Compact Laser Displacement Sensor

LAT 61
USER´S MANUAL

di-soric

About this Manual

Introduction	***Introduction*** provides precautions on the safe and correct use of this system. Be sure to read the precautions provided in this section.
Chapter 1 Before Use	***Chapter 1*** provides information on the configuration, installation, and connection of the system (including the sensor head and Setting and monitoring software HL-G1SMI.
Chapter 2 I/O Terminal Block	***Chapter 2*** provides information on the I/O lines of the sensor head.
Chapter 3 Functions	***Chapter 3*** provides information on the functions of the system.
Chapter 4 Control Troubleshooting	***Chapter 4*** provides information on the troubleshooting of the system.
Chapter 5 Specifications	***Chapter 5*** provides the specifications of the sensor head.

Safety Precautions

This product is used to detect objects, and does not incorporate control functions for the purpose of maintaining safety including the prevention of accidents.
Do not use this product as a human sensor to protect human bodies.
Use products that conform to the laws, regulations, and international standards, such as OSHA, ANSI, and IEC standards, for applications protecting human bodies.
In order to ensure the correct use of the product, read this user manual carefully before use.

⚠WARNING

- Incorporate safety measures, such as a double safety mechanism, into the system if the use of the system is likely to result in injury or serious consequential loss.
- Do not use the system in combustion gas atmospheres. Otherwise, the system may result in explosion.
- This product was developed and manufactured for use in industrial environments.

⚠CAUTION

- Always observe the specifications including the ratings and ambient conditions.
  Otherwise, the system may result in overheating or generate smoke.
- Do not disassemble or modify the system. Otherwise, an electric shock may be received or the system may generate smoke.
- Do not touch the wires when the system is energized. Otherwise, an electric shock may be received.

Correct Handling

Pay attention to the following items when installing and using the system.

Installation Environment

■ Do not install the system in the following places.

- Places where the ambient temperature, humidity, or the illumination level of the light receiving surface is in excess of the operating environmental conditions. (➔ Refer to "Operating Environment".)
- Places that causes dew condensation as a result of radical temperature changes.
- Places with corrosive gas or flammable gas.
- Places with excessive dust, iron powder, or salt.
- Places where organic solvents, such as benzine, paint thinner, and alcohol, and strong alkaline substances, such as ammonia and sodium hydroxide are likely to adhere to the system.
- Places with strong vibration and shock.
- Places exposed to direct sunlight.
- Places where water, oil, or chemicals are sprayed.
- Places where a heavy load is imposed on the sensor head.

Operating Environment

■ Ambient Temperature, Humidity, and Illuminance

Ambient temperature

- Use the system within the range of the specifications (➔ refer to Chapter 6 "Specifications").
  Sensor head: -10°C to 45°C
- Keep the following storage temperature range in the case of storing the sensor head.
  Sensor head: -20°C to 60°C
- The life of the semiconductor laser depends on the operating ambient temperature. Take appropriate measures, such as the use of a cooling fan, to drop the ambient temperature of the sensor head as much as possible if the sensor head is used close to heat radiating objects.
- The sensor head radiates heat as well. Therefore, be sure to install the sensor head in places with as good thermal conductivity as possible. Mount the sensor head to an aluminum or steel plate with a minimum surface area of 200 cm^2 if the

ambient temperature is 40°C or higher.
In the case of installing two or more sensor heads in parallel, mount each sensor head to an aluminum or steel plate with a minimum surface area of 200 cm^2 and make sure that the ambient temperature does not exceed 40°C.

Ambient humidity

- Use the system within a relative humidity (RH) range of 35% to 85%.
  Do not use the system in places that may cause dew condensation as a result of radical temperature changes.

Ambient illuminance of light receiving surface

Make sure that the illumination level of the light receiving surface does not exceed 3,000 lx under incandescent light.

■ Power Supply Voltage

Be sure to supply a rated voltage of 21.6 to 26.4 VDC.

■ Environment

- The internal circuit may be damaged if an external surge voltage (single-polarity, full-wave voltage) in excess of 500 V ± 1.2 x 50 μs is imposed. Insert a surge absorber between power input terminals if the external surge voltage is likely to exceed 500 V.
- Always keep the emitter and receiver of the sensor head clean. Make sure that the emitter and receiver are free of substances that refract light, such as water, oil, or fingerprints, or surface water, or matters that block light, such as dust and dirt. Clean the emitter and receiver with a soft lint-free cloth or lens cleaning paper.
- Check that the receiver will not receive direct ambient light the same as the laser light in wavelength, such as sunlight. Mount an appropriate object, such as a light shield plate, to the sensor head if high accuracy is especially required.
- Do not use the system in places with flammable or corrosive gas or excessive dust, places where water is sprayed, places exposed to direct sunlight, or places with strong vibration or shock.

Protective Structure

- The sensor head is of penetration-resistant type, but the connector is not of dust-, water-, or corrosion-proof construction. Therefore, Do not use the product underwater or in the rain. Pay attention to the operating environment.

Warm-up Time

In order to ensure the performance of the system, allow a warm-up time of at least 30 minutes after the system is turned ON.

Countermeasures against Noise

- Install the system separated as much as possible from noise generating sources, such as high-tension lines, high-voltage equipment, power lines, power equipment, machines generating high-voltage ON/OFF surges, welding machines, and inverter motors.
- Install the system separated as much as possible from radio equipment incorporating transmission circuitry, such as amateur radio transmitters.
- Do not touch the connector parts when the system is energized. Keep in mind that the internal circuit may be damaged if an excessive level of static electricity is imposed on the connector parts.
- Separate the sensor cable from other wires at least 100 mm, and make sure that the sensor cable is not in parallel with them. Separate the sensor cable from high-voltage and power circuit lines. Shield the sensor cable with grounded conduits if it is unavoidable to lay the sensor cable together with high-voltage or power circuit lines.
- Separate the I/O signal lines at least 100 mm away from power lines and power supply lines. All signal lines should be connected as short as possible.
- The analog output of the system is adversely influenced by heavy noise in the power supply. In that case, use a noise filter or noise-cut transformer.
- It is recommended to use shield cables for I/O signal wires and connect the shields to the frame ground (FG) for countermeasures against noise.
- The analog output is easily affected by external noise. Use the shield cable and lay it as short as possible.
- Ground the FG at a resistance not exceeding 100 Ω independently. The FG may be adversely affected if the ground is shared with other equipment.

Power Supply

■ Applicable Power Supply

- Select a power supply with a maximum ripple of 0.5 V (peak to peak) and a minimum current capacity of 0.5 A.
- Be sure to ground the FG terminal in order to prevent an adverse influence of high-frequency noise if a commercially available switching regulator is used for the power supply.
- A transformer may be connected to the power supply on the condition that the transformer is of isolation type. The product or the power supply may be damaged if an auto transformer is used.
- In order to protect the system from abnormally high voltages from the power supply line, be sure to use an isolated power supply with a built-in protective circuit.
- In the case of using a power supply that does not incorporate a protective circuit, be sure to connect the power supply to the system through a protective element, such as a fuse.

■ Power Supply Sequence for Sensor Head

- Arrange a power supply sequence so that the sensor head will be turned ON earlier than the I/O power supply.
- Arrange a power supply sequence so that the I/O power supply will be turned ON earlier than the sensor head.
- Do not turn ON the sensor head again within 10 seconds after the sensor head is turned OFF.
- The system will be ready to operate approximately 40 to 50 seconds after the system is turned ON, depending on the contents of settings. No outputs are determined during startup. Do not output anything during the period.
- An analog voltage of 11 V and an analog current of approximately 21.6 mA will be output until the system becomes ready to operate.
- Do not turn OFF the system while system settings are being saved. In the worst case, the sensor head system may be damaged and fail to restart.

Instantaneous Power Failure

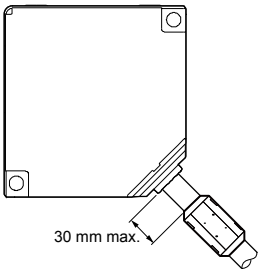
If an instantaneous power failure occurs, the system will operate continuously or go to the initial power-on state, depending on the duration of the power failure. Do not use the system in environments where instantaneous power failures occur.

CE Compliant Conditions

Make sure that the length of signal and power lines connected to the product is less than 30 m.

Attach a ferrite core to the head cable as shown below.

Recommended ferrite core: SEIWA ELECTRIC MFG. Co., Ltd.E04SR200935AB or equivalent one



Laser Product Handling

JIS/IEC

■ Laser Diode Sensor

The laser is classified in accordance with JIS (JIS C 6802: 2005) and IEC (IEC 60825-1: 2007) standards.

Wavelength	655 nm
Max. output	1 mW
Class	2

■ Precautions

1) Be careful not to stare at the laser beam directly or the reflected light of the mirror surface.

2) Install the sensor so the laser beam will be located higher or lower than eye level in order not to watch the beam directly while the system is in operation.

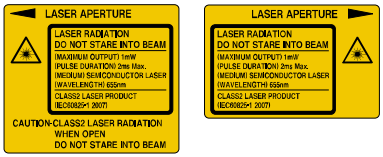
3) Contact the nearest office of di-soric GmbH & Co. KG if system breaks down. The product is not provided with a function to stop laser beam radiation automatically when the sensor head is disassembled. Do not disassemble the sensor head, or otherwise you may be exposed to the laser beam.

4) Do not use the system in methods other than that specified in this manual.

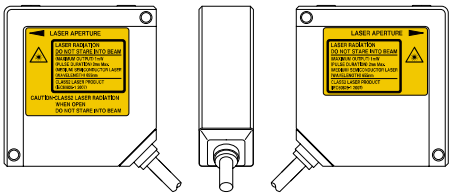
⚠CAUTION	You may be exposed to hazardous laser radiation if the system is controlled or adjusted in procedures not specified in this manual.

5) Read the descriptions of the warning label carefully before use.
The warning label (English) is affixed to the side of the sensor head. Warning labels in Japanese, Korean, and Chinese are enclosed. Use them as needed.

■ Warning label



<Label position>

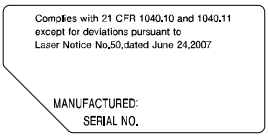


FDA

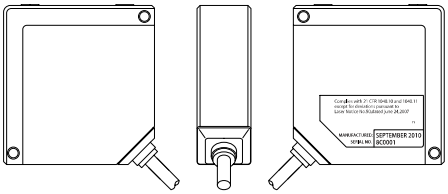
■ Export to US

The laser product mounted on equipment and exported to the United States is subjected to the regulation of the Food and Drug Administration (FDA). In order to prevent the users' injury caused by laser products, the FDA specifies PART 1040 (Performance Standards for Light-Emitting Products). The FDA classifies laser products according to the degree of risk and provides safety measures for respective classes. (→ refer to "FDA Standards".)

● Certification and Identification Label



<Label position>



■ FDA Standards

Requirements	Class[*1]					
	I	IIa	II	IIIa	IIIb	IV
Performance (all laser products)						
Protective housing [1040.10(f)(1)]	R[*2]	R[*2]	R[*2]	R[*2]	R[*2]	R[*2]
Safety interlock [1040.10 (f) (2)]	R[*3,4]	R[*3,4]	R[*3,4]	R[*3,4]	R[*3,4]	R[*3,4]
Location of controls [1040.10(f)(7)]	N/A	R	R	R	R	R
Viewing optics [1040.10(f)(8)]	R	R	R	R	R	R
Scanning safeguard [1040.10(f)(9)]	R	R	R	R	R	R
Performance (laser system)						
Remote interlock connector [1040.10(f)(3)]	N/A	N/A	N/A	N/A	R	R
Key control [1040.10(f)(4)]	N/A	N/A	N/A	N/A	R	R
Emission indicator [1040.10(f)(5)]	N/A	N/A	R	R	R[*10]	R[*10]
Beam attenuator [1040.10(f)(6)]	N/A	N/A	R	R	R	R
Manual reset mechanism [1040.10(f)(10)]	N/A	N/A	N/A	N/A	N/A	R[*13]
Performance (specific-purpose products)						
Medical [1040.11(a)]	S	S	S	S[*8]	S[*8]	S[*8]
Surveying, leveling, alignment [1040.11(b)]	S	S	S	S	NP	NP
Demonstration [1040.11(c)]	S	S	S	S	S[*11]	S[*11]
Labeling (all laser products)						
Certification/identification [1010.2,3]	R	R	R	R	R	R
Protective housings [1040.10(g)(6),(7)]	D	R[*5]	R[*5]	R[*5]	R[*5]	R[*5]
Aperture [1040.10(g)(4)]	N/A	N/A	R	R	R	R
Class warning [1040.10(g)(1),(2),(3)]	N/A	R[*6]	R[*7]	R[*9]	R[*12]	R[*12]
Information (all laser products)						
User information [1040.10(h)(1)]	R	R	R	R	R	R
Product literature [1040.10(h)(2)(i)]	N/A	R	R	R	R	R
Service information [1040.10(h)(2)(ii)]	R	R	R	R	R	R

R: Required
N/A: Not applicable
S: Requirements: Same as for other products of that Class.
NP: Not permitted
D: Depends on level of inner radiation

*1 Class is based on the maximum level of laser exposure duringoperation.

