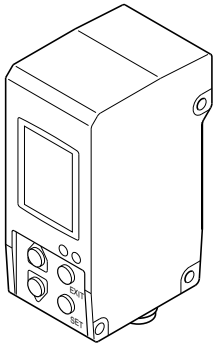
Instruction Manual

Laser Line-shape Sensor SHP Series



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FOREWORD

Thank you for purchasing the Laser Line-shape Sensor SHP Series. We hope you are fully satisfied with this product and enjoy its performance. To ensure your satisfaction, please follow the instructions below.

- Carefully read this instruction manual and keep it for future reference.
- If you have any question about the instructions here or a request for replacing the lost instruction manual, contact the sales office or store where you purchased the product.
- The contents in this instruction manual are protected by copyright and all rights are reserved by OPTEX FA CO., LTD. The descriptions and information included in this manual shall not be copied nor reproduced to any other form.

> WARNING This product cannot be used as a safety device to protect human body.

Warranty

Whereas all of our products are tested in accordance with the strict internal standard, a faulty unit may unexpectedly be distributed. If this is the case with your product, identify its status and contact the sales office or store where you purchased it.

- The warranty period shall be one(1) year after its delivery to the customer.
- If the failure results from a manufacturer's fault, the manufacturer will replace the product (by sending a substitute) without charge except the following cases:
  1. Failure due to any abuse or misuse
  2. Failure due to a cause other than the product
  3. Failure due to unapproved modification or repair
  4. Failure due to acts of God

This warranty is limited to the delivered product only.
This warranty shall not cover the secondary damage caused by the faulty product.

SAFETY PRECAUTIONS

Carefully read and understand the safety precautions before operation. They provide the important information to protect your health and property. Strictly follow this instruction manual, and do not apply any installing/ operating procedure which is not described in this manual.

Meanings of Safety Symbols

WARNING Indicates a possible hazard that may result in death or serious injury if the product is used without observing the stated instructions.

CAUTION Indicates a possible hazard that may result in personal injury or property damage if the product is used without observing the stated instructions.

Mandatory Requirements

WARNING

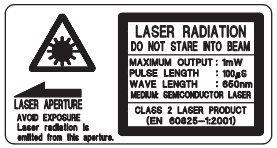
- Do not stare into laser beam or point laser beam at eyes since it may damage the eyesight.
- If smoke or abnormal smell occurs, stop operation and turn power supply off. If the problem requires a repair, contact the sales office or store where you purchased the product.
- This product cannot be used as a safety device to protect human body.
- Use the service voltage specified in the specifications.
- Do not touch the main unit and cable with wet hands. It may cause electric shock.
- Use only the special amplifier unit and extension cable to connect the sensor head. Other unit/cable may cause an accident or a damage of the product.
- Do not connect/disconnect the connection cable, terminal board or wiring when the power is on.

Cautions for Laser Product

This sensor emits visible laser beam compliant with JIS C6802/IEC/FDA, laser safety standard Class 2 (II). The warning and description labels are attached to the side of the sensor body.

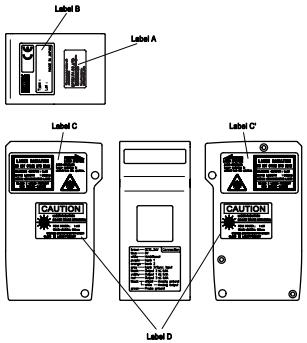
Laser type of this product

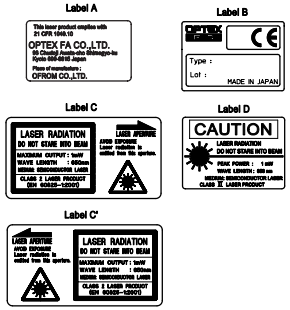
Type	Red Laser Diode
Wavelength	650nm
Output	1mW



This sensor is subject to the FDA laser standard when exported to U.S.A, and notified to CDRH (Center for Devices and Radiological Health). Contact the us for the further details.

> **WARNING** Use of controls or adjustments or performance of procedures other than the specified herein may result in hazardous radiation exposure.





