1-point teaching is set.



■ Setting method



- Changing the tolerance setting does not update the HIGH and LOW set values. After changing the setting, execute 1-point teaching again.

Note

- You cannot set this to a value that is equal to or less than the hysteresis.
- Hysteresis can be set regardless of the tolerance value. Depending on the set value, 1-point teaching may fail.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Distance type	Set value (mm)	Default value (mm)	Setting resolution (µm)
Tolerance	30 mm	0.0001 to 9.5000	+2.0000	0.1
	50 mm	0.001 to 95.000	+5.000	1
	85 mm	0.001 to 95.000	+10.000	
	120 mm	0.001 to 95.000	+15.000	
	250 mm	0.01 to 950.00	+100.00	10

4.5 Output Setting

■ Overview

This is a function setting related to output operation.

4.5.1 Output Delay Timer Selection

■ Overview

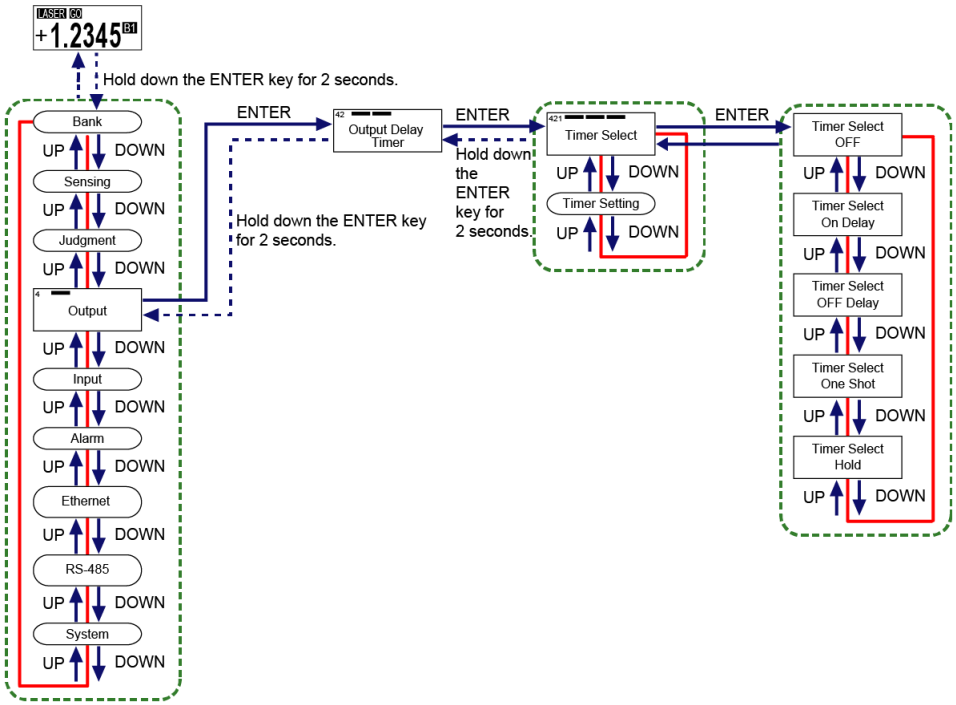
This setting is used to set the timing from ON to OFF or from OFF to ON for the measured value judgment result (HIGH / GO/ LOW).

Set value	Operation
OFF (No timer)	No change is made in the timing for the measured value judgment result.
On Delay	When the measured value judgment result is turned ON from OFF, the ON output is delayed for the timer's time.
Off Delay	When the measured value judgment result is turned OFF from ON, the OFF output is delayed for the timer's time.
One Shot	When the measured value judgment result is turned ON from OFF, the ON output is held for the timer's time and then OFF output is given.
Hold	The output signal is held for a period from when sensing is started to when the measured value reset input is turned ON.

Note

- When the output delay timer or timer's time is changed during output delay operation, the changed set value is reflected when the output is changed next time.

■ Setting method



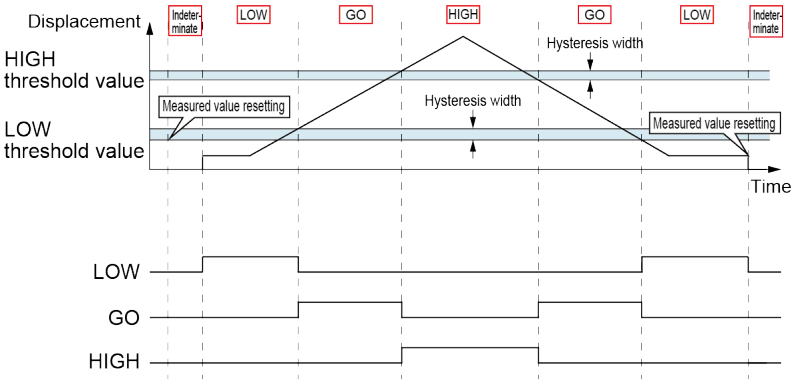
Note

- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Timer selection	OFF (No timer)	OFF (No timer)
	On Delay	
	Off Delay	
	One Shot	
	Hold	

OFF (No timer)

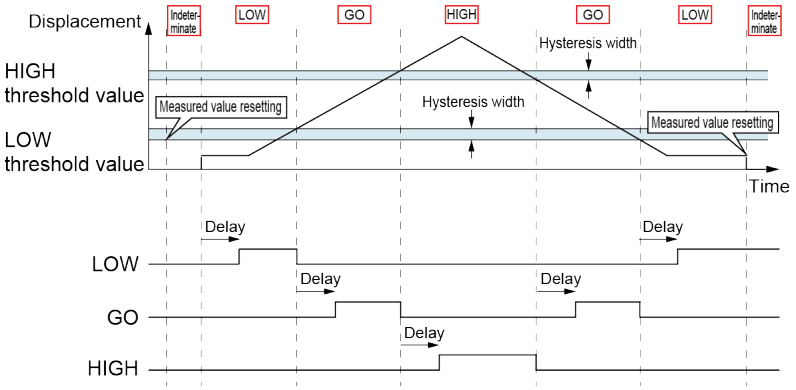
When set to"OFF (No timer)", the measured value judgment result will be as shown in the following diagram.



On Delay

When set to "On Delay", the output will be delayed for the timer's time from the time when the judgment result is turned ON.

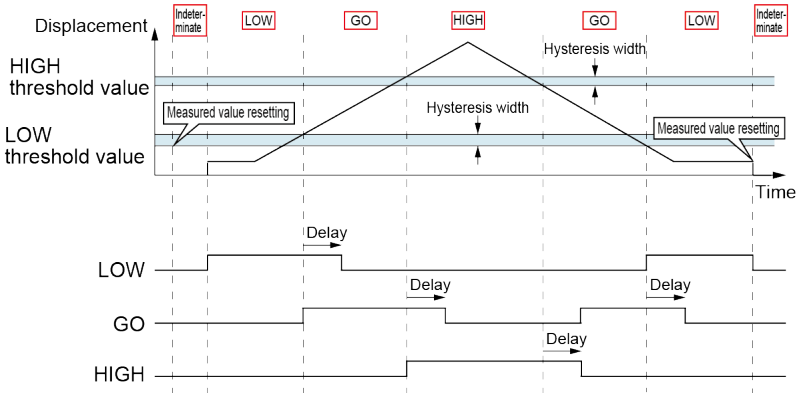
If the ON duration is less than the timer's time, the delay does not appear in the measured value judgment result.



Off Delay

When set to "Off Delay", the output will be delayed for the timer's time from the time when the judgment result is turned OFF.

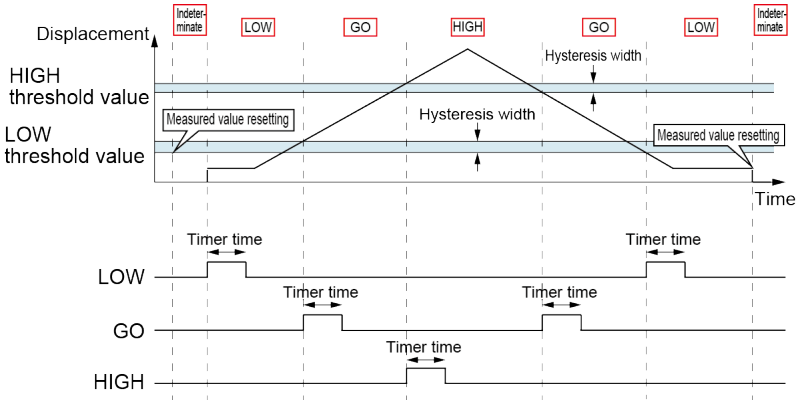
If the OFF duration is less than the timer's time, the delay does not appear in the measured value judgment result.



One Shot

When set to "One Shot", the the output will be generated for the timer's time.

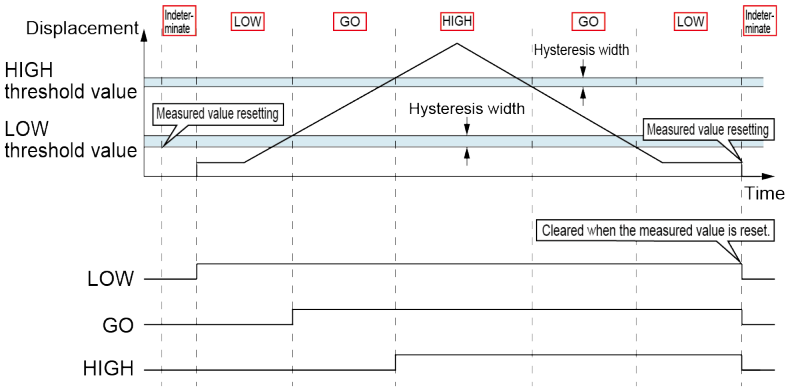
If the judgment result changes from OFF to ON again while the ON output is held, the ON time will not be extended because the change is not reflected in it.



Hold

When set to"Hold", the ON output will be held at the timing when the judgment result is turned ON.

Executing measured value resetting releases the hold state.

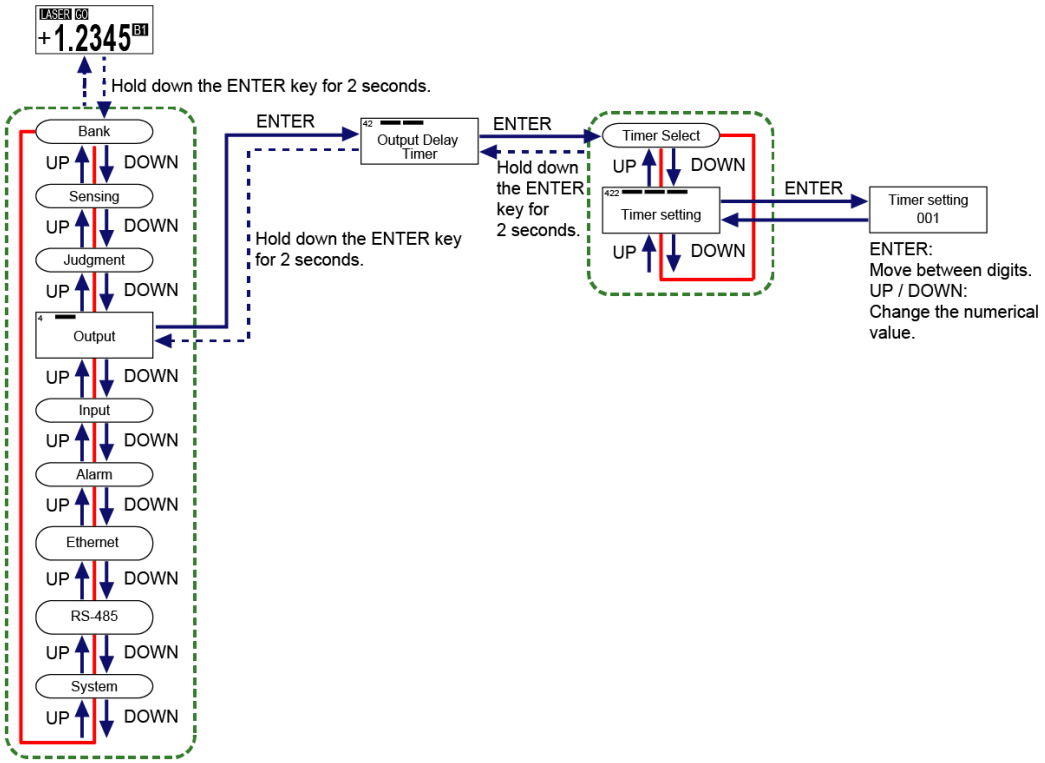

Displacement
Indeter-minate
LOW
GO
HIGH
GO
LOW
Indeter-minate
Hysteresis width
HIGH threshold value
Measured value resetting
Hysteresis width
LOW threshold value
Measured value resetting
Time
Cleared when the measured value is reset.
LOW
GO
HIGH

4.5.2 Output Delay Timer Setting

■ Overview

This setting is used to set the delay time in milliseconds for the delay timer selected in "4.5.1 Output Delay Timer Selection".

■ Setting method



Note

- The output delay timer setting is reflected only when "Off Delay", "On Delay", or "One Shot" is selected in Output delay timer selection.
  The output delay timer setting is not reflected when "OFF (No timer)" or "Hold" is selected.
- The set timer time value is shared by all output delay timer settings.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value (ms)	Default value (ms)
Timer Setting	1 to 100	1

4.6 Input Setting

■ Overview

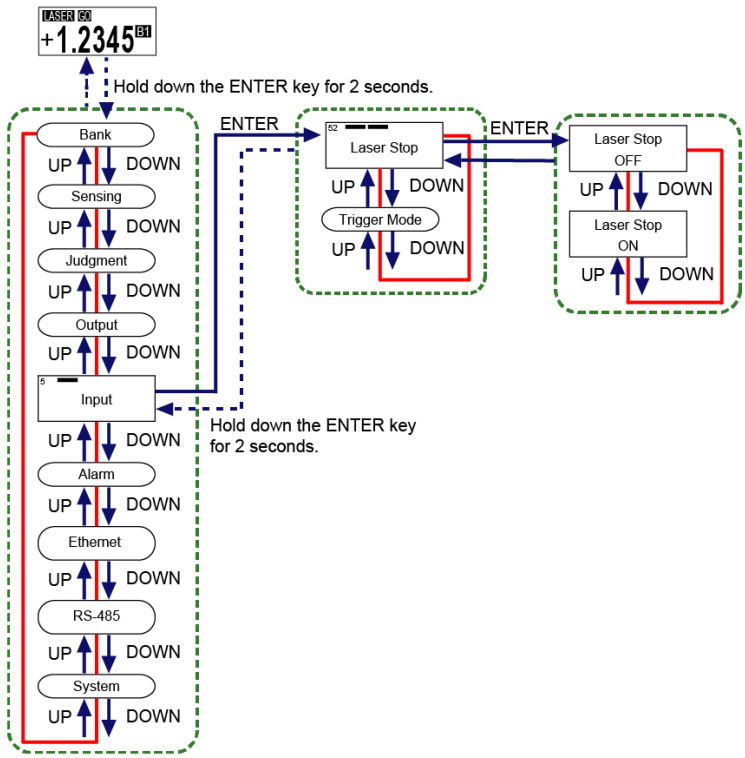
This is a function setting related to input operation.

4.6.1 Laser Stop

■ Overview

This is a function that switches ON and OFF the laser emission.
When the setting is OFF, laser will be emitted. When it is ON, laser emission will be stopped.

■ Setting method



Note

- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

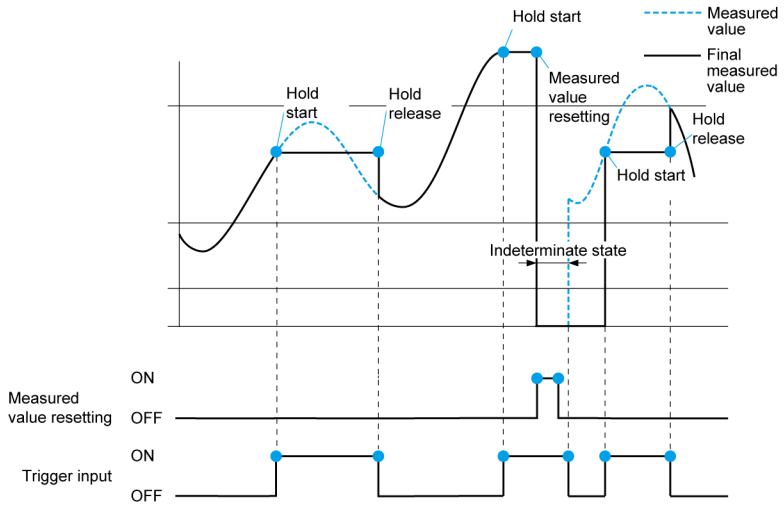
Setting item	Set value	Default value
Laser Stop	OFF (Laser emitted)	OFF
	ON (Emission stopped)	

4.6.2 Trigger Mode

The following describes a method to hold the final measured value using a trigger input.
This mode can be selected from the following two types: "Hold" or "One Shot".

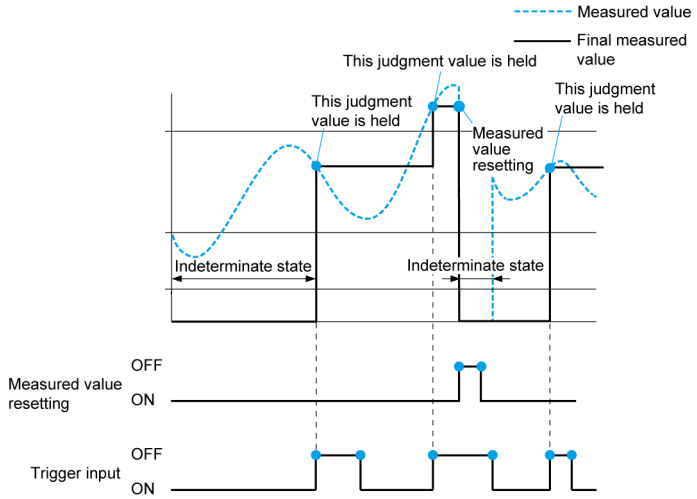
■ Hold

If trigger input turns ON, this function holds the final measured value while the input is ON.

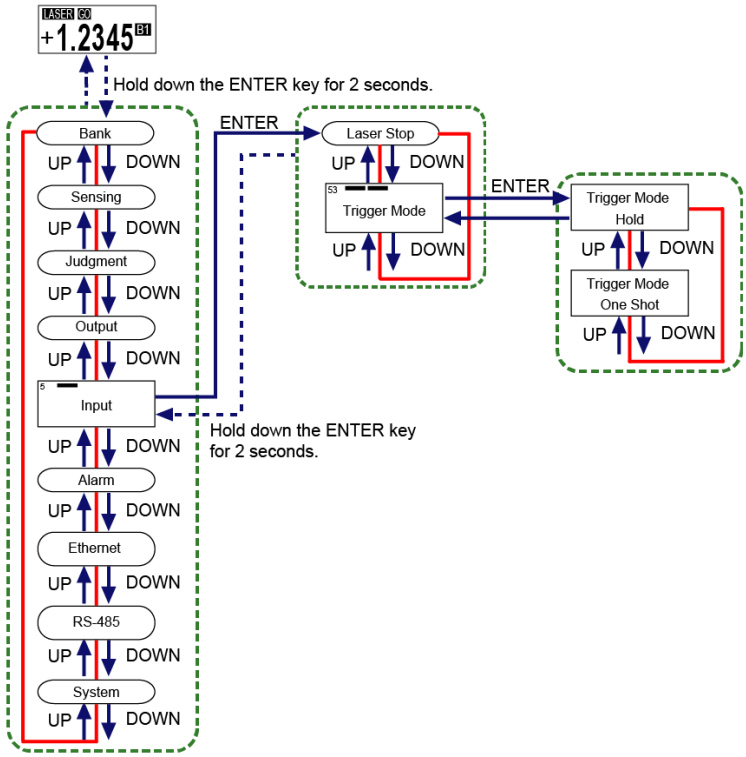


■ One Shot

Each time trigger input turns ON (rising edge), this function updates and holds the final measured value.



■ Setting method



Note

- Trigger mode can be set to "One Shot" only when "None (Normal mode)" is selected in Hold mode.
- The hold releasing conditions are as follows.
  - When a setting change is made to cause the measured value to be in an indeterminate state
  - When "All Areas" is executed in Settings initialization
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Trigger Mode	Hold	Hold
	One Shot	

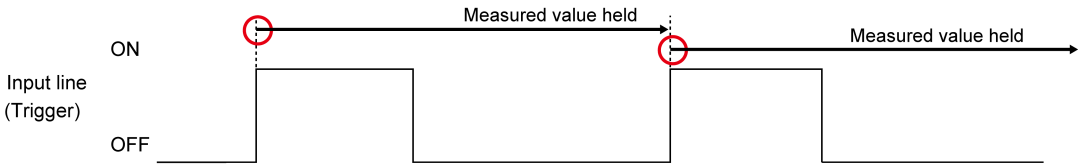
Trigger input by input line

■ Timing chart for trigger input

● Hold

* When set to Hold, measured values are held only when trigger input is ON.

● One Shot



* When set to One Shot, measured value being held is refreshed when trigger turns ON.

Stop ● Do not use trigger input by I/O line and trigger input by communication at the same time.

● Trigger input by "IN1 (trigger input)" on the Input line must be continued for at least 2 ms.

Note

- The trigger input can also be set by using external communications. For details, refer to "5 External Communication Control (Ethernet)" or "6 External Communication Control (RS-485)".
- When settings initialization, bank switching, or bank copy is executed, the trigger input by a communication command is cleared.
- When Trigger Mode is changed, the trigger set by the communication command is cleared and the measured value is set to an indeterminate value.

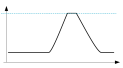
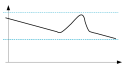
4.7 Alarm Setting

■ Overview

The alarm setting provides function settings related to data processing in an unmeasurable state.

Unmeasurable state refers to a state where the light receiving waveform of CMOS does not allow for correct calculation of measured values.

The types of unmeasurable states are as shown below.

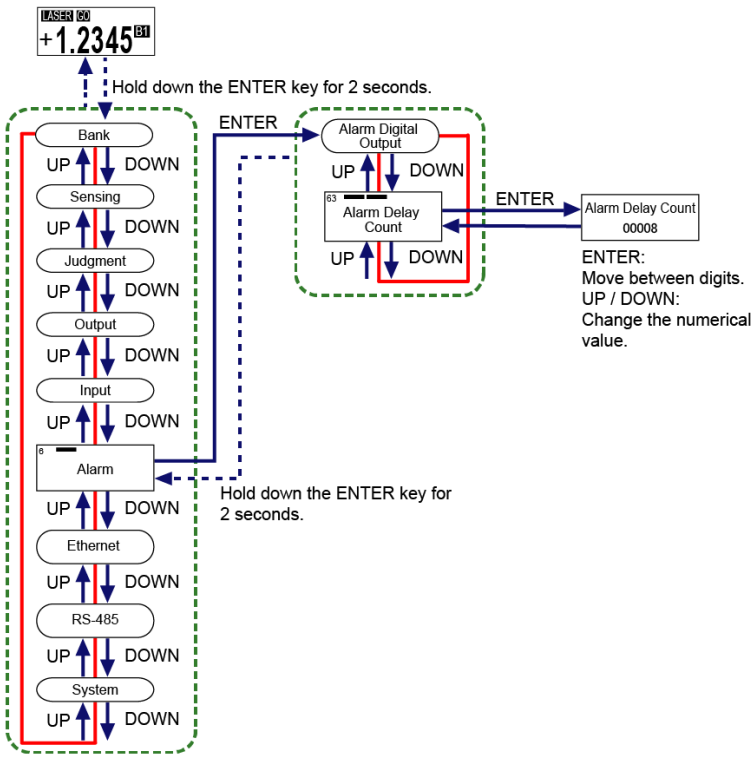
Type of unmeasurable state	Description
Excessive intensity of received light	Intensity of received light is saturated. 
Insufficient intensity of received light	Intensity of received light is insufficient.
Excessive extraneous light	Extraneous light is excessive. 

4.7.1 Alarm Delay Count

■ Overview

You will be notified of an alarm if an unmeasurable state is detected. This function allows you to delay the notification until the set sampling count is reached. While an alarm is being delayed, the last measured value is held.

■ Setting method



Setting item	Set value	Default value
Alarm delay count	0: Alarm notification OFF	8
	1 to 65535 (times)	

Note

- If you set the alarm delay count to “0”, the alarm notification is turned OFF.
- The delay time is calculated by multiplying the alarm delay count by the sampling cycle.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.
- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

4.7.2 Alarm Digital Output

■ Overview

This function allows you to set the digital output operation at alarm occurrence (measured value display, measured value reference by communication).

An alarm will be output if an unmeasurable state continues for more than the sampling count set in "4.7.1 Alarm Delay Count".

Set value	Output result
Hold	The previous measured value will be displayed.(Note 1)
Alarm	"ALARM" will be displayed on the display section.

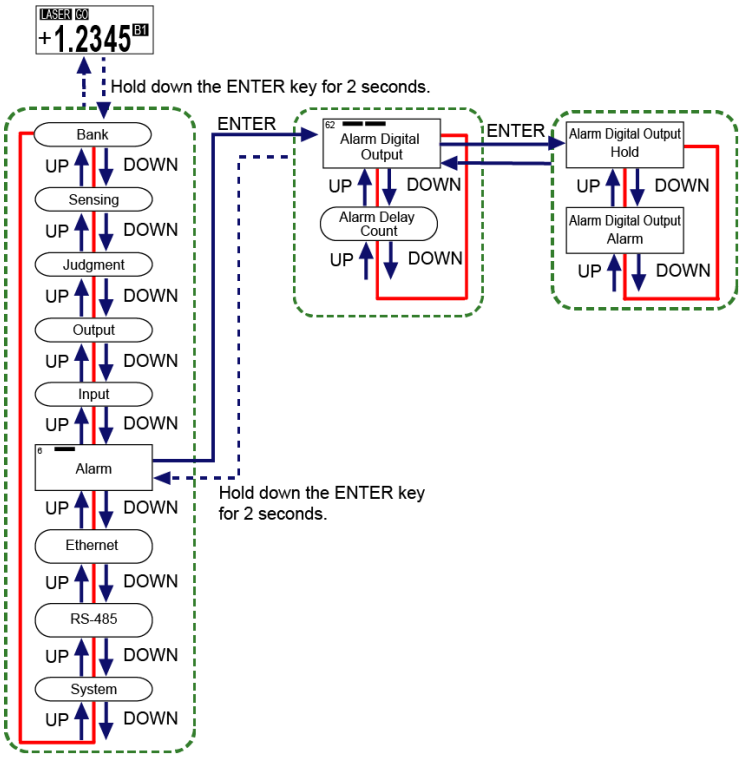
(Note 1) If the set value of Alarm digital output is changed in an unmeasurable state, ---- will be displayed continuously on the display section. Clear the unmeasurable state to return to the normal measured value.

■ Output result of communication

Depending on the setting conditions, the output result will be as shown below.

		Display section	Communication output
Normal state	HIGH set value < Measured value	Measured value	Measured value
	LOW set value ≤ Measured value ≤ HIGH set value	Measured value	Measured value
	Measured value < LOW set value	Measured value	Measured value
Alarm state	Alarm digital output setting: Hold	Previous measured value	Previous measured value
	Alarm digital output setting: Alarm	ALARM	+9,999,999
Indeterminate state	–	----	-9,999,999

■ Setting method



Note

- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Alarm digital output	Hold	Hold
	Alarm	

4.8 System Setting

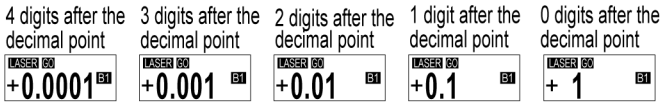
■ Overview

This is a function setting related to the system settings such as initialization and display language.