*2 Required wherever and whenever such human access to laser radiation levels that exceed the limits of Class I is not necessary for the product to perform its intended function.

*3 Required at the protective housing which is designed to be removed or displaced during operation or maintenance, if removal or displacement of the protective housing could permit human access to laser or collateral radiation.

*4 The requirements for interlock differ depending on the class of inner radiation.

*5 The contents of label differ depending on the level and wavelength of laser radiation inside the protective housing.

*6 Warning statement label

*7 CAUTION logotype

*8 The method to measure the level of laser radiation to human body is required.

*9 CAUTION if 2.5mWcm^{-2} or less, DANGER if greater than 2.5mWcm^{-2}.

*10 Time difference is needed between instruction and emission.

*11 Exception should be provided for demonstration of laser products or light shows using laser of Class IIIb or IV.

*12 DANGER logotype

*13 Required on and after August 20, 1986.

Maintenance and Inspection

■ Maintenance Instructions

- Be sure to turn OFF the system to stop laser emission before cleaning the system.
- Molded resin is used in some parts of the system. Do not use organic solvents such as paint thinner or benzine to wipe the dirt on the system.
- Do not wipe the glass portion of the laser aperture too strongly. Scratches on the glass may cause measurement errors.

(1) Cleaning Emitter and Receiver on Front Side of Sensor Head

- Always keep the emitter and receiver of the sensor head clean. Make sure that the emitter and receiver are free of substances that refract light, such as water, oil, or fingerprints, or surface water, or matters that block light, such as dust and dirt. Inspect the surfaces regularly and always keep them clean.
- Blow away large particles of dust, if any, using a camera lens blower.
- To remove small particles of dust or fingerprints, use soft lens cleaning cloth or lens cleaning paper and lightly wipe them out.
- Use cloth moistened with a small amount of alcohol to wipe out tough dirt carefully.

■ Inspection

Inspect the system regularly to maintain the performance of the system and make it possible to use the system under optimum conditions.

● Major Inspection Items

- Check that no I/O terminal connections are loose or disconnected.
- Check that the glass surface on the laser aperture is free of dust, dirt or fingerprints.
- Check that the power supply voltage is within the rated range (21.6 to 26.4 VDC).
- Check that the operating ambient temperature during use is within the specification range (a sensor head temperature range of -10°C to 45°C).
- Check that operating ambient humidity (RH) is within a range of 35% to 85%.

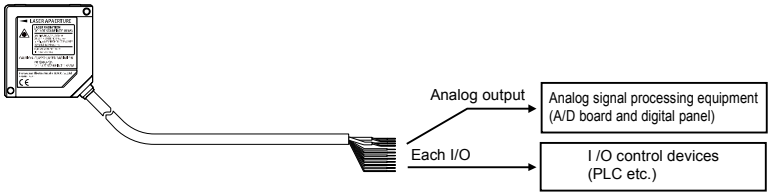
1

Before Use

This Chapter provides information on the configuration, installation, and connection of the system.

1-1 System Configuration

1-1-1 System Configuration

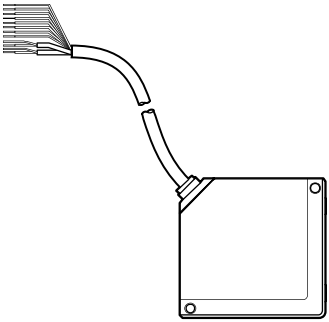


1-1-2 List of System Components & Accessories

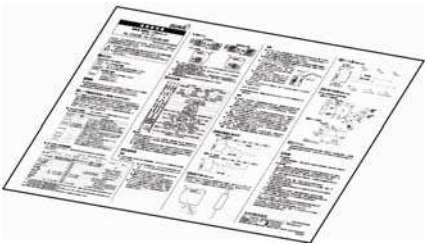
■ Sensor Head Accessories

The accessories of the sensor head are shown below.

Sensor head (Standard type)

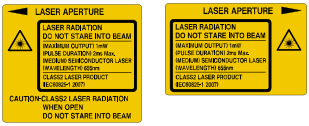


Sensor Head Instruction Manual



German, French, English

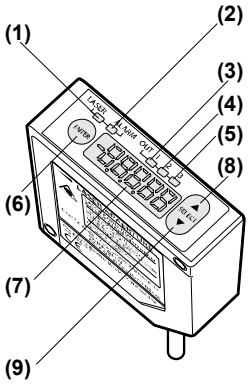
Warning label

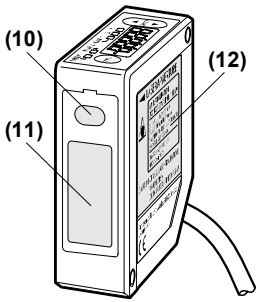


Sticker: English

Attachments: Japanese x 1 set
Chinese x 1 set
Korean x 1 set

1-2 Part Names and Functions





(1) Laser Indicator (LASER)
Lights up in green during laser emission.

(2) Alarm Indicator (ALARM)
Lights up in orange if a measurement alarm results.

(3) OUT1 Indicator (OUT1)
Lights up in yellow during OUT1 output.

(4) OUT2 Indicator (OUT2)
Lights up in yellow during OUT2 output.

(5) OUT3 Indicator (OUT3)
Lights up in yellow during OUT3 output.

(6) [ENTER] Key
Used to enter items.

(7) Digital Display
Displays measurement values and system errors.

(8) [UP] Key
Used to select items.

(9) [DOWN] Key
Used to select items.

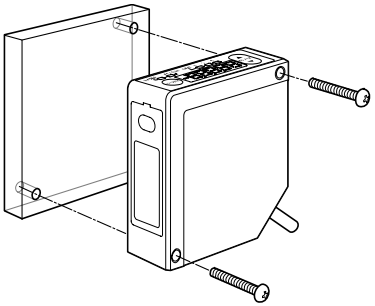
(10) Emitter
Emits the laser light.

(11) Receiver
Receives reflected light from measurement targets.

(12) Warning Label
Shows the laser emission position.
Read the description carefully before use.

1-3 Installation Method

Before installing each device, read carefully the explanation of the setting environment, concern about noise and radiation, and power supply.
(➔ Refer to "Introduction" – "Correct Handling".)
Fix the sensor head securely with M4 screws inserted into the two screw holes of the sensor head.

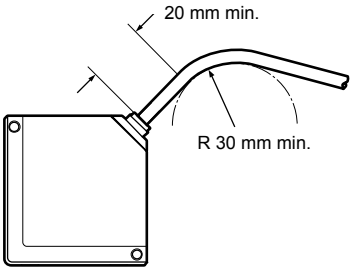


CHECK

- The tightening torque should be 0.8N·m or less.
- Never impose force around the connectors of the sensor head cable and extension cable. Do not bend the cables near the connectors. Doing so may result in cable disconnection.
- Pay utmost attention not to bend the sensor cable in excess if the sensor needs to be moved.

■ Extension Cable

- Do not pull the cable with a force of 29.4N or over when wiring the cable when the sensor head is fixed. The cable may be bent with a radius of 30 mm or over. However, do not bend the cable within 20 mm of the sensor head.



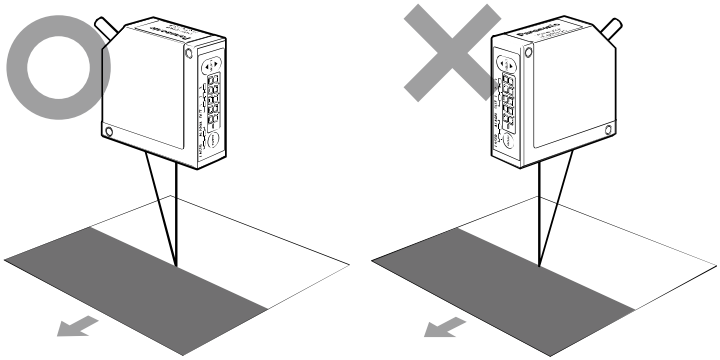
■ Mounting Direction of Sensor Head

Mount the sensor head in the direction shown below toward the measuring target in order to ensure the precise and stable measurement operation of the sensor head.

● Installation direction toward the moving target

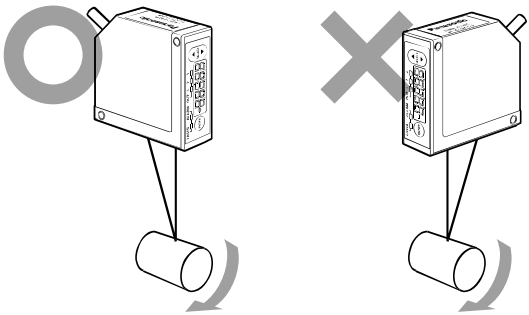
• Measurement of targets with extremely different adjacent colors or materials

When measuring a moving target that has extremely different adjacent colors or materials, set the direction of the sensor head as shown below in order to minimize the measurement error of the sensor head.



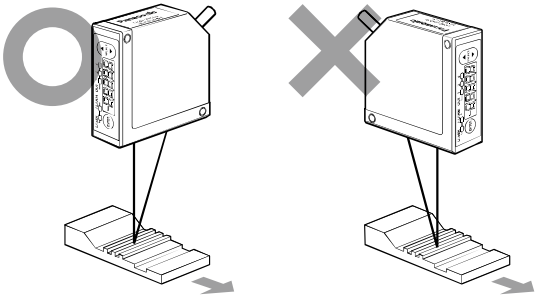
• Measurement of rotating targets

When measuring a rotating target, set the direction of the sensor head as shown below in order to minimize the adverse influence of vertical oscillation or displacement.



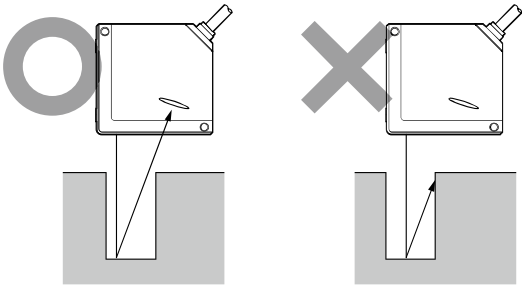
• Measurement of targets with level differences

When measuring a moving target that has level differences, set the direction of the sensor head as shown below in order to minimize interference caused by the edges of the target.



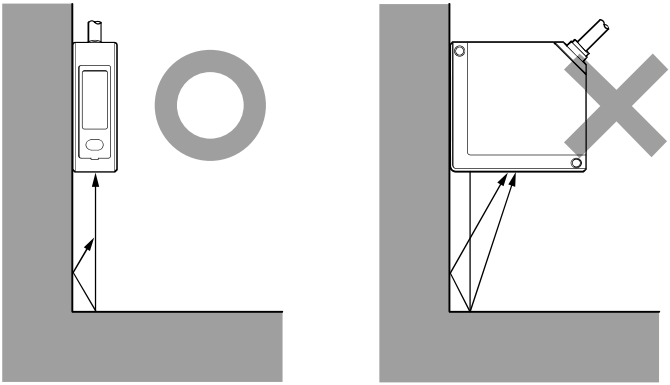
● Measurement of targets in narrow space or slots

When measuring a target in a narrow space or slot, set the direction of the sensor head as shown below in order not to block the light path between the emitter and receiver.



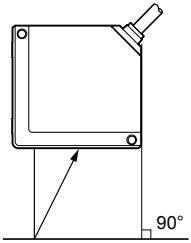
● When mounting the sensor head to a wall surface

Set the direction of the sensor head as shown below so that the receiver will not receive multi-reflected light from the wall. If the wall reflectance is high, painting the surface matte-black is effective.



● Sensor head angle to the center of measurement targets

Mount the sensor head so that the emitter and receiver will be located in parallel to each other as shown in the illustration on the right-hand side.
➔ Refer to "6-1 Sensor Head Specifications" for the measurement center distance and measurement range.



2

I/O Terminal Block

This chapter provides information on the I/O lines of the sensor head.

2-1 Functions and Arrangements of I/O Terminal Block

Analog Output Lines

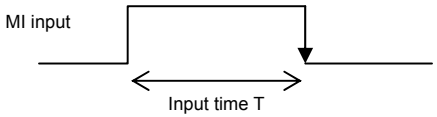
No.	Name	Function	Wiring color	
7	A(V)	Analog voltage output	Shield single conductor	Black
8	AGND	Analog ground		
9	A(I)	Analog current output	Shield single conductor	Gray
10	AGND	Analog ground		

I/O Terminal Block

No.	Name	Function	Wiring color
1	OUT1	Judgment output 1	Black
2	OUT2	Judgment output 2	White
3	OUT3	Judgment output 3 or alarm output	Gray
4	TM	Timing input	Pink
5	MI	Zero-set ON, Zero-set OFF, Reset, Memory change, Teaching, Save, and Laser Control inputs	Violet
6	NP	NPN/PNP type switching input	Pink/Violet
11	+ V	24 VDC input for power supply	Brown
12	0V	Power supply ground	Blue

* MI input varies with the period of input as shown below.