Precautions for Installation

WARNING

- Installing the unit in the following conditions may result in fire, electric shock or product damage.
  - High humidity
  - High temperature due to a direct sunlight, etc.
  - Much dust
  - Poor ventilation
  - Static electricity
  - Corrosive gas or flammable gas
  - Exposure to water, oil, or chemicals
  - Direct exposure to vibration or impact

CAUTION

- Do not apply electricity during wiring. Ensure that the analog output does not contact with other wiring.
- Avoid parallel wiring and placing in the same piping with high-voltage cable or power transmission cable, since they may cause noise resulting in malfunction. Keep the power and signal cords in short length.
- Do not pull or apply impact forcibly since it may cause product damage.
- When using switching regulator for power supply, ensure grounding the frame ground terminal.

Operating Precautions

- Do not use the sensor in transient state (i.e. during warm-up time) after power on (5 minutes).
- The sensor performance may depend on the individual unit.
- Wipe off dirt on the cover (glass) of the emitting/receiving parts using a soft cloth etc., at every operation since it may cause incorrect detection.

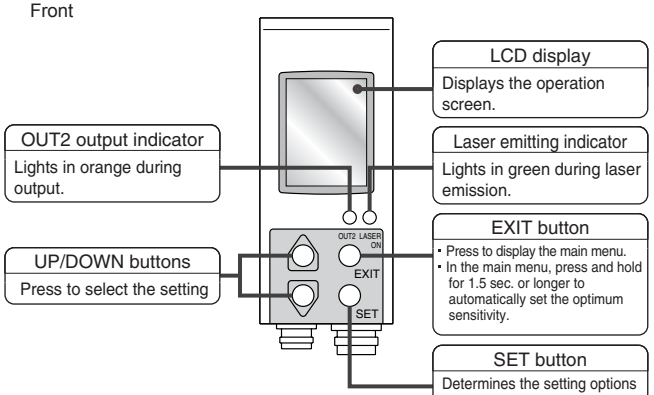
WARNING Operations other than specified herein may result in hazardous radiation exposure.

CAUTION Direct impact on the cover (glass) of emitting/receiving parts may result in damage of the product.

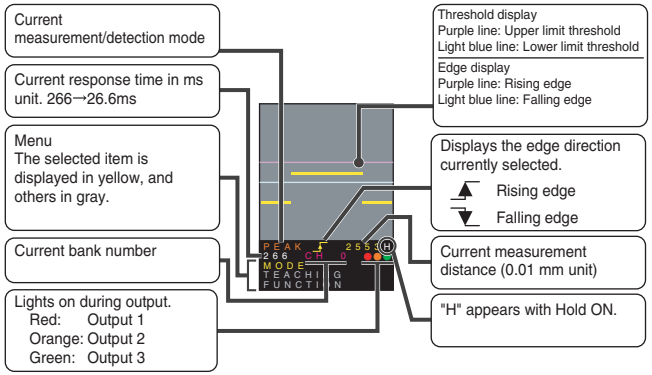
BASIC INFORMATION BEFORE USE

Parts Identifications

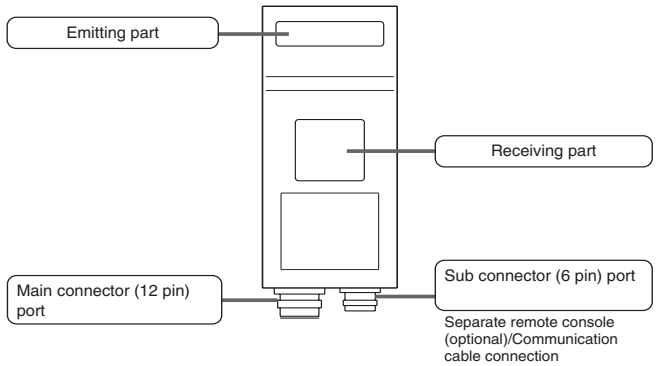
Front



LCD display



Detection surface



Specifications

Main connection cable

Insulator color		Brown	12 - 24V DC
		Blue	0 V
		White	Hold release
		Purple	Bank input 1
		Orange	Bank input 2/ Remote teach
		Gray	Bank input 3/Synchronization input
		Black	Output(OUT) 2 ≦100mA
		Yellow	Output(OUT) 1 ≦100mA
		Red	Output(OUT) 3 ≦100mA
	Black	Shield wire	Analog ground
		White	Analog output 4 mA - 20 mA
		Green	Frame ground
Weight	Approx. 100 g		