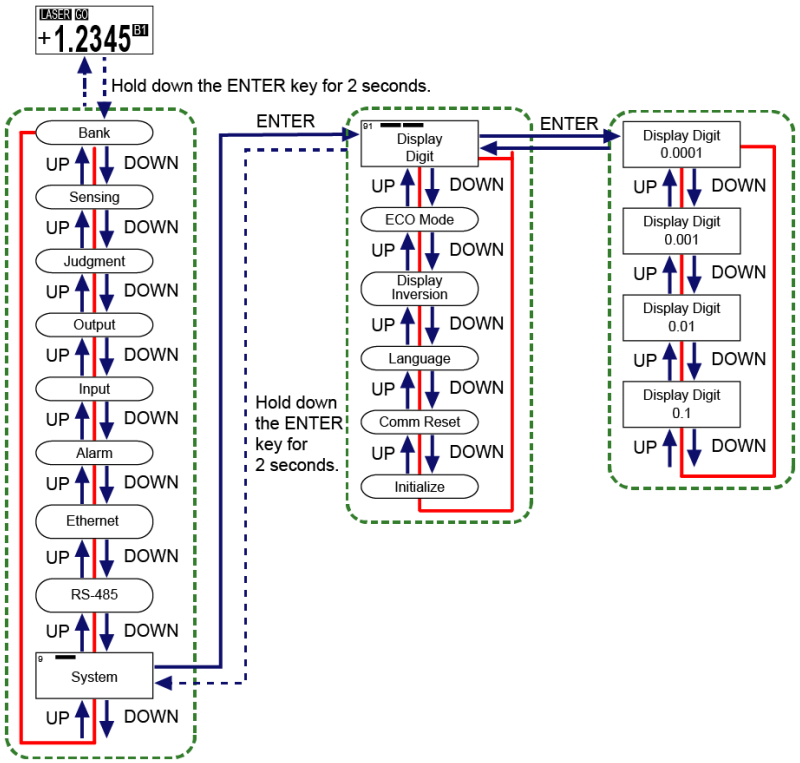
4.8.1 Display Digit

■ Overview

This function allows you to switch the number of digits after the decimal point on the display section.



■ Setting method



Note

- Any numbers after the specified number of digits displayed are rounded down.
- Teaching may fail or errors may occur in measured value judgment results or calculation results due to the digits after the decimal point that are not displayed depending on the product type or settings.
- This function only applies to measured values that are displayed on the measurement display.

  It does not apply to the measured values displayed during teaching, HIGH set value / LOW set value, etc.
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Distance type	Set value	Default value
Display digit	30 mm	4 digits (0.0001) 3 digits (0.001) 2 digits (0.01) 1 digit (0.1)	4 digits (0.0001)
	50 mm	3 digits (0.001) 2 digits (0.01) 1 digit (0.1) 0 digits (1)	3 digits (0.001)
	85 mm		
	120 mm		
	250 mm	2 digits (0.01) 1 digit (0.1) 0 digits (1)	2 digits (0.01)

4.8.2 ECO Mode

■ Overview

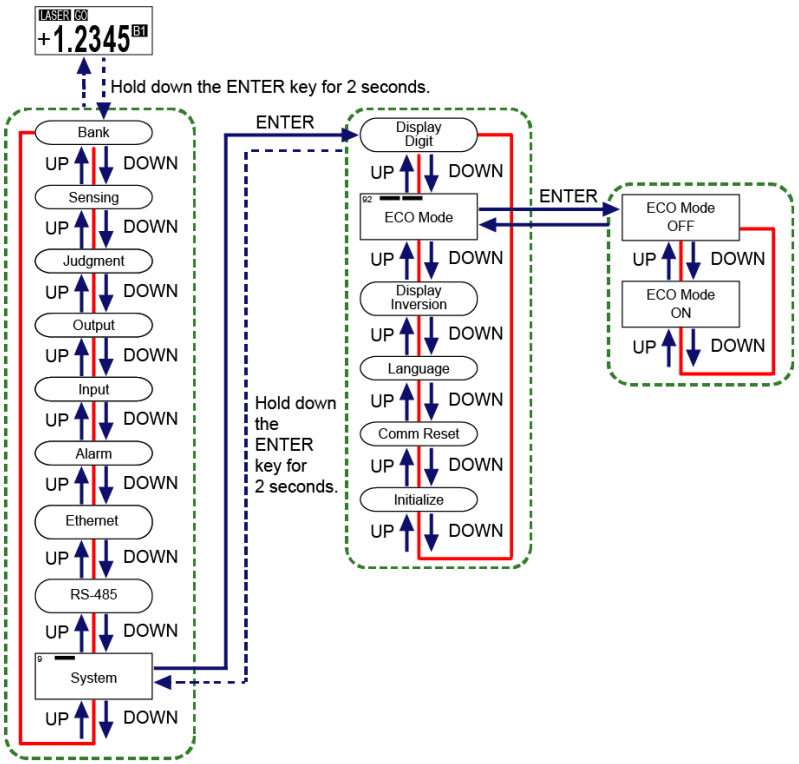
By setting the Eco mode to ON to turn OFF the display section except when operating the product, you can extend the life of the display section.

If the Eco mode is set to ON, the display section will turn OFF when no key is operated for 180 seconds.

If the Eco mode is set to OFF, the display brightness of the display section will decrease when no key is operated for 180 seconds and then blink every 5 seconds.

If you press any key while the display section is OFF (Eco mode: ON) or the brightness has decreased (Eco mode: OFF), it turns ON again at normal brightness.

■ Setting method



Note

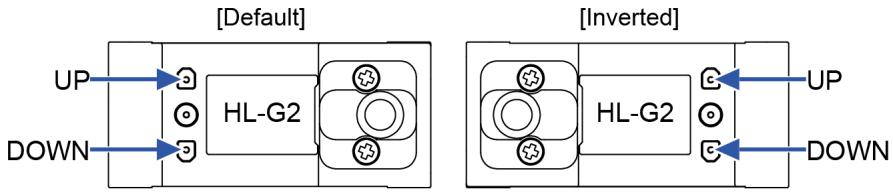
- It is not possible to return to normal brightness by sending a communication command. (Excluding the case where the Eco mode setting is changed)
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
ECO mode	OFF	ON
	ON	

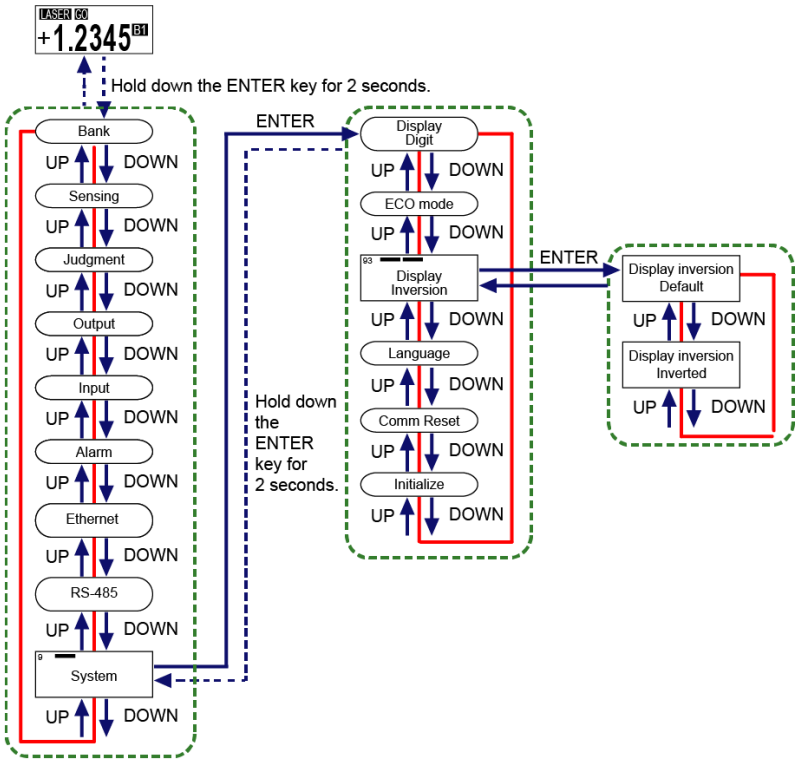
4.8.3 Display Inversion

■ Overview

The display on the display section can be inverted upside down. When the display is inverted, the positions of the <UP> and <DOWN> keys are swapped.



■ Setting method



Note

- Hold down the <ENTER> key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

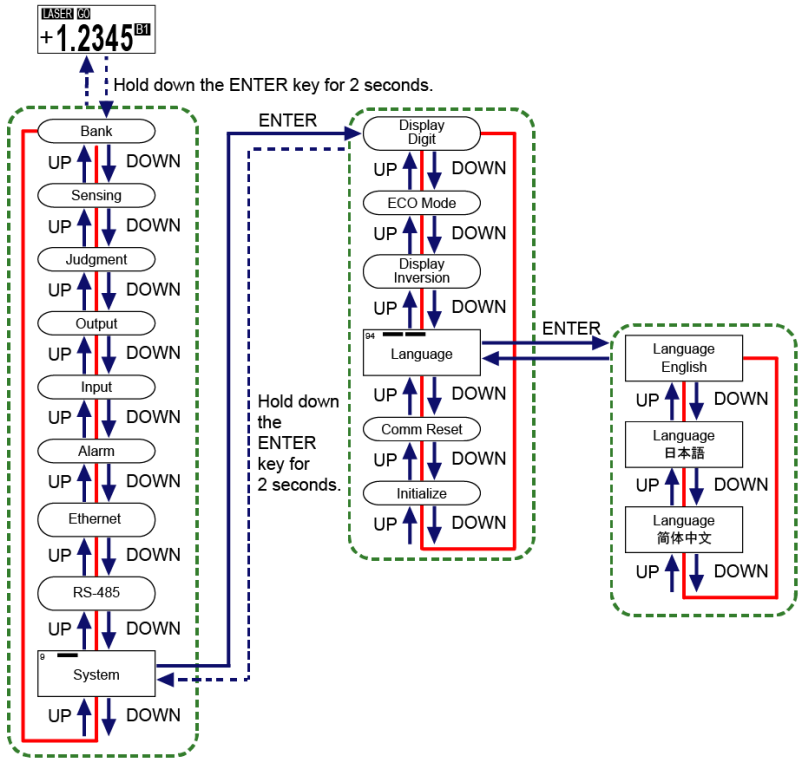
Setting item	Set value	Default value
Display inversion	Default	Default
	Inverted	

4.8.4 Language Setting

■ Overview

This function allows you to change the language to be displayed on the display section.

■ Setting method



Note

- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

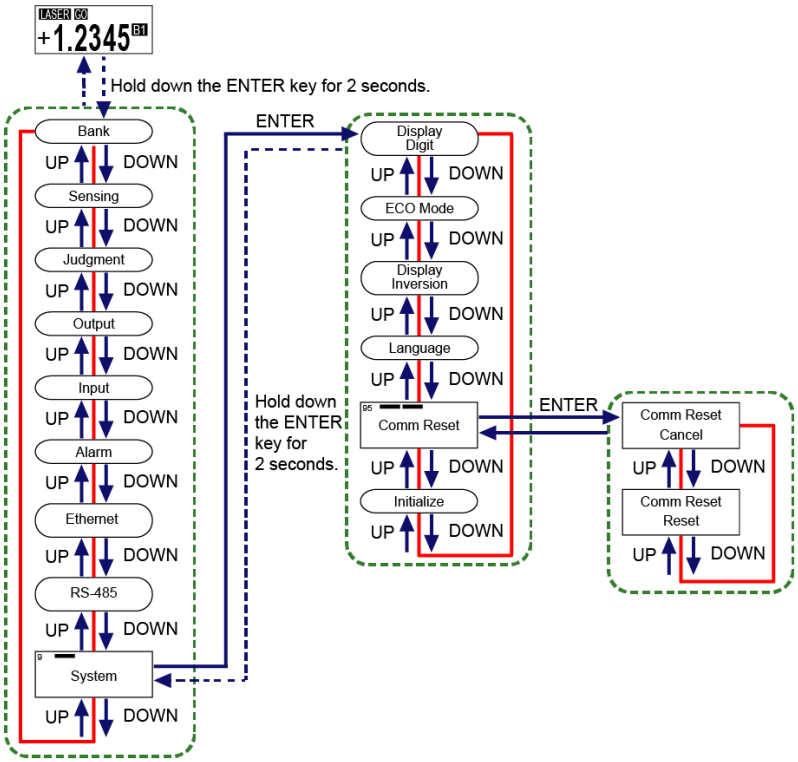
Setting item	Set value	Default value
Language	English	English
	Japanese	
	Simplified Chinese	

4.8.5 Resetting Communication Settings

■ Overview

This function is used to reflect the Ethernet or RS-485 settings.

■ Setting method



Note

- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

Setting item	Set value	Default value
Comm Reset	Cancel	—
	Reset	

4.8.6 Settings Initialization

■ Overview

This function allows you to initialize each setting.

Initialization method	Operation
Bank1	Initializes the settings of Bank 1.
Bank2	Initializes the settings of Bank 2.
Bank3	Initializes the settings of Bank 3.
Bank4	Initializes the settings of Bank 4.
All Banks	Initializes the settings of Bank 1 to Bank 4.
All Areas	Initializes all settings except the language setting, NPN/PNP setting, and RS-485/Ethernet communication setting.
Set value initialization	Initializes all settings except RS-485/Ethernet communication setting.

■ Types of initialized setting items

Major setting item	Setting item	Specified Bank/ ALL Bank	All Areas	Set value initialization
Sensing setting	Sampling Frequency	○	○	○
	Average Times	○	○	○
	Brightness Tuning	○	○	○
	Hold Mode	○	○	○
	Inversion of Measured Value	×	○	○
	Span	○	○	○
	Offset	○	○	○
Judgment setting	HIGH set value	○	○	○
	LOW set value	○	○	○
	Hysteresis	○	○	○
	Teaching type	○	○	○
	Tolerance	○	○	○
Output setting	Output Delay Timer Selection	○	○	○
	Output Delay Timer Setting	○	○	○
Input setting	Laser Stop	×	○	○
	Trigger Mode	○	○	○
Alarm setting	Alarm Digital Output	○	○	○
	Alarm Delay Count	○	○	○
System setting	Display Digit	○	○	○
	ECO Mode	×	○	○
	Display Inversion	×	○	○
	Language Setting	×	×	○

Major setting item	Setting item	Specified Bank/ ALL Bank	All Areas	Set value initialization
System setting	Bank	×	○	○
	NPN/PNP	×	×	○
	Key Lock	×	○	○
	Zero Setting	○	○	○
	Ethernet Communication Setting	×	×	×
	EtherNet/IP Encapsulation Inactivity Timeout	×	○	○
	RS-485 Communication Setting	×	×	×

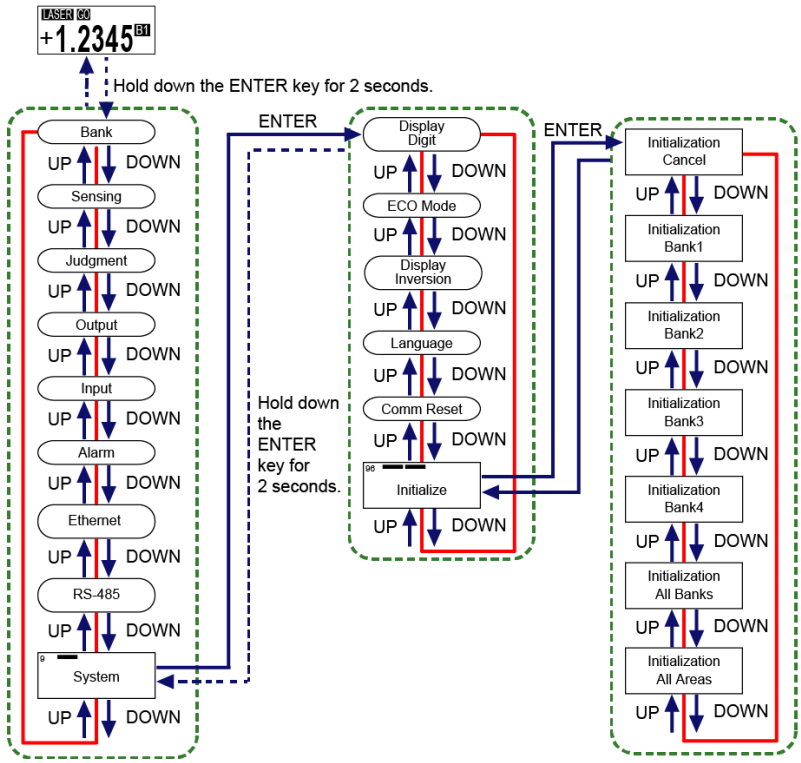
(Note 1) ○: Initialized, ×: Not initialized

- For the following setting methods, refer to the User's Manual of the **HL-G2 Configuration Tool** software.

Major setting item	Setting item	Specified Bank/ ALL Bank	All Areas	Set value initialization
Setting settable only from **HL-G2 Configuration Tool**	Label	×	○	○
	Automatic writing after starting	×	○	○
	Write interval	×	○	○
	Request destination IP address	×	×	×
	Request destination port No.	×	×	×
	Request destination processor number	×	×	×
	Request destination network number	×	×	×
	Request destination station number	×	×	×
	Request source port No.	×	×	×
	Starting register No.	×	○	○
	Transmission parameter	×	○	○
	Port No.	×	×	×

(Note 1) ○: Initialized, ×: Not initialized

■ Setup method (Bank 1 to Bank 4, All Banks, All Areas)



Note

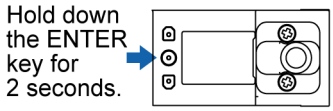
- Priority is given to initialization if any key operation or external input is performed while initialization is being executed.
- Both "Ethernet communication settings" and "RS-485 communication settings" are excluded from initialization.

  Manually return to initial values for these settings.
- Hold down the<ENTER>key for 2 seconds on the setting screen, and the setting change is suspended and the screen returns to the previous display.

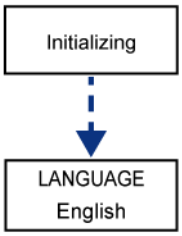
Setting item	Set value	Default value
Initialize	Cancel (No setting)	—
	Bank1	
	Bank2	
	Bank3	
	Bank4	
	All Banks	
	All Areas	

■ Setting method (Set value initialization)

To execute Set value initialization, turn on the power while holding down the <ENTER> key for 2 seconds or more.



While Set value initialization is being executed, "Initializing" appears for 2 seconds. Then, the display changes to the Language setting screen.



4.9 1 point/2 points/3 points Teaching

■ Overview

This method is used to set the HIGH set value and LOW set value using one or more sensing objects.

- When performing teaching, it is necessary to set a teaching type in advance.
  For details on setting the teaching type, refer to "4.4.4 Teaching Mode".

- In the following case, teaching cannot be started.
  - Hold mode is set to other than "None (Normal mode)".

Note

- In the following cases, teaching will fail.
  - Alarm state
  - Indeterminate state
  - The measured value is +OVER or -OVER displayed.
  - Hold state (In this case, the state changes to indeterminate state after execution of teaching.)
  - When the measured value is the same at multiple points
  - When the calculated HIGH set value / LOW set value does not meet "(HIGH set value - LOW set value) > hysteresis × 2"
- The HIGH and LOW set values saved in teaching are set according to the setting resolution of the product, where any numbers less than the resolution are internally processed as 0.

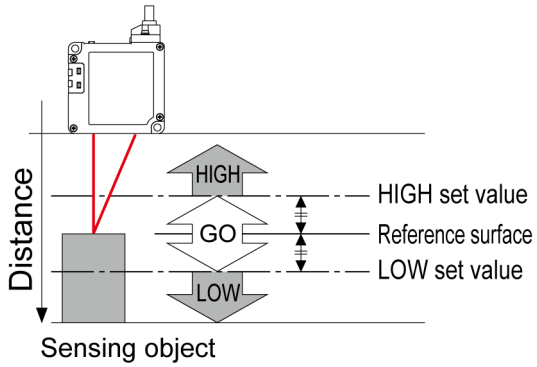
Settings	Operation	Reference page
1 point teaching	This method is to perform 1 point teaching on the distance from the reference plane of a sensing object and to set HIGH set value / LOW set value.	"4.9.1 1 point Teaching"
2 points teaching	This method is to perform teaching on the reference planes of two sensing objects and set the HIGH set value / LOW set value based on the measured results.	"4.9.2 2 points Teaching"
3 points teaching	This method is to perform teaching on the reference planes of sensing objects 1, 2, and 3 and set the HIGH set value / LOW set value based on the measured results.	"4.9.3 3 points Teaching"

4.9.1 1 point Teaching

■ Overview

This method is to perform teaching on sensing objects and set the value obtained by adding the tolerance to the teaching result as the HIGH set value and the value obtained by subtracting the tolerance from the teaching result as the LOW set value.

- When performing 1 point teaching, it is necessary to set the tolerance in advance. For details on setting the tolerance, refer to "4.4.5 Tolerance".

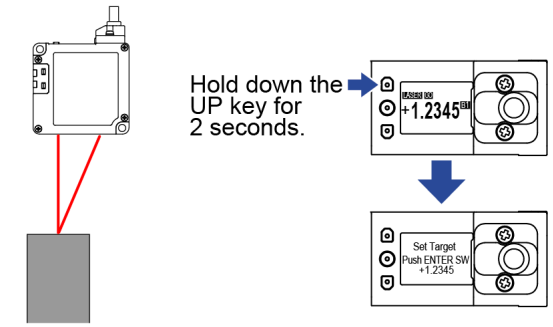


Note

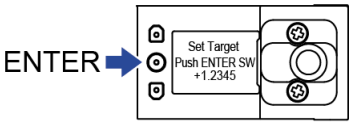
- If the value obtained by adding the tolerance to the reference plane exceeds the setting range of the HIGH set value, the HIGH set value is the maximum value in the setting range.
- If the value obtained by subtracting the tolerance from the reference plane falls below the setting range of the LOW set value, the LOW set value is the minimum value in the setting range.

Procedure

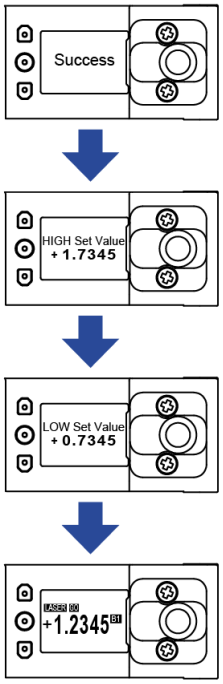
1. Set Teaching type to "1 point teaching".
2. On the measurement display, insert the sensing object and hold down the <UP> key for 2 seconds. Confirm that a message saying "Set Target - Push ENTER SW" is displayed at the top of the display. The display changes to the 1st point input screen.



3. Press the<ENTER>key. Teaching will be executed.

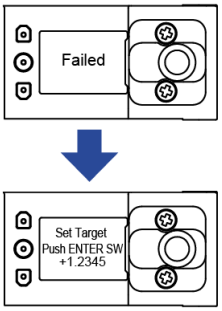


4. When teaching is completed, "Success" is displayed on the display section. Then, the newly set HIGH set value and LOW set value are displayed in sequence, and the display returns to the measurement display.



(Note 1) The HIGH set value and LOW set value are those when the tolerance is set to 0.5000.

5. If the measured value is in an alarm state, etc.,"Failed"is displayed as the result of teaching. Re-examine positional relationship among the sensing objects and perform teaching again.


Failed
Set Target
Push ENTER SW
+1.2345

1 point teaching using external communication

This section describes how to execute 1 point teaching using communication commands from an external host device.

- Execute teaching on the measurement display.

- During the execution of teaching using communication commands, do not write data to other setting information.

Procedure

1. Using a communication command from an external host device, set "Teaching type" to "1: 1 point teaching".
2. Confirm that "Teaching execution state" is set to "0: Not executed".
3. Insert the sensing object and set "Execution of teaching" to "1: Start teaching". "Teaching execution state" changes to "1: Being executed".
4. Confirm that the measured value that you want to use as the reference value has been obtained, and set "Teaching 1st point setting" to "0: Execute".
5. If teaching is "successful", "Teaching execution state" changes to "2: Success" and the HIGH and LOW set values are set newly. Confirm that the set values have been updated.
6. If teaching "fails", "Teaching execution state" changes to "3: Failed" and the HIGH and LOW set values remain unchanged.
   Re-examine positional relationship among the sensing objects and perform teaching again.

Note

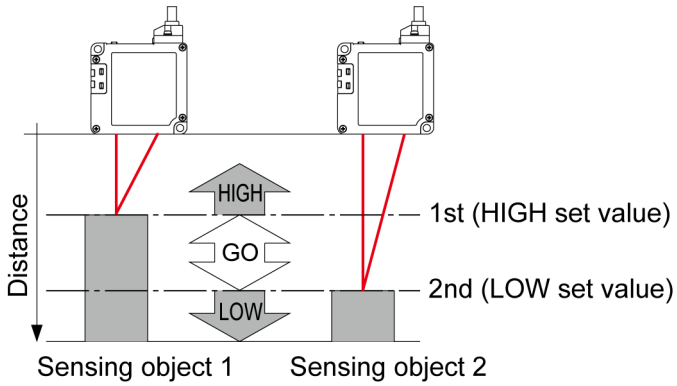
- Screen transition by operating switches on this product is not possible during the execution of teaching using communication commands.
- The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

4.9.2 2 points Teaching

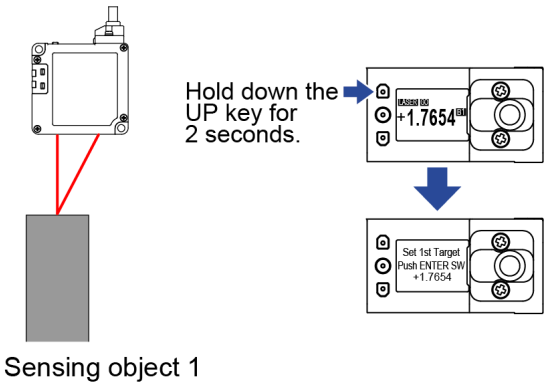
■ Overview

Measure two workpieces and set the higher final measured value to the HIGH set value and the lower final measured value to the LOW set value.

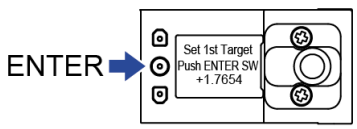


1 2 Procedure

1. Set Teaching type to "2 points teaching".
2. On the measurement display, insert the 1st sensing object.
3. With the 1st sensing object inserted, hold down the<UP>key for 2 seconds. Confirm that a message saying"Set 1st Target - Push ENTER SW"is displayed at the top of the display. The display changes to the 1st point input screen.

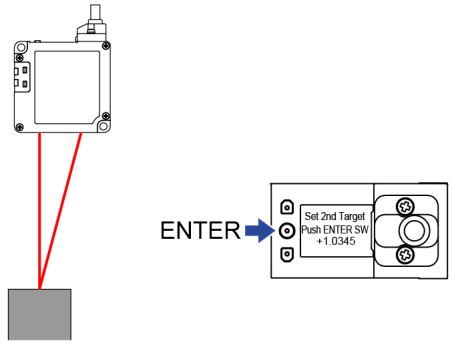


4. Press the<ENTER>key. Teaching for the 1st point is executed.



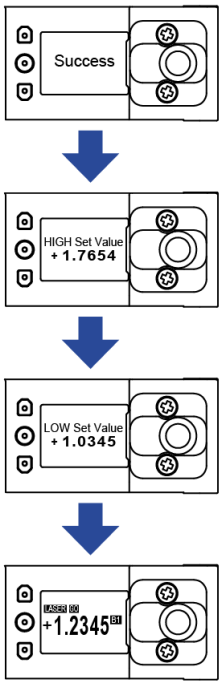
5. Confirm that a message saying"Set 2nd Target and Push ENTER SW"is displayed at the top of the display. The display changes to the 2nd point input screen.

With the 2nd sensing object inserted, press the<ENTER>key. Teaching for the 2nd point is executed.



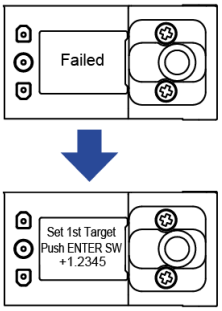
Sensing object 2

6. When teaching is completed,"Success"is displayed on the display section. Then, the newly set HIGH set value and LOW set value are displayed in sequence, and the display returns to the measurement display.



7. If the sensing object is not detected stably, for example, if the 1st and 2nd points have the same measured value,"Failed"will be displayed.

Re-examine positional relationship among the sensing objects and perform teaching again.


Failed
Set 1st Target
Push ENTER SW
+1.2345

2 points teaching using external communication

This section describes how to execute 2 points teaching using communication commands from an external host device.

- Execute teaching on the measurement display.

- During the execution of teaching using communication commands, do not write data to other setting information.