Period of input	Function
30 ms	Zero-set ON
80 ms	Reset
130 ms	Memory change (M0)
180 ms	Memory change (M1)
230 ms	Memory change (M2)
280 ms	Memory change (M3)
330 ms	Teaching a (Determines displacement judgment value a)
380 ms	Teaching b (Determines displacement judgment value b)
430 ms	Zero-set OFF (Cancel)
480 ms	Save
530 ms	Laser ON
580 ms	Laser OFF



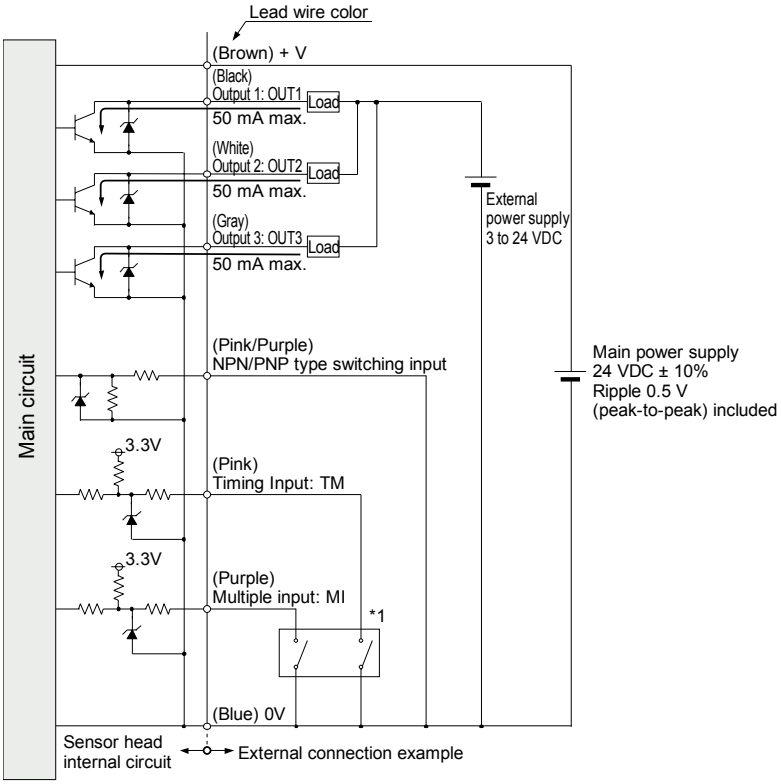
Enter MI input for the desired period with a tolerance of ±10 ms (T±10 ms).
Two or more MI inputs can be entered in sequence on the condition that a minimum interval of 10 ms is set between adjacent MI inputs.

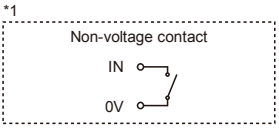
CHECK

- The action of NP switching input is determined by the input state of the sensor head with the power turned ON.
- The sensor head does not save setting changes made over the multi-input line. Save the settings over the multi-input line (period of input 480 ms).

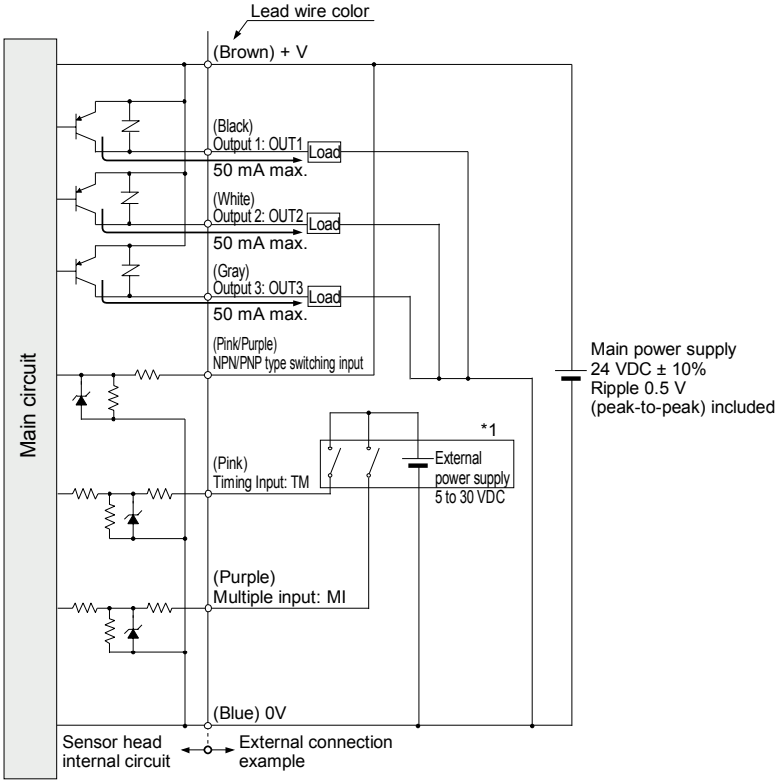
2-2 I/O Circuit

■ NPN Type

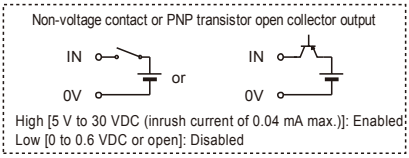




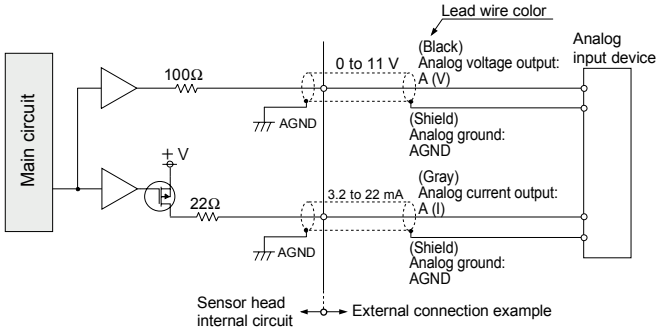
■ PNP Type


Lead wire color
(Brown) + V
(Black)
Output 1: OUT1
Load
50 mA max.
(White)
Output 2: OUT2
Load
50 mA max.
(Gray)
Output 3: OUT3
Load
50 mA max.
(Pink/Purple)
NPN/PNP type switching input
Main circuit
Main power supply
24 VDC ± 10%
Ripple 0.5 V
(peak-to-peak) included
*1
(Pink)
Timing Input: TM
External
power supply
5 to 30 VDC
(Purple)
Multiple input: MI
(Blue) 0V
Sensor head
internal circuit
External connection
example

*1


Non-voltage contact or PNP transistor open collector output
IN
0V
or
IN
0V
High [5 V to 30 VDC (inrush current of 0.04 mA max.)]: Enabled
Low [0 to 0.6 VDC or open]: Disabled

2-3 Analog Output Circuit

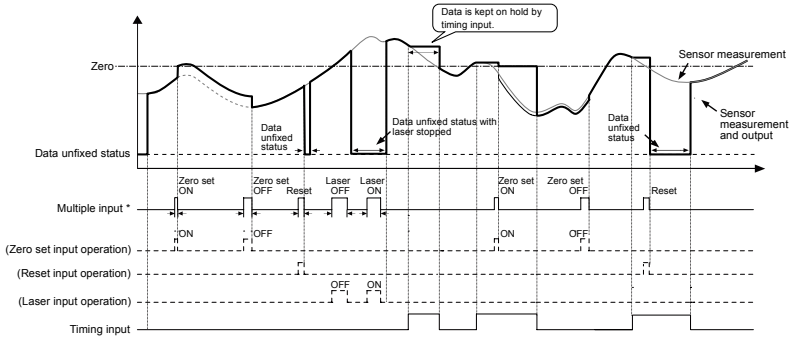


CHECK

- Do not short-circuit the analog output terminals or apply voltage to them.
- Use shielded wires for the analog output terminals.

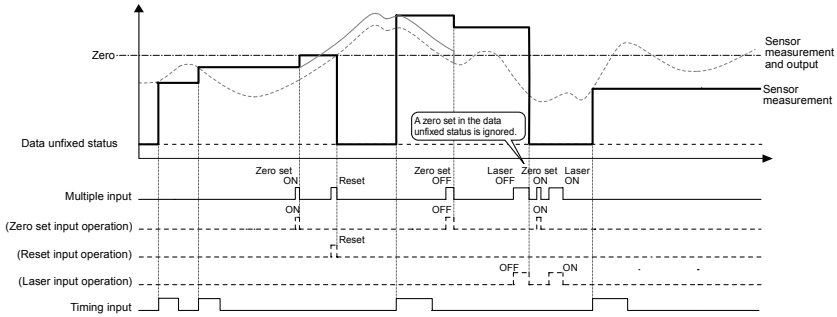
2-4 Timing Chart

● NORMAL measurement (with timing mode set to “Hold”)



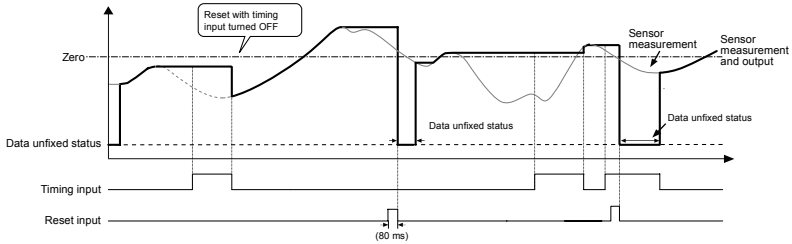
* The function of multiple input varies with the period of input.
Zero set ON: 30ms Zero set OFF: 430 ms Reset: 80 ms
Laser ON: 530 ms Laser OFF: 580 ms

● NORMAL measurement (with timing mode set to “One-shot”)



For the period of multiple input time, refer to NORMAL measurement (with timing mode set to Hold)

● PEAK measurement



- A zero set will be enabled by timing input while the HOLD status is valid.
- A reset input by timing input during the HOLD status will cause a data unfixed status. The system will hold this status until the timing input is cancelled.
- No zero set will be enabled while the data unfixed status is kept on hold.
- The system will hold reset input while the data unfixed status is valid until the timing input is cancelled.
- Judgment output is determined by the measured value and "displacement judgment". The output will be turned OFF while the data unfixed status is valid.
- When any data unfixed status other than that caused by reset input is valid, the console displayed value, analog output, and judgment output will become the same in performance.
- Analog output during the data unfixed status is indicated by the initial setting.
- If the system has been set to "Offset", the offset value will be added when a zero set is executed.
- If a zero set is executed during PEAK to PEAK measurement, the present measurement value will become zero (i.e., the reference value of measurement). Therefore, the measurement value will start from a negative (-) value if the system is reset while a zero set is executed.
- If "digital output at alarm" is fixed, the judgment output of the sensor head will be interlocked with the fixed value.

Processing of zero set/timing/reset inputs

	On timing input	Reset input (during data unfixed time)
Zero set input (ON/OFF)	Reflected at the time of zero set input.	Invalid
Timing input		The data unfixed status is kept on hold.
Reset input	A data unfixed status will occur at the time of reset input (HOLD status while timing input is ON).	

Function of timing input (level)

Analysis mode	Function
NORMAL measurement	The measurement value will be kept on hold with timing input turned ON in this mode, and the hold status will be canceled with the timing input turned OFF.
PEAK measurement VALLEY measurement	The measurement value will be kept on hold at the moment the input signal turned ON in this mode, and the hold status will be canceled with the input signal turned OFF. The peak (bottom) value will be reset when the HOLD status is cancelled.
PEAK to PEAK measurement	The measurement value will be kept on hold at the moment the input signal is turned ON in this mode, and the hold status will be canceled with the input signal turned OFF. The data will be set to zero when the HOLD status is cancelled.

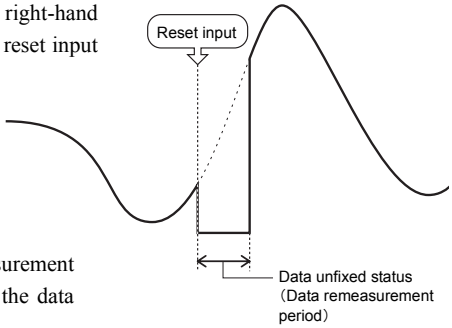
2-5 Conditions When Output Data Become Unfixed

The operation status will be judged as a data unfixed status (i.e., there is no determined data) immediately after settings changes are made, the system is reset, or laser stop input is turned ON. This status is not an alarm status.

The data unfixed status starts at the time of restarting measurement after setting refreshment or resetting until the number of data measurement times reaches an average.
Under the data unfixed status, a digital output of -999.9999 [mm] and an analog output of 11.000 [V] or 21.6 [mA][*1] will be turned ON.

*1 This is the initial value. Under the data unfixed status, the analog output of the system can be changed to a fixed value. For more information, → refer to "3-3-7 Alarm Settings" – "Analog Output at Alarm".
*2 Under the data unfixed status, the zero set input will be ignored.
*3 For cancelling the data unfixed status, → refer to Chapter 5 "Troubleshooting".

For example, the graph on the right-hand side shows the digital display at reset input for NORMAL measurement.



The table below shows the measurement value display and output under the data unfixed status or alarm status.