Specifications

Main body

Model	NPN output	SHP-100CN
	PNP output	SHP-100CP
Detection range	Laser-receiving range	100mm±25 mm 17 mm (Width)/75 mm (Distance) to 27 mm (Width)/125 mm (Distance)
Emission		0.3 mm x 32 mm (Width)
		Class 2(II) Red Laser Diode (Wavelength 650 nm, max. output 1 mW)
Power supply		12 - 24V DC -5% +10%
Power consumption (Electric power)		120mA/24V max., 180mA/12V max. , incl. analog output current
Linearity *1		±0.5% FS (Z direction)
Resolution *2		50 μm (Z direction)
Sampling cycle		33 ms max.
Control output		NPN/PNP open collector, 30 V/100 mA max. (Remain voltage: max. 1.8V) 3 outputs
Analog output		4 mA - 20mA Out of the measuring range: 24 mA (Load impedance: max. 300 ohms)
Load dependence		±0.05%
Temperature drift		±0.05% FS/℃
Warm-up		5 min max.
Indicator	Output indicator	Orange LED
	Laser emitting indicator	Green LED
Ambient light	Sunlight	10,000 lx
	HF lamp	3,000 lx
Operating temperature		-10 ℃ to +40 ℃(No condensation)
Operating humidity		35 to 85%/RH
Storage temperature/humidity		-20 ℃ to +60 ℃ / 35 % to 95 %/RH
Bank		8(switchable)
Window size		Selectable
Shock resistance		10 to 55 Hz DA 1.5 mm XYZ ea. direction: 2 H
Vibration resistance		50 G(500 m/s²)
Protection category		IP66
Material		Main unit: Zinc die-casting/PC, Emitting/receiving window: Glass
Weight		Approx. 250 g(Excluding attached cable)

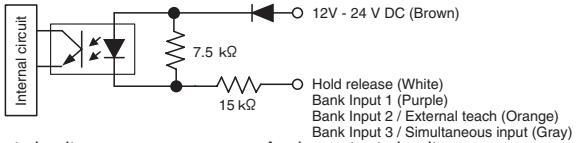
*1 : Measuring object: white ceramic, IMG GAIN: 0

*2 : Measuring object: white ceramic at the center measurement distance, IMG GAIN: 0

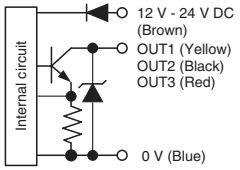
Input/Output Circuit Diagram

NPN type

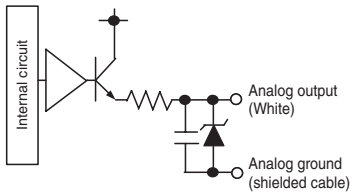
Input circuit (Bank input, Hold release)



Output circuit

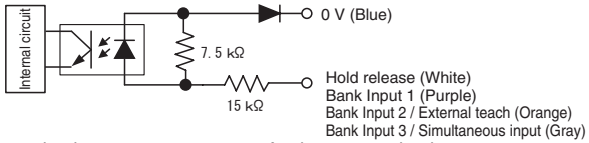


Analog output circuit

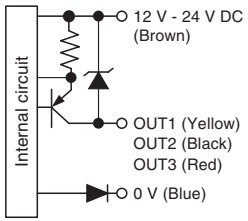


PNP type

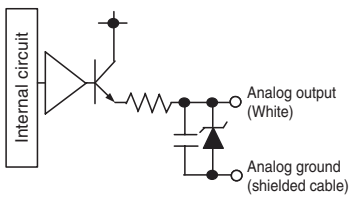
Input circuit (Bank input, Hold release)