Procedure

1. Using a communication command from an external host device, set "Teaching type" to "2: 2 points teaching".
2. Confirm that "Teaching execution state" is set to "0: Not executed".
3. Insert the 1st sensing object and set "Execution of teaching" to "1: Start teaching". "Teaching execution state" changes to "1: Being executed".
4. Confirm that the measured value that you want to use for the 1st point has been obtained, and set "Teaching 1st point setting" to "0: Execute".
5. Insert the 2nd sensing object and confirm that "Teaching execution state" is set to "1: Execute".
6. Confirm that the measured value that you want to use for the 2nd point has been obtained, and set "Teaching 2nd point setting" to "0: Execute".
7. If teaching is "successful", "Teaching execution state" changes to "2: Success" and the HIGH and LOW set values are set newly. Confirm that the set values have been updated.
8. If teaching "fails", "Teaching execution state" changes to "3: Failed" and the HIGH and LOW set values remain unchanged.
   Re-examine positional relationship among the sensing objects and perform teaching again.

Note

- Screen transition by operating switches on this product is not possible during the execution of teaching using communication commands.
- The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

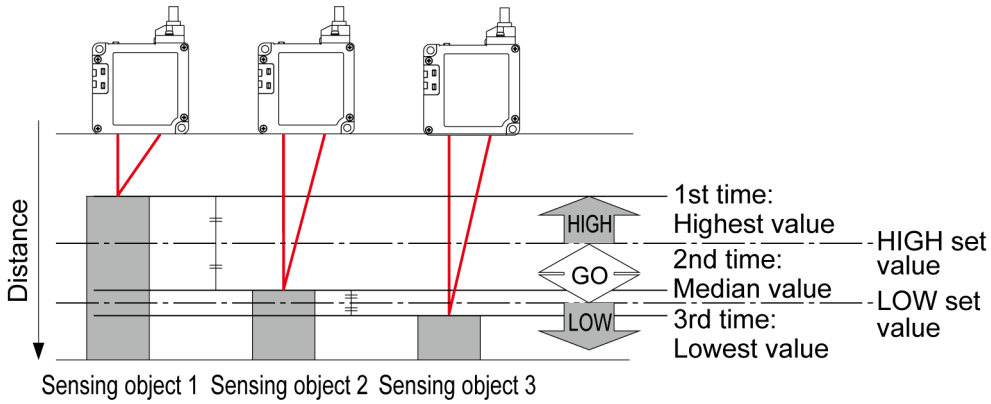
Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

4.9.3 3 points Teaching

■ Overview

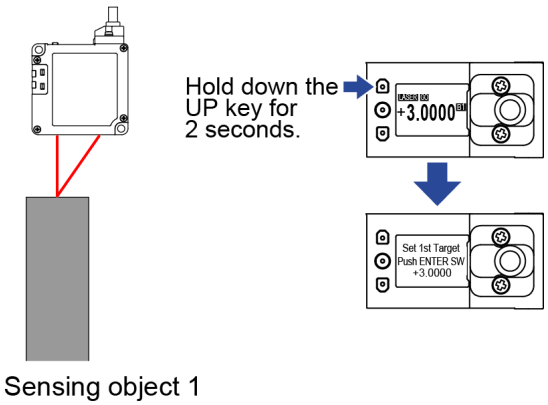
This method is to perform teaching on three sensing objects and set the HIGH set value and LOW set value for each of them based on the measured results.

Among the three measured values, the highest value is the maximum value, the second highest value is the median value, and the third highest value is the minimum value. The intermediate value between the highest value and the median value is set as the HIGH set value, and the intermediate value between the lowest value and the median value is set as the LOW set value.

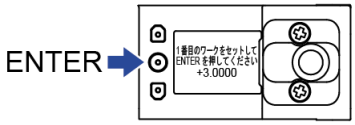


1 2 Procedure

1. Set Teaching type to "3 points teaching".
2. On the measurement display, insert the 1st sensing object.
3. With the 1st sensing object inserted, hold down the<UP>key for 2 seconds. Confirm that a message saying"Set 1st Target - Push ENTER SW"is displayed at the top of the display. The display changes to the 1st point input screen.

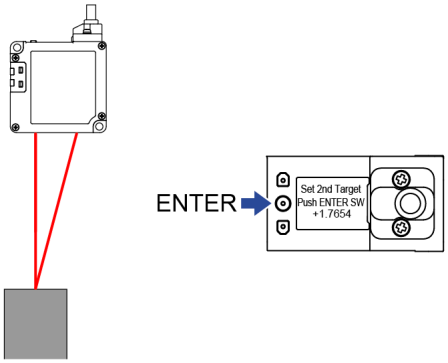


4. Press the<ENTER>key. Teaching for the 1st point is executed.



5. Confirm that a message saying"Set 2nd Target and Push ENTER SW"is displayed at the top of the display. The display changes to the 2nd point input screen.

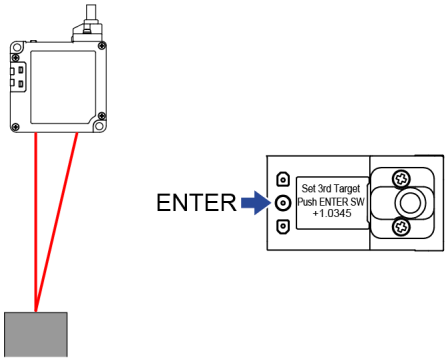
With the 2nd sensing object inserted, press the<ENTER>key. Teaching for the 2nd point is executed.



Sensing object 2

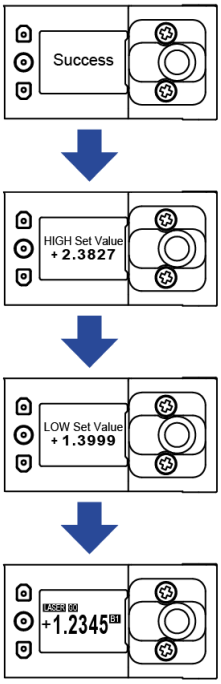
6. Confirm that a message saying"Set 3rd Target and Push ENTER SW"is displayed at the top of the display. The display changes to the 3rd point input screen.

With the 3rd sensing object inserted, press the<ENTER>key. Teaching for the 3rd point is executed.



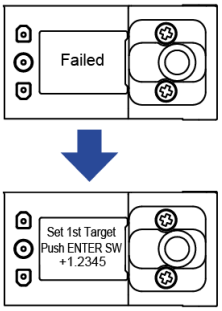
Sensing object 3

7. When teaching is completed, "Success" is displayed on the display section. Then, the newly set HIGH set value and LOW set value are displayed in sequence, and the display returns to the measurement display.



8. If the sensing object is not detected stably, for example, if two or more of the three teaching points have the same measurement value,"Failed"will be displayed.

Re-examine positional relationship among the sensing objects and perform teaching again.



3 points teaching using external communication

This section describes how to execute 3 points teaching using communication commands from an external host device.

- Execute teaching on the measurement display.

- During the execution of teaching using communication commands, do not write data to other setting information.

Procedure

1. Using a communication command from an external host device, set "Teaching type" to "3: 3 points teaching".
2. Confirm that "Teaching execution state" is set to "0: Not executed".
3. Insert the 1st sensing object and set "Execution of teaching" to "1: Start teaching". "Teaching execution state" changes to "1: Being executed".
4. Confirm that the measured value that you want to use for the 1st point has been obtained, and set "Teaching 1st point setting" to "0: Execute".
5. Insert the 2nd sensing object and confirm that "Teaching execution state" is set to "1: Execute".
6. Confirm that the measured value that you want to use for the 2nd point has been obtained, and set "Teaching 2nd point setting" to "0: Execute".
7. Insert the 3rd sensing object and confirm that "Teaching execution state" is set to "1: Execute".
8. Confirm that the measured value that you want to use for the 3rd point has been obtained, and set "Teaching 3rd point setting" to "0: Execute".
9. If teaching is "successful", "Teaching execution state" changes to "2: Success" and the HIGH and LOW set values are set newly. Confirm that the set values have been updated.
10. If teaching "fails", "Teaching execution state" changes to "3: Failed" and the HIGH and LOW set values remain unchanged.

    Re-examine positional relationship among the sensing objects and perform teaching again.

Note

- Screen transition by operating switches on this product is not possible during the execution of teaching using communication commands.
- The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

4.10 Zero Setting

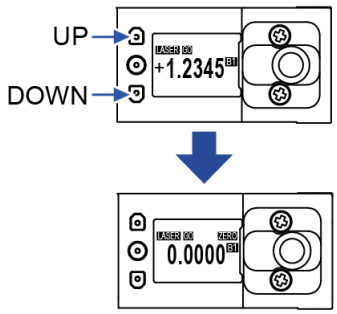
■ Overview

This function is used to forcibly set the measured value to "0". You can use the function to adjust the reference point when this product has been replaced or when the workpiece has been changed.

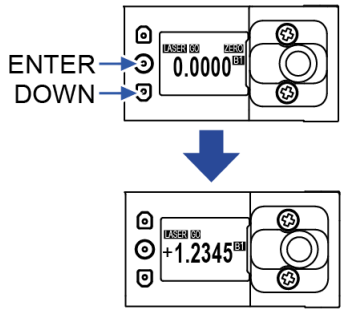
When the zero set is set, the measured value at the location where the setting is executed is set to zero. Depending on where the zero set is set, the display value for the sensing location changes.

1 2 Procedure

1. Simultaneously hold down the<UP>and<DOWN>keys on the measurement display to complete zero setting.



2. Simultaneously hold down the<DOWN>and<ENTER>keys on the measurement display to clear the zero set setting.



Note

- If you execute Inversion of Measured Value in the state where zero set setting is complete and the measured value is set to 0, the measured value changes from 0. After executing Inversion of Measured Value, make an adjustment again.
- When the light receiving state of CMOS is "unmeasurable", Zero set ON cannot be set. (For information on unmeasurable state, refer to "4.7 Alarm Setting".)
- For whether or not Zero set ON can be set depending on the sensor indication such as " Indeterminate" or "Alarm" state, refer to the table below.

  Even if the light receiving state of CMOS is unmeasurable, the measured value may still be displayed on the display due to trigger input or alarm delay. Note that zero set ON cannot be set also in this case.

Sensor display	Light receiving state of CMOS	
	Measurable	Unmeasurable
Normal (Inside the measurement range)	○	×
Normal (Outside the measurement range)	△	×
Alarm	△	×
Indeterminate	△	×

(Note 1) ○: Zero set ON can be set.

△: Zero set ON setting can be set, but is not recommended because the correction value will be indeterminate.

×: Zero set ON cannot be set.

- When zero setting is executed in a state where an offset is set, the measured value is set to the offset value.

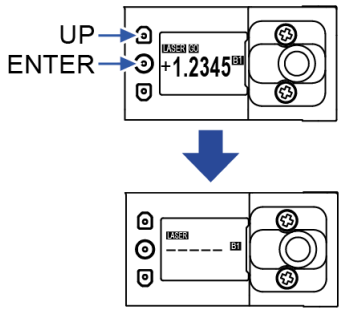
4.11 Measured Value Resetting

■ Overview

This function is used to reset the moving average data of the measured value or the value held by the hold function.

1 2 Procedure

1. Simultaneously hold down the<UP>and<ENTER>keys on the measurement display to reset the measured value.



Note

- When the resetting function is executed, all the "Judgment output" values are turned OFF.

4.12 Key Lock

This function is used to disable key operation to prevent the conditions set in each setting mode from being changed by mistake.

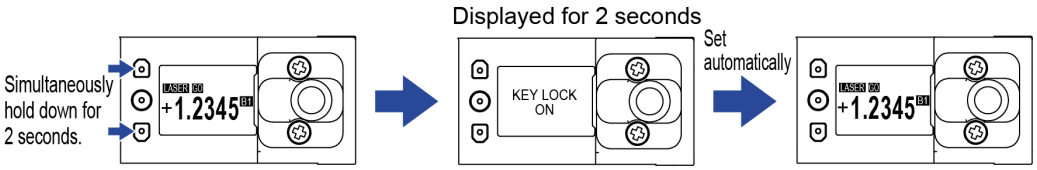
While the key lock setting is activated, all key operations other than key lock release cannot be performed.

4.12.1 Key Lock Setting

Procedure

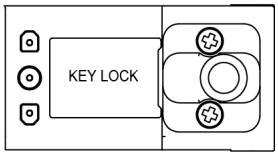
1. Simultaneously hold down the <UP> and <DOWN> keys on the measurement display for 2 seconds.

   "KEY LOCK ON" is displayed in the display section for 2 seconds to indicate that the setting has been completed.



Note

- If you perform any key operation while the key lock setting enabled,"KEY LOCK ON" will be displayed on the display section and no key operation will be accepted.

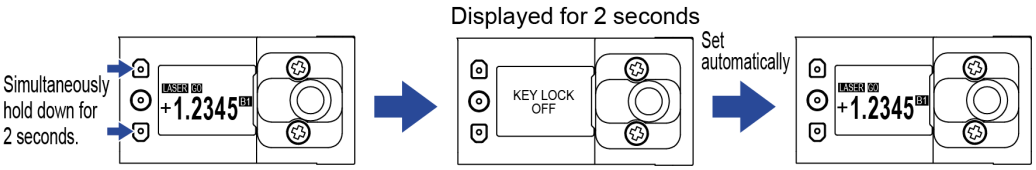


- If you perform key lock setting using the tool software **HL-G2 Configuration Tool** or an external device, "KEY LOCK ON" is not displayed on the display section.

4.12.2 Key Lock OFF

Procedure

1. While the key lock setting is ON, simultaneously hold down the <UP> and <DOWN> keys for 2 seconds.
   "KEY LOCK OFF"is displayed on the display section for 2 seconds and the key lock is released.



Note

- If you perform key lock release using the tool software**HL-G2 Configuration Tool** or an external device,"KEY LOCK OFF" is not displayed on the display section.

4.13 Self-monitoring

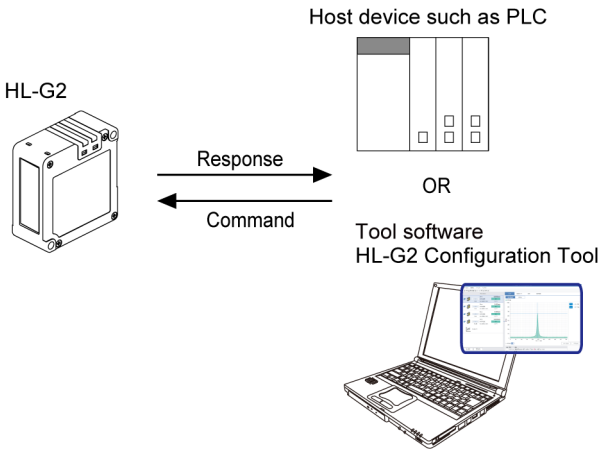
This product self-diagnoses and outputs its state as communication data in one of the following four states.

In addition, except for the normal state, detailed status information on each state is also output.

State	Description
Normal	Indicates the normal state.
Notification	Indicates the state in which issues that occur during normal use, such as setting errors or a drop in received light intensity, are detected.
Caution	Indicates the state in which sensor replacement is recommended because the saving count has exceeded the upper limit, for example.
Error	Indicates the state in which sensor replacement or wiring check is required due to component damage or wiring breakage or for some other reason.

You can check the state of the product by issuing commands from an external host device or by using the tool software **HL-G2 Configuration Tool**.

The **HL-G2** sensor returns flag data that indicates the state as a response, as well as detailed status information on each state.



■ Factors that cause the status of each state

The factors that cause "Notification," "Caution," and "Error" that you may be notified of are shown below.

State	Description	Conditions	Remarks
Notification	Excessive intensity of received light	An alarm occurred due to saturation of the received light intensity.	"ALARM" will be displayed on the display section. (Only when the Alarm digital output setting is "Alarm")
	Insufficient intensity of received light	An alarm occurred due to insufficient received light intensity.	
	Excessive extraneous light	An alarm occurred because the sensor fell in an unmeasurable state due to excessive extraneous light.	
	Outside the measurement range	The measured raw value is outside the measurement range.	–

State	Description	Conditions	Remarks
Caution	Cumulative operation hours exceeded	Cumulative operating hours exceed the upper limit of this product.	–
	Number of writes to internal memory exceeded	The number of writes to internal memory (non-volatile memory) has exceeded the upper limit of this product.	–
Error	Beam-emitting circuit error	An error occurred due to a failure of the LD unit or drive circuit.	The corresponding error code will be displayed on the display section. For error messages and actions to be taken, refer to "8.2 Error Messages and Action Methods".
	System error	An error occurred in CPU or communication start processing.	

■ Detailed status information on each state

Communication commands can be used to read detailed information on "Notification", "Caution", and "Error". For the status of each state, a 16-bit area is secured, where each bit is allocated with detailed information.

When a state occurs, the corresponding status bit for the factor that caused it is 1. (The bit is 0 if any of the above states occurs.)

Detailed information on “Notification”

Bit position	Description
0	Excessive intensity of received light
1	Insufficient intensity of received light
2	Outside the measurement range
3	Excessive extraneous light
4	0 (Reserved)
5	0 (Reserved)
6	0 (Reserved)
7	0 (Reserved)
8	0 (Reserved)
9	0 (Reserved)
10	0 (Reserved)
11	0 (Reserved)
12	0 (Reserved)
13	0 (Reserved)
14	0 (Reserved)
15	0 (Reserved)

Note

- If the measured raw value is outside the following ranges, the "Outside the measurement range" bit is set to 1.

Distance type	Measured raw value (mm)	
	Minimum value	Maximum value
30 mm	-5	5
50 mm	-10	10
85 mm	-20	20
120 mm	-30	30
250 mm	-150	150

Detailed information on “Caution”

Bit position	Description
0	Cumulative operation hours exceeded
1	Number of writes to internal memory exceeded
2	0 (Reserved)
3	0 (Reserved)
4	0 (Reserved)
5	0 (Reserved)
6	0 (Reserved)
7	0 (Reserved)
8	0 (Reserved)
9	0 (Reserved)
10	0 (Reserved)
11	0 (Reserved)
12	0 (Reserved)
13	0 (Reserved)
14	0 (Reserved)
15	0 (Reserved)

Detailed information on “Error”

Bit position	Description
0	Beam-emitting circuit error
1	0 (Reserved)
2	System error
3	0 (Reserved)
4	0 (Reserved)
5	0 (Reserved)
6	0 (Reserved)

Bit position	Description
7	0 (Reserved)
8	0 (Reserved)
9	0 (Reserved)
10	0 (Reserved)
11	0 (Reserved)
12	0 (Reserved)
13	0 (Reserved)
14	0 (Reserved)
15	0 (Reserved)

The communication commands for the external host device vary depending on the communication protocol to be used. For details, refer to the table below.

Communication protocol	Reference page
Modbus TCP	"5.2 Modbus TCP"
EtherNet/IP	"5.3 EtherNet/IP"
SLMP	"5.4 SLMP"
Modbus RTU	"6.3 Modbus RTU"

(MEMO)

5 External Communication Control (Ethernet)

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5.1 Ethernet Communication Setting

■ Overview

By using communication, you can reference and set the set values of this product from an external host device.

It is also possible to reference measured values and the operating state of the product.

The following three communication protocols are supported.

Communication protocol	Optional Cable
ModbusTCP	CN-8E-C2 CN-8E-C5
EtherNet/IP	
SLMP	

- When changing settings using communication commands (or using a tool software **HL-G2 Configuration Tool**), make sure to save the set values. If not saved, the set values are discarded when the power is turned OFF.

5.1.1 Connection and Setting Method

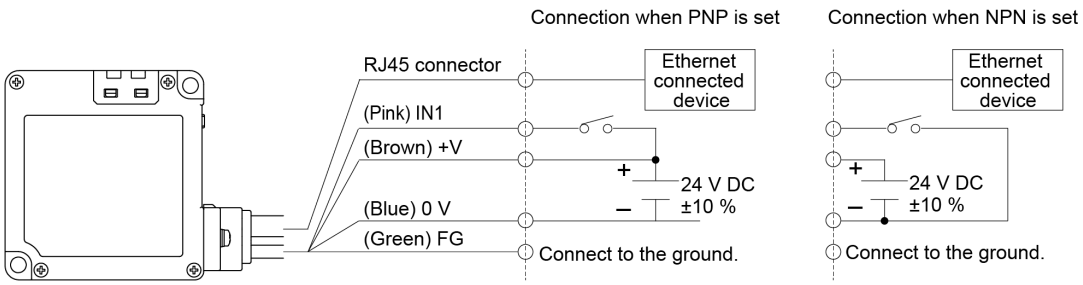
■ Communication specifications

Item	Settings
Communication protocol	Modbus TCP, EtherNet/IP, SLMP
Communication method(Note 1)	Full-duplex / half-duplex transmission
Communication speed(Note 1)	10 Mbps / 100 Mbps
Interface	100BASE-TX / 10BASE-T

(Note 1) Automatic detection by auto-negotiation function

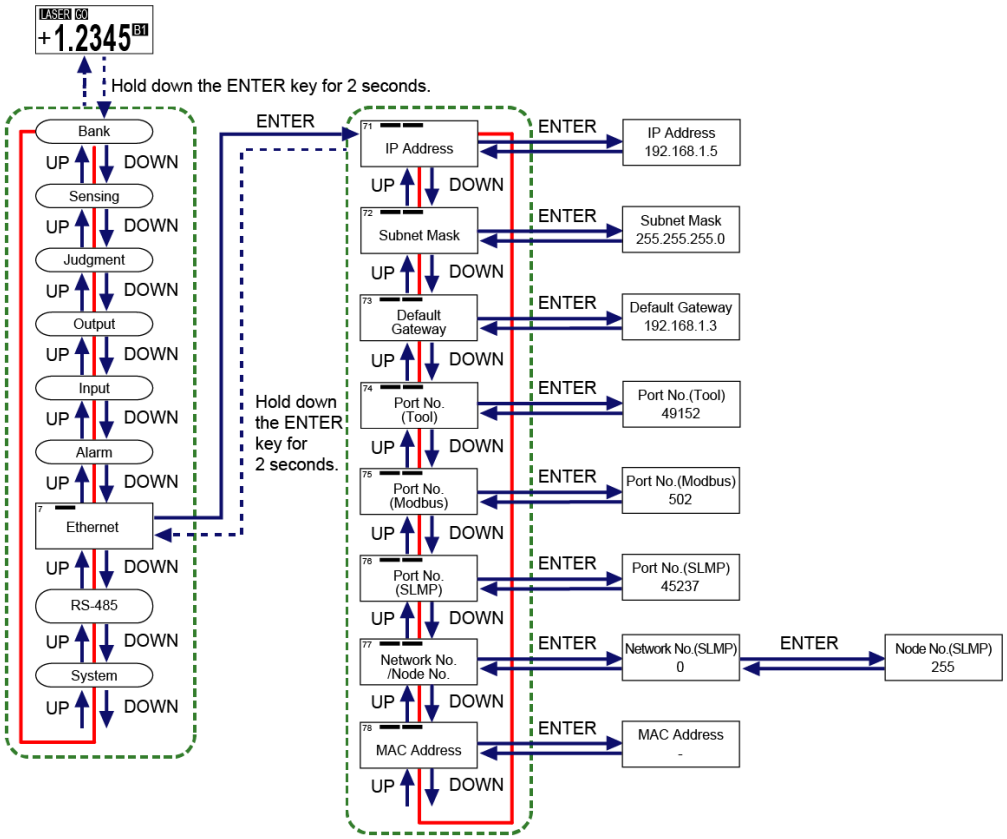
■ Connection method

After connecting the sensor to an optional cable, connect the RJ45 connector of the cable to the communication unit or Ethernet connected device.



After connecting the RJ45 connector, turn ON the power supply and make the necessary settings according to the protocol to be used.

■ Setting method



The setting items vary depending on the communication protocol to be used.
For details on the setting method, refer to the table below.

Communication protocol	Reference page
ModbusTCP	"5.2.1 Modbus TCP Setting Method"
EtherNet/IP	"5.3.1 EtherNet/IP Setting Method"
SLMP	"5.4.1 SLMP Setting Method"

- Resetting communication settings or restarting the sensor is required for the communication settings to be reflected.

Note

- You can check the MAC address on the screen, but not set it.
- When changing the setting of the IP address, subnet mask, or default gateway, perform a combination error check.

  Therefore, even if a combination turns out to be a possible combination in the end, an error may occur when an attempt is made to change an individual setting, disabling further settings.

  In such a case, set the default gateway to 0.0.0.0 (no default gateway setting) once, set the IP address and subnet mask, and then set the default gateway again.
- Simultaneously pressing the <UP> and <DOWN> keys while moving between the digits returns to the first digit.

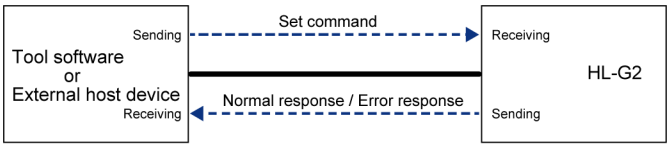
5.2 Modbus TCP

■ Overview

By using the Modbus TCP protocol, you can write settings and operation instructions, and read the setting data, measured values, and operating state of the **HL-G2** from the tool software **HL-G2 Configuration Tool** or an external host device.

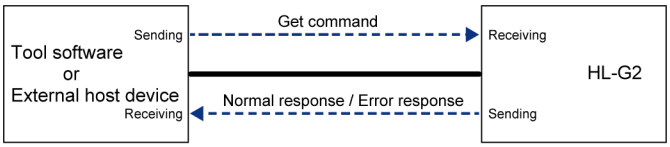
■ When receiving a Set command

On receiving a Set command, the HL-G2 updates the settings and operates according to the operation instructions.



■ When receiving a Get command

On receiving a Get command, the HL-G2 returns the setting as a response.



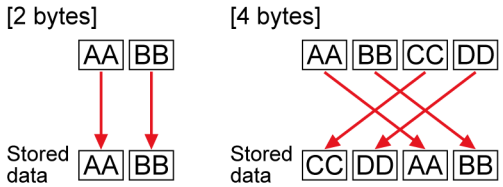
■ Register size

The relationship between the register size and the data type are as follows

Size	Meaning
1-byte register	Unsigned 8-bit integer type
2-byte register	Unsigned 16-bit integer type
4-byte register	Signed 32-bit integer type

Note

- The Modbus standard treats all registers as 2 bytes for message processing, which means that 1-byte registers in this product are expanded to 2 bytes, and 4-byte registers are divided into two 2-byte registers.
- Data is stored in the 2-byte and 4-byte registers in the following positional relationships.



5.2.1 Modbus TCP Setting Method

After selecting "Ethernet communication setting" in the Setting mode of this product, some additional settings are required depending on the communication protocol to be used.

For how to select "Ethernet communication setting", refer to "5.1.1 Connection and Setting Method".

Setting item	Description	Set value	Default value
IP Address	Set the IP address.	000,000,000,000 to 255,255,255,255	192.168.1.6
Subnet Mask	Set the subnet mask.	000,000,000,000 to 255,255,255,255	255.255.255.0
Default Gateway	Set the default gateway.	000,000,000,000 to 255,255,255,255	192.168.1.1
Port No.(Tool)	Set the port number of this product for connecting the tool software **HL-G2 Configuration Tool**.	1 to 65535(Note 1)(Note 2)	49152
Port No. (Modbus)	Set the port number of this product for connecting an external host device via Modbus TCP.	1 to 65535(Note 1)(Note 2)	502
Port No.(SLMP)	Set the port number of this product for connecting an external host device via the SLMP server function.	No need to set	-
Network No.	Set the network number and node number for SLMP communication.	No need to set	-
Node No.			

(Note 1) The set value "44818" cannot be specified because it is used for other purposes.

(Note 2) The same number cannot be specified for "Port No. (Tool)" and "Port No. (Modbus)".

■ IP setting conditions

1. IP Address
   - The first octet cannot be set to 0, 127, or 224 to 255.
2. Subnet Mask
   - When each octet is expressed in binary notation and viewed from the first octet, the subnet mask must start with a series of 1's followed by a series of 0's in all remaining octets.
3. Combination of IP Address and Subnet Mask
   - All bits in the host address segment of the IP address cannot be set to 0's.
   - All bits in the host address segment of the IP address cannot be set to 1's.
   - All bits in the network address segment of the IP address cannot be set to 0’s.
4. Default Gateway
   - The first octet cannot be set to 0, 127, or 224 to 255.
     (However, 0.0.0.0 can be set.)
5. Combination of Default Gateway and Subnet Mask
   - All bits in the host address segment of the default gateway cannot be set to 0’s.
   - All bits in the host address segment of the default gateway cannot be set to 1’s.
6. Combination of IP Address, Subnet Mask, and Default Gateway

- The default gateway and the IP address must exist in the same network segment (subnet).