	Data unfixed status	Alarm status
Status	Measurement data is unfixed. (Average buffer has not reached the setting number of times.)	Measurement disabled status due to poor light intensity or when the target object is off the measurement range.
Digital output	-999.9999 [mm]	The previous value (default) is kept on hold.
Analog output	Interlocks with the analog output at alarm	The previous value (default) is kept on hold.
Terminal output	OFF	OFF

The following conditions will result in the data unfixed status.

- Reset input after the power is turned ON
- Sampling cycle switching
- Initialization
- Laser control interruption
- Average times switching

* There are cases where the data unfixed status does not occur depending on the setting conditions.

3

Functions

This Chapter provides information on the functions of the system.

3-1 Classification of Functions

In this system, all functions are classified into eight categories to ensure stable measurement and various outputs.

Classification	Panel display	Function
Sensing Settings	Pro1	Function settings for precise and stable measurement by controlling the received light intensity of the sensor.
Data Processing Settings	Pro2	Function settings for processing measurement values.
Output Settings	Pro3	Function settings related to output data processing.
Analog Settings	Pro4	Function settings related to analog output processing.
Alarm Settings	Pro5	Function settings related to alarm output processing.

System Settings	Pro7	System settings such as "Initialization," "Save," and communications settings.
Buffering Settings	*	Function settings related to buffering.

3-2 Function List & Initial Values

Class	Function	Details Initial value	Memory change*	Ref. page
	Memory Change	Changes memory for saving the setting contents. Default: M0	☆	3-11
Sensing settings	Sampling Cycle	Sets the sampling cycle for measurement. Default: 500 µs	○	3-13
	Shutter Time	Controls the receiving light intensity of the sensor according to the amount of reflected light from measurement targets. Default: Auto	○	3-14
	Light Intensity Monitor	Checks the current received light intensity.	-	3-15
Data Processing Settings	Average Times	Sets the average number of times of moving average. Default: 1024	○	3-16
	Analysis Mode	Sets the analysis mode. Default: Normal measurement	○	3-17
	Span	Sets the measurement coefficient. Default: 1.0000	○	3-17
	Offset	Sets the measurement offset. Default: 00000 mm	○	3-20
	Zero-set OFF	Clears the zero-set state. Default: OFF	○	3-19

Class	Function		Details	Initial value	Memory change*	Ref. page
Output Settings	Judgment Output Selection		Sets the operation of the output block.	Default: 2-state	○	3-22
	Displacement Judgment	Threshold a	Sets threshold a and threshold b.	Default: +(detection range) Default: -(detection range)	○	3-24
		Threshold b				
		Hysteresis	Sets the hysteresis.	Default: +(0.2% of setting range)	○	
	Judgment Output OFF Delay		Delays the timing of judgment output switched OFF from ON.	Default: OFF	○	3-25
	Measurement Value Display on Panel		Turns OFF the rightmost digits on the digital display.	Default: SET 1	○	3-27
Analog Settings	Analog Output Selection		Selects the desired output type from current output and voltage output.	Default: Current output	○	3-28
	Analog Scaling	Meas A	Performs scaling the analog current output and the analog voltage output to any desired value.	Default: Negative measurement range	○	3-29
		Current A		Default: +4.000 mA	○	
		Voltage a		Default: 0.000 V	○	
		Meas B		Default: Positive measurement range	○	
		Current B		Default: +20.000 mA	○	
		Voltage b		Default: 10.000 V	○	
Alarm Settings	Analog Output at Alarm		Sets the analog output status at alarm operation.	Default: Holds previous value	○	3-31
	Digital Output at Alarm		Sets the digital output status at alarm operation.	Default: Holds previous value	○	3-32
	Alarm Delay Times		Holds the previous normal value up to the setting number of times if an alarm is issued.	Default: 8 times	○	3-33
System Settings	Timing Mode		Sets the timing input mode.	Default: Hold	☆	3-39
	Laser Control		Switches laser emission/stop.	Default: Emission	☆	3-40
	Eco Mode		Turns OFF the LED indicators on the control panel for energy saving while the system is in RUN mode.	Default: Eco OFF	☆	3-41
	View Version		Displays the software version of the sensor.		-	3-42
	Initialization		Initializes the memory settings currently in use.		×	3-43
	Save		Saves all memory settings.		×	3-44
	Timing		Holds the measurement value.	Default: OFF	×	3-45

* Memory change ○: Up to four types of settings can be saved by performing memory change.

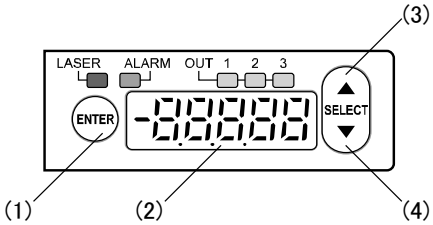
×: Settings cannot be changed by performing memory change.

☆: Settings are saved as common settings for all memories. Settings cannot be executed on a memory-to-memory basis.

3-3 Operation of Each Function

3-3-1 Basic Operation

■ Panel Configuration



(1) [ENTER] Key
Used to enter items.

(2) Digital Display
Displays measurement values, set values, and system errors.

(3) [UP] Key
Used to select items.

(4) [DOWN] Key
Used to select items.

3

Digital Display

The decimal point position varies with each model.

Measurement value and set value

30-mm type 15.000

50/80/120-mm type 10.000

Data unfixed status ------

Alarm status with the “digital output at alarm” set to a fixed value.

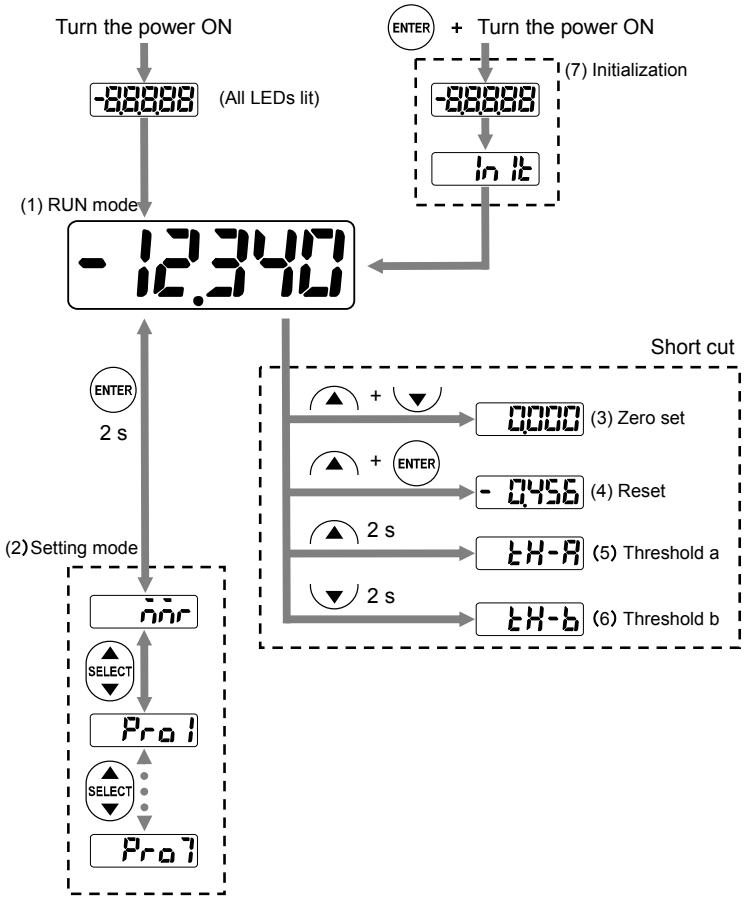
30-mm type 99.999

50/80/120-mm type 99.999

■ Basic Operation

The following section explains how to operate the system in RUN mode after the system is turned ON, make function changes in the system, and reset the system to RUN mode, along with the shortcut functions of the system in RUN mode.

The operation of the system common to each function is explained below. For more information on settings peculiar to the respective functions, → refer to "3-3-2 Memory Change" through "3-3-9 System Settings."



(1) RUN mode

The measurement value will appear on the digital display in this mode.
The system will be set to this mode when the system is turned ON.

(2) Setting mode

Use this mode to make setting changes.
RS-422/485 write commands cannot be received while the system is in this mode.
An error command indicating that the system is in setting mode will be returned if a write command is received.
Refer to the next page for the transition of the screen while the system is in setting mode.

(3) Zero set

The measurement value will be set to zero in this mode.

(4) Reset

The measured value kept on hold by the system in measurement mode will be reset.

(5) Threshold a

The screen will change to the threshold-a setting screen.

(6) Threshold b

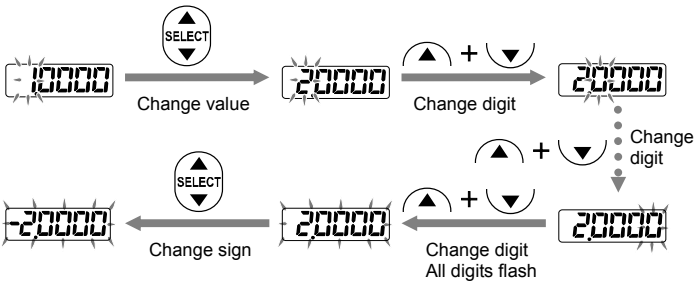
The screen will change to the threshold-b setting screen.

(7) Initialization

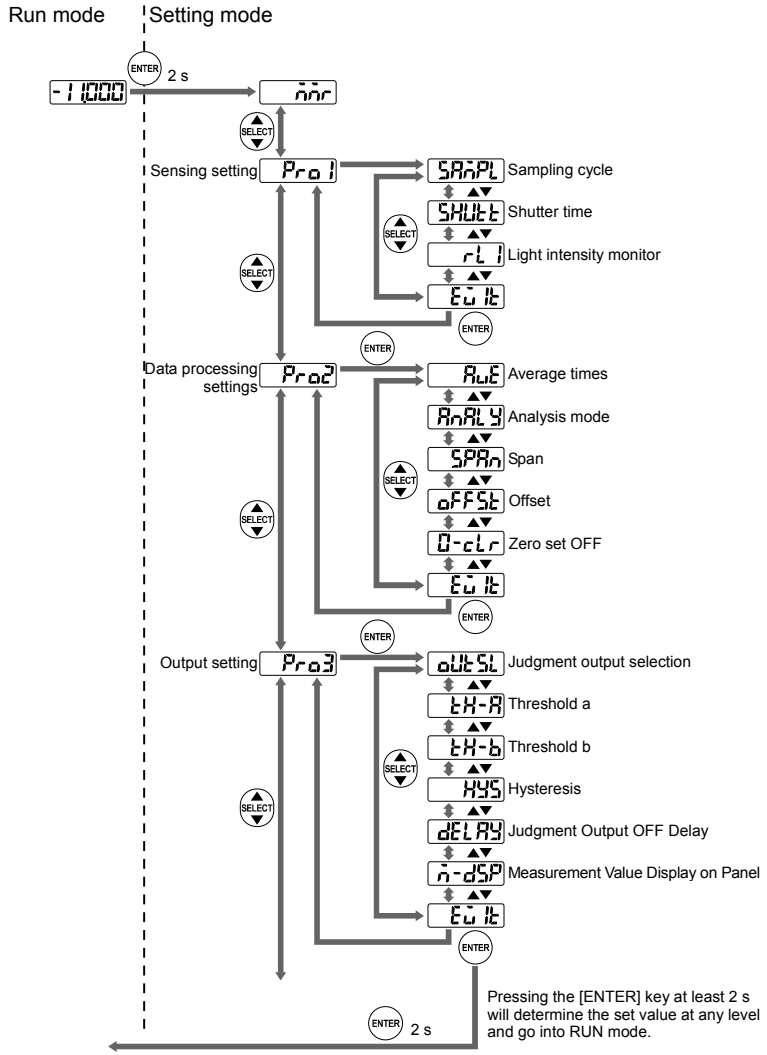
Initialization deletes all settings and returns them to the factory default settings.