Output circuit



Analog output circuit



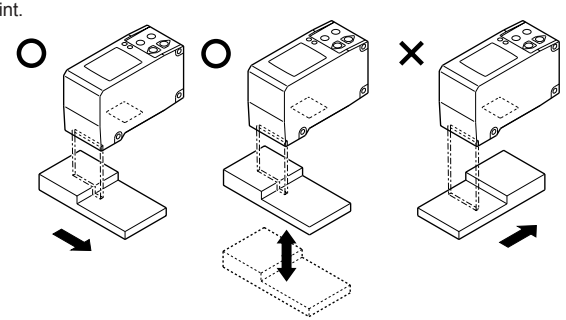
INSTALLATION

Sensor installation

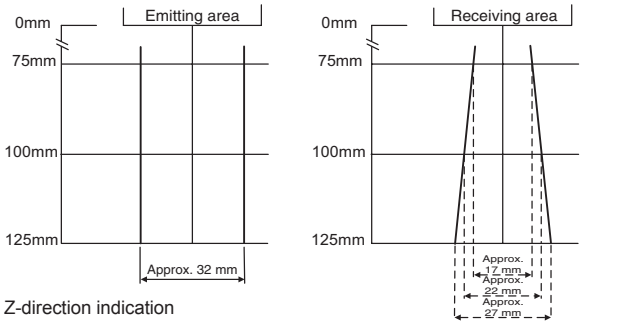
WARNING

- Avoid the operator's eye height for unit installation.
- Install the unit before connecting the special amplifier. (Turn the power off before starting installation work.)

The detection surface (the side of the emitting/receiving parts) should be parallel to the target object. Adjust the spot to conform to the detection point.



Measurement range and indicated value



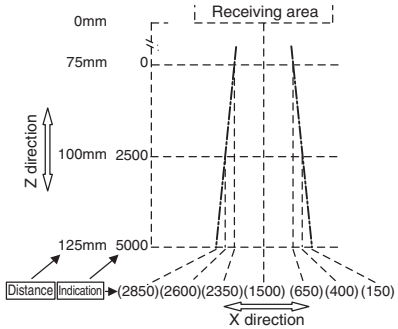
Z-direction indication

The distance indication refers the "0" point to the position of 75 mm distant from the sensor.

The unit is 0.01 mm (ex. "2500" = "25 mm").

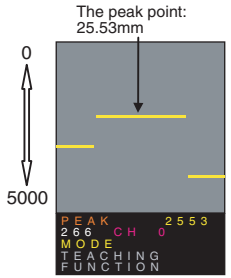
X-direction indication

The indication is relative value referring to the center point of sensor as "1500."
In the center area (within 100 mm from the sensor front face), the indication 100 in variation is equal to 1 mm.



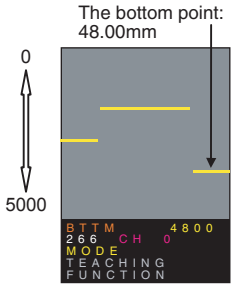
Peak detection mode

Indicates the distance between the peak point in the measurement range (i.e. the edge closest to the sensor) and the reference position.



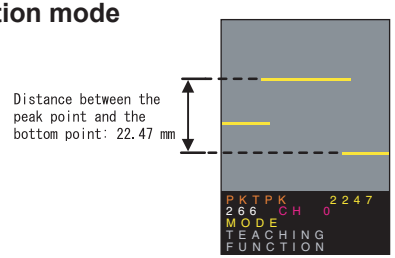
Bottom detection mode

Indicates the distance between the bottom point in the measurement range (i.e. the edge farthest from the sensor) and the reference position.



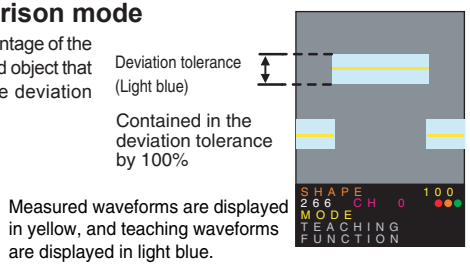
Peak-to-peak detection mode

Indicates the distance between the peak point and the bottom point in the measurement range.