5.2.2 Modbus TCP Supported Functions

- Send and receive commands to and from this product on the measurement display.

The Modbus TCP protocol supports the following functions.

Function code	Function	Description of function
0x01	Read Coil Status	Reads the ON/OFF state of a specified coil.
0x03	Read Holding Register	Reads the value of specified holding register.
0x06	Preset Single Register	Changes the content of a specified holding register.
0x10	Write Multiple registers	Changes the content of a consecutive multiple holding registers.

■ Error code

In the following cases, an error code will be returned as a response.
Check the content of the error code and, if there is an error in the send data, correct the error.
If there is no error in the send data, power cycle the product or external device.

Error code	Cause	Countermeasure
0x01	Function code error	Use a function code that is supported.
0x02	Specified address error (Address error) ● The specified address does not exist. ● An attempt was made to read from a register not permitted to be read. ● An attempt was made to write to a register not permitted to be written. ● A read-prohibited address is specified.	Review the address.
0x03	Error in the specified No. of coils, No.of registers, or data (Data error) ● The specified message length is invalid. ● The specified No. of coils or No. of registers is less than 1. ● The specified No. of coils is more than 2000. ● The specified No. of registers is more than 125. (Function code: 0x03) ● The specified No. of registers is more than 123. (Function code: 0x10) ● The No. of write registers does not match the data (No. of register values). ● The write register value is incorrect (out of range, inconsistent). ● The specified register is insufficient for 4-byte data.	Review the value to be written and the send data to be included in the message.
0x04	Other error ● This product is not ready to read/write data.	Review the state of this product.

Error code	Cause	Countermeasure
	● This product failed to write data.	

5.2.3 Modbus TCP Function Codes

- Send and receive commands to and from this product on the measurement display.

■ 0X01: Read Coil Status

Reads the ON/OFF state of a specified coil. The coil status is indicated in 1 bit (1 = ON, 0 = OFF).

Request message

Byte position	Meaning	Remarks
0	Transaction identifier	–
1	Transaction identifier	–
2	Protocol identifier	0x00 must be specified.
3	Protocol identifier	0x00 must be specified.
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	–
7	Function code	0x01
8	READ coil address (Upper)	–
9	READ coil address (Lower)	–
10	READ No. of coils (Upper)	–
11	READ No. of coils (Lower)	–

Response message (normal)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x01
8	No. of bytes n	Length from "byte position 9" onwards
9	Coil state 1	–
…	…	…
9+n-1	Coil state n	–

Response message (Error)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x81
8	Error code	–

■ 0x03: Read Holding Register

Reads the value of specified holding register. Since the register data is 16 bits, it is stored in 2 bytes in the response message.

The maximum number of holding registers that can be read in a single session is 125.

Request message

Byte position	Meaning	Remarks
0	Transaction identifier	–
1	Transaction identifier	–
2	Protocol identifier	0x00 must be specified.
3	Protocol identifier	0x00 must be specified.
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	–
7	Function code	0x03
8	READ coil address (Upper)	–
9	READ coil address (Lower)	–
10	READ No. of coils (Upper)	–
11	READ No. of coils (Lower)	–

Response message (normal)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	

Byte position	Meaning	Remarks
6	Unit identifier	Returns the request message value.
7	Function code	0x03
8	No. of bytes (No. of registers n × 2)	Length from "byte position 9" onwards
9	Register value 1 (Upper)	–
10	Register value 1 (Lower)	–
…	…	…
8+(n-1)×2+1	Register value n (Upper)	–
8+(n-1)×2+2	Register value n (Lower)	–

Response message (Error)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x83
8	Error code	–

■ 0x06: Preset Single Register

Changes the content of a specified holding register. The maximum number of holding registers that can be written in a single session is 1.

When changing multiple holding registers, use function code 0x10.

Request message

Byte position	Meaning	Remarks
0	Transaction identifier	–
1	Transaction identifier	–
2	Protocol identifier	0x00 must be specified.
3	Protocol identifier	0x00 must be specified.
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	–
7	Function code	0x06
8	WRITE register address (Upper)	–
9	WRITE register address (Lower)	–
10	Register value (Upper)	–

Byte position	Meaning	Remarks
11	Register value (Lower)	–

Response message (normal)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x06
8	WRITE register address (Upper)	–
9	WRITE register address (Lower)	–
10	Register value (Upper)	–
11	Register value (Lower)	–

Response message (Error)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x86
8	Error code	–

■ 0x10: Write Multiple Registers

Changes the content of a consecutive multiple holding registers. The maximum number of holding registers that can be written in a single session is 123.

Request message

Byte position	Meaning	Remarks
0	Transaction identifier	–
1	Transaction identifier	–
2	Protocol identifier	0x00 must be specified.
3	Protocol identifier	0x00 must be specified.

Byte position	Meaning	Remarks
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	–
7	Function code	0x10
8	WRITE register address (Upper)	–
9	WRITE register address (Lower)	–
10	WRITE No. of registers (Upper)	–
11	WRITE No. of registers (Lower)	–
12	No. of bytes (No. of registers n × 2)	Length from "byte position 13" onwards
13	Register value 1 (Upper)	–
14	Register value 1 (Lower)	–
…	…	…
12+(n-1)×2+1	Register value n (Upper)	–
12+(n-1)×2+2	Register value n (Lower)	–

Response message (normal)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	
6	Unit identifier	Returns the request message value.
7	Function code	0x10
8	WRITE register address (Upper)	–
9	WRITE register address (Lower)	–
10	WRITE No. of registers (Upper)	–
11	WRITE No. of registers (Lower)	–

Response message (Error)

Byte position	Meaning	Remarks
0	Transaction identifier	Returns the request message value.
1	Transaction identifier	
2	Protocol identifier	0x00
3	Protocol identifier	0x00
4	Message length (Upper)	Length from "byte position 6" onwards
5	Message length (Lower)	

Byte position	Meaning	Remarks
6	Unit identifier	Returns the request message value.
7	Function code	0x90
8	Error code	–

- Always use "0" for the protocol identifier. If a value other than 0 is specified, the message is discarded.

Note

- If the message length exceeds 270 bytes, the communication is terminated.
- If the message length is less than 12 bytes, the message is discarded.
- If the actual message length of the received message does not match the "message length" in the message, the message is discarded.
- For this product, the unit identifier has no meaning. In the response message set the unit identifier specified in the request message.
- For the registers and coils that can be specified, refer to "5.2.4 Modbus TCP Setting Registers" and "5.2.5 List of Coils".

Operation of multiple coil/register access functions in the event of an error

In Modbus communication, Read Coil Status, Read Holding Register, and Write Multiple registers access multiple coils/registers at the same time.

If an error occurs when accessing some or all coils/registers, these functions will operate as follows.

■ Read Coil Status/Read Holding Register

1. If the following condition is met, read processing is not started and an error response (Other error) is returned.
   - This product is not ready to read data.
2. Even if any of the following conditions are met, read processing continues as if the value 0 were read. However, it is not counted in the number of successful reads.
   - The specified address does not exist.
   - There is no read attribute in the specified address.
3. If the number of successful reads is not 0, a normal response is returned. If it is 0, an error response (Address error) is returned.

■ Write Multiple registers

1. If the following condition is met, write processing is not started and an error response (Other error) is returned.
   - This product is not ready to write data.
2. If there is even one register that meets any of the following conditions, data is not written to all registers and an error response is returned. (Refer to "Error codes" for the error code.)
   - A read-prohibited address is specified.(Address error)
   - The specified write value is invalid (out of range, inconsistent) (Data error).
   - The specified register is insufficient for 4-byte data.(Data error)
3. Even if any of the following conditions are met, write processing continues, ignoring the address. However, it is not counted in the number of successful writes.
   - The specified address does not exist.
   - There is no write attribute in the specified address.
4. If the following condition is met, Write processing is interrupted and an error response (Other error) is returned.
   - Write to the specified address failed.
5. If the number of successful writes is not 0, a normal response is returned. If it is 0, an error response (Address error) is returned.

5.2.4 Modbus TCP Setting Registers

- In a Modbus protocol message, specify a value obtained by subtracting 400001 from the address listed in the table below.

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400011	Sensor state	Notifies the state of this product.	Refer to "5.2.5 List of Coils".	R	2
400012	Self-monitoring detail: Notification	Notifies that an issue that occurs during normal use, such as a setting error or a drop in received light intensity, is detected.	Refer to "5.2.5 List of Coils".	R	2
400013	Self-monitoring detail: Caution	Notifies that sensor replacement is recommended because the saving count has exceeded the upper limit, for example.	Refer to "5.2.5 List of Coils".	R	2
400014	Self-monitoring detail: Error	Notifies that sensor replacement or wiring check is required due to component damage or wiring breakage or for some other reason.	Refer to "5.2.5 List of Coils".	R	2
400015	Error code	Used for reading the error code.	-	R	2
400020	Measured value	Used for reading the measured value. This value is expressed as an integer value in increments of 0.1 µm. Any numbers after the digit of 0.01 µm are rounded down.	-	R	4
400022	Peak intensity of received light	Used for reading the peak intensity of received light.	When normal: 0 to 1,023 Indeterminate: 65,535	R	2
400051	Usage prohibited	-	-	-	-
400052	Zero setting	Forcibly sets the measured value to zero. Read: Zero setting state Write: Switching zero set setting	0: OFF 1: ON	RW	1
400053	Usage prohibited	-	-	-	-
400054	Set value saving	Saves the settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400055	Usage prohibited	-	-	-	-
400056	Measured value resetting	Resets the measured value.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400057	Usage prohibited	-	-	-	-
400058	Bank switching	Switches the bank in which the set values are to be saved.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4	RW	1
400059	Usage prohibited	-	-	-	-
400060	Bank copy	Copies the settings saved in one bank to another bank.	0: Copy from Bank 1 to Bank 2 1: Copy from Bank 1 to Bank 3 2: Copy from Bank 1 to Bank 4 3: Copy from Bank 2 to Bank 1 4: Copy from Bank 2 to Bank 3 5: Copy from Bank 2 to Bank 4 6: Copy from Bank 3 to Bank 1 7: Copy from Bank 3 to Bank 2 8: Copy from Bank 3 to Bank 4 9: Copy from Bank 4 to Bank 1 10: Copy from Bank 4 to Bank 2 11: Copy from Bank 4 to Bank 3	W	1
400061	Usage prohibited	-	-	-	-
400062	Settings initialization	Initializes each setting.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4 5: All Banks 6: All Areas	W	1
400063	Usage prohibited	-	-	-	-
400071	Language setting	Sets the language to be displayed on the display section.	0: English 1: Japanese 2: Simplified Chinese	RW	1
400101	HIGH set value	Sets the HIGH set value. The minimum value and maximum value vary depending on the distance type. (Note 2)	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000	RW	4

Register address	Data item	Description	Set value	Attribute	Size (bytes)
		This value is expressed as an integer value in increments of 0.1 µm.	85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000		
400103	LOW set value	Sets the LOW set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
400105	Hysteresis	Sets the hysteresis. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 0, Max. value: 95,000 50 mm type: Min. value: 0, Max. value: 950,000 85 mm type: Min. value: 0, Max. value: 950,000 120 mm type: Min. value: 0, Max. value: 950,000 250 mm type: Min. value: 0, Max. value: 9,500,000	RW	4
400108	Key lock	Disables key operation.	0: Disable key lock 1: Enable key lock	RW	1
400109	Eco mode	Turns OFF the display section when not operated to save electricity.	0: OFF 1: ON	RW	1
400110	Alarm delay count	Delays the notification until the set sampling count is reached for alarm notification due to detection of an unmeasurable state.	0: Alarm detection notification OFF 1 to 0xFFFF: Delay count (1 to 65535)	RW	2
400111	Display Digit	Sets the number of digits to be displayed for the measured value.	[30 mm distance type]	RW	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
		The number of digits varies depending on the distance type.	0: Display 4 digits after the decimal point 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point [50 mm / 85 mm / 120 mm distance type] 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point [250 mm distance type] 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point		
400112	Display Inversion	Inverts the organic EL display upside down.	0: Default 1: Inverted	RW	1
400113	Sampling Frequency	Changes the sampling cycle according to the moving speed of the object.	0: 100 µs 1: 200 µs 2: 500 µs 3: 1ms 4: 2 ms	RW	2
400114	Average Times	This drop-down list allows the user to set a moving average count.	0: 1 time 1: 4 times 2: 16 times 3: 64 times 4: 256 times 5: 512 times 6: 1024 times	RW	2

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400115	Hold mode	Sets the method for holding measured values.	0: None (Normal mode) 1: Peak hold 2: Bottom hold 3: Peak-to-peak hold	RW	2
400116	Span	Multiplies the measured value after zero setting by a span (factor) and outputs the result. This value is expressed as an integer value multiplied by 10,000.	1000 to 99999	RW	4
400118	Offset	Sets the offset value. The minimum value and maximum value vary depending on the distance type. This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
400120	Tolerance	Sets the tolerance. The minimum value and maximum value vary depending on the distance type.(Note 3) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 1, Max. value: 95,000 50 mm type: Min. value: 10, Max. value: 950,000 85 mm type: Min. value: 10, Max. value: 950,000 120 mm type: Min. value: 10, Max. value: 950,000 250 mm type: Min. value: 100, Max. value: 9,500,000	RW	4
400122	Output delay timer selection	Sets the ON to OFF or OFF to ON timing for the measured value judgment result.	0: OFF 1: On Delay 2: Off Delay 3: One Shot 4: Hold	RW	1
400123	Output Delay Timer Setting	Sets the delay time when On Delay or Off Delay is selected for Output delay timer selection, or the judgment holding time when One Shot is selected for it.	1 to 100 (Unit: milliseconds)	RW	2

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400124	Inversion of Measured Value	Switches the positive/negative direction of the measured value.	0: Normal 1: Reverse	RW	1
400125	Alarm digital output	Sets the digital output state at alarm occurrence.	0: Hold 1: In Alarm state	RW	1
400126	Brightness Tuning	Sets the laser beam brightness adjustment method depending on the target workpiece to be measured.	0: OFF 1: ON	RW	1
400127	Usage prohibited	-	-	-	-
400128	Trigger input (external input)	Used for reading the trigger input state by external input.	0: OFF 1: ON	R	1
400129	Hold state	Used for reading the hold state of the measured value.	0: Release 1: Hold	R	1
400130	Trigger mode	Sets the method for holding the final measured value.	0: Hold 1: One Shot	RW	1
400131	Trigger input (communication)	Sets trigger input.	0: OFF 1: ON	RW	1
400132	Usage prohibited	-	-	-	-
400133	Teaching execution state	Used for reading the teaching state.	0: Not executed 1: Being executed 2: Success 3: Failed	R	1
400134	Teaching Mode	Sets the teaching method.	1: 1 point 2: 2 points 3: 3 points	RW	1
400135	Usage prohibited	-	-	-	-
400136	Execution of teaching	Used for executing or interrupting teaching.	0: Interrupt teaching 1: Start teaching	W	1
400137	Usage prohibited	-	-	-	-
400138	Teaching 1st point setting	Used for executing teaching for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400139	Usage prohibited	-	-	-	-
400140	Teaching 2nd point setting	Used for executing teaching for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400141	Usage prohibited	-	-	-	-
400142	Teaching 3rd point setting	Used for executing teaching for the 3rd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400143	Usage prohibited	-	-	-	-

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400144	Brightness Tuning execution state	Used for reading the brightness tuning execution state.	0: Not executed 1: 1st point being executed 2: 2nd point being executed 3: Success 4: Failed	R	1
400145	Usage prohibited	-	-	-	-
400146	Brightness Tuning 1st point setting	Used for executing brightness tuning for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400147	Usage prohibited	-	-	-	-
400148	Brightness Tuning 2nd point setting	Used for executing brightness tuning for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400149	Usage prohibited	-	-	-	-
400150	Laser Stop	Sets ON/OFF of laser emission.	0: OFF (Laser emitted) 1: ON (Emission stopped)	RW	1
400151	Usage prohibited	-	-	-	-
400153	Port No. (Modbus)	Set the port number of this product for connecting an external host device via Modbus TCP.	1 to 0xFFFF	RW	2
400154	Port No. (tool)	Set the port number of this product for connecting the tool software **HL-G2 Configuration Tool**.		RW	2
400155	IP Address (4th octet)	Sets the IP address.	0 to 255	RW	1
400156	IP Address (3rd octet)			RW	1
400157	IP Address (2nd octet)			RW	1
400158	IP Address (1st octet)			RW	1
400159	Subnet Mask (4th octet)	Sets the subnet mask.	0 to 255	RW	1
400160	Subnet Mask (3rd octet)			RW	1
400161	Subnet Mask (2nd octet)			RW	1
400162	Subnet Mask (1st octet)			RW	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400163	Default Gateway (4th octet)	Sets the default gateway.	0 to 255	RW	1
400164	Default Gateway (3rd octet)			RW	1
400165	Default Gateway (2nd octet)			RW	1
400166	Default Gateway (1st octet)			RW	1
400167	Communication speed	Sets the communication speed.	0: 9600 bps 1: 19200 bps 2: 38400 bps 3: 115200 bps 4: 230400 bps	RW	1
400168	Parity/Stop Bit	Sets the parity check method and the stop bit length.	0: NON + 2bit 1: EVEN + 1bit 2: ODD + 1bit	RW	1
400169	Device Address	Assigns a unique address number to identify the device via the Modbus RTU protocol. It is used as a unit identifier.	1 to 247	RW	1
400170	Termination resistance	Sets the **HL-G2** that constitutes a final terminal.	0: OFF 1: ON	RW	1
400171	Resetting communication settings	Reflects the Ethernet or RS-485 settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400172	Usage prohibited	-	-	-	-

(Note 1) Do not specify 1 to 255.

(Note 2) Be sure to set a HIGH set value that is greater than the LOW set value.

The HIGH set value and the LOW set value cannot be set to values that make the difference between them to be a value that is equal to or less than twice the hysteresis.

(Note 3) Be sure to set a tolerance value that is greater than the hysteresis value.

Note

- When the measured value is above the positive limit of the display range, "+9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is below the negative limit of the display range, "-9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is indeterminate, "-9,999,999 (in increments of 0.1 µm)" is output.
- In an alarm state, "+9,999,999 (in increments of 0.1 µm)" is output. However, this excludes cases where Alarm digital output is set to "Hold".

5.2.5 List of Coils

- When using setting registers for communication commands, specify a value obtained by subtracting 1 from the coil address listed in the table below.

Register address	Coil address	Data item	Description	Attribute
400011	1	Alarm state	0: Not in Alarm state 1: In Alarm state	R
	2	Data in an indeterminate state	0: Not in Indeterminate state 1: Indeterminate state	R
	3	Judgment output state (HI)	0: OFF 1: ON	R
	4	Judgment output state (GO)	0: OFF 1: ON	R
	5	Judgment output state (LO)	0: OFF 1: ON	R
	6	Judgment output state at timer OFF (HI)(Note 1)	0: OFF 1: ON	R
	7	Judgment output state at timer OFF (GO)(Note 1)	0: OFF 1: ON	R
	8	Judgment output state at timer OFF (LO)(Note 1)	0: OFF 1: ON	R
	9	Hold state	0: Release 1: Hold	R
	10	Zero setting state	0: OFF 1: ON	R
	11	Laser state	0: Stop emission 1: Start emission	R
	12	Self-monitoring: Error	"1: Error" is set when one of coil addresses 49 to 64 is set to 1.	R
	13	Self-monitoring: Caution	“1: Caution” is set when "Self-monitoring: Error" is OFF and one of coil addresses 33 to 48 is set to 1.	R
	14	Self-monitoring: Notification	"1: Notification" is set when one of coil addresses 17 to 64 is set to 1.	R
	15, 16	-	Reserved. Indeterminate value will be read.	R
400012(Note 2)	17	Excessive intensity of received light	0: No occurrence of excessive intensity of received light 1: Occurrence of excessive intensity of received light	R
	18	Insufficient intensity of received light	0: No occurrence of insufficient intensity of received light 1: Occurrence of insufficient intensity of received light	R

Register address	Coil address	Data item	Description	Attribute
	19	Outside the measurement range	0: No occurrence of outside the measurement range 1: Occurrence of outside the measurement range	R
	20	Excessive extraneous light	0: No occurrence of excessive extraneous light 1: Occurrence of excessive extraneous light	R
	21 to 32	-	Reserved; indeterminate value will be read.	R
400013(Note 3)	33	Cumulative operation hours exceeded	0: No occurrence of cumulative operation hours exceeded 1: Occurrence of cumulative operation hours exceeded	R
	34	Number of writes to internal memory exceeded	0: No occurrence of number of writes to internal memory exceeded 1: Occurrence of number of writes to internal memory exceeded	R
	35 to 48	-	Reserved; indeterminate value will be read.	R
400014(Note 4)	49	Beam-emitting circuit error	0: No occurrence of beam-emitting circuit error 1: Occurrence of beam-emitting circuit error	R
	50	-	Reserved; indeterminate value will be read.	R
	51	System error	0: No occurrence of system error 1: Occurrence of system error	R
	52 to 64	-	Reserved; indeterminate value will be read.	R

(Note 1) No more than one of (HI), (GO), and (LO) is turned ON at the same time.

(Note 2) For details on “Notification”, refer to "Detailed status information on each state".

(Note 3) For details on “Caution”, refer to "Detailed status information on each state".

(Note 4) For details on “Error”, refer to "Detailed status information on each state".

5.3 EtherNet/IP

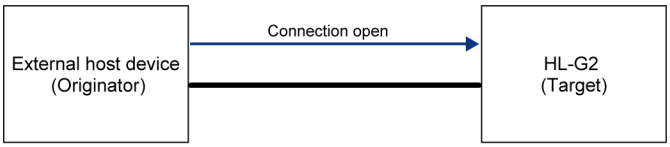
■ Overview

EtherNet/IP performs cyclic communication or message communication with external host devices that support EtherNet/IP.

■ Cyclic communication

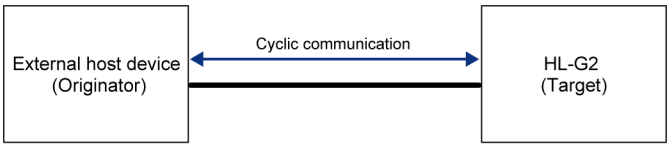
This is a function that performs data transmission at a constant interval (RPI) between this product and external host devices.

In cyclic communication, one device opens a communication line called a connection to the partner device.



Set the connection information for cyclic communication in the "originator" (external host device). The originator connects to the "target" (this product) based on the connection information.

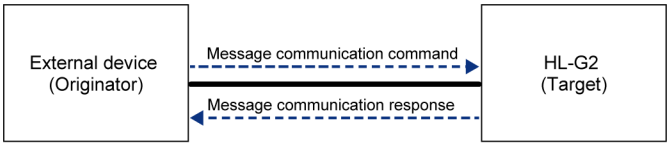
When a connection is opened, cyclic communication starts. The settings are made according to the connection information.



■ Message communication

This is a function that allows data to be sent at a desired timing. It can be used to send and receive data that is not supported by cyclic communication.

In message communication, Class 3 (with connection) and UCMM (without connection) can be used.



5.3.1 EtherNet/IP Setting Method

After selecting "Ethernet communication setting" in the Setting mode of this product, some additional settings are required depending on the communication protocol to be used.

For how to select "Ethernet communication setting", refer to "5.1.1 Connection and Setting Method".

Setting item	Description	Set value	Default value
IP Address	Set the IP address.	000,000,000,000 to 255,255,255,255	192.168.1.6
Subnet Mask	Set the subnet mask.	000,000,000,000 to 255,255,255,255	255.255.255.0
Default Gateway	Set the default gateway.	000,000,000,000 to 255,255,255,255	192.168.1.1
Port No.(Tool)	Set the port number of this product for connecting the tool software **HL-G2 Configuration Tool**.	No need to set	-
Port No. (Modbus)	Set the port number of this product for connecting an external host device via Modbus TCP.	No need to set	-
Port No.(SLMP)	Set the port number of this product for connecting an external host device via the SLMP server function.	No need to set	-
Network No.	Set the network number and node number of the SLMP that communicates with this product.	No need to set	-
Node No.			

■ IP setting conditions

1. IP Address
   - The first octet cannot be set to 0, 127, or 224 to 255.
2. Subnet Mask
   - When each octet is expressed in binary notation and viewed from the first octet, the subnet mask must start with a series of 1's followed by a series of 0's in all remaining octets.
3. Combination of IP Address and Subnet Mask
   - All bits in the host address segment of the IP address cannot be set to 0's.
   - All bits in the host address segment of the IP address cannot be set to 1's.
   - All bits in the network address segment of the IP address cannot be set to 0’s.
4. Default Gateway
   - The first octet cannot be set to 0, 127, or 224 to 255.
     (However, 0.0.0.0 can be set.)
5. Combination of Default Gateway and Subnet Mask
   - All bits in the host address segment of the default gateway cannot be set to 0’s.
   - All bits in the host address segment of the default gateway cannot be set to 1’s.
6. Combination of IP Address, Subnet Mask, and Default Gateway
   - The default gateway and the IP address must exist in the same network segment (subnet).

Communication Settings for External Devices

The following settings are required for connecting this product with an external device such as a PLC.

■ Registration of EDS (Electronic Data Sheets) files

Register EDS files of this product in the external device.

The EDS files can be downloaded from our website:

https://industry.panasonic.com/global/en/downloads/?tab=software

For details on how to register EDS files, check the instruction manual of the external device to be used.

Note

- The EDS files contain the following connection information.
  - Connection name
  - I/O direction
  - Assembly Instance
  - Size (byte)
  - RPI range
  - Application type

■ Communication settings for this product

The settings for cyclic communication should be in accordance with the "Settable range" shown below. For details, refer also to the above EDS files.

For details on how to set up cyclic communication using an external host device, refer to the manual for the product.

Cyclic communication setting data

Item No.	Item name		Settable range
1	Specifying Real time formats		
1.1		O→T Real time format	Heartbeat format
1.2		T→O Real time format	Modeless format
2	Forward Open parameters		
2.1		O→T RPI	10 to 10000 (milliseconds)
2.2		O→T Network Connection Parameters	0x4802 (Redundant Owner: No Connection Type: Point to Point Priority: Scheduled Fixed /Variable: Fixed Connection Size: 2 bytes)
2.3		T→O RPI	10 to 10000 (milliseconds)
2.4		T→O Network Connection Parameters	0x4802 or 0x2812 (Redundant Owner: No Connection Type: Point to Point Priority: Scheduled Fixed /Variable: Fixed Connection Size: 2 bytes)
2.5		Transport Class and Trigger	0x01 (Direction: Client Trigger: Cyclic Class: 1)
2.6		Connection_Path	20 04 24 3C 2C FE 2C 64

5.3.2 EtherNet/IP Supported Functions

- Send and receive commands to and from this product on the measurement display.

This product supports the following EtherNet/IP objects.

■ 0x01 Identity Object

Class attributes

ID	Access	Name	Remarks
1	Get	Revision	–
2	Get	Max Instance	–
3	Get	Number of Instances	Not returned by Get_Attribute_All
6	Get	Maximum ID Number Class Attributes	–
7	Get	Maximum ID Number Instance Attributes	–

Instance attributes

ID	Access	Name	Remarks
1	Get	Vendor ID	–
2	Get	Device Type	–
3	Get	Product Code	–
4	Get	Revision	–
		Major Revision	–
		Minor Revision	–
5	Get	Status	Refer to "Set status events".
6	Get	Serial Number	Returns the S/N (4-digit number) indicated on this product.
7	Get	Product Name	–

Services

ID	Service name	Class	Instance	Remarks
0x01	Get_Attribute_All	○	○	–
0x05	Reset	×	○	Parameter: Only 0 is supported. Disconnects all EtherNet/IP connections. However, this cannot be executed during cyclic communication.
0x0E	Get_Attribute_Single	○	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0x02 Message Router Object

Class attributes

ID	Access	Name	Remarks
1	Get	Revision	–
2	Get	Max Instance	Not returned by Get_Attribute_All.
3	Get	Number of Instances	Not returned by Get_Attribute_All.
6	Get	Maximum ID Number Class Attributes	–
7	Get	Maximum ID Number Instance Attributes	–

(Note 1) Although this product does not support class attribute IDs 4 and 5, it returns 0 for these attributes when Get_Attribute_All is selected.