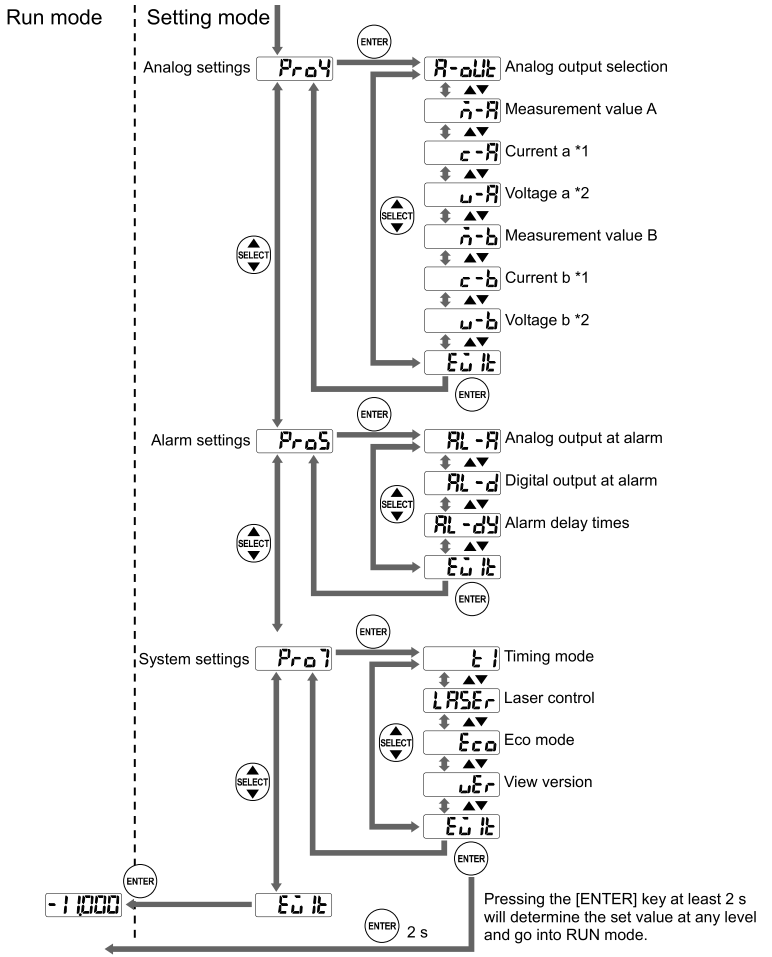
● Making Setting Value Changes

"Span," "Offset," "Displacement judgment," "Analog scaling," "Number of alarm delay times" setting values can be changed freely.



■ Screen Transition in Setting Mode





*1 Not displayed when "Voltage" is selected for "Analog Output Selection."

*2 Not displayed when "Current" is selected for "Analog Output Selection."

3-3-2 Memory Change

The memory to save setting contents can be changed with M0 through M3.

Setting	Function	Panel display
M0	Memory M0	n0
M1	Memory M1	n1
M2	Memory M2	n2
M3	Memory M3	n3

* [ ] indicates the default value.

CHECK

- Select the first number to be changed when the system goes into setting mode.
- A memory change will not switch the current memory until the memory change is executed after the system restarts.
- Data unstability may result when the memory change is executed.
- If setting changes are made with a serial communications command, save the changes so that the changes will be reflected when the system is turned ON again.

● Setting Procedure

1 Display the "Memory Change" screen while the system is in setting mode.

2 Press the [ENTER] key. The memory will be displayed. (ENTER)

3 Press the [UP]/[DOWN] key to make memory changes. (Example: Changing the memory to “M3”.) (SELECT)

4 Press the [ENTER] key to determine the memory. (ENTER)

● Memory Saving Settings

Each function that has been set can be saved in four ways in the memory area in the sensor head.

Measurement and judgment conditions can be saved individually according to the type of measurement object. Therefore, memory number changes will be possible without entering the set values for a wide variety of functions.
Memory changes are made with external commands and settings in the control panel.

Storable Functions in Memory

The function settings that can be stored in the memory are divided into two types. One of them can be stored in each specified memory number and the other one can be stored as setting values common to all memories.

For the above two types of storable functions in detail, → refer to "3-2 Function List & Initial Values".

3-3-3 Sensing Setting [Pro1]

■ Sampling Cycle [SAmPL]

This function is used to make measurement cycle settings.

TECHNIQUE

When measuring an object with poor received light intensity, such as black rubber, extend the sampling cycle to get sufficient light to perform stable measurement.

Cycle	Frequency	Panel display	Meas. object
200 μs	5 kHz	[200]	Bright ↕ Brightness of meas. object ↕ Dark
500 μs	2 kHz	[500]	
1 ms	1 kHz	[1000]	
2 ms	500 Hz	[2000]	

*1 The measurement range may become narrow depending on measurement object type.

*2 [ ] indicates the default value.

● Setting Procedure

1 Display the "Sensing Setting" screen while the system is in setting mode. → [Pro1]

2 Press the [ENTER] key. The "Sampling Cycle" screen will be displayed. → (ENTER) → [SAmPL]

3 Press the [ENTER] key. The present sampling cycle will be displayed. → (ENTER) → [500]

4 Press the [UP]/[DOWN] key to make sampling cycle changes. (Example: Changing the sampling cycle to 1 ms.) → (SELECT ▲▼) → [1000]

5 Press the [ENTER] key to determine the sampling cycle. → (ENTER) → [SAmPL]

■ Shutter Time SHUtt

The shutter time controls the receiving light intensity of the sensor according to the amount of reflected light from measurement targets.

If the shutter time is set to AUTO, the light intensity feedback function automatically controls the light intensity to an optimum level. In the case of fixing the shutter time, use the light intensity monitor and select a fixed value of approximately 1000 to 1300.

Setting	Function	Initial value
AUTO	Shutter time automatic setting	AUto
1 to 31	Fixed (See the table below.)	

● Setting Procedure

1 Display the "Sensing Setting" screen while the system is in setting mode. → Pro1

2 Press the [ENTER] key. The "Sampling Cycle" screen will appear. (ENTER) → SAMPL

3 Press the [DOWN] key once. The "Shutter Time" screen will be displayed. (SELECT ▼) → SHUtt

4 Press the [ENTER] key. The present shutter time will be displayed. (ENTER) → AUto

5 Press the [UP]/[DOWN] key to make shutter time changes. (Example: Changing the shutter time to 31.) (SELECT ▲▼) → 31

6 Press the [ENTER] key and determine the shutter time. (ENTER) → SHUtt

The following table shows the relation between the set values for shutter time and actual shutter apertures.

Set value	Shutter aperture	Set value	Shutter aperture	Set value	Shutter aperture	Set value	Shutter aperture
AUTO	Auto	8	0.24%	16	1.95%	24	15.9%
1	0.04%	9	0.31%	17	2.54%	25	20.7%
2	0.05%	10	0.40%	18	3.30%	26	26.9%
3	0.06%	11	0.53%	19	4.29%	27	35.0%
4	0.08%	12	0.68%	20	5.58%	28	45.5%
5	0.11%	13	0.89%	21	7.25%	29	59.2%
6	0.14%	14	1.16%	22	9.43%	30	76.9%
7	0.18%	15	1.50%	23	12.3%	31	100%

■ Light Intensity Monitor rL1

This function is used to check the current received light intensity.

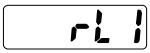
The peak light intensity will be displayed in a range of 0 to 4095.

● Setting Procedure

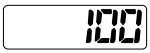
1 Display the "Sensing Setting" screen while the system is in setting mode.

2 Press the [ENTER] key. The "Sampling Cycle" screen will appear.

3 Press the [DOWN] key twice. The "Meas Suf Selection" screen will be displayed.



4 Press the [ENTER] key. The present light intensity will be displayed.



3-3-4 Data Processing Settings Pro2

■ Average Times AvE

This function is used to set the average number of times of moving average. Use the function to stabilize unstable measurement values (including variations).

Setting	Function	Panel display
1 time	1-time moving average processing	1
4 times	4-time moving average processing	4
16 times	16-time moving average processing	16
64 times	64-time moving average processing	64
256 times	256-time moving average processing	256
1024 times	1024-time moving average processing	1024

* [ ] indicates the default value.

CHECK

Data unstability may result until the movement average buffer reaches the setting number of times (→ refer to "2-5 Conditions When Output Data Become Unfixed"). If there is an alarm when the moving average buffer is cleared, moving averaging will start after the alarm state is cleared. Moving averaging based on the previous data will be performed if an alarm occurs until the setting number of times is reached after moving averaging starts.

● Setting Procedure

1 Display the "Data Processing Setting" screen while the system is in setting mode. → Pro2

2 Press the [ENTER] key. The "Average Times" screen will be displayed. (ENTER) → AvE

3 Press the [ENTER] key. The present number of average times will be displayed. (ENTER) → 1024

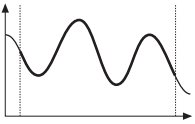
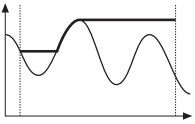
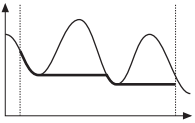
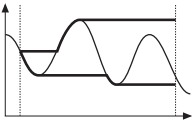
4 Press the [UP]/[DOWN] key to change the number of average times. (Example: Changing the number of average times to 256.) (SELECT) → 256

5 Press the [ENTER] key and determine the number of average times. (ENTER) → AvE

■ Analysis Mode AnALY

This function is used to set the analysis mode.

The following table shows the function of each analysis mode.

Setting	Function		Panel display
NORMAL		The measurement value is output in real time.	norn
PEAK		Holds and outputs the maximum measurement value.	PEAP
VALLEY		Holds and outputs the minimum measurement value.	uALLY
PEAK to PEAK (P-P)		Holds and outputs the difference between the maximum and minimum values.	P-2-P

* [ ] indicates the default value.

TECHNIQUE

Peak to Peak can be used for vibration or eccentricity measurement.

● Setting Procedure

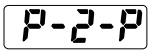
1 Display the "Data Processing Setting" screen while the system is in setting mode. → Pro2

2 Press the [ENTER] key. The "Average Time" screen will be displayed. (ENTER) → AuE

3 Press the [DOWN] key once. The "Analysis Mode" screen will be displayed. (SELECT ▼) → AnALY

4 Press the [ENTER] key. The present analysis mode will be displayed. (ENTER) → norn

5 Press the [UP]/[DOWN] key to make analysis mode changes. (Example: Switching to PEAK to PEAK mode.)

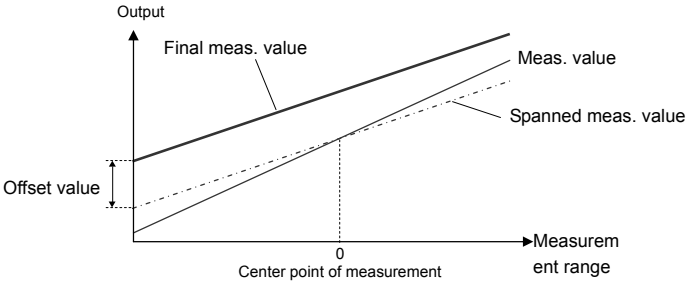


6 Press the [ENTER] key to determine the mode setting.

■ Span SPAn

The system can output measurement values with a span (factor) multiplied.

Final measurement value = Span x measurement value + offset



Setting range	Function	Initial value
0.1000 to +9.9999	Set a span in a range from 0.1000 to +9.9999.	1.0000

● Setting Procedure

1 Display the "Data Processing Setting" screen while the system is in setting mode. → Pro2

2 Press the [ENTER] key. The "Average Time" screen will be displayed. → ENTER → AvE

3 Press the [DOWN] key twice. The "Span" screen will be displayed. → SELECT → SPAn

4 Press the [ENTER] key. The present span will be displayed. The leftmost digit will be selected. → ENTER → -1.0000

5 Press the [UP]/[DOWN] keys together to change the selected digit. → ▲ ▼ → 1.0000

6 Press the [UP]/[DOWN] key to change the value of the selected digit. (Example: Changing the value to 2.0000.) → SELECT → -2.0000

7 Press the [ENTER] key to determine the span. → ENTER → SPAn

■ Offset 

A desired setting value can be added to/subtracted from the measurement value.

TECHNIQUE

Measurement judgment will be possible from an offset in combination with "displacement judgment" by setting the size of the master workpiece (reference measurement object) for the offset, measuring the master workpiece, and turning the "zero set" ON.

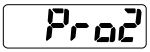
Setting range	Function	Initial value
-95000 to +95000	-Set an offset in a range from 95000 to +95000. (The decimal point position varies with each model.)	

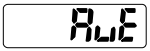
CHECK

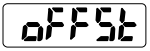
- Set "Offset" and turn "Zero Set" ON to make the setting value an offset value.
- The display limit of the measurement value is ±95000. Make sure that the setting value does not exceed the display limit.

3

● Setting Procedure

1 Display the "Data Processing Setting" screen while the system is in setting mode. 

2 Press the [ENTER] key. The "Average Time" screen will be displayed.  

3 Press the [DOWN] key three times. The "Offset" screen will be displayed.  

4 Press the [ENTER] key. The present offset value will be displayed. The leftmost digit will be selected.  

5 Press the [UP]/[DOWN] keys together to change the selected digit. 

6 Press the [UP]/[DOWN] key to change the value of the selected digit or its sign. (Example: Changing the value to +2.500 [mm].)  

7 Press the [ENTER] key and determine the offset value.  

■ Zero-set OFF [0-clr]

This function cancels the zero set for measurement values.

Setting	Function	Panel display
Reset	The zero set is not canceled.	YES
Hold	The zero set is canceled.	no

Supplemental remarks

• External multi input (MI) can turn the zero set ON and OFF. (→ refer to "2-1 Functions and Arrangements of I/O Terminal Block.")

● Setting Procedure

1 Display the "Data Processing Setting" screen while the system is in setting mode. — Pro2

2 Press the [ENTER] key. The "Average Time" screen will be displayed. — ENTER — AvE

3 Press the [DOWN] key four times. The "Zero-set OFF" screen will be displayed. — SELECT — 0-clr

4 Press the [ENTER] key. "Yes/No" will be displayed. — ENTER — YES

5 Press the [UP]/[DOWN] key to make "Yes/No" changes. (Example: Maintaining the zero-set state.) — SELECT — no

6 Press the [ENTER] key. — ENTER — 0-clr

3-3-5 Output Settings Pro3

■ Judgment Output Selection oUt5L

This function makes it possible to select the operation of the output block.