Shape comparison mode

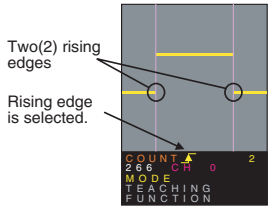
Indicates the percentage of the portion of compared object that is contained in the deviation tolerance.



Measured waveforms are displayed in yellow, and teaching waveforms are displayed in light blue.

Edge count mode

Indicates the number of the selected-type edge.

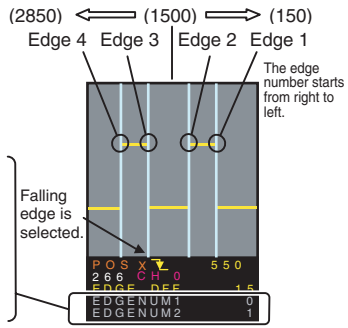


Position X mode

You can select either of the following options:

- To indicate the X position of the selected-type edge.
- To indicate the distance (X-direction) between the two(2) specified edges.

Indicates the distance between the two(2) edges specified in "EDGENUM."
Example
EDGENUM1: 2
EDGENUM2: 4
Indicates the distance (X-direction) between Edge 2 and Edge 4.
If "0" is selected in "EDGENUM1," the position of the edge number selected in "EDGENUM2"

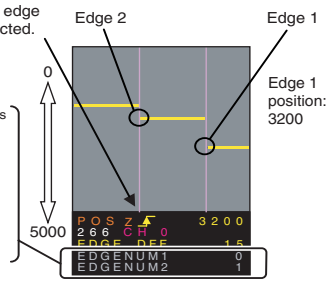


Position Z mode

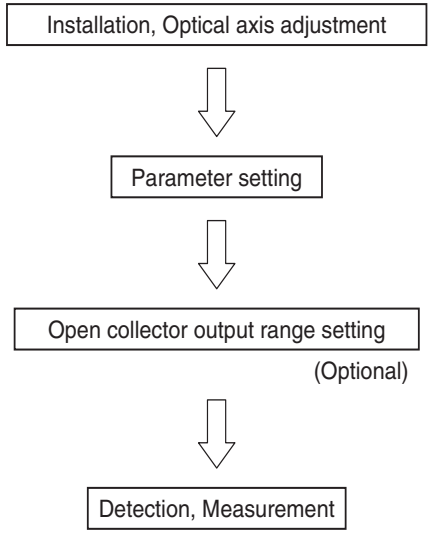
Position Z mode

- You can select either of the following options:
- To indicate the Z position of the selected-type edge.

Indicates the distance between the two(2) edges specified in "EDGENUM."
Example
EDGENUM1: 1
EDGENUM2: 2
Indicates the distance (Z-direction) between Edge 2 and Edge 1.
If "0" is selected in "EDGENUM1," the distance from the reference position (Z-direction) of the edge number selected in "EDGENUM2" is displayed.