Instance attributes

ID	Access	Name	Remarks
1	Get	Object_list	–
	Get	Number	–
	Get	Classes	–
2	Get	Number Available	The total of connections for cyclic communication and message communication is at most 16.

Services

ID	Service name	Class	Instance	Remarks
0x01	Get_Attribute_All	○	○	–
0x0E	Get_Attribute_Single	○	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0x06 Connection Manager

Class attributes

None

Instance attributes

None

Services

ID	Service name	Class	Instance	Remarks
0x4E	Forward Close	×	○	–
0x54	Forward Open	×	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0xF5 TCP/IP Interface

Class attributes

ID	Access	Name	Remarks
1	Get	Revision	–
2	Get	Max Instance	–
3	Get	Num Instance	–
6	Get	Maximum ID Number Class Attributes	–
7	Get	Maximum ID Number Instance Attributes	–

Instance attributes

ID	Access	Name	Remarks
1	Get	Status (Note 1)	–
2	Get	Configuration Capability	–
3	Get	Configuration Control	–
4	Get	Physical Link Object	–
		Path size	–
		Path	–
5	Get	Interface Configuration	–
		IP Address	–
		Network Mask	–
		Gateway Address	–
		Name Server	Not used ("0" is always returned.)
		Name Server 2	Not used ("0" is always returned.)
		Domain Name	Not used (A NULL value is always returned.)
6	Get	Host Name	Not used (A NULL value is always returned.)
13	Get/Set	Encapsulation Inactivity Timeout	1 to 3600 seconds (0: No connection timeout) Default: 120 seconds

(Note 1) Status (I/F Config Status, Pending) will not be updated if IP address, subnet mask, or default gateway is changed via other than EtherNet/IP. Status will be updated after the communication settings are reset.

(Note 2) Although this product does not support class attribute IDs 7 to 12 returns 0 for these attributes when Get_Attribute_All is selected.

Services

ID	Service name	Class	Instance	Remarks
0x01	Get_Attribute_All	×	○	–
0x0E	Get_Attribute_Single	○	○	–
0x10	Set_Attribute_Single	×	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0xF6 Ethernet Link

Class attributes

ID	Access	Name	Remarks
1	Get	Revision	–
2	Get	Max Instance	–
3	Get	Number of Instances	–

Instance attributes

ID	Access	Name	Remarks
1	Get	Interface Speed	–
2	Get	Interface Flags	–
3	Get	Physical Address	–
11	Get	Interface Capability	–
		Capability Bits	–
		Speed/Duplex Options	–
		Speed / Duplex Array Count	–
		Speed/Duplex Array	–
		Speed/Duplex Pair	–
		Interface Speed	–
		Interface Duplex Mode	–

(Note 1) Although this product does not support class attribute IDs 4 to 10, it returns 0 for these attributes when Get_Attribute_All is selected.

Services

ID	Service name	Class	Instance	Remarks
0x01	Get_Attribute_All	×	○	–
0x0E	Get_Attribute_Single	○	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0x04 Assembly Object

Class attributes

ID	Access	Name	Remarks
1	Get	Revision	–

Instance attributes (Instance ID: 100 T->O)

ID	Access	Name	Remarks
3	Get	Data	For details, refer to "5.3.3 Cyclic Communication Output Information".
4	Get	Size	

Services

ID	Service name	Class	Instance	Remarks
0x0E	Get_Attribute_Single	○	○	–

(Note 1) ○: Supported, ×: Not supported

■ 0x64 HL-G2 Object

Class attributes

None

Instance attributes (Instance ID: 1)

Refer to "5.3.5 HL-G2 Object Attribute List".

Services

ID	Service name	Class	Instance	Remarks
0x0E	Get_Attribute_Single	×	○	–
0x10	Set_Attribute_Single	×	○	–

(Note 1) ○: Supported, ×: Not supported

Note

- This product automatically detects the Speed/Duplex setting of Ethernet connections using the auto-negotiation function. Even when connecting to a fixed Speed/Duplex network that does not support the auto-negotiation function, if the connection is successful, the EthernetLink object (F6h) returns "3: Auto-negotiation successful" as Negotiation Status (2nd to 4th bits) in Interface Flags (Instance Attribute: 2).

■ Error codes

The table below lists the error codes that can occur when this product accesses the HL-G2 Object via message communication.

Check the content of the error code and, if there is an error in the send data, correct the error.

If there is no error in the send data, power cycle the product or external device.

For error codes that can occur when the product accesses other objects, refer to the EtherNet/IP Specification, "**THE CIP NETWORKS LIBRARY**".

Error code	Description	Countermeasure
0x08	Service ID not supported	Review the service ID.
0x05	Path destination unknown error	Review the combination of class ID and instance ID.

Error code	Description	Countermeasure
0x10	Not in executable state	Review the state of this product.
0x14	Attribute not supported	Review the attribute ID.
0x0E	Attribute cannot be written	Review the service ID or attribute ID.
0x2C	Attribute cannot be read	Review the service ID or attribute ID.
0x20	Request parameter invalid	Review the value to be written to the attribute and the size of the send data to be included in the message.
0x19	Command execution error	Review the state of this product.

■ Set status events

Set status event	Bit 4 to Bit 7	Bit 8	Bit 9	Bit 10	Bit 11
Cumulative operation hours exceeded	-	0	1	0	0
Number of writes to internal memory exceeded	-	0	1	0	0
Internal memory access error (user area)	5	0	0	1	0
Dark level adjustment error	5	0	0	0	1
Communication start processing error	5	0	0	0	1
CPU error	5	0	0	0	1
Internal memory access error (system area)	5	0	0	0	1
Internal access error	5	0	0	0	1
Start processing error	5	0	0	0	1
Beam-emitting circuit error	5	0	0	0	1

5.3.3 Cyclic Communication Output Information

This product uses the cyclic communication function to cyclically send measured values and the operating status of this product to external devices.

The contents of the data to be sent during cyclic communication (same as the contents returned by 0x04 Assembly Object - Instance ID: 100 - Attribute ID: 3) are shown below.

Cyclic Communication Output Information

Byte position	Bit position	Description	Remarks
0 to 3	-	Measured value	The measured value is output in little endian as a 4-byte signed integer value in increments of 0.1 µm. Any numbers after the digit of 0.01 µm are rounded down.
4.5	0	Alarm state	–
	1	Data in an indeterminate state	–
	2	Judgment output state (HI)	–
	3	Judgment output state (GO)	–
	4	Judgment output state (LO)	–
	5	Judgment output state at timer OFF (HI)	No more than one bit position is turned ON at the same time.
	6	Judgment output state at timer OFF (GO)	
	7	Judgment output state at timer OFF (LO)	
	8	Hold state	–
	9	Zero setting state	Turns ON when the "Zero set" setting is enabled.
	10	Laser state	Turns ON when the laser is turned on.
	11	Self-monitoring: Error	Turns ON when either byte position 10 or 11 is ON.
	12	Self-monitoring: Caution	Turns ON when "Self-monitoring: Error" is OFF and either byte position 8 or 9 is ON.
	13	Self-monitoring: Notification	Turns ON when any of byte positions 6 to 11 is ON.
	14.15	(Reserved)	–
6.7	0	Excessive intensity of received light	–
	1	Insufficient intensity of received light	–
	2	Outside the measurement range	–
	3	Excessive extraneous light	–
	4 to 15	(Reserved)	–
8.9	0	Cumulative operation hours exceeded	–

Byte position	Bit position	Description	Remarks
	1	Number of writes to internal memory exceeded	–
	2 to 15	(Reserved)	–
10.11	0	Beam-emitting circuit error	–
	1	(Reserved)	–
	2	System error	Turns ON when an E1xx error occurs.
	3 to 15	(Reserved)	–
12.13	–	Peak intensity of received light	The peak intensity of received light is output in little endian as a 2-byte unsigned integer value. The range of the output values is as follows. Normal: 0 to 1023 Indeterminate: 0xFFFF
14.15	–	(Reserved)	–

Note

- For details on "Notification" (byte positions 6 and 7), "Caution" (byte positions 8 and 9), and "Error" (byte positions 10 and 11), refer to "4.13 Self-monitoring".
- It may take several milliseconds to several seconds for this product to save set values depending on the condition. While the set values are being saved, the transmission processing is suspended. Therefore, messages may not be sent in the cyclic communication cycle.

5.3.4 Message Communication Commands

The message communication function allows data to be sent and received at a desired timing.

It performs message communication by issuing a service based on the specified class, instance, attribute, etc. For information on the classes, instances, attributes, and services that can be used with this product, refer to "5.3.2 EtherNet/IP Supported Functions".

- Send and receive commands to and from this product on the measurement display.

5.3.5 HL-G2 Object Attribute List

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
2304	Sensor state	Notifies the state of this product.	Refer to byte positions 4 and 5 in "5.3.3 Cyclic Communication Output Information".	Get	2
2305	Self-monitoring detail: Notification	Notifies that an issue that occurs during normal use, such as a setting error or a drop in received light intensity, is detected.	Refer to byte positions 6 and 7 in "5.3.3 Cyclic Communication Output Information".	Get	2
2306	Self-monitoring detail: Caution	Notifies that sensor replacement is recommended because the saving count has exceeded the upper limit, for example.	Refer to byte positions 8 and 9 in "5.3.3 Cyclic Communication Output Information".	Get	2
2307	Self-monitoring detail: Error	Notifies that sensor replacement or wiring check is required due to component damage or wiring breakage or for some other reason.	Refer to byte positions 10 and 11 in "5.3.3 Cyclic Communication Output Information".	Get	2
2308	Error code	Used for reading the error code.	-	Get	2
2311	Measured value	Used for reading the measured value. This value is expressed as an integer value in increments of 0.1 µm.	-	Get	4
2312	Zero Setting	Forcibly sets the measured value to zero. Read: Zero setting state Write: Switching zero set setting	0: OFF 1: ON	Get/Set	1
2313	Set value saving	Saves the settings.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2314	Measured value resetting	Resets the measured value.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2315	Bank switching	Switches the bank in which the set values are to be saved.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4	Get/Set	1
2316	Bank copy	Copies the settings saved in one bank to another bank.	0: Copy from Bank 1 to Bank 2 1: Copy from Bank 1 to Bank 3 2: Copy from Bank 1 to Bank 4 3: Copy from Bank 2 to Bank 1	Set	1

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
			4: Copy from Bank 2 to Bank 3 5: Copy from Bank 2 to Bank 4 6: Copy from Bank 3 to Bank 1 7: Copy from Bank 3 to Bank 2 8: Copy from Bank 3 to Bank 4 9: Copy from Bank 4 to Bank 1 10: Copy from Bank 4 to Bank 2 11: Copy from Bank 4 to Bank 3		
2317	Settings initialization	Initializes each setting.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4 5: All Banks 6: All Areas	Set	1
2321	Language setting	Sets the language to be displayed on the display section.	0: English 1: Japanese 2: Simplified Chinese	Get/Set	1
2318	HIGH set value	Sets the HIGH set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	Get/Set	4
2319	LOW set value	Sets the LOW set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000	Get/Set	4

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
			120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000		
2320	Hysteresis	Sets the hysteresis. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 0, Max. value: 95,000 50 mm type: Min. value: 0, Max. value: 950,000 85 mm type: Min. value: 0, Max. value: 950,000 120 mm type: Min. value: 0, Max. value: 950,000 250 mm type: Min. value: 0, Max. value: 9,500,000	Get/Set	4
2322	Key lock	Disables key operation.	0: Disable key lock 1: Enable key lock	Get/Set	1
2323	Eco mode	Turns OFF the display section when not operated to save electricity.	0: OFF 1: ON	Get/Set	1
2324	Alarm delay count	Delays the notification until the set sampling count is reached for alarm notification due to detection of an unmeasurable state.	0: Alarm detection notification OFF 1 to 65535 (times)	Get/Set	2
2325	Display Digit	Sets the number of digits to be displayed for the measured value. The number of digits varies depending on the distance type.	[30 mm distance type] 0: Display 4 digits after the decimal point 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point [50 mm / 85 mm / 120 mm distance type] 1: Display 3 digits after the decimal point	Get/Set	1

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
			2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point [250 mm distance type] 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point		
2326	Display Inversion	Inverts the organic EL display upside down.	0: Default 1: Inverted	Get/Set	1
2327	Sampling Frequency	Changes the sampling cycle according to the moving speed of the object.	0: 100 µs 1: 200 µs 2: 500 µs 3: 1ms 4: 2 ms	Get/Set	2
2328	Average Times	This drop-down list allows the user to set a moving average count.	0: 1 time 1: 4 times 2: 16 times 3: 64 times 4: 256 times 5: 512 times 6: 1024 times	Get/Set	2
2329	Hold mode	Sets the method for holding measured values.	0: None (Normal mode) 1: Peak hold 2: Bottom hold 3: Peak-to-peak hold	Get/Set	2
2330	Span	Multiplies the measured value after zero setting by a span (factor) and outputs the result. This value is expressed as an integer value multiplied by 10,000.	1000 to 99999	Get/Set	4
2331	Offset	Sets the offset value. The minimum value and maximum value vary depending on the distance type.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000	Get/Set	4

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
		This value is expressed as an integer value in increments of 0.1 µm.	85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000		
2332	Tolerance	Sets the tolerance. The minimum value and maximum value vary depending on the distance type.(Note 3) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 1, Max. value: 95,000 50 mm type: Min. value: 10, Max. value: 950,000 85 mm type: Min. value: 10, Max. value: 950,000 120 mm type: Min. value: 10, Max. value: 950,000 250 mm type: Min. value: 100, Max. value: 9,500,000	Get/Set	4
2333	Output delay timer selection	Sets the ON to OFF or OFF to ON timing for the measured value judgment result.	0: OFF 1: On Delay 2: Off Delay 3: One Shot 4: Hold	Get/Set	1
2334	Output delay timer setting	Sets the delay time when On Delay or Off Delay is selected for Output delay timer selection, or the judgment holding time when One Shot is selected for it.	1 to 100 (Unit: milliseconds)	Get/Set	2
2335	Inversion of Measured Value	Switches the positive/negative direction of the measured value.	0: Normal 1: Reverse	Get/Set	1
2336	Alarm digital output	Sets the digital output state at alarm occurrence.	0: Hold 1: In Alarm state	Get/Set	1
2337	Brightness Tuning	Sets the laser beam brightness adjustment method depending on the target workpiece to be measured.	0: OFF 1: ON	Get/Set	1
2338	Trigger input (external input)	Used for reading the trigger input state by external input.	0: OFF 1: ON	Get	1
2339	Hold state	Used for reading the hold state of the measured value.	0: Release 1: Hold	Get	1
2340	Trigger mode	Sets the method for holding the final measured value.	0: Hold 1: One Shot	Get/Set	1

Attribute (dec)	Data item	Description	Set value	Access	Size (bytes)
2341	Trigger input (communication)	Sets trigger input.	0: OFF 1: ON	Get/Set	1
2342	Teaching execution state	Used for reading the teaching state.	0: Not executed 1: Being executed 2: Success 3: Failed	Get	1
2343	Teaching Mode	Sets the teaching method.	1: 1 point 2: 2 points 3: 3 points	Get/Set	1
2344	Execution of teaching	Used for executing or interrupting teaching.	0: Interrupt teaching 1: Start teaching	Set	1
2345	Teaching 1st point setting	Used for executing teaching for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2346	Teaching 2nd point setting	Used for executing teaching for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2347	Teaching 3rd point setting	Used for executing teaching for the 3rd point.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2348	Brightness Tuning execution state	Used for reading the brightness tuning execution state.	0: Not executed 1: 1st point being executed 2: 2nd point being executed 3: Success 4: Failed	Get	1
2349	Brightness Tuning 1st point setting	Used for executing brightness tuning for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2350	Brightness Tuning 2nd point setting	Used for executing brightness tuning for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	Set	1
2351	Laser Stop	Sets ON/OFF of laser emission.	0: OFF (Laser emitted) 1: ON (Emission stopped)	Get/Set	1

(Note 1) Do not specify 1 to 255.

(Note 2) Be sure to set a HIGH set value that is greater than the LOW set value.

The HIGH set value and the LOW set value cannot be set to values that make the difference between them to be a value that is equal to or less than twice the hysteresis.

(Note 3) Be sure to set a tolerance value that is greater than the hysteresis value.

Note

- When the measured value is above the positive limit of the display range, "+9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is below the negative limit of the display range, "-9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is indeterminate, "-9,999,999 (in increments of 0.1 µm)" is output.
- In an alarm state, "+9,999,999 (in increments of 0.1 µm)" is output. However, this excludes cases where Alarm digital output is set to "Hold"

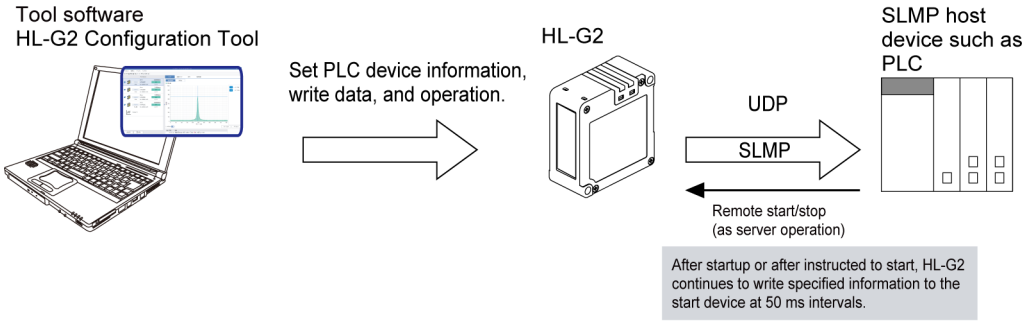
5.4 SLMP

■ Overview

SLMP has the following two types of functions.

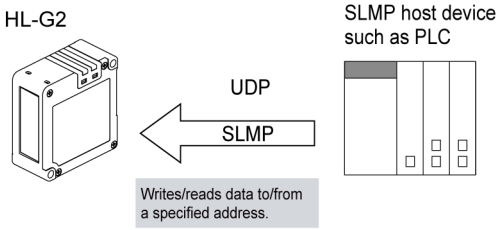
■ Client functions

Clients write data of this product to an external host device cyclically.



■ Server functions

This product functions as a server to receive commands from an external host device and return a response.



5.4.1 SLMP Setting Method

After selecting "Ethernet communication setting" in the Setting mode of this product, some additional settings are required depending on the communication protocol to be used.

For how to select "Ethernet communication setting", refer to "5.1.1 Connection and Setting Method".

Setting item	Description	Set value	Default value
IP Address	Set the IP address.	000,000,000,000 to 255,255,255,255	192.168.1.6
Subnet Mask	Set the subnet mask.	000,000,000,000 to 255,255,255,255	255.255.255.0
Default Gateway	Set the default gateway.	000,000,000,000 to 255,255,255,255	192.168.1.1
Port No.(Tool)	Set the port number of this product for connecting the tool software **HL-G2 Configuration Tool**.	1 to 65535(Note 1)(Note 2)	49152
Port No. (Modbus)	Set the port number of this product for connecting an external host device via Modbus TCP.	No need to set	-
Port No.(SLMP)	Set the port number of this product for connecting an external host device via the SLMP server function.(Note 3)	1 to 65535(Note 4)(Note 5)	45237
Network No.	Set the network number and node number of the SLMP that communicates with this product.(Note 6)(Note 7)	0 to 239	0
Node No.		255/1 to 120/125/126	255

(Note 1) The set value "44818" cannot be specified because it is used for other purposes.

(Note 2) The same number cannot be specified for "Port No. (Tool)" and "Port No. (Modbus)".

(Note 3) Change the port number depending on the external communication device to be used.

(Note 4) The set values”2222”, “9090”, and “44818” cannot be specified because they are used for other purposes.

(Note 5) The same number as "Request source Port No." in "Client communication setting" cannot be specified.

(Note 6) If the network number is 0, the node number cannot use any numbers other than 255.

(Note 7) If the network number is 1 to 239, the node number must be set to a number between 1 to 120, or 125 or 126.

■ IP setting conditions

1. IP Address
   - The first octet cannot be set to 0, 127, or 224 to 255.
2. Subnet Mask
   - When each octet is expressed in binary notation and viewed from the first octet, the subnet mask must start with a series of 1's followed by a series of 0's in all remaining octets.
3. Combination of IP Address and Subnet Mask
   - All bits in the host address segment of the IP address cannot be set to 0's.

- All bits in the host address segment of the IP address cannot be set to 1's.
- All bits in the network address segment of the IP address cannot be set to 0’s.

4. Default Gateway
   - The first octet cannot be set to 0, 127, or 224 to 255.
     (However, 0.0.0.0 can be set.)
5. Combination of Default Gateway and Subnet Mask
   - All bits in the host address segment of the default gateway cannot be set to 0’s.
   - All bits in the host address segment of the default gateway cannot be set to 1’s.
6. Combination of IP Address, Subnet Mask, and Default Gateway
   - The default gateway and the IP address must exist in the same network segment (subnet).

5.4.2 SLMP Supported Functions

- Send and receive commands to and from this product on the measurement display.

This section describes the details of various functions of the Seamless Message Protocol (SLMP) supported by this product.

■ Common specifications

- User Datagram Protocol (UDP) is used for sending and receiving SLMP messages
- Binary mode is used for formats of SLMP messages.
- Parameters of SLMP messages including the device number, number of devices, read data, write date comply with the SLMP standard.
- Since the UDP is a protocol that does not require connections, no new connections are required to be set up in advance.
- Since the UDP port is dedicated to the SLMP, simultaneous connection and communication is possible with other protocols (Modbus TCP and EtherNet/IP) of this product.
- Reads and writes read/set parameters that can be operated by the user.
- Communication settings of this product must be made to enable the client and server functions.

  For the communication setting method, refer to "5.4.1 SLMP Setting Method".

■ Server functions

Type	Operation	Processing
Internal memory	Batch read	Reads values from consecutive devices with the start device number specified.
	Batch write	Writes values to consecutive devices with the start device number specified.
	Random read	Reads values from devices with the device numbers specified. Non-consecutive device numbers can be specified at random.
	Random write	Writes values to devices with the device numbers specified. Non-consecutive device numbers can be specified at random.
Remote control	Remote RUN	Starts cyclic writing from this product to an external device.
	Remote STOP	Stops cyclic writing from this product to an external device.
	Processor type read	Returns the model name and model code of this product as a response.
Wrap test		Responds to a wrap test request.
Device connection	Connected device detection	Responds to a device detection request.
	Connected device IP address setting	Sets the IP addresses of connected devices in this product.

Type	Operation	Processing
Parameter setting	Device information comparison	Responds to a device information comparison request.

■ Client functions

Type	Operation	Processing
Internal memory	Batch write	This product uses this command to perform cyclic writing. The device code of the write destination is fixed to "Data register (A8H)".

■ Combination of network numbers and station numbers

Network number (N)	Station number (M)	Remarks
0 (00H)	255(FFH)	Indicates the local station (connected station).
		Supported by ST type, MT type, and LMT type SLMP messages.
		If the network number is 0, the station number cannot use any number other than 255.
1 to 239(01H to EFH)	1 to 120 (01H to 78H) 125 (7DH),126 (7EH)	Indicates another station
		Supported by ST type and MT type SLMP messages.
		LMT type SLMP messages are not supported (only used by the local station).

Note

- The following are cases where request messages received by the server function are accepted.
  - The request message addressed to the local station (combination of network No. = 0, station No. = 255, and processor No. = 03FFH) is accepted.
  - When the request message is addressed to other nodes (combination of network No. = N, node No. = M, and processor No. = 03FFH), it is accepted if the network No. and node No. coincide with those of this product.
- It may take several milliseconds to several seconds for this product to save set values depending on the condition.

  While the set values are being saved, the transmission processing is suspended. Therefore, messages may not be sent in the cycle of cyclic writing.

5.4.3 SLMP Supported Commands

- Send and receive commands to and from this product on the measurement display.

■ Server function supported command list

Type	Operation	Command name	Command code (Hex)	Supported PDU Type(Note 1)			
				ST	MT	EMT	LMT
Internal memory	Batch read	Read	0401H	○	○	-(Note 2)	△
	Batch write	Write	1401H	○	○	-(Note 2)	△
	Random write	Write Random	1402H	○	○	-(Note 2)	△
	Random read	Read Random	0403H	○	○	-(Note 2)	△
Remote control	Remote RUN	Remote Run	1001H	○	○	-(Note 2)	△
	Remote STOP	Remote Stop	1002H	○	○	-(Note 2)	△
	Processor type read	Read Type Name	0101H	○	○	-(Note 2)	△
Wrap test		Self Test	0619H	○	○	-(Note 2)	△
Device connection	Connected device detection	Node Search	0E30H	-(Note 2)	○	-(Note 2)	-(Note 2)
	Connected device IP address setting	IP Address Set	0E31H	-(Note 3)	○	-(Note 2)	△
Parameter setting	Device information comparison	Device Info Compare(Note 4)	0E32H	-(Note 3)	○	-(Note 2)	-(Note 3)

(Note 1) ○: Supported

△: Supported with restrictions (Expanded node numbers are not supported. Only local nodes are supported. Message splitting is not supported).

-: Not covered by specifications

(Note 2) No response is returned.

(Note 3) The complete code C05CH is returned in the requested type.

(Note 4) Type name code: 0109H

Vendor code: 02000008H

Note

- For device types that can be specified with this product, refer to "List of Supported Device Codes".
- **Mode**and**Clear mode**of the**Remote Run**command are not supported. The command is always executed forcibly and does not clear internal memory.
- This product does not support IPv6. It does not return a response after receiving an IPv6 format address from the**Node Search**command.

  It returns the complete code C05CH after receiving an IPv6 format address from the**IP Address Set**.

■ Client function supported command list

Type	Operation	Command name	Command code (Hex)	Supported PDU Type(Note 1)			
				ST	MT	EMT	LMT
Internal memory	Batch write	Write	1401H	×	○	-	×

(Note 1) ○: Supported
×: Not supported
-: Not covered by specifications

Note

- The method to start "Cyclic writing" of the client functions is as follows.

  [Start]
  - Using the tool software **HL-G2 Configuration Tool**, set "Automatic writing after starting" to "ON", and then restart this product. Automatic writing starts.
  - Using the "Remote RUN" button of the tool software **HL-G2 Configuration Tool**, you can start writing at a desired timing.
  - By sending the SLMP command "Remote Run" from the external host device to this product, it is possible to start writing at a desired timing.

  [Stop]
  - Using the tool software **HL-G2 Configuration Tool**, set "Automatic writing after starting" to "OFF", and then restart this product. Automatic writing stops.
  - Using the "Remote STOP" button of the tool software **HL-G2 Configuration Tool**, you can stop the started writing at a desired timing.
  - By sending the SLMP command "Remote Stop" from the external host device to this product, it is possible to stop the started writing at a desired timing.

  [Other constraints]
  - The product does not accept the "Remote Run" command while executing cyclic writing. (It returns an error.)
  - "Automatic writing after starting" cannot be stopped by the "Remote Stop" command.
  - While executing cyclic writing, this product does not accept changes to the "Request destination IP address", "Request destination port No.", "Request destination processor number", "Request destination network number", "Station number", "Request source port No.", and "Write interval". (It returns an error.)

■ List of Supported Device Codes

The device codes that can be accessed by the SLMP request message in the receiving process and access units are as follows:

Device name	Size unit	Device code	Base	Target	RW in bit unit	RW in word unit	RW in double word unit
Data register	Word	A8H	Decimal	Refer to "5.4.4 "Data Register" Device Number List".	×	○	○
Output	Bits	9DH	Hexade cimal	Sensor status and detailed information of self monitoring	○	×	×

- To read/write data from/to the data register in units of double words, allocate the specified device number to the lower bytes and the specified device number + 1 to the higher bytes.

- If any address (device number) that is not listed in the device number list is contained, an error is returned.
- If writing data to an address (device number) with a read-only attribute, an error is returned.

■ Cyclic writing

Before executing cyclic writing, configure the"Client communication settings"and"Client send data settings"below.

For details on the setting method, refer to the User's Manual for the tool software**HL-G2 Configuration Tool**.