An alarm will not be output if "3-state" is selected.
The final decision process is done in digital measurements. When an alarm is turned ON, the value will be set to +999.9999 with which judgment processing will be performed, provided that a fixed value has been set with “digital output at alarm”.

Judgment Output Selection	Output operation			
	OUT1	OUT2	OUT3	
				Display, Threshold a, Threshold b, Displacement (+)
Logic LoGIc	Judgment 1	Judgment 2	Alarm	OUT1 ON/OFF Output status; OUT2 ON/OFF Output status
Independent Ind	Judgment 1	Judgment 2	Alarm	OUT1 ON/OFF Output status; OUT2 ON/OFF Output status
2-state 2oAL	Judgment 1	Judgment 2	Alarm	OUT1 ON/OFF Output status; OUT2 ON/OFF Output status
3-state 3oAL	Judgment 1	Judgment 2	Judgment 3	OUT1(HI) ON/OFF Output status; OUT2(GO) ON/OFF Output status; OUT3(LO) ON/OFF Output status

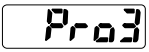
* [ ] indicates the default value.

CHECK

OUT3 settings are related to the operation of the output lines. An alarm is output through the OUT3 output line unless a 3-state value has been set. The OUT3 indicator on the sensor head and the OUT3 output readout function, however, will be turned OFF without being interlocked with the alarm. Check the alarm state with the alarm indicator and alarm readout function.

- Setting Procedure

1 Display the "Output Setting" screen while the system is in setting mode.



2 Press the [ENTER] key. The "Judgment Output Selection" screen will be displayed.

3 Press the [ENTER] key. The present output type will be displayed.

4 Press the [UP]/[DOWN] key to make output type changes. (Example: Changing the output type to "Independent.")

5 Press the [ENTER] key to determine the output type.

■ Displacement Judgment

This function is used to set an upper limit (threshold a), lower limit (threshold b), and hysteresis for the judgment of measurement values.

Item	Panel display	Setting range	Function
Threshold a	tH-A	-95000 to +95000	Sets threshold a, threshold b and hysteresis.
Threshold b	tH-b	-95000 to +95000	
Hysteresis	HYS	0 to +95000	

Supplemental remarks

The following default values apply.

Type	Threshold a	Threshold b	Hysteresis
30 mm	+4 mm	-4 mm	8 µm
50 mm	+10 mm	-10 mm	20 µm
85 mm	+20 mm	-20 mm	40 µm
120 mm	+60 mm	-60 mm	120 µm

3

CHECK

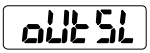
- Make settings so that threshold a is larger than threshold b. The sensor head will perform automatic discrimination, however, if the opposite settings are made.
- The decimal point position varies with each model.

● Setting Procedure

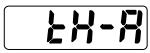
Setting Threshold a

1 Display the "Output Setting" screen while the system is in setting mode.

2 Press the [ENTER] key. The "Judgment Output Selection" screen will be displayed.



3 Press the [DOWN] key once. The "Threshold a" screen will be displayed.

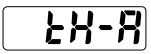


4 Press the [ENTER] key. The present threshold will be displayed. The leftmost digit will be selected.

5 Press the [UP]/[DOWN] keys together to change the selected digit.

6 Press the [UP]/[DOWN] key to change the selected digit or its sign. (Example: Changing the value to +5 [mm].)

7 Press the [ENTER] key to determine the threshold.



■ Judgment Output OFF Delay dELAY

This function delays the timing of switching ON to OFF of judgment output.

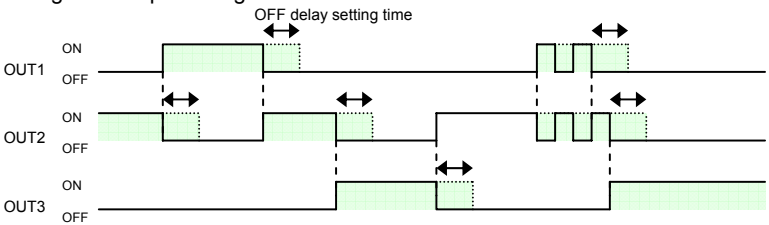
TECHNIQUE

This function is useful for applying output to a control device when the output is changing at high speed.

Setting	Function	Panel display
OFF	Output according to the sampling cycle.	oFF
2 ms	2-ms OFF-delay	2mS
4 ms	4-ms OFF-delay	4mS
10 ms	10-ms OFF-delay	10mS
20 ms	20-ms OFF-delay	20mS
40 ms	40-ms OFF-delay	40mS
100 ms	100-ms OFF-delay	100mS
Hold	Output once turned ON will be kept on hold. The output kept on hold will be released with reset input.	HoLd

* [ ] indicates the default value.

Judgment output timing



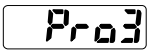
The solid lines shows OFF setting actions. OFF timing will be delayed according to the OFF-delay set time as shown by the dotted lines.

CHECK

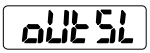
- If actual output is turned ON earlier than the OFF-delay set time, the OFF-delay set time will be enabled from the point where the output is turned OFF.
- If "Logic" or "Independent" or "2-state" is selected with the judgment output selection function, OUT3 (alarm output) will not be OFF-delayed regardless of OFF-delay settings.

● Setting Procedure

1 Display the "Output Setting" screen while the system is in setting mode.



2 Press the [ENTER] key. The "Judgment Output Selection" screen will be displayed.



3 Press the [DOWN] key four times. The "OFF-delay" screen will be displayed.

4 Press the [ENTER] key. OFF-delay settings will be displayed.

5 Press the [UP]/[DOWN] key to make OFF-delay setting changes. (Example: Changing the setting to Hold.)

6 Press the [ENTER] key to determine the OFF-delay setting.

■ Measurement Value Display on Panel n-dSP

The rightmost digits on the digital display can be turned OFF.

Setting	Function	Panel Display
FULL	All the digits are displayed.	FULL
Set 1	The rightmost digit is OFF.	SEt 1
Set 2	The rightmost two digits are OFF.	SEt2

● Setting Procedure

1 Display the "Output Setting" screen while the system is in setting mode.

Pro3

2 Press the [ENTER] key. The "Judgment Output Selection" screen will be displayed.

ENTER → oUtSL

3 Press the [DOWN] key five times. The "Measurement Value Display on Panel" screen will be displayed.

SELECT → n-dSP

4 Press the [ENTER] key. The "Measurement Value Display on Panel" screen will be displayed.

ENTER → SEt 1

5 Press the [UP]/[DOWN] key to make a setting change for the measurement value display on the panel. (Example: Changing the present setting to Set 2.)

SELECT → SEt2

6 Press the [ENTER] key to determine the setting for the measurement value display on the panel.

ENTER → n-dSP

● Set2 usage example

In this example "FULL" is changed to "Set2."

3-3-6 Analog Settings PrA4

■ Analog Output Selection A-Out

This function selects the desired output type from current output and voltage output.

The accuracy of selected analog output will be guaranteed.

Setting	Function	Panel display
Current	Output current	I-Out
Voltage	Output voltage	U-Out

* [ ] indicates the default value.

● Setting Procedure

1 Display the "Analog Setting" screen while in setting mode. — PrA4

2 Press the [ENTER] key. The "Analog Output Selection" screen will be displayed. — ENTER — A-Out

3 Press the [ENTER] key. The present output type will be displayed. — ENTER — I-Out

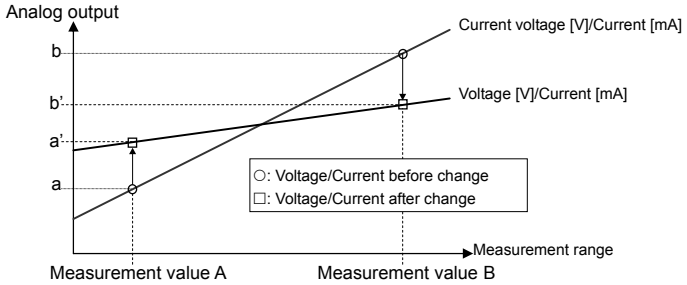
4 Press the [UP]/[DOWN] key to make output type changes. (Example: Changing the output type to voltage output.) — SELECT — U-Out

5 Press the [ENTER] key to determine the output type. — ENTER — A-Out

■ Analog Scaling

This function scales analog current output or analog voltage output to any desired value.

Measurement values A and B on any two measurement point can be scaled with currents a and b or voltages a and b on any two points. Analog output is turned ON according to the scaling set for analog output selection.



Item	Panel display	Setting range	Function	Initial value
Meas A	n-A	-95000 to +95000	Make measurement value, current, and voltage settings.	Negative measurement range
Meas B	n-b	-95000 to +95000		Positive measurement range
Current a (*1)	c-A	+4.000 to 20.000		4.000
Current b (*1)	c-b	+4.000 to 20.000		20.000
Voltage a (*2)	u-A	0 to +10.000		0.000
Voltage b (*2)	u-b	0 to +10.000		10.000

*1 Not displayed when "Voltage" is selected for "Analog Output Selection."

*2 Not displayed when "Current" is selected for "Analog Output Selection."

Supplemental remarks

The following default measurement values A and B apply.

Type	Meas. Val A	Meas B
30 mm	-4 mm	+4 mm
50 mm	-10 mm	+10 mm
85 mm	-20 mm	+20 mm
120 mm	-60 mm	+60 mm

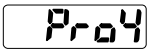
CHECK

- The display limit of the measurement value is ±95000. Make sure that the setting value does not exceed the display limit.
- Check the input range of your input device such as AD board before setting.
- The decimal point position of measurement values varies with each model.

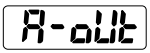
● Setting Procedure

Setting current a (current for measurement value A)

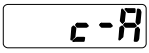
1 Display the "Analog Setting" screen while in setting mode.



2 Press the [ENTER] key. The "Analog Output Selection" screen will be displayed.



3 Press the [DOWN] key twice. The "Current a" screen will be displayed.

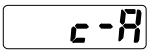


4 Press the [ENTER] key. The present set value will be displayed. The leftmost digit will be selected.

5 Press the [UP]/[DOWN] keys together to change the selected digit.

6 Press the [UP]/[DOWN] key to change the value of the selected digit. (Example: Changing the value to 5.000 [mA].)

7 Press the [ENTER] key to determine the set value.



3-3-7 Alarm Settings PrOS

■ Analog Output at Alarm AL-A

This function is used to set the analog output status at alarm operation.

Analog output in the alarm state (where measurement is disabled owing to lack of light) can be kept on hold or set to a fixed value selectively.

Setting	Function	Panel display
Hold	Holds the analog output immediately before the alarm.	HoLd
Fixed Value	Fixed-value output	FIX

* [ ] indicates the default value.

Supplemental remarks

- A fixed current output of 21.6 [mA] or voltage output of +11.000 [V] applies.
- The fixed value is applied to the side set with "Analog Output Selection."

CHECK

- Check the input range of your input device such as AD board before setting.
- The above settings will apply when there is data unstability.

● Setting Procedure

1 Display the "Alarm Setting" screen while in setting mode. PrOS

2 Press the [ENTER] key. The "Analog output at alarm" will be displayed. ENTER AL-A

3 Press the [ENTER] key. The Hold/Fix will be displayed. ENTER HoLd

4 Press the [UP]/[DOWN] key to set the system to Hold/Fix. (Example: Changing the selection to the fixed value.) SELECT FIX

5 Press the [ENTER] key to determine the set value. ENTER AL-A

■ Digital Output at Alarm AL-d

This function is used to set the digital output status at alarm operation.

This function makes settings related to digital output (on the digital display block of the sensor head and measurement values over serial communication) in the alarm state (where measurement is disabled owing to lack of light). The digital data will be set to +99999 if the fixed value is selected. The measurement value immediately before the alarm will be displayed if the system is set to hold.

TECHNIQUE

Selecting the fixed value can detect the alarm issued status easily from the measurement result. With this convenient function, the alarm status can be confirmed as well when the measurement value is loaded by data buffering function.

Setting	Function	Panel display
Hold	Holds the digital output immediately before the alarm.	HoLd
Fixed Value	Fixed-value output	FIX

* [ ] indicates the default value.

CHECK

- If the alarm state occurs after the fixed value is selected, judgment output interlocked with digital output will be turned ON.

● Setting Procedure

1 Display the "Alarm Setting" screen while in setting mode. — PrOS

2 Press the [ENTER] key. The "Analog output at alarm" screen will be displayed. — ENTER — AL-A

3 Press the [DOWN] key once. The "Digital output at alarm" screen will be displayed. — SELECT — AL-d

4 Press the [ENTER] key. The present Hold/Fix will be displayed. — ENTER — HoLd

5 Press the [UP]/[DOWN] key to select Hold/Fix. (Example: Changing the selection to the fixed value.) — SELECT — FIX

6 Press the [ENTER] key to determine the set value. — ENTER — AL-d

■ Alarm Delay Times AL-dY

This function holds the previous normal value up to the setting number of times if an alarm is issued.