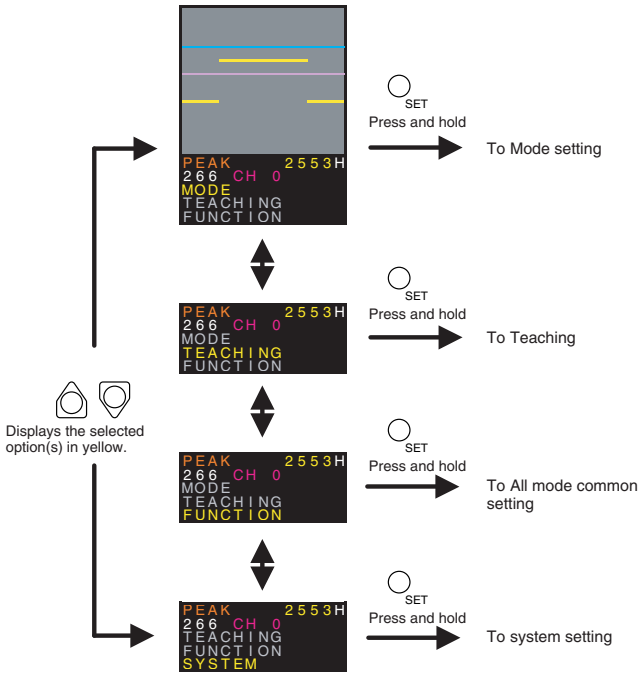
OPERATING PROCEDURE



SETTINGS

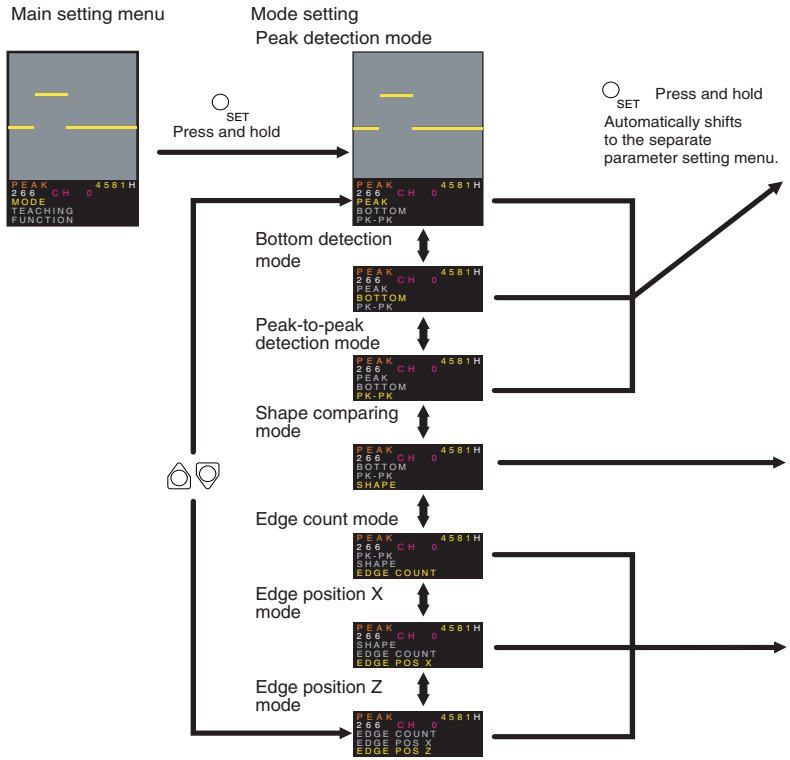
Main setting

Main setting menu



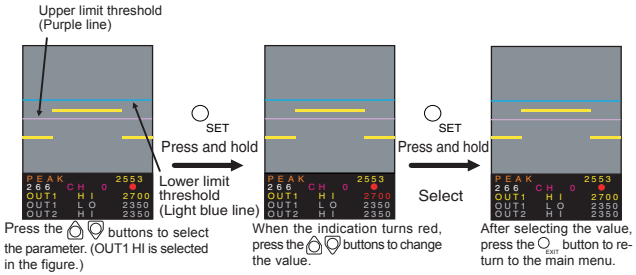
Mode setting, Separate parameter setting

Mode setting

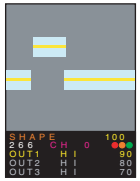


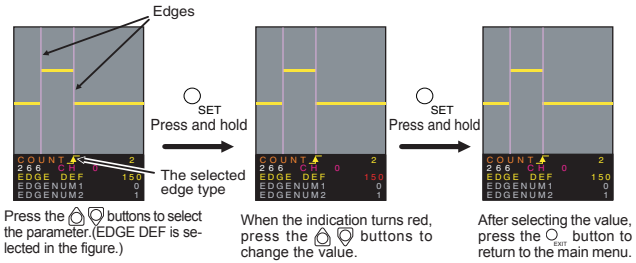
When the mode setting is made, the setting values of separate parameter can be changed without changing the mode anymore. To allow this, press the “SET” button once on the Main setting menu to go on to the menu of Separate parameter setting mode, then change the setting values. When the mode is set again, the following setting values are reset to the initial values; upper/lower thresholds of OUT1 to OUT3, span value for 4mA, and span value for 20mA.

Separate