Client communication setting

No.	Setting item	Description	Set value	Default value
1	Request destination IP address	Write destination IP address for cyclic writing	000.000.000.000 to 255.255.255.255	192.168.1.100
2	Request destination port No.	Write destination UDP port number for cyclic writing	1 to 65535	45237
3	Request destination processor number	Write destination processor number for cyclic writing	1 to 65535	03FFH
4	Request destination network number	Write destination network number for cyclic writing	0 or 1 to 239	0
5	Request destination station number	Write destination node number for cyclic writing	When network number is 0: 255 When network number is other than 0: 1 to 120, or 125 or 126	255
6	Request source port No.	UDP port number of this product for cyclic writing	1 to 65535(Note 1)	45238
7	Write interval	Write interval for cyclic writing (ms)	50 to 10000(Note 2)	500

No.	Setting item	Description	Set value	Default value
8	Automatic writing after starting	Automatically starts cyclic writing when the product is started	ON/OFF	OFF

(Note 1) The set values 2222, 9090, and 44818 cannot be specified because they are used for other purposes. In addition, the same number as "Port No. (SLMP)" cannot be specified.

(Note 2) The set value must be specified in increments of 10 ms.

The following table shows data to be written by a SLMP request message in cyclic writing of the client functions. The write device is fixed to"Data register".

The data to be written to external devices is created in the order of the items in the table below, with unselected items removed from output and then subsequent items moved up. There are also data items to be output together when a certain data item is selected.

List of cyclic writing data items

Write data	Size (byte)	Details / Remarks	Number of devices
Measured value	4	The value is output in little endian in increments of 0.1 μm. Any numbers after the digit of 0.01 μm are rounded down.	2
Decimal point position (for measured value)	2	Output when the measured value is selected. All types: 10,000 (fixed value) Value for dividing and converting the measured value to mm units	1
Internal status	2	Bit 0 Alarm state Bit 1 Data indeterminate state Bit 2 Judgment output state (HI) Bit 3 Judgment output state (GO) Bit 4 Judgment output state (LO) Bit 5 Judgment output state at timer OFF (HI) Bit 6 Judgment output state at timer OFF (GO) Bit 7 Judgment output state at timer OFF (LO) Bit 8 Hold state Bit 9 Zero setting state Bit 10 Laser state Bit 11 Self-monitoring: Error Bit 12 Self-monitoring: Caution Bit 13 Self-monitoring: Notification Bit 14 - Bit 15 -	1
Notification	2	Detailed information of "Notification" specified by the self-monitoring function Bit 0 Excessive intensity of received light Bit 1 Insufficient intensity of received light Bit 2 Outside the measurement range Bit 3 Excessive extraneous light Bit 4 - Bit 5 - Bit 6 - Bit 7 - Bit 8 -	1

Write data	Size (byte)	Details / Remarks	Number of devices
		Bit 9 - Bit 10 - Bit 11 - Bit 12 - Bit 13 - Bit 14 - Bit 15 -	
Caution	2	Detailed information of "Caution" specified by the self-monitoring function Bit 0: Cumulative operation hours exceeded Bit 1 Number of writes to internal memory exceeded Bit 2 - Bit 3 - Bit 4 - Bit 5 - Bit 6 - Bit 7 - Bit 8 - Bit 9 - Bit 10 - Bit 11 - Bit 12 - Bit 13 - Bit 14 - Bit 15	1
Error	2	Detailed information of "Error" specified by the self-monitoring function Bit 0 Beam-emitting circuit error Bit 1 - Bit 2 System error Bit 3 - Bit 4 - Bit 5 - Bit 6 - Bit 7 - Bit 8 - Bit 9 - Bit 10 - Bit 11 - Bit 12 - Bit 13 - Bit 14 - Bit 15 -	1
Peak intensity of received light	2	0 to 1023 (0000H to 03FFH): FFFFH in the indeterminate state	1

Write data	Size (byte)	Details / Remarks	Number of devices
Update flag (Count)	2	Output when one of the following is selected: measured value, peak intensity of received light, internal status, or detailed information. ● 1 to 65535: Incremented when writing the following to the PLC as client operation: measured value, internal status, detailed information, or peak intensity of received light ● Starts from 1 when 65535 is reached.	1
Current set bank No.	2	Bank No. currently set.(unsigned integer type)	1
Label data	MAX 128	The label strings being held are output in the following format: ● 1st byte: Data length of label string ● 2nd byte to n-th byte: Label string data ● If n is odd: the (n+1)th byte is padded with 00H to make it an even number of bytes in total. ● The above data is packed every 2 bytes to match the data register size (2 bytes). When packing, the (2m-1)th byte is set to the lower byte of the data register and the 2mth byte is set to the upper byte.	MAX 64

Note

- For detailed information on "Notification", "Caution", and "Abnormality", refer to "4.13 Self-monitoring".

■ Supported complete codes

No.	Use case when an error occurs	Complete code
1	The received SLMP request message has been properly processed.	0000H
2	The received SLMP request message is either one of the following. ● Command is non-compliant. ● Subcommand combination is non-compliant.	C059H
3	● The network number and node number of the received SLMP request message are addressed to other nodes and are different from the values of this product. ● There is an error in the request message. ● The write result is no good. ● A RUN request was made when the IP address, port number, or cycle of the write destination was “0”. ● The return data of the return test exceeds 960 bytes. ● The host name of the server set by 0E31H exceeds 32 bytes.	C05CH
4	The request data size of the request message does not match the request message size.	C061H
5	● The request cannot be processed because another function is in operation. ● A RUN request was received during a cyclic write operation at startup. ● A STOP request was received during a cyclic write operation at startup. ● A RUN request was received during an arbitrary write operation.	CEE0H
6	● The number of devices (number of points) of the request command is larger than 144 (total value of the number of word access points and the number of double word access points in the case of Read Random / Write Random).	CEE1H

No.	Use case when an error occurs	Complete code
	● The request message size exceeds 1472 bytes.	
7	The response message exceeds 1472 bytes.	CEE2H
8	● The combination of the IP address, subnet mask, and default gateway set by 0E31H is illegal. ● The communication protocol of the server's communication partner unit set by 0E31H is other than UDP(1).	CF20H
9	Received a LMT type PDU whose total number of divisions and division number are other than 0.	CF44H

Note

- When the request message size exceeds 1472 bytes, CEE1H is returned.
- The upper limit of the number of device points shall be 144.

Operation of multiple device access commands in the event of an error

In SLMP communication, there are a bulk read command and a bulk write command that allow a consecutive access to multiple devices by specifying the start device number and the number of devices.

There are also a random read command and a random write command that allow an access to optional multiple devices by individually specifying multiple device numbers.

If an error occurs when accessing some or all devices, these commands will operate as follows.

■ Bulk read and random read commands

1. If the following condition is met, read processing does not start and an error response is returned.
   - This product is not ready to read from devices.
2. Even if any of the following conditions are met, read processing continues as if the value 0 were read. However, it is not counted in the number of successful reads.
   - The specified device number does not exist.
   - There is no read attribute in the specified device number.
3. If the number of successful reads is not 0, a normal response is returned. If it is 0, an error response is returned.

■ Bulk write and random write commands

1. If the following condition is met, write processing does not start and an error response is returned.
   - This product is not ready to write to devices.
2. If there is even one device that meets any of the following conditions, data is not written to all registers and an error response is returned.
   - The specified device number does not exist.
   - The specified write value is invalid (out of range, inconsistent).
3. Even if the following condition is met, write processing continues, ignoring the device number. However, it is not counted in the number of successful writes.
   - There is no write attribute in the specified device number.
4. If the following condition is met, write processing is interrupted and an error response is returned.
   - Write to the specified device number failed.
5. If the number of successful writes is not 0, a normal response is returned. If it is 0, an error response is returned.

5.4.4 "Data Register" Device Number List

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
10	Sensor state	Notifies the state of this product.	The byte positions 0H to FH in "5.4.5 "Output" Device Number List" are arranged in numbered order from the upper bits.	R	2
11	Self-monitoring detail: Notification	Notifies if the detection status is unstable.	The byte positions 10H to 1FH in "5.4.5 "Output" Device Number List" are arranged in numbered order from the upper bits.	R	2
12	Self-monitoring detail: Caution	Notifies if the detection state is "Caution".	The byte positions 20H to 2FH in "5.4.5 "Output" Device Number List" are arranged in numbered order from the upper bits.	R	2
13	Self-monitoring detail: Error	Notifies if the detection state is "Error".	The byte positions 30H to 3FH in "5.4.5 "Output" Device Number List" are arranged in numbered order from the upper bits.	R	2
14	Error code	Used for reading the error code.	-	R	2
19	Measured value	Used for reading the measured value. This value is expressed as an integer value in increments of 0.1 µm. Any numbers after the digit of 0.01 µm are rounded down. The value is output in little endian in increments of 0.1 µm.	-	R	4
21	Peak intensity of received light	Used for reading the peak intensity of received light.	When normal: 0 to 1023 Indeterminate: 65535	R	2
51	Zero Setting	Forcibly sets the measured value to zero. Read: Zero setting state Write: Switching zero set setting	0: OFF 1: ON	RW	1
53	Set value saving	Saves the settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
55	Measured value resetting	Resets the measured value.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
57	Bank switching	Switches the bank in which the set values are to be saved.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4	RW	1
59	Bank copy	Copies the settings saved in one bank to another bank.	0: Copy from Bank 1 to Bank 2 1: Copy from Bank 1 to Bank 3 2: Copy from Bank 1 to Bank 4 3: Copy from Bank 2 to Bank 1 4: Copy from Bank 2 to Bank 3 5: Copy from Bank 2 to Bank 4 6: Copy from Bank 3 to Bank 1 7: Copy from Bank 3 to Bank 2 8: Copy from Bank 3 to Bank 4 9: Copy from Bank 4 to Bank 1 10: Copy from Bank 4 to Bank 2 11: Copy from Bank 4 to Bank 3	W	1
61	Settings initialization	Initializes each setting.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4 5: All Banks 6: All Areas	W	1
70	Language setting	Sets the language to be displayed on the display section.	0: English 1: Japanese 2: Simplified Chinese	RW	1
100	HIGH set value	Sets the HIGH set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000	RW	4

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
			120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000		
102	LOW set value	Sets the LOW set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
104	Hysteresis	Sets the hysteresis. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 0, Max. value: 95,000 50 mm type: Min. value: 0, Max. value: 950,000 85 mm type: Min. value: 0, Max. value: 950,000 120 mm type: Min. value: 0, Max. value: 950,000 250 mm type: Min. value: 0, Max. value: 9,500,000	RW	4
107	Key lock	Disables key operation.	0: Disable key lock 1: Enable key lock	RW	1
108	Eco mode	Turns OFF the display section when not operated to save electricity.	0: OFF 1: ON	RW	1
109	Alarm delay count	Delays the notification until the set sampling count is reached for alarm notification due to detection of an unmeasurable state.	0: Alarm detection notification OFF 1 to 65535 (times)	RW	2
110	Display Digit	Sets the number of digits to be displayed for the measured value. The number of digits varies depending on the distance type.	[30 mm distance type] 0: Display 4 digits after the decimal point	RW	1

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
			1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point [50 mm / 85 mm / 120 mm distance type] 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point [250 mm distance type] 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point		
111	Display Inversion	Inverts the organic EL display upside down.	0: Default 1: Inverted	RW	1
112	Sampling Frequency	Changes the sampling cycle according to the moving speed of the object.	0: 100 µs 1: 200 µs 2: 500 µs 3: 1ms 4: 2 ms	RW	2
113	Average Times	This drop-down list allows the user to set a moving average count.	0: 1 time 1: 4 times 2: 16 times 3: 64 times 4: 256 times 5: 512 times 6: 1024 times	RW	2
114	Hold mode	Sets the method for holding measured values.	0: None (Normal mode)	RW	2

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
			1: Peak hold 2: Bottom hold 3: Peak-to-peak hold		
115	Span	Multiplies the measured value after zero setting by a span (factor) and outputs the result. This value is expressed as an integer value multiplied by 10,000.	1000 to 99999	RW	4
117	Offset	Sets the offset value. The minimum value and maximum value vary depending on the distance type. This value is expressed as an integer value in increments of 0.1 μm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
119	Tolerance	Sets the tolerance. The minimum value and maximum value vary depending on the distance type.(Note 3) This value is expressed as an integer value in increments of 0.1 μm.	30 mm type: Min. value: 1, Max. value: 95,000 50 mm type: Min. value: 10, Max. value: 950,000 85 mm type: Min. value: 10, Max. value: 950,000 120 mm type: Min. value: 10, Max. value: 950,000 250 mm type: Min. value: 100, Max. value: 9,500,000	RW	4
121	Output delay timer selection	Sets the ON to OFF or OFF to ON timing for the measured value judgment result.	0: OFF 1: On Delay 2: Off Delay 3: One Shot 4: Hold	RW	1
122	Output Delay Timer Setting	Sets the delay time when On Delay or Off Delay is selected for Output delay timer selection, or the judgment holding time when One Shot is selected for it.	1 to 100 (Unit: milliseconds)	RW	2

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
123	Inversion of Measured Value	Switches the positive/negative direction of the measured value.	0: Normal 1: Reverse	RW	1
124	Alarm digital output	Sets the digital output state at alarm occurrence.	0: Hold 1: In Alarm state	RW	1
125	Brightness Tuning	Sets the laser beam brightness adjustment method depending on the target workpiece to be measured.	0: OFF 1: ON	RW	1
127	Trigger input (external input)	Used for reading the trigger input state by external input.	0: OFF 1: ON	R	1
128	Hold mode	Used for reading the hold state of the measured value.	0: Release 1: Hold	R	1
129	Trigger mode	Sets the method for holding the final measured value.	0: Hold 1: One Shot	RW	1
130	Trigger input (communication)	Sets trigger input.	0: OFF 1: ON	RW	1
132	Teaching execution state	Used for reading the teaching state.	0: Not executed 1: Being executed 2: Success 3: Failed	R	1
133	Teaching Mode	Sets the teaching method.	1: 1 point 2: 2 points 3: 3 points	RW	1
135	Execution of teaching	Used for executing or interrupting teaching.	0: Interrupt teaching 1: Start teaching	W	1
137	Teaching 1st point setting	Used for executing teaching for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
139	Teaching 2nd point setting	Used for executing teaching for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
141	Teaching 3rd point setting	Used for executing teaching for the 3rd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
143	Brightness Tuning execution state	Used for reading the brightness tuning execution state.	0: Not executed 1: 1st point being executed 2: 2nd point being executed 3: Success 4: Failed	R	1
145	Brightness Tuning 1st point setting	Used for executing brightness tuning for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1

Device number (dec)	Data item	Description	Set value	Attribute	Size (bytes)
147	Brightness Tuning 2nd point setting	Used for executing brightness tuning for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
149	Laser Stop	Sets ON/OFF of laser emission.	0: OFF (Laser emitted) 1: ON (Emission stopped)	RW	1
170	Resetting communication settings	Reflects the Ethernet or RS-485 settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	2

(Note 1) Do not specify 1 to 255.

(Note 2) Be sure to set a HIGH set value that is greater than the LOW set value.

The HIGH set value and the LOW set value cannot be set to values that make the difference between them to be a value that is equal to or less than twice the hysteresis.

(Note 3) Be sure to set a tolerance value that is greater than the hysteresis value.

Note

- When the measured value is above the positive limit of the display range, "+9,600,000 (in increments of 0.1 μm)" is output.
- When the measured value is below the negative limit of the display range, "-9,600,000 (in increments of 0.1 μm)" is output.
- When the measured value is indeterminate, "-9,999,999 (in increments of 0.1 μm)" is output.
- In an alarm state, "+9,999,999 (in increments of 0.1 μm)" is output. However, this excludes cases where Alarm digital output is set to "Hold"

5.4.5 "Output" Device Number List

Device number (Hex)	Data item	Description	Attribute
0H	Alarm state	0: Not in Alarm state 1: In Alarm state	R
1H	Data in an indeterminate state	0: Not in Indeterminate state 1: Indeterminate state	R
2H	Judgment output state (HI)	0: OFF 1: ON	R
3H	Judgment output state (GO)	0: OFF 1: ON	R
4H	Judgment output state (LO)	0: OFF 1: ON	R
5H	Judgment output state at timer OFF (HI) (Note 1)	0: OFF 1: ON	R
6H	Judgment output state at timer OFF (GO)(Note 1)	0: OFF 1: ON	R
7H	Judgment output state at timer OFF (LO)(Note 1)	0: OFF 1: ON	R
8H	Hold state	0: Release 1: Hold	R
9H	Zero setting state	0: OFF 1: ON	R
AH	Laser state	0: Stop emission 1: Start emission	R
BH	Self-monitoring: Error	"1: Error" is set when one of device numbers (Hex) 30H to 3FH is set to 1.	R
CH	Self-monitoring: Caution	“1: Caution” is set when "Self-monitoring: Error" is OFF and one of device numbers (Hex) 20H to 2FH is set to 1.	R
DH	Self-monitoring: Notification	"1: Notification" is set when one of device numbers (Hex) 10H to 3FH is set to 1.	R
EH, FH	—	Reserved; indeterminate value will be read.	R
10H	Excessive intensity of received light	0: No occurrence of excessive intensity of received light 1: Occurrence of excessive intensity of received light	R
11H	Insufficient intensity of received light	0: No occurrence of insufficient intensity of received light 1: Occurrence of insufficient intensity of received light	R
12H	Outside the measurement range	0: No occurrence of outside the measurement range	R

Device number (Hex)	Data item	Description	Attribute
		1: Occurrence of outside the measurement range	
13H	Excessive extraneous light	0: No occurrence of excessive extraneous light 1: Occurrence of excessive extraneous light	R
14H to 1FH	—	Reserved; indeterminate value will be read.	R
20H	Cumulative operation hours exceeded	0: No occurrence of cumulative operation hours exceeded 1: Occurrence of cumulative operation hours exceeded	R
21H	Number of writes to internal memory exceeded	0: No occurrence of number of writes to internal memory exceeded 1: Occurrence of number of writes to internal memory exceeded	R
22H to 2FH	—	Reserved; indeterminate value will be read.	R
30H	Beam-emitting circuit error	0: No occurrence of beam-emitting circuit error 1: Occurrence of beam-emitting circuit error	R
31H	—	Reserved; indeterminate value will be read.	R
32H	System error	0: No occurrence of system error 1: Occurrence of system error	R
33H to 3FH	—	Reserved; indeterminate value will be read.	R

(Note 1) No more than one of (HI), (GO), and (LO) is turned ON at the same time.

(MEMO)

6 External Communication Control (RS-485)

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6.1 RS-485 Communication Setting

■ Overview

By using communication, you can reference and set the set values of this product from an external host device.

It is also possible to reference measured values and the operating state of the product.

The following communication protocol is supported.

Communication protocol	Optional Cable
Modbus RTU	CN-8R-C2 CN-8R-C5 CN-8R-C10 CN-8R-C20

- When changing settings using communication commands (or using a tool software **HL-G2 Configuration Tool**), make sure to save the set values. If not saved, the set values are discarded when the power is turned OFF.

6.2 Connection and Setting Method

■ Communication specifications

Item	Settings
Communication method	Half-duplex
Communication speed (bps)	9,600 bps, 19,200 bps, 38,400 bps, 115,200 bps, 230,400 bps
Synchronization method	Start-stop synchronization
Data length	8 bits
Parity/Stop Bit	No parity + Stop bit length: 2 bits, Even parity + Stop bit length: 1 bit, Odd parity + Stop bit length: 1 bit
Supported protocol	Modbus RTU
Transfer mode	RTU mode(Note 1)

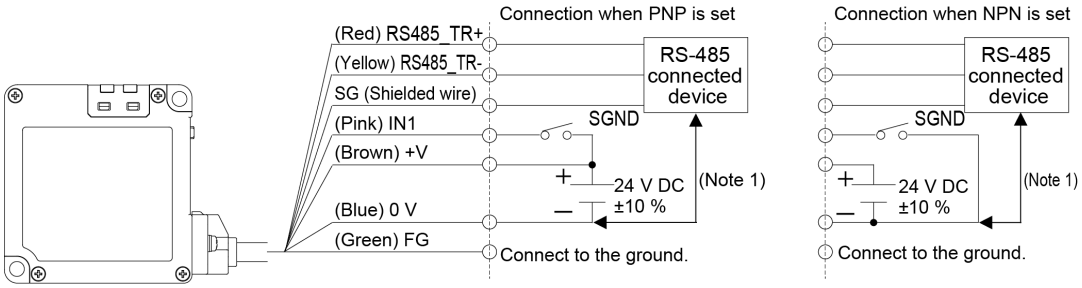
(Note 1) This product does not support "ASCII mode".

Note

- Using a slower communication speed may result in slower display updates of the tool software**HL-G2 Configuration Tool**when multiple units are connected.
  When connecting multiple units, we recommend using the fastest possible communication settings.

■ Connection method

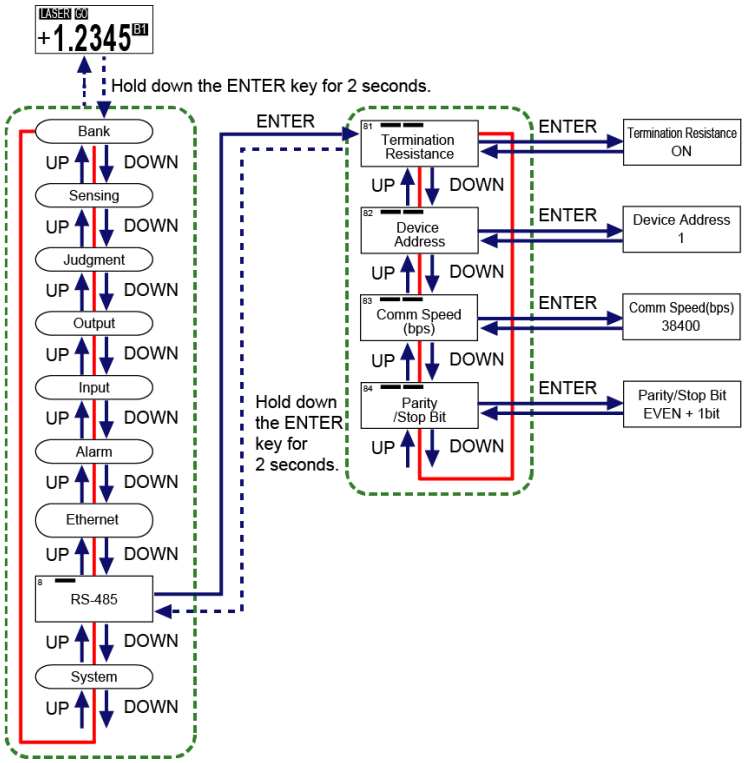
After connecting the sensor to an optional cable, perform wiring to the communication unit or RS-485 connected device as shown below.



(Note 1) Connect the cables so as not to cause a potential difference between the sensor unit power supply (0 V) and the GND of the RS-485 connected device power supply. Failure to do so may cause failure or malfunction of the connected device or this product.

After wiring, turn ON the power supply and make the necessary settings according to the protocol to be used.

■ Setting method



Setting item	Description	Set value	Default value
Termination resistance	Sets the **HL-G2** that constitutes a final terminal.	OFF ON	ON
Device Address	Assigns a unique address number to identify the device via the Modbus RTU protocol. It is used as a unit identifier.	001 to 247	001
Communication speed	Set the communication speed.	9600	38400
		19200	
		38400	
		115200	
		230400	
Parity/Stop Bit	Sets the parity check method and the stop bit length.	NON + 2bits	EVEN + 1bit
		EVEN + 1bit	
		ODD + 1bit	

- Resetting communication settings or restarting the sensor is required for the communication settings to be reflected.

Note

- Simultaneously pressing the <UP> and <DOWN> keys while moving between the device address digits returns to the first digit.

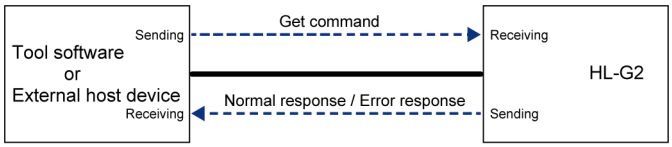
6.3 Modbus RTU

■ Overview

By using the Modbus RTU protocol, you can write settings and operation instructions, and read the setting data, measured values, and operating state of this product from the tool software **HL-G2 Configuration Tool** or an external host device.

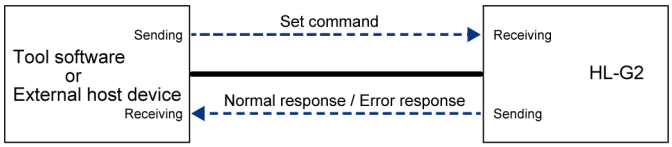
■ When receiving a Set command

On receiving a Set command, the HL-G2 updates the settings and operates according to the operation instructions.



■ When receiving a Get command

On receiving a Get command, the HL-G2 returns the setting as a response.



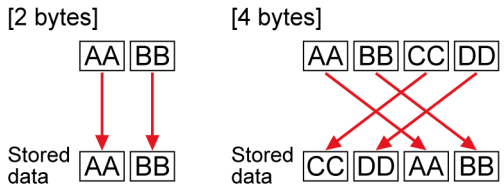
■ Register size

The relationship between the register size and the data type are as follows

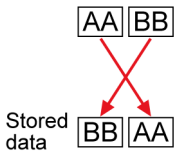
Size	Meaning
1-byte register	Unsigned 8-bit integer type
2-byte register	Unsigned 16-bit integer type
4-byte register	Signed 32-bit integer type

Note

- The Modbus standard treats all registers as 2 bytes for message processing, which means that 1-byte registers in this product are expanded to 2 bytes, and 4-byte registers are divided into two 2-byte registers.
- Data is stored in the 2-byte and 4-byte registers in the following positional relationships.



- A CRC (2 bytes) is stored in order of the lower 8 bits (1 byte) and the upper 8 bits (1 byte).



6.3.1 Modbus RTU Supported Functions

- Send and receive commands to and from this product on the measurement display.

The Modbus RTU protocol supports the following functions.

Function code	Function	Description of function
0x01	Read Coil Status	Reads the ON/OFF state of a specified coil.
0x03	Read Holding Register	Reads the value of specified holding register.
0x06	Preset Single Register	Changes the content of a specified holding register.
0x10	Write Multiple registers	Changes the content of a consecutive multiple holding registers.

■ Error code

In the following cases, an error code will be returned as a response.
Check the content of the error code and, if there is an error in the send data, correct the error.
If there is no error in the send data, power cycle the product or external device.

Error code	Description	Countermeasure
0x01	Function code error	Use a function code that is supported.
0x02	Specified address error (Address error) ● The specified address does not exist. ● An attempt was made to read from a register not permitted to be read. ● An attempt was made to write to a register not permitted to be written. ● A read-prohibited address is specified.	Review the address.
0x03	Error in the specified No. of coils, No.of registers, or data (Data error) ● The specified message length is invalid. ● The specified No. of coils or No. of registers is less than 1. ● The specified No. of coils is more than 2000. ● The specified No. of registers is more than 125. (Function code: 0x03) ● The specified No. of registers is more than 123. (Function code: 0x10) ● The No. of write registers does not match the data (No. of register values). ● The write register value is incorrect (out of range, inconsistent). ● The specified register is insufficient for 4-byte data.	Review the value to be written and the send data to be included in the message.
0x04	Other error ● This product is not ready to read/write data.	Review the state of this product.

Error code	Description	Countermeasure
	● This product failed to write data.	

6.3.2 Modbus RTU Function Codes

- Send and receive commands to and from this product on the measurement display.

■ 0X01: Read Coil Status

Reads the ON/OFF state of a specified coil. The coil status is indicated in 1 bit (1 = ON, 0 = OFF).

Request message

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x01
2	READ coil address (Upper)	–
3	READ coil address (Lower)	–
4	READ No. of coils (Upper)	–
5	READ No. of coils (Lower)	–
6	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
7	CRC (Upper)	

Response message (normal)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x01
2	No. of bytes n	Length from "byte position 3" onwards (excluding the CRC)
3	Coil state 1	
…	…	…
3+n-1	Coil state n	
3+n	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
3+n+1	CRC (Upper)	

Response message (Error)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x81
2	Error code	–
3	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
4	CRC (Upper)	

■ 0x03: Read Holding Register

Reads the value of specified holding register. Since the register data is 16 bits, it is stored in 2 bytes in the response message.

The maximum number of holding registers that can be read in a single session is 125.