The previous normal value will be kept on hold up to the setting number of delay times if an alarm is issued (where measurement is disabled owing to lack of light).
Alarm output (OUT3) will be turned ON when the alarm status continues more than the setting number of delay times, and analog output and digital output will be turned ON according to the setting for analog output at alarm and the setting for digital output at alarm, respectively.

TECHNIQUE

This function is effective if the user does not require the output of instantaneous alarms resulting for the surface condition changes of measurement objects.

Setting range	Function	Initial value
0 to 65534	0 (OFF) to 65534 times	00008
65535	Holds the measurement value before the alarm.	

3

● Setting Procedure

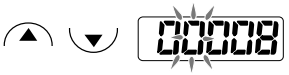
1 Display the "Alarm Setting" screen while in setting mode.

2 Press the [ENTER] key. The "Analog output at alarm" screen will be displayed.

3 Press the [DOWN] key twice. The "Alarm Delay Times" screen will be displayed.

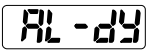
4 Press the [ENTER] key. The number of alarm delay times will be displayed. The leftmost digit will be selected.

5 Press the [UP]/[DOWN] keys together to change the selected digit.



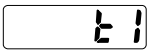
6 Press the [UP]/[DOWN] key to change the value of the selected digit. (Example: Changing the value to 0 times (OFF).)

7 Press the [ENTER] key and determine the number of delay times.



3-3-9 System Settings

■ Timing Mode



This function is used to set the timing input mode.

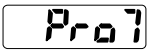
Set the operation of the system with timing input turned ON.
For the operation of the system in this mode, refer to "2-4 Timing Chart."

Setting	Function	Panel display
Hold	Measurement hold with timing input	Hold
One Shot	Measurement variable with timing input	1Shot

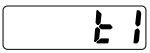
* [ ] indicates the default value.

● Setting Procedure

1 Display the "System Setting" screen while in setting mode.



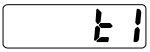
2 Press the [ENTER] key. The "Timing Mode" screen will be displayed.



3 Press the [ENTER] key. Hold/One Shot will be displayed.

4 Press the [UP]/[DOWN] key to select Hold or One Shot. (Example: Changing the selection to "One Shot.")

5 Press the [ENTER] key to determine the set value.



■ Laser Control LASEr

This function is used to select the laser emission/stop.

This function makes it possible to stop unrequired laser emission while the system is not in measurement operation.

Setting	Function	Panel display
Emission	Laser emission is ON	on
Stop	Laser emission is OFF	oFF

* [ ] indicates the default value.

CHECK

The system will be in a data unfixed state temporarily if the laser control is set to "Stop" and then set to "Emission."

● Setting Procedure

1 Display the "System Setting" screen while the system is in setting mode. — Pro7

2 Press the [ENTER] key. The "Timing Mode" screen will be displayed. — ENTER — t1

3 Press the [DOWN] key once. The "Laser Control" screen will be displayed. — SELECT — LASEr

4 Press the [ENTER] key. The ON/OFF will be displayed. — ENTER — on

5 Press the [UP]/[DOWN] key to select ON/OFF. (Example: Changing the selection to OFF.) — SELECT — oFF

6 Press the [ENTER] key to determine the set value. — ENTER — LASEr

■ Eco Mode [Eco]

This function turns OFF the LED indicators on the control panel while in RUN mode for energy saving.

Setting	Details	Panel display
Eco-OFF	Eco Mode is OFF.	E-oFF
Eco-ON	Only LEDs on the digital display will be turned OFF.	E-on
Eco-FULL	All the LEDs will be turned OFF.	E-FUL

* [ ] indicates the default value.

Supplemental remarks

- The display will be restored by switching while the LEDs are turned OFF while the system is in eco mode. The LEDs will be turned OFF again if the system is not operated for 20 seconds.
- The LEDs will be always lit while the system is in setting mode.

● Setting Procedure

1 Display the "System Setting" screen while the system is in setting mode. → Pro7

2 Press the [ENTER] key. The "Timing Mode" screen will be displayed. → ENTER → t1

3 Press the [DOWN] key twice. The eco mode screen will be displayed. → SELECT → Eco

4 Press the [ENTER] key. The present mode setting will be displayed. → ENTER → E-oFF

5 Press the [UP]/[DOWN] key to make mode changes. (Example: Changing the mode to Eco-FULL.) → SELECT → E-FUL

6 Press the [ENTER] key to determine the mode setting. → ENTER → Eco

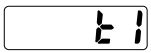
■ View Version 

This function is used to take the following procedure to display the version of the Setting and Monitoring Software HL-G1SMI, i.e., the function setting software for the sensor head.

● Setting Procedure

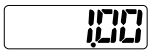
1 Display the "System Setting" screen while in setting mode.

2 Press the [ENTER] key. The "Timing Mode" screen will be displayed.



3 Press the [DOWN] key three times. The "View Version" screen will be displayed.

4 Press the [ENTER] key. The present version will be displayed.



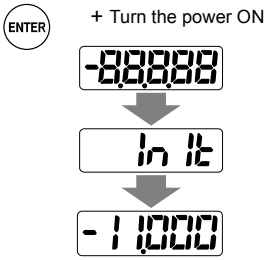
3-3-10 Other System Settings

■ Initialize

This function is used to delete all the setting contents in the memory and returns them to the factory default settings.

If the initialization is not saved, the system operates with the previous settings at the next start-up.

●Setting Procedure



1 Turn ON the system while pressing the [ENTER] key.
The initial screen will be displayed after the startup screen appears.
The memory is initialized and the system is set to RUN mode.

■ Save

● Setting Changes in Control Panel of Sensor Head

Press the [ENTER] key and save the change in each item.
When the system is turned ON again, the last saved settings will be reflected.

● Saving input over the multi-input (MI) line

Multi-input can be entered for a certain period to save settings made.
For details, → refer to "2-1 Functions and Arrangements of I/O Terminal Block".

3-3-11 Measurement Control with External Input

■ Timing

This function makes it possible to hold the measurement value at the desired timing.

The measurement value will be kept on hold with external input timing (TM). The judgment output is kept on hold as well simultaneously.
Timing settings can be executed with communications command but not with the operation of the panel.
For the operation of the system in this mode, → refer to "2-4 Timing Chart".

TECHNIQUE

"Judgment Output" will be kept on hold by setting the timing input to "ON" at the desired timing. This enables loading of the judgment result at a later time.

CHECK

- The timing input status cannot be stored by executing “Save”. Timing input will be OFF right after the system is turned ON or a memory change is made.
- If the timing mode is set to "One Shot," the internal memory will be cleared (set to timing OFF) after one-shot processing is executed when timing ON is executed with a communications command.
- If the timing mode is set to "Hold," the external input status will be reflected on the memory.

■ Zero Set

This function makes it possible to set the measurement value to zero at the desired timing.

The measurement value can be set to zero at the desired timing by using external multi input (MI).
Input a specified pulse width as multi input.
Zero set settings can be executed with communications commands and the operation of the panel.
For the operation of the system in this mode, → refer to "2-4 Timing Chart".

CHECK

- An offset value will be set by executing “Zero Set” after setting the offset value.

● Setting Procedure

1 Press the [UP]/[DOWN] keys together while in Run mode.
Zero Set will be executed.

■ Reset

The function resets the measurement value.

At the time of making a peak measurement, valley measurement, or peak-to-peak measurement with external multi input (MI), the measurement value kept on hold at the desired timing can be reset.
Input a specified pulse width as multi input.
The pulse width can be input into the high-function type through a communications command.
For details, → refer to "2-4 Timing Chart".

TECHNIQUE

All judgment outputs will be turned OFF when "Reset" is executed. This function can be applied to judge each measurement object for peak, valley, or peak-to-peak measurements.

CHECK

- If "Reset" is executed, the system will be in a data unfixed status, analog output will be set to a preset fix value (21.6 [mA] and +11.000 [V]), and all the judgment outputs will be OFF.
- If Reset ON is executed by a communications command, the memory contents will be cleared to zero after Reset is executed.
- The sensor head does not save setting changes made over the multi-input line. Save the settings over the multi-input line, through the panel, with the communications command, or with the operation of the console if the settings need to be maintained after the system is turned OFF.

● Setting Procedure

1 Press the [UP]/[ENTER] keys together while in Run mode.
Reset will be executed.

4

Troubleshooting

This Chapter provides information on the troubleshooting of the system.
Read this Chapter if something seems to be wrong with the system.

4-1 Corrective Actions

If an error or trouble occurs during use of the system or a system failure is suspected, read this chapter carefully first and carry out the corresponding corrective actions.

Trouble type

- SET Trouble in sensor head settings.
- COM Trouble in communication control.
- MEAS Trouble in the measurement method or display of measurement values.
- LED Trouble in alarm or error LED indications.
- LASER Trouble in laser emission.

CHECK

- For the details of conditions where measurement value is unfixed, → refer to "2-5 Conditions When Output Data Become Unfixed".
- For problems related to memory saving and terminal settings, → refer to "3-3-2 Memory Change".

Type	Problem	Cause	Corrective action	Ref. page
SET	• The sensor head indicator does not light up. • The sensor head does not operate.	The connecting cable is not connected properly.	Check the connection between the sensor head and connection cable.	1-2
		The connecting cable is disconnected.	Check the wiring between the connection cable and connector.	2-2
		Power is not supplied to the controller.	Check the connection between the 24-VDC external power and sensor head.	2-2
		The operation of the sensor head is stopped.	Turn ON the sensor head again.	3-6
		The eco mode is set to “Eco-FULL”.	The LED will be lit by operating any switch. Make eco-mode settings if necessary.	3-40
LASER	The laser beam is not emitted.	The laser control setting is turned OFF and saved.	Save the laser control setting turned ON, otherwise the system will start with the laser beam turned OFF.	3-39 3-43

Type	Problem	Cause	Corrective action	Ref. page
MEAS	There is a difference between the actual distance to the measurement object and measurement value.	The measurement object is fluctuating or vibrating.	Stop the fluctuation or vibration of the measurement object.	1-8
		The measurement object is tilted.	Place the measurement object as perpendicularly as possible.	1-8
		The received light waveform is saturated or insufficient.	Adjust the received light intensity using the shutter time.	3-14
MEAS	The correct measurement value is not displayed.	The measurement object is out of the measurement range.	Check the measurement range of the sensor head used.	6-9
		The scaling is not set correctly.	Set the correct scaling.	3-29
		The light emitter/receiver is dirty.	Remove the dirt on the light emitter/receiver.	6 1-6
MEAS	Measurement values vary.	The moving average is small.	Increase the number of moving average.	3-16
		The light emitter/receiver is dirty.	Remove the dirt on the light emitter/receiver.	6 1-6
		The mounting direction of the sensor head is wrong.	Check the mounting direction of sensor head.	1-7
		The sensor head or measurement object is tilted.	Check the mounting of the sensor head and the setting position of the measurement object.	1-7

Type	Problem	Cause	Corrective action	Ref. page
MEAS LED	The alarm indicator lights up and measurement cannot be done.	The reflected beam from the beam emitting spot is blocked.	Move the position of the beam projection spot or change the mounting direction of the sensor head so the reflected beam should not be blocked.	1-9
		The beam emitting spot is applied to the R portion (curved surface) of the measurement object.	Apply the beam projection spot to the top of R portion or adjust the beam diameter so it comes larger by moving the measurement object back and forth within the measurement range.	1-8
		The reflected beam has directionality because the surface of the object is hairline-finished.	Check the mounting direction of sensor head.	1-7
		The received light intensity is insufficient because the sampling cycle is too short.	Set a longer sampling cycle or shutter time (when shutter time is set to a fixed value).	3-13 3-14

Type	Problem	Cause	Corrective action	Ref. page
MEAS LED	The alarm indicator lights up and measurement cannot be done. The measurement range is limited.	The sampling cycle is too long and this causes excessive received light intensity beyond the adjustable range.	Set a shorter sampling cycle and reduce the emitted light intensity (enter a smaller number to the shutter time).	3-13 3-14

4-2 Initialization

- Initialization deletes all settings and returns them to the factory default settings.
- For more information, ➔ refer to "3-3-10 Other System Settings - Initialization".

5

Specifications

This Chapter provides the specifications of the sensor head.