Request message

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x03
2	READ coil address (Upper)	–
3	READ coil address (Lower)	–
4	READ No. of registers (Upper)	–
5	READ No. of registers (Lower)	–
6	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
7	CRC (Upper)	

Response message (normal)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x03
2	No. of bytes (No. of registers n × 2)	Length from "byte position 3" onwards (excluding the CRC)
3	Register value 1 (Upper)	–
4	Register value 1 (Lower)	–
…	…	…
2+(n-1)×2+1	Register value n (Upper)	–
2+(n-1)×2+2	Register value n (Lower)	–
2+n×2+1	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
2+n×2+2	CRC (Upper)	

Response message (Error)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x83
2	Error code	–
3	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
4	CRC (Upper)	

■ 0x06: Preset Single Register

Changes the content of a specified holding register. The maximum number of holding registers that can be written in a single session is 1.

When changing multiple holding registers, use function code 0x10.

Request message

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x06
2	WRITE register address (Upper)	–
3	WRITE register address (Lower)	–
4	Register value (Upper)	–
5	Register value (Lower)	–
6	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
7	CRC (Upper)	

Response message (normal)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x06
2	WRITE register address (Upper)	–
3	WRITE register address (Lower)	–
4	Register value (Upper)	–
5	Register value (Lower)	…
6	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
7	CRC (Upper)	

Response message (Error)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x86
2	Error code	–
3	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
4	CRC (Upper)	

■ 0x10: Write Multiple Registers

Changes the content of a consecutive multiple holding registers. The maximum number of holding registers that can be written in a single session is 123.

Request message

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x10
2	WRITE register address (Upper)	–
3	WRITE register address (Lower)	–
4	WRITE No. of registers (Upper)	–
5	WRITE No. of registers (Lower)	–
6	No. of bytes (No. of registers n × 2)	Length from "byte position 7" onwards (excluding the CRC)
7	Register value 1 (Upper)	–
8	Register value 1 (Lower)	–
…	…	…
6+(n-1)×2+1	Register value n (Upper)	–
6+(n-1)×2+2	Register value n (Lower)	–
6+n×2+1	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
6+n×2+2	CRC (Upper)	

Response message (normal)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x10
2	WRITE register address (Upper)	–
3	WRITE register address (Lower)	–
4	WRITE No. of registers (Upper)	–
5	WRITE No. of registers (Lower)	…
6	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
7	CRC (Upper)	

Response message (Error)

Byte position	Meaning	Remarks
0	Unit identifier	–
1	Function code	0x90
2	Error code	–
3	CRC (Lower)	Value calculated for the entire message frame ("byte position 0" onwards, excluding the CRC)
4	CRC (Upper)	

- For the "unit identifier", set the "device address".

Note

- For the registers and coils that can be specified, refer to "6.3.3 Modbus RTU Setting Registers" and "6.3.4 List of Coils".

■ CRC calculation method

The CRC used for Modbus RTU is calculated using the CRC-16 algorithm (with 0xA001 as the generator polynomial).

Calculate the CRC by following the steps below.

1. Initialize a 16-bit variable with 0xFFFF. This is the crc_tmp variable.
2. Calculate the exclusive OR of the first 8 bits (1 byte) of the message and the lower byte of the crc_tmp variable, and store the result in the crc_tmp variable.
3. Determine the LSB of the crc_tmp variable.
   - If the LSB of the crc_tmp variable is 0

     Shift the crc_tmp variable 1 bit to the right.
   - If the LSB of the crc_tmp variable is 1

     Shift the crc_tmp variable 1 bit to the right.

     Calculate the exclusive OR of the crc_tmp variable and 0xA001, and store the result in the crc_tmp variable.
4. Repeat step 3 for a total of 8 times.
5. Repeat steps 2 through 4 for the next 8 bits (1 byte) of the message to process all data in the message.
6. The crc_tmp variable is the final CRC value. The CRC is stored in the message frame in order of the lower 8 bits and the upper 8 bits.

Operation of multiple coil/register access functions in the event of an error

In Modbus communication, Read Coil Status, Read Holding Register, and Write Multiple registers access multiple coils/registers at the same time.

If an error occurs when accessing some or all coils/registers, these functions will operate as follows.

■ Read Coil Status/Read Holding Register

1. If the following condition is met, read processing is not started and an error response (Other error) is returned.
   - This product is not ready to read data.
2. Even if any of the following conditions are met, read processing continues as if the value 0 were read. However, it is not counted in the number of successful reads.
   - The specified address does not exist.
   - There is no read attribute in the specified address.
3. If the number of successful reads is not 0, a normal response is returned. If it is 0, an error response (Address error) is returned.

■ Write Multiple registers

1. If the following condition is met, write processing is not started and an error response (Other error) is returned.
   - This product is not ready to write data.
2. If there is even one register that meets any of the following conditions, data is not written to all registers and an error response is returned. (Refer to "Error codes" for the error code.)
   - A read-prohibited address is specified.(Address error)
   - The specified write value is invalid (out of range, inconsistent) (Data error).
   - The specified register is insufficient for 4-byte data.(Data error)
3. Even if any of the following conditions are met, write processing continues, ignoring the address. However, it is not counted in the number of successful writes.
   - The specified address does not exist.
   - There is no write attribute in the specified address.
4. If the following condition is met, Write processing is interrupted and an error response (Other error) is returned.
   - Write to the specified address failed.
5. If the number of successful writes is not 0, a normal response is returned. If it is 0, an error response (Address error) is returned.

6.3.3 Modbus RTU Setting Registers

- In a Modbus protocol message, specify a value obtained by subtracting 400001 from the address listed in the table below.

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400011	Sensor state	Notifies the state of this product.	Refer to "6.3.4 List of Coils".	R	2
400012	Self-monitoring detail: Notification	Notifies that an issue that occurs during normal use, such as a setting error or a drop in received light intensity, is detected.	Refer to "6.3.4 List of Coils".	R	2
400013	Self-monitoring detail: Caution	Notifies that sensor replacement is recommended because the saving count has exceeded the upper limit, for example.	Refer to "6.3.4 List of Coils".	R	2
400014	Self-monitoring detail: Error	Notifies that sensor replacement or wiring check is required due to component damage or wiring breakage or for some other reason.	Refer to "6.3.4 List of Coils".	R	2
400015	Error code	Used for reading the error code.	-	R	2
400020	Measured value	Used for reading the measured value. This value is expressed as an integer value in increments of 0.1 µm. Any numbers after the digit of 0.01 µm are rounded down.	-	R	4
400022	Peak intensity of received light	Used for reading the peak intensity of received light.	When normal: 0 to 1023 Indeterminate: 65535	R	2
400051	Usage prohibited	-	-	-	-
400052	Zero Setting	Forcibly sets the measured value to zero. Read: Zero setting state Write: Switching zero set setting	0: OFF 1: ON	RW	1
400053	Usage prohibited	-	-	-	-
400054	Set value saving	Saves the settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400055	Usage prohibited	-	-	-	-
400056	Measured value resetting	Resets the measured value.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400057	Usage prohibited	-	-	-	-
400058	Bank switching	Switches the bank in which the set values are to be saved.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4	RW	1
400059	Usage prohibited	-	-	-	-
400060	Bank copy	Copies the settings saved in one bank to another bank.	0: Copy from Bank 1 to Bank 2 1: Copy from Bank 1 to Bank 3 2: Copy from Bank 1 to Bank 4 3: Copy from Bank 2 to Bank 1 4: Copy from Bank 2 to Bank 3 5: Copy from Bank 2 to Bank 4 6: Copy from Bank 3 to Bank 1 7: Copy from Bank 3 to Bank 2 8: Copy from Bank 3 to Bank 4 9: Copy from Bank 4 to Bank 1 10: Copy from Bank 4 to Bank 2 11: Copy from Bank 4 to Bank 3	W	1
400061	Usage prohibited	-	-	-	-
400062	Settings initialization	Initializes each setting.	1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4 5: All Banks 6: All Areas	W	1
400063	Usage prohibited	-	-	-	-
400071	Language setting	Sets the language to be displayed on the display section.	0: English 1: Japanese 2: Simplified Chinese	RW	1
400101	HIGH set value	Sets the HIGH set value. The minimum value and maximum value vary depending on the distance type. (Note 2)	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000	RW	4

Register address	Data item	Description	Set value	Attribute	Size (bytes)
		This value is expressed as an integer value in increments of 0.1 µm.	85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000		
400103	LOW set value	Sets the LOW set value. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
400105	Hysteresis	Sets the hysteresis. The minimum value and maximum value vary depending on the distance type. (Note 2) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 0, Max. value: 95,000 50 mm type: Min. value: 0, Max. value: 950,000 85 mm type: Min. value: 0, Max. value: 950,000 120 mm type: Min. value: 0, Max. value: 950,000 250 mm type: Min. value: 0, Max. value: 9,500,000	RW	4
400108	Key lock	Disables key operation.	0: Disable key lock 1: Enable key lock	RW	1
400109	Eco mode	Turns OFF the display section when not operated to save electricity.	0: OFF 1: ON	RW	1
400110	Alarm delay count	Delays the notification until the set sampling count is reached for alarm notification due to detection of an unmeasurable state.	0: Alarm detection notification OFF 1 to 0xFFFF: Delay count (1 to 65535)	RW	2
400111	Display Digit	Sets the number of digits to be displayed for the measured value.	[30 mm distance type]	RW	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
		The number of digits varies depending on the distance type.	0: Display 4 digits after the decimal point 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point [50 mm / 85 mm / 120 mm distance type] 1: Display 3 digits after the decimal point 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point [250 mm distance type] 2: Display 2 digits after the decimal point 3: Display 1 digit after the decimal point 4: Do not display after the decimal point		
400112	Display Inversion	Inverts the organic EL display upside down.	0: Default 1: Inverted	RW	1
400113	Sampling Frequency	Changes the sampling cycle according to the moving speed of the object.	0: 100 µs 1: 200 µs 2: 500 µs 3: 1ms 4: 2 ms	RW	2
400114	Average Times	This drop-down list allows the user to set a moving average count.	0: 1 time 1: 4 times 2: 16 times 3: 64 times 4: 256 times 5: 512 times 6: 1024 times	RW	2

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400115	Hold mode	Sets the method for holding measured values.	0: None (Normal mode) 1: Peak hold 2: Bottom hold 3: Peak-to-peak hold	RW	2
400116	Span	Multiplies the measured value after zero setting by a span (factor) and outputs the result. This value is expressed as an integer value multiplied by 10,000.	1000 to 99999	RW	4
400118	Offset	Sets the offset value. The minimum value and maximum value vary depending on the distance type. This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: -95,000, Max. value: 95,000 50 mm type: Min. value: -950,000, Max. value: 950,000 85 mm type: Min. value: -950,000, Max. value: 950,000 120 mm type: Min. value: -950,000, Max. value: 950,000 250 mm type: Min. value: -9,500,000, Max. value: 9,500,000	RW	4
400120	Tolerance	Sets the tolerance. The minimum value and maximum value vary depending on the distance type.(Note 3) This value is expressed as an integer value in increments of 0.1 µm.	30 mm type: Min. value: 1, Max. value: 95,000 50 mm type: Min. value: 10, Max. value: 950,000 85 mm type: Min. value: 10, Max. value: 950,000 120 mm type: Min. value: 10, Max. value: 950,000 250 mm type: Min. value: 100, Max. value: 9,500,000	RW	4
400122	Output delay timer selection	Sets the ON to OFF or OFF to ON timing for the measured value judgment result.	0: OFF 1: On Delay 2: Off Delay 3: One Shot 4: Hold	RW	1
400123	Output Delay Timer Setting	Sets the delay time when On Delay or Off Delay is selected for Output delay timer selection, or the judgment holding time when One Shot is selected for it.	1 to 100 (Unit: milliseconds)	RW	2

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400124	Inversion of Measured Value	Switches the positive/negative direction of the measured value.	0: Normal 1: Reverse	RW	1
400125	Alarm digital output	Sets the digital output state at alarm occurrence.	0: Hold 1: In Alarm state	RW	1
400126	Brightness Tuning	Sets the laser beam brightness adjustment method depending on the target workpiece to be measured.	0: OFF 1: ON	RW	1
400127	Usage prohibited	-	-	-	-
400128	Trigger input (external input)	Used for reading the trigger input state by external input.	0: OFF 1: ON	R	1
400129	Hold state	Used for reading the hold state of the measured value.	0: Release 1: Hold	R	1
400130	Trigger mode	Sets the method for holding the final measured value.	0: Hold 1: One Shot	RW	1
400131	Trigger input (communication)	Sets trigger input.	0: OFF 1: ON	RW	1
400132	Usage prohibited	-	-	-	-
400133	Teaching execution state	Used for reading the teaching state.	0: Not executed 1: Being executed 2: Success 3: Failed	R	1
400134	Teaching Mode	Sets the teaching method.	1: 1 point 2: 2 points 3: 3 points	RW	1
400135	Usage prohibited	-	-	-	-
400136	Execution of teaching	Used for executing or interrupting teaching.	0: Interrupt teaching 1: Start teaching	W	1
400137	Usage prohibited	-	-	-	-
400138	Teaching 1st point setting	Used for executing teaching for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400139	Usage prohibited	-	-	-	-
400140	Teaching 2nd point setting	Used for executing teaching for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400141	Usage prohibited	-	-	-	-
400142	Teaching 3rd point setting	Used for executing teaching for the 3rd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400143	Usage prohibited	-	-	-	-

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400144	Brightness Tuning execution state	Used for reading the brightness tuning execution state.	0: Not executed 1: 1st point being executed 2: 2nd point being executed 3: Success 4: Failed	R	1
400145	Usage prohibited	-	-	-	-
400146	Brightness Tuning 1st point setting	Used for executing brightness tuning for the 1st point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400147	Usage prohibited	-	-	-	-
400148	Brightness Tuning 2nd point setting	Used for executing brightness tuning for the 2nd point.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400149	Usage prohibited	-	-	-	-
400150	Laser Stop	Sets ON/OFF of laser emission.	0: OFF (Laser emitted) 1: ON (Emission stopped)	RW	1
400151	Usage prohibited	-	-	-	-
400153	Port No. (Modbus)	Set the port number of this product for connecting an external host device via Modbus TCP.	1 to 0xFFFF	RW	2
400154	Port No. (tool)	Set the port number of this product for connecting the tool software **HL-G2 Configuration Tool**.		RW	2
400155	IP Address (4th octet)	Sets the IP address.	0 to 255	RW	1
400156	IP Address (3rd octet)			RW	1
400157	IP Address (2nd octet)			RW	1
400158	IP Address (1st octet)			RW	1
400159	Subnet Mask (4th octet)	Sets the subnet mask.	0 to 255	RW	1
400160	Subnet Mask (3rd octet)			RW	1
400161	Subnet Mask (2nd octet)			RW	1
400162	Subnet Mask (1st octet)			RW	1

Register address	Data item	Description	Set value	Attribute	Size (bytes)
400163	Default Gateway (4th octet)	Sets the default gateway.	0 to 255	RW	1
400164	Default Gateway (3rd octet)			RW	1
400165	Default Gateway (2nd octet)			RW	1
400166	Default Gateway (1st octet)			RW	1
400167	Communication speed	Sets the communication speed.	0: 9600 bps 1: 19200 bps 2: 38400 bps 3: 115200 bps 4: 230400 bps	RW	1
400168	Parity/Stop Bit	Sets the parity check method and the stop bit length.	0: NON + 2bit 1: EVEN + 1bit 2: ODD + 1bit	RW	1
400169	Device Address	Assigns a unique address number to identify the device via the Modbus RTU protocol. It is used as a unit identifier.	1 to 247	RW	1
400170	Termination resistor	Sets the **HL-G2** that constitutes a final terminal.	0: OFF 1: ON	RW	1
400171	Resetting communication settings	Reflects the Ethernet or RS-485 settings.	0: Execute 1 to 255: (Reserved) (Note 1)	W	1
400172	Usage prohibited	-	-	-	-

(Note 1) Do not specify 1 to 255.

(Note 2) Be sure to set a HIGH set value that is greater than the LOW set value.

The HIGH set value and the LOW set value cannot be set to values that make the difference between them to be a value that is equal to or less than twice the hysteresis.

(Note 3) Be sure to set a tolerance value that is greater than the hysteresis value.

Note

- When the measured value is above the positive limit of the display range, "+9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is below the negative limit of the display range, "-9,600,000 (in increments of 0.1 µm)" is output.
- When the measured value is indeterminate, "-9,999,999 (in increments of 0.1 µm)" is output.
- In an alarm state, "+9,999,999 (in increments of 0.1 µm)" is output. However, this excludes cases where Alarm digital output is set to "Hold"

6.3.4 List of Coils

- When using setting registers for communication commands, specify a value obtained by subtracting 1 from the coil address listed in the table below.

Register address	Coil address	Data item	Description	Attribute
400011	1	Alarm state	0: Not in Alarm state 1: In Alarm state	R
	2	Data in an indeterminate state	0: Not in Indeterminate state 1: Indeterminate state	R
	3	Judgment output state (HI)	0: OFF 1: ON	R
	4	Judgment output state (GO)	0: OFF 1: ON	R
	5	Judgment output state (LO)	0: OFF 1: ON	R
	6	Judgment output state at timer OFF (HI)(Note 1)	0: OFF 1: ON	R
	7	Judgment output state at timer OFF (GO)(Note 1)	0: OFF 1: ON	R
	8	Judgment output state at timer OFF (LO)(Note 1)	0: OFF 1: ON	R
	9	Hold state	0: Release 1: Hold	R
	10	Zero setting state	0: OFF 1: ON	R
	11	Laser state	0: Stop emission 1: Start emission	R
	12	Self-monitoring: Error	"1: Error" is set when one of coil addresses 49 to 64 is set to 1.	R
	13	Self-monitoring: Caution	“1: Caution” is set when "Self-monitoring: Error" is OFF and one of coil addresses 33 to 48 is set to 1.	R
	14	Self-monitoring: Notification	"1: Notification" is set when one of coil addresses 17 to 64 is set to 1.	R
	15, 16	-	Reserved; indeterminate value will be read.	R
400012(Note 2)	17	Excessive intensity of received light	0: No occurrence of excessive intensity of received light 1: Occurrence of excessive intensity of received light	R
	18	Insufficient intensity of received light	0: No occurrence of insufficient intensity of received light 1: Occurrence of insufficient intensity of received light	R

Register address	Coil address	Data item	Description	Attribute
	19	Outside the measurement range	0: No occurrence of outside the measurement range 1: Occurrence of outside the measurement range	R
	20	Excessive extraneous light	0: No occurrence of excessive extraneous light 1: Occurrence of excessive extraneous light	R
	21 to 32	-	Reserved; indeterminate value will be read.	R
400013(Note 3)	33	Cumulative operation hours exceeded	0: No occurrence of cumulative operation hours exceeded 1: Occurrence of cumulative operation hours exceeded	R
	34	Number of writes to internal memory exceeded	0: No occurrence of number of writes to internal memory exceeded 1: Occurrence of number of writes to internal memory exceeded	R
	35 to 48	-	Reserved; indeterminate value will be read.	R
400014(Note 4)	49	Beam-emitting circuit error	0: No occurrence of beam-emitting circuit error 1: Occurrence of beam-emitting circuit error	R
	50	-	Reserved; indeterminate value will be read.	R
	51	System error	0: No occurrence of system error 1: Occurrence of system error	R
	52 to 64	-	Reserved; indeterminate value will be read.	R

(Note 1) No more than one of (HI), (GO), and (LO) is turned ON at the same time.

(Note 2) For details on “Notification”, refer to "Detailed status information on each state".

(Note 3) For details on “Caution”, refer to "Detailed status information on each state".

(Note 4) For details on “Error”, refer to "Detailed status information on each state".

(MEMO)

7 Maintenance

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7.1 Maintenance and Inspection

7.1.1 Maintenance Precautions

- When cleaning, be sure to turn off the power supply to do cleaning while the laser radiation is stopped.
- Never use thinner, benzene, or other organic solvents to wipe off dirt or dust because some parts are resin-molded.
- Avoid wiping the front cover of laser opening with force. Doing so may damage the front cover to cause an error.
- The light emitting and receiving surfaces of the sensor head must be free of oil, fingerprints, and other substances that refract light as well as dust, grit, and other objects that intercept light. Otherwise, it will cause an error. Regularly perform inspection and keep it clean.
- Remove large dust or grit particles using a blower for camera lens.
- Wipe off small dust or stains like fingerprints with a soft lens cleaner or lens cleaning paper.

7.1.2 Main Inspection Items

Inspect the sensor regularly to maintain performance and enable optimum use.

The main inspection items are as follows:

- Is the connection of each input and output line loose or disconnected?
- Is the front cover for the laser opening of the sensor head stained with dust, grit, fingerprints, etc.?
- Is the supplied power within the rated voltage range (21.6 V to 26.4 V)?
- Is the ambient temperature within the specified range (sensor head: -10 °C to +45 °C)?
- Is the ambient humidity within the specified range (35% to 85% RH)?

8 Troubleshooting

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8.1 Solutions to Problems

Solutions to frequently encountered problems and errors are described below.

Note

- Check the wiring.
- Check if the NPN/PNP setting is correct.
- Check the voltage and capacity of the power supply.

Symptom	Cause	Action method	Reference page
Nothing is displayed on the display section.	Power is not supplied.	Check if the capacity of the power supply is sufficient. Connect the power supply correctly.	"9.1 Specifications"
	Eco mode is ON.	Set Eco mode to OFF.	"4.8.2 ECO Mode"
No laser is emitted.	Laser stop setting is saved in the ON state.	If the laser emission stop setting is saved in the ON state, the system is started with the laser stopped. Set it to OFF.	"4.6.1 Laser Stop"
Expected measured values are not output.	The sensing objects are not within the measurement range.	Check if the sensing objects are within the measurement range.	-
	Obstacles exist within the measurement range.	Remove the obstacles.	-
	The hold function is ON.	Check the settings of the hold function.	"4.3.4 Hold Mode"
	This product is not installed correctly.	Install the product correctly.	"3.3 Sensor Installation Direction and Angle"
	The span settings are not set.	Perform span adjustment in the actual installation conditions.	"4.3.6 Span"
	Dust, dirt, or other foreign matter adhered to the beam emitting and receiving parts of this product.	With a lint-free soft cloth or lens cleaning paper, wipe off any dirt that adhered to the beam emitting and receiving parts of this product.	-
	Dust, dirt, or other foreign matter adhered to the sensing objects.	Remove any dust, dirt, or other foreign matter that adheres to the sensing object.	-
	Dust, grit, or other substances are attached to the operating environment.	Use a dust collector or similar device to remove and prevent dust, grit, and other substances from flying in the operating environment.	-
	The distance between this product and the sensing objects is too far.	Ensure that the distance between this product and the sensing objects is within the specified range.	"9.1 Specifications"
Measured values are not stable.	This product is installed in a location subject to severe vibration.	Take measures against vibration.	-

Symptom	Cause	Action method	Reference page
Alarm indicator is lit and measurement cannot be performed. (Refer also to “Expected measured values are not output”.)	The intensity of received light is judged to be insufficient because it exceeds the adjustment range.	Increase the sampling cycle.	"4.3.1 Sampling Frequency" "4.7 Alarm Setting"
	The intensity of received light is judged to be excessive because it exceeds the adjustment range.	Make sure that this product and the sensing objects are facing each other to prevent specularly reflected light beams from entering the beam receiving part.	"4.7 Alarm Setting"
	Extraneous light is judged to be excessive.	Re-examine the measurement environment to ensure that the level of sunlight and other extraneous light is low.	"4.7 Alarm Setting"
Communication via Ethernet / RS-485 cannot be performed properly.	The optional cable and communication speed to be used are not correctly selected.	Select the optional cable and communication speed to be used correctly.	"5.1.1 Connection and Setting Method" "6.2 Connection and Setting Method"
	The communication settings for this product are incorrect.	Check the communication settings for this product. Resetting communication settings or restarting the product is required for the communication settings to be reflected.	
	The communication settings for external devices are incorrect.	Check the settings of the connected external device and set to correct communication specifications.	
	The station numbers are not set correctly.	When connecting multiple units, make sure that there is no duplicate station number.	
	The terminal is not selected correctly.	Set the termination resistance to ON only for the product located at the terminal and set the termination resistance to OFF for the rest of products.	"6.2 Connection and Setting Method"
	Commands are not sent in correct data format.	Refer to the error codes and send the commands in correct format.	"8.2 Error Messages and Action Methods"
	Commands are sent consecutively without waiting for a response.	Send a command only after a response is received from this product.	-
Set values return to their previous values after restart.	Set values are not saved during use of Ethernet/ RS-485 communication.	When changing settings using communication commands (or using a tool software **HL-G2 Configuration Tool**), make sure to save the set values. If not saved, the set values are discarded when the power is turned OFF.	-
Keys cannot be operated	The key lock function is ON.	Set the key lock function to OFF.	"4.12 Key Lock"
	Brightness tuning is executed using communication commands.	Operate the keys after executing brightness tuning using communication commands.	"Brightness tuning using external communication"
	Teaching is executed using communication commands.	Operate the keys after executing teaching using communication commands.	"1 point teaching

Symptom	Cause	Action method	Reference page
			using external communication" "2 points teaching using external communication" "3 points teaching using external communication"

- If the product still does not operate normally after you check the above, contact our office.

8.2 Error Messages and Action Methods

If an error occurs during setting or measurement, one of the error codes listed below will be displayed on the display section.

Error code	Description	Action method
E100**	Dark level adjustment error	Install the sensor so that strong light or fluctuating light does not enter the sensor, and turn the power OFF and then ON.
E110**	Communication start processing error	Turn the power OFF and then ON.
E120**	CPU error	Turn the power OFF and then ON.
E130**	Internal memory access error (system area)	Turn the power OFF and then ON.
E131**	Internal memory access error (user area)	Refer to "4.8.6 Settings Initialization" and execute Set value initialization.
E140**	Internal access error	Turn the power OFF and then ON.
E150**	Start processing error	Turn the power OFF and then ON.
E200**	Beam-emitting circuit error	We recommend that the sensor be replaced.

(Note 1) Internal information is set in the last two digits ("**" section) of each error code.

- When an error has occurred, check whether the sensor is subject to excessive vibration.
- If the product still does not operate normally after you cleared the above, contact our office.

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9 Specifications and Dimensions

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9.1 Specifications

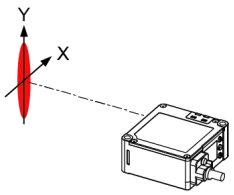
Model name		HL-G203B-S-MK	HL-G205B-S-MK	HL-G208B-S-MK	HL-G212B-S-MK	HL-G225B-S-MK
Measurement center distance		30 mm	50 mm	85 mm	120 mm	250 mm
Measurement range		±5 mm	±10 mm	±20 mm	±30 mm	±150 mm
Beam Diameter(Note 2)(Note 3)		X axis: approx. 40 µm Y axis: approx. 1,000 µm	X axis: approx. 60 µm Y axis: approx. 2,000 µm	X axis: approx. 90 µm Y axis: approx. 3,000 µm	X axis: approx. 100 µm Y axis: approx. 4,000 µm	X axis: approx. 300 µm Y axis: approx. 8,000 µm
Resolution		0.5 µm	1.5 µm	2.5 µm	4 µm	15 µm
Linearity	Limited range	±0.05 % F.S. (27.5 mm to 32.5 mm)	±0.05 % F.S. (45 mm to 55 mm)	±0.05 % F.S. (75 mm to 95 mm)	±0.05 % F.S. (105 mm to 135 mm)	±0.15 % F.S. (200 mm to 300 mm)
	Other than above	±0.075 % F.S.	±0.075 % F.S.	±0.075 % F.S.	±0.075 % F.S.	±0.25 % F.S.
Temperature characteristics		0.03 % F.S./°C				
Measuring method		Diffuse reflection				
Light source		Red semiconductor laser: Class 2 (IEC/EN/JIS/GB/KS/FDA Laser Notice No. 56(Note 4)) Maximum output: 1 mW, Peak emission wavelength: 655 nm				
Light receiving element		CMOS image sensor				
Power supply voltage		Power supply units with a current capacity of 500 mA or more, including 24 VDC ±10%, ripple 0.5 V (P-P)				
Current consumption		150 mA or less(Note 5)				
Sampling cycle		100 µs, 200 µs, 500 µs, 1 ms, 2 ms				
Communication interface	Ethernet	• Only Auto Negotiation 10 M/100 Mbps (Half Duplex / Full Duplex) supported. Communication may be unstable if connected to a device that does not support Auto Negotiation. • IEEE802.3u, 10BASE-T / 100BASE-TX RJ45 • Supported protocol: EtherNet/IP, Modbus TCP, and SLMP				
	RS-485	• Communication speed : 9,600 bps / 19,200 bps / 38,400 bps / 115,200 bps / 230,400 bps • Supported protocol : Modbus RTU • Maximum number of connected units : 16				
External input	IN1	• Trigger input • The input conditions are interlocked with NPN/PNP setting of the control output **When NPN output is selected** • Source current: approx. 1.5 mA • Input conditions Invalid: 3 V to 26.4 VDC or when released Valid: 0 VD to 1.5 VDC **When PNP output is selected** • Sink current: approx. 2.5 mA				

Model name		HL-G203B-S-MK	HL-G205B-S-MK	HL-G208B-S-MK	HL-G212B-S-MK	HL-G225B-S-MK
		• Input conditions Invalid: 0 VD to 11 VDC or when released Valid: 19 VDC to 26.4 VDC				
Indicators	Laser radiation	Lit while laser beams are being emitted (Green LED)				
	Alarm	Lit when measurement is not possible due to insufficient or excessive received light intensity, or due to excessive extraneous light (Orange LED)				
Display section		0.9 inch organic EL Measured value: signed 5-digit (maximum of 4 digits after the decimal point)				
Degree of protection		IP67				
Pollution degree		2				
Grounding method		Capacitor grounding				
Insulation resistance		20 MΩ or higher, using 500 VDC megger				
Vibration resistance		Durability: 10 Hz to 55 Hz (cycle: 1 minute) with 1.5 mm double amplitude in X, Y, and Z directions for 2 hours each				
Ambient operating illuminance Incandescent lamp		500 m/s^2 (approx. 50 G) in X, Y, and Z directions three times each				
Ambient operating temperature		3,000 lx or less (illuminance on the light receiving surface)				
Ambient operating humidity		-10 °C to +45 °C (No icing) During storage: -20 °C to +60 °C (No icing)				
Ambient operating illuminance Incandescent lamp		35 % to 85 % RH (No condensation) During storage: 35 % to 85 % (No condensation)				
Operating altitude(Note 6)		2,000 m or less				
Materials		Product casing: Aluminum die casting, Front cover: Glass, Cable: PVC				
Optional cable		CN-8E-C□ (For Ethernet communication), CN-8R-C□ (For RS-485 communication)				
Weight		Product only: approx. 150 g, including packaging: approx. 200 g				

(Note 1) Unless otherwise specified, the above specifications are typical values measured under the following measurement conditions. They do not guarantee performance for all target objects.

Power supply voltage: 24 VDC, ambient temperature: 20 °C, sampling cycle: 1 ms, average count: 512 times, measurement center distance, target object: visible light shielding ceramic

(Note 2) The X and Y axes of the beam diameter are specified as shown in the figure below.



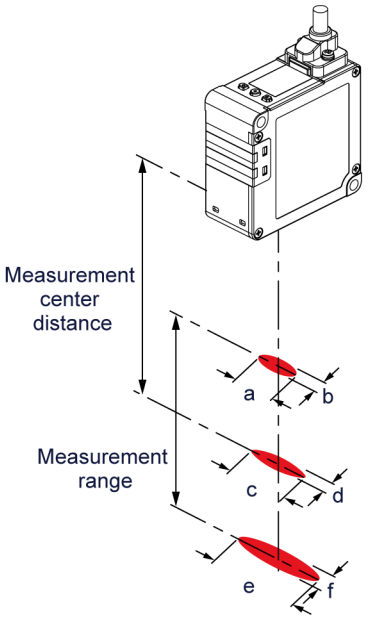
(Note 3) The beam diameter is defined as $1/e^2$ (approx. 13.5 %) of the center light intensity. Due to leak light outside the defined range, the measurement values may be affected if the reflectance around the detecting point is higher than that of the detecting point.

(Note 4) This product complies with the FDA regulations (FDA 21 CFR 1040.10 and 1040.11) in accordance with FDA Laser Notice No. 56, except for complying with IEC 60825-1 Ed. 3.

(Note 5) Current consumption of the sensor only. External input current is not included.

(Note 6) Do not use or store this product in environments where ambient air is pressurized to an air pressure higher than the atmospheric pressure at an altitude of 0 m.

9.1.1 Beam Diameter



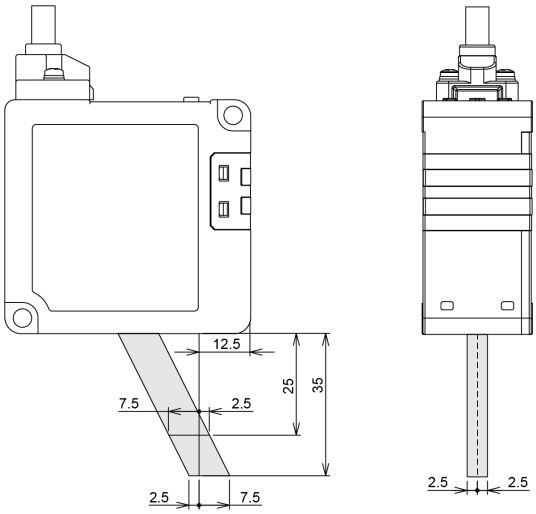
Model name	Beam diameter (Unit: mm)					
	a	b	c	d	e	f
HL-G203B-S-MK	0.7	0.1	1.0	0.04	1.3	0.1
HL-G205B-S-MK	1.2	0.2	2.0	0.06	2.8	0.2
HL-G208B-S-MK	2.0	0.3	3.0	0.09	4.0	0.2
HL-G212B-S-MK	2.8	0.3	4.0	0.1	5.2	0.3
HL-G225B-S-MK	2.5	0.7	8.0	0.3	13.5	0.5

9.1.2 Mutual Interference Area

When two or more units of this product are installed side by side, no mutual interference will occur as long as the laser spots of the other units are outside the shaded area ▭ shown in the figure below. Install the product so that the laser spots of other products do not fall within the range of the shaded area ▭.

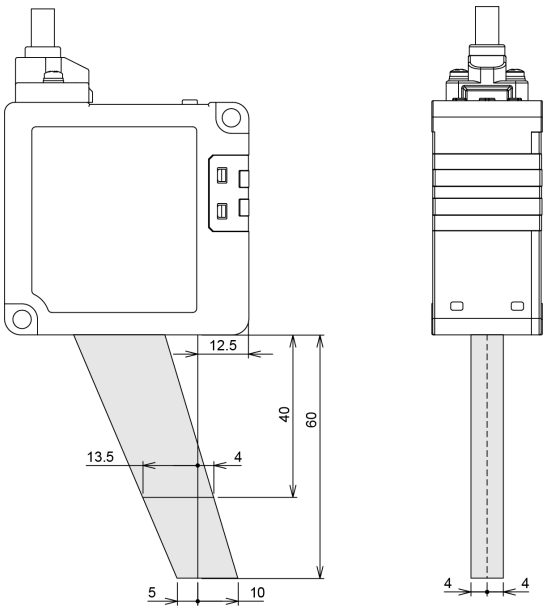
■ 30 mm type (HL-G203B-S-MK)

Unit: mm



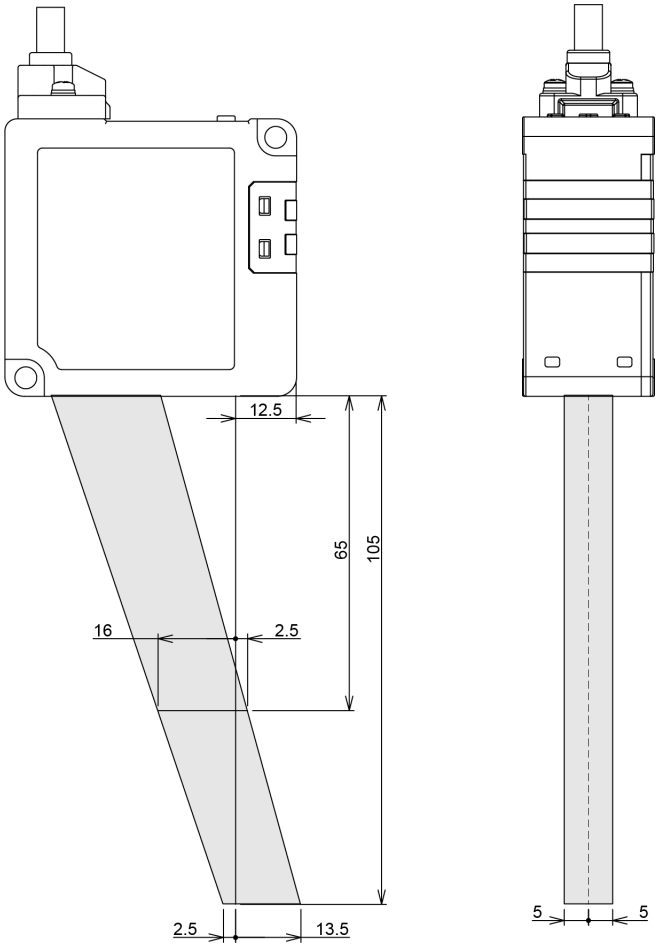
■ 50 mm type (HL-G205B-S-MK)

Unit: mm



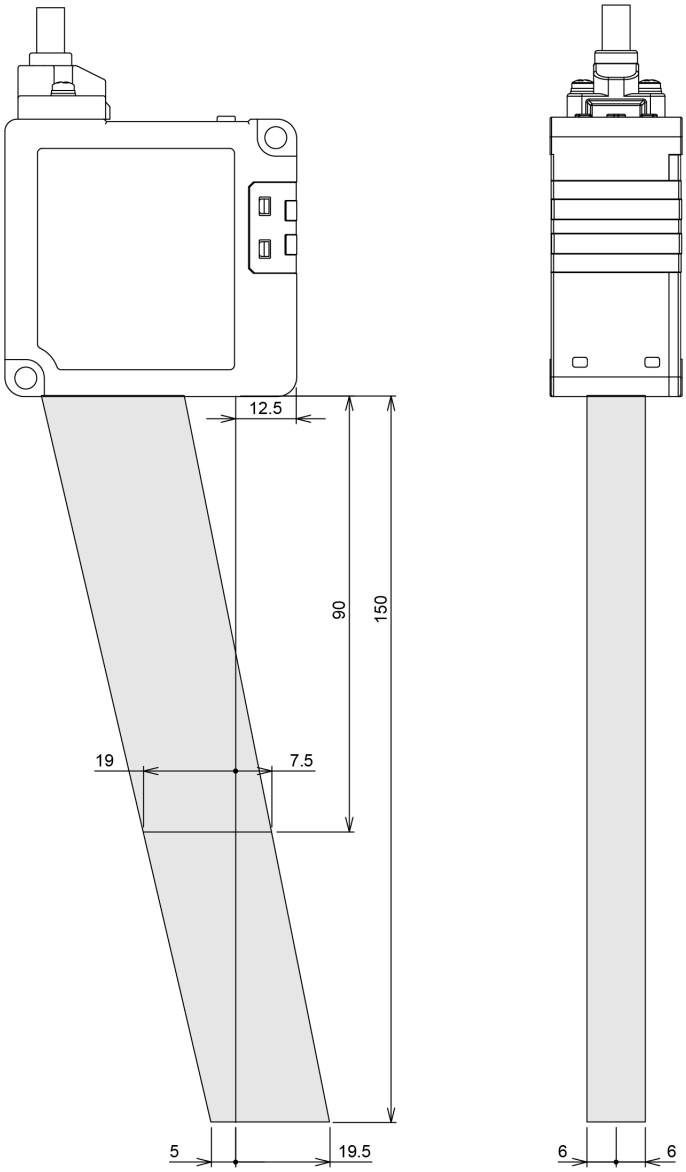
■ **85 mm type (HL-G208B-S-MK)**

Unit: mm



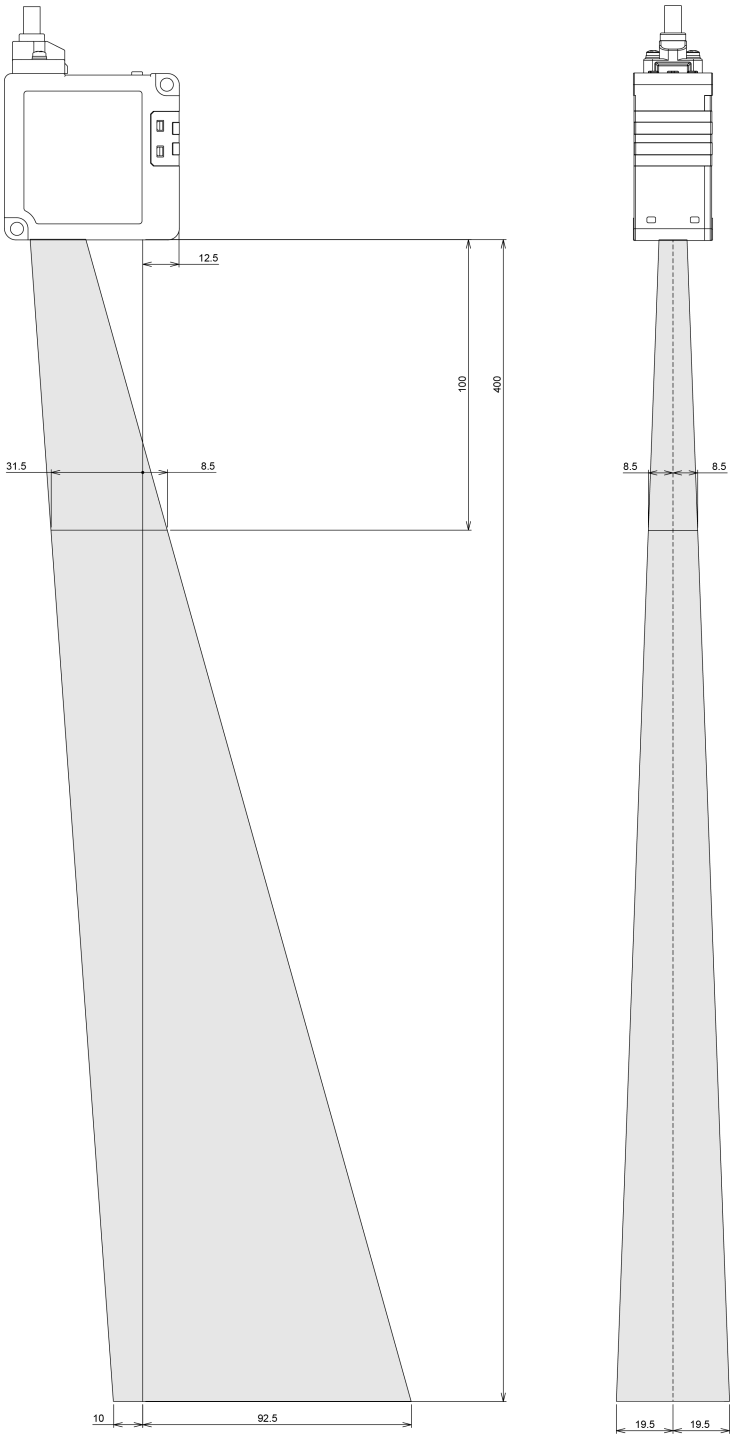
■ **120 mm type (HL-G212B-S-MK)**

Unit: mm



■ **250 mm type (HL-G225B-S-MK)**

Unit: mm



9.2 Shapes and Dimensions

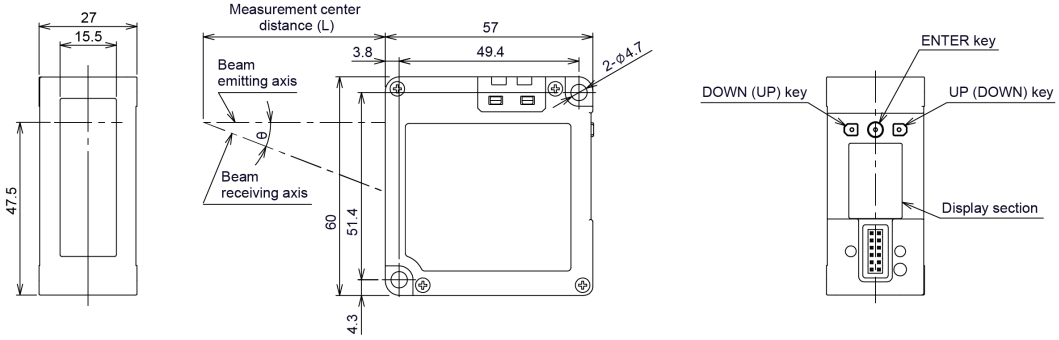
9.2.1 Product

HL-G2□□B-S-MK

Unit: mm

Model name	Measurement center distance (L)	θ
HL-G203B-S-MK	30 mm	30 °
HL-G205B-S-MK	50 mm	24 °
HL-G208B-S-MK	85 mm	17 °
HL-G212B-S-MK	120 mm	13 °
HL-G225B-S-MK	250 mm	6.5 °

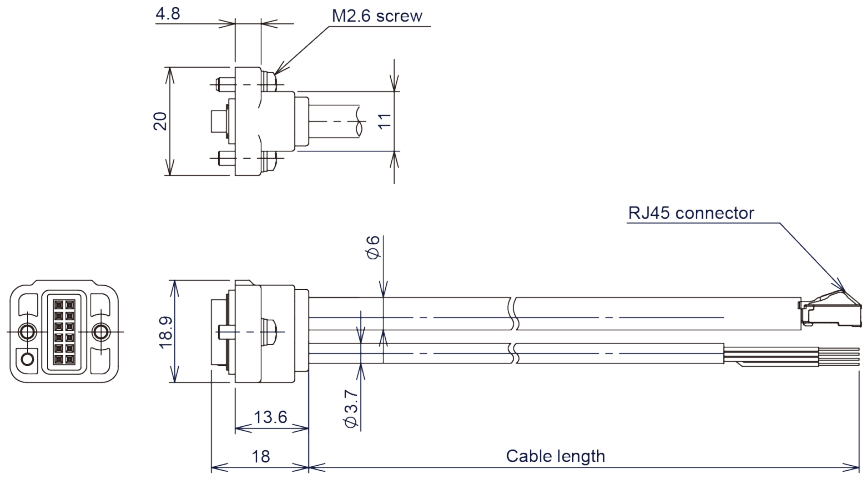
TOLERANCE	
6 AND UNDER	±0.3
OVER 6 TO 30 INCL.	±0.4
OVER 30 TO 120 INCL.	±0.8
OVER 120 TO 315 INCL.	±1.2
OVER 315 TO 630 INCL.	±1.8
OVER 630 TO 1000 INCL.	±2.5



9.2.2 Optional Cable

CN-8E-C□ (For Ethernet communication)
Unit: mm

Model name	Cable length
CN-8E-C2	2 m
CN-8E-C5	5 m

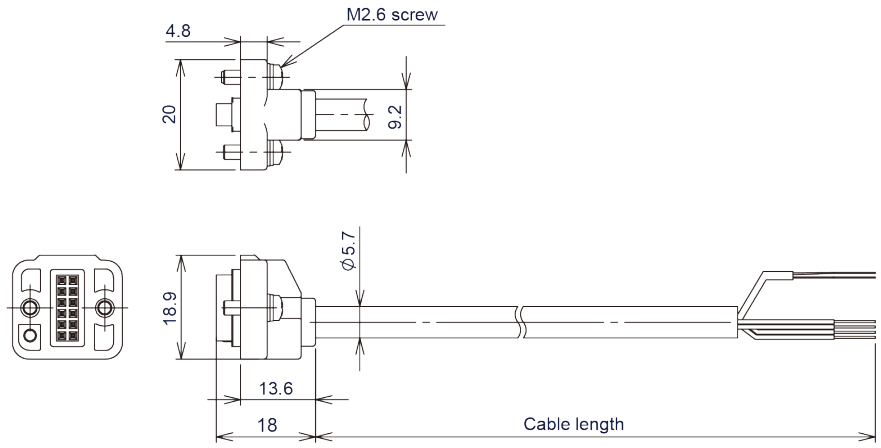


TOLERANCE OF CABLELENGTH	
TOTAL LENGTH	TOLERANGE
1000 OR LESS	+20 % OF TOTAL LENGTH -0
OVER 1000 TO 2000 INCL.	+200 -0
OVER 2000	+20 % OF TOTAL LENGTH -0

TOLERANCE	
6 AND UNDER	±0.3
OVER 6 TO 30 INCL.	±0.4
OVER 30 TO 120 INCL.	±0.8
OVER 120 TO 315 INCL.	±1.2
OVER 315 TO 630 INCL.	±1.8
OVER 630 TO 1000 INCL.	±2.5

CN-8R-C□ (For RS-485 communication)
Unit: mm

Model name	Cable length
CN-8R-C2	2 m
CN-8R-C5	5 m
CN-8R-C10	10 m
CN-8R-C20	20 m



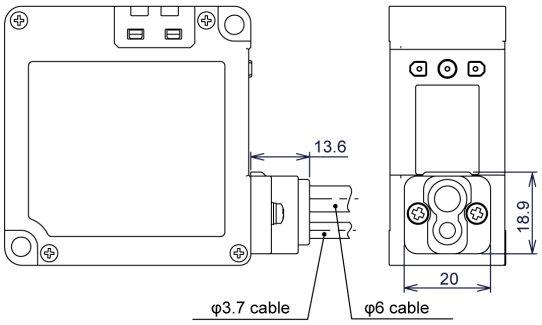
TOLERANCE OF CABLELENGTH	
TOTAL LENGTH	TOLERANGE
1000 OR LESS	+20% OF TOTAL LENGTH -0
OVER 1000 TO 2000 INCL.	+200 -0
OVER 2000	+20% OF TOTAL LENGTH -0

TOLERANCE	
6 AND UNDER	±0.3
OVER 6 TO 30 INCL.	±0.4
OVER 30 TO 120 INCL.	±0.8
OVER 120 TO 315 INCL.	±1.2
OVER 315 TO 630 INCL.	±1.8
OVER 630 TO 1000 INCL.	±2.5

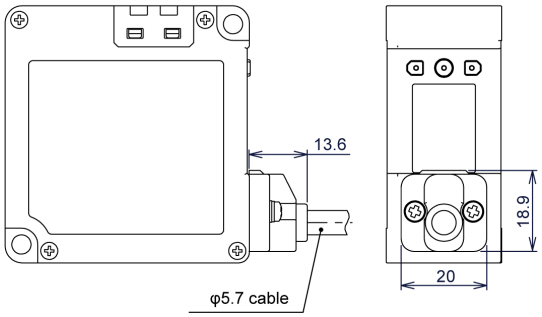
9.2.3 Optional Cable Installation Diagram

Unit: mm

<CN-8E-C□ installed state>



<CN-8R-C□ installed state>



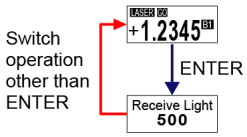
TOLERANCE	
6 AND UNDER	±0.3
OVER 6 TO 30 INCL.	±0.4
OVER 30 TO 120 INCL.	±0.8
OVER 120 TO 315 INCL.	±1.2
OVER 315 TO 630 INCL.	±1.8
OVER 630 TO 1000 INCL.	±2.5

Appendix Screen Transition List

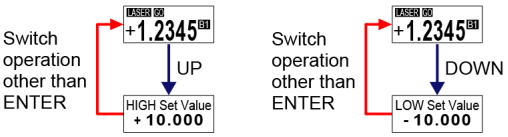
Screen Transition List App-2

Screen Transition List

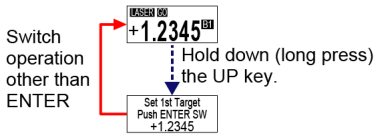
■Received light intensity monitor



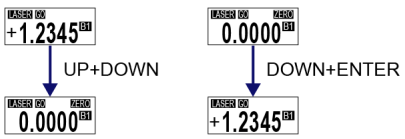
■HIGH set value setting / LOW set value setting



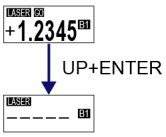
■1-point / 2-point / 3-point teaching



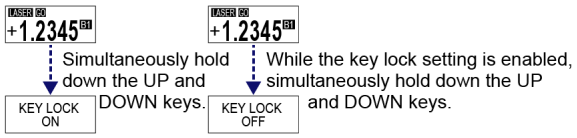
■Zero setting ON / Zero setting OFF



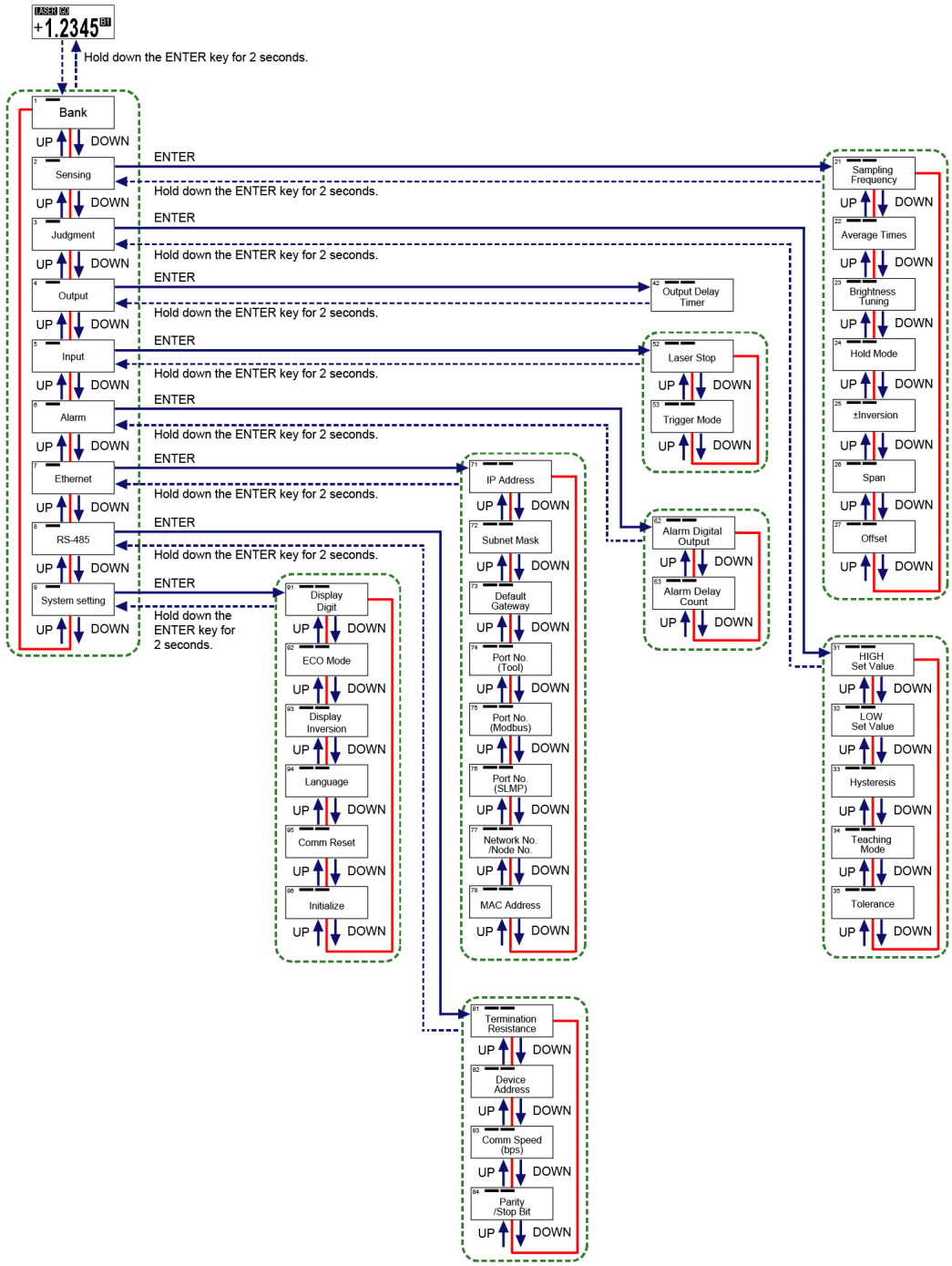
■Measured value resetting



■Key lock



■Setting mode



(MEMO)

Revision History

Revision history	Revision date	Revision item
1st edition	January 2024	-
2nd edition	April. 2024	Made revisions in line with the change of the company name. Added "Types of initialized setting items".

(MEMO)

(MEMO)

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