5-1 Sensor Head Specifications

● Standard Type

Model No.		LAT 61K 30/8 IUPN	LAT 61K 50/20 IUPN	LAT 61K 85/40 IUPN	LAT 61K 120/120 IUPN
Supply voltage		24 VDC ±10% including ripple 0.5 V (P-P)			
Current consumption		100 mA max.			
Measurement method		Diffuse reflection			
Measurement center distance		30 mm	50 mm	85 mm	120 mm
Measurement range		±4 mm	±10 mm	±20 mm	±60 mm
Beam source		Red semiconductor laser Class 2 (JIS/IEC/FDA laser notice No. 50) Max output: 1 mW, Emission peak wavelength: 655 nm			
Beam diameter (*1)		0.1×0.1 mm	0.5×1 mm	0.75×1.25 mm	1.0×1.5 mm
Beam receiving element		CMOS image sensor			
Resolution		0.5 μm	1.5 μm	2.5 μm	8 μm
Linearity		±0.1% F.S.			
Temperature characteristics		±0.08% F.S./°C			
Sampling cycle		200 μs, 500 μs, 1 ms, 2 ms			
Analog output	Voltage	Output range: 0 to 10.5 V (normal), 11 V (at alarm) Output impedance: 100Ω			
	Current	Output range: 3.2 to 20.8 mA (normal), 21.6 mA (at alarm) Load impedance: 300Ω max.			
OUT1 OUT2 OUT3		Judgment output or alarm output (switchable) NPN open-collector transistor/PNP open-collector transistor (switchable) <Settings for NPN> Peak in-flow current: 50 mA Applied voltage: 3 to 24 VDC (between output and 0 V) Residual voltage: 2 V max. (at in-flow current of 50 mA) <Settings for PNP> Peak in-flow current: 50 mA Residual voltage: 2.8 V max. (at in-flow current of 50 mA)			
	Output operation	Open when the output is ON.			
	Short-circuit protection	Incorporated (Auto-reset)			
NP switching input		At 0 V: NPN open-collector output At supply voltage of 24 VDC: PNP open-collector output			
Timing input		NPN operation: ON when connecting or connected to 0 V (depending on settings) PNP operation: ON when connecting or connected to positive terminal of external power supply (depending on settings)			
Multiple input		Zero set, zero set OFF, reset, memory change, teaching, save, or laser control depending on input time. NPN operation: Depending on time to connect 0 V PNP operation: Depending on time to connect positive terminal of external power supply			

Indicator	Laser radiation indicator	Green LED ON at laser radiation
	Alarm indicator	Orange LED ON when measurement is impossible as a result of insufficient or excessive light quantity
	Output indicator	Yellow LED (No. of indicators: 3) ON at output
Digital display		Red LED for sign and 5-digit display
Protective structure		IP67
Pollution degree		2
Insulation resistance		20 MΩ min. at 250-VDC megger (between charged parts and casing)
Dielectric Withstand		1000 VAC for 1 min. (between charged parts and casing)
Vibration resistance		Endurance: 10 to 55 Hz (at 1-minute cycle), 1.5-mm double-amplitude two hours each in X, Y, and Z directions
Shock resistance		500m/s^2 three times each in X, Y, and Z directions
Ambient illumination (*2)		3,000 lx max. (illumination level of light receiving surface under incandescent light)
Ambient temperature		-10°C to 45°C (No dew condensation or icing allowed), At storage: -20°C to +60°C
Ambient humidity		35 to 85%RH, At storage: 35 to 85%RH
Ambient height		2000 m or less
Material		Casing: PBT, Front cover: Acrylic, Cable: PVC
Cable length		5 m
Mass		Approx. 70 g (without cable), approx. 320 g (including cable), and approx. 380 g (with packing)
Accessory		Laser warning label: 1 set
Applicable standards		Conforming to EMC Directive

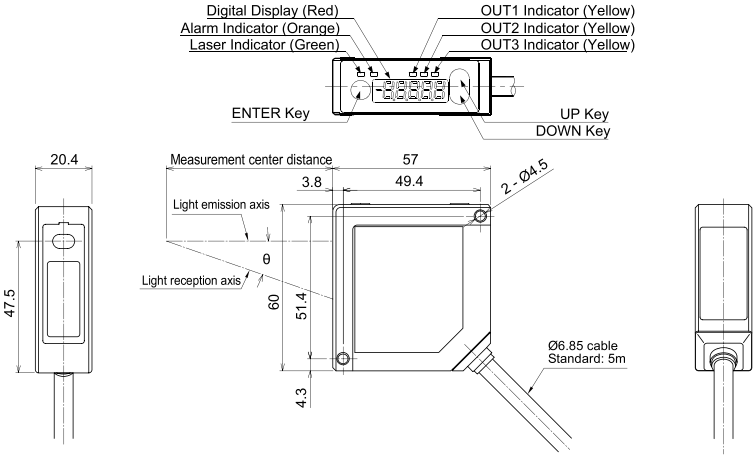
The following measurement conditions are applied unless otherwise specified; power voltage: 24 VDC, ambient temperature: 20°C, sampling cycle: 500 µs, average number of sampling times: 1024 times, measurement center distance, and measurement object: white ceramic.

*1 The diameter is the size of the object at the measurement center distance and determined by 1/e^2 (approximately 13.5%) of the center beam intensity. The reflectance around the detecting point may be higher than at the point due to leak light outside the specified area, and this may affect the measurement value.

*2 Variance is ±0.1% F.S. or less depending on the ambient illuminance.

5-2 Dimensions

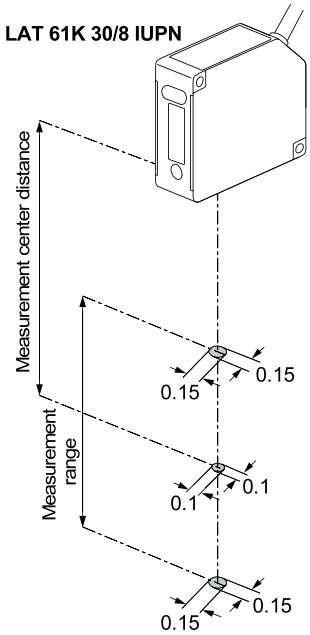
■ Sensor Head



5-3 Characteristics

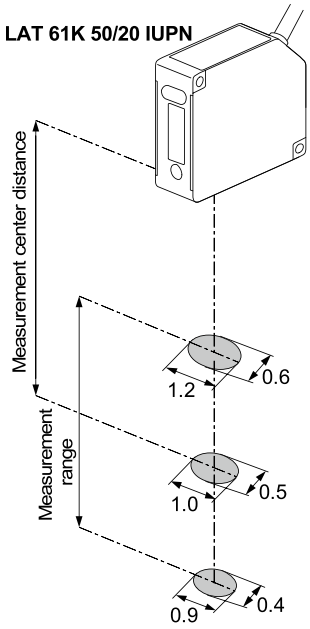
■ Beam Diameter

● 30-mm type



Unit: mm

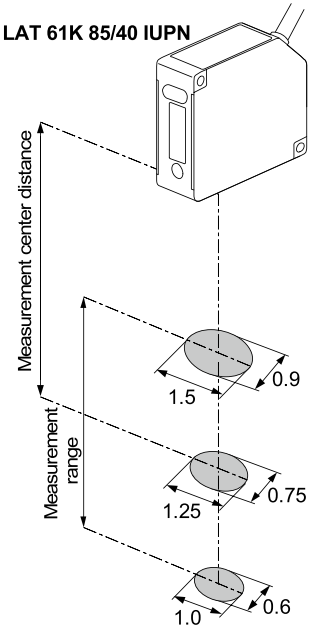
● 50-mm type



Unit: mm

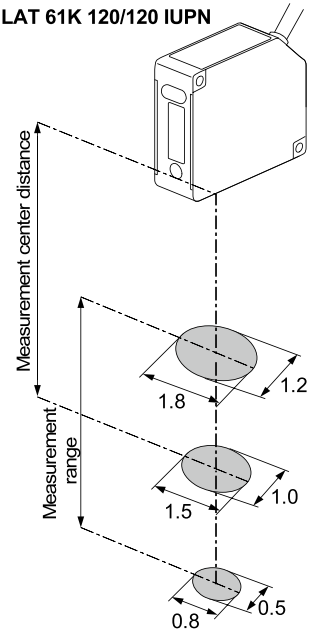
5

● 85-mm type



Unit: mm

● 120-mm type



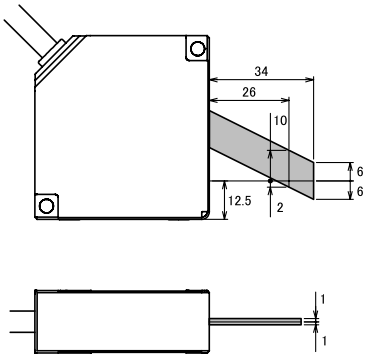
Unit: mm

5

■ Mutual Interference Area

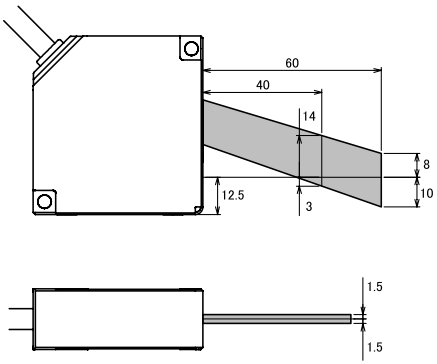
In the case of installing two or more diffuse reflective sensor heads side by side, mutual interference will occur if the laser spots of the other sensor heads fall within the shaded area ( ) shown below. Install the sensor heads so that the laser spots of the other sensor heads will fall outside the shaded area ( ).

● 30-mm Type (LAT 61K 30/8 IUPN)



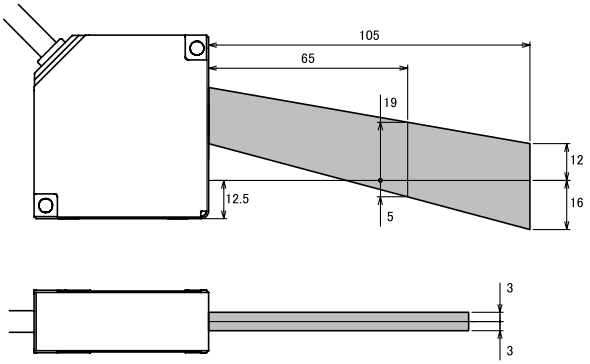
Unit: mm

● 50-mm Type (LAT 61K 50/20 IUPN)



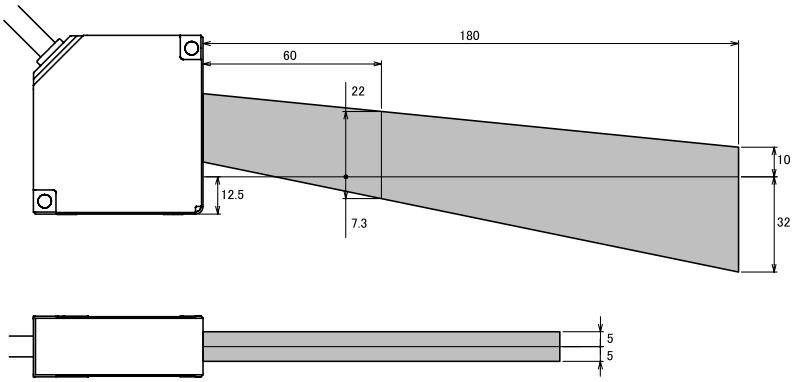
Unit: mm

● 85-mm Type (LAT 61K 85/40 IUPN)



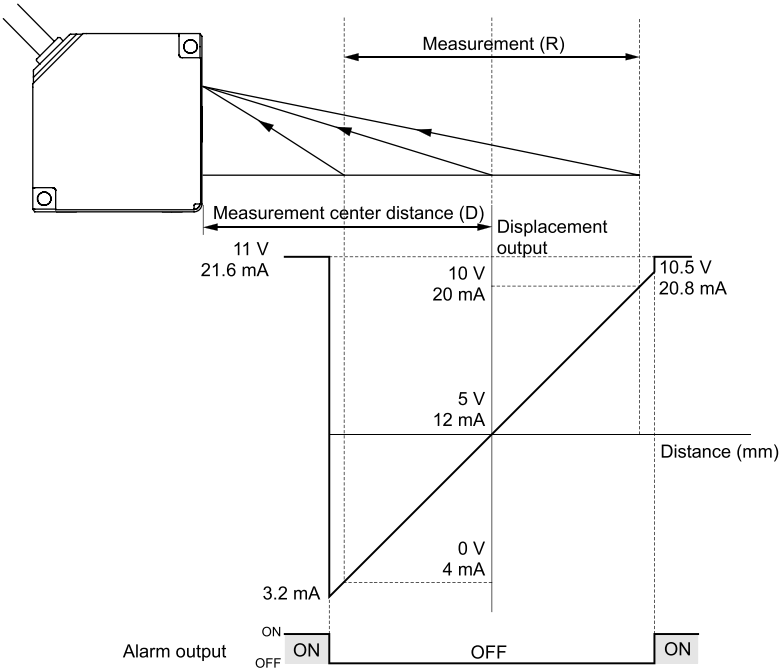
Unit: mm

● 120-mm Type (LAT 61K 120/120 IUPN)



Unit: mm

■ Output Characteristics



*1 In the figure above, analog output setting is used as the initial setting.

	Type	Measurement center distance (D)	Measurement (R)
30-mm	LAT 61K 30/8 IUPN	30 mm	±4 mm
80-mm	LAT 61K 50/20 IUPN	50 mm	±10 mm
85-mm	LAT 61K 85/40 IUPN	85 mm	±20 mm
210-mm	LAT 61K 120/120 IUPN	120 mm	±60 mm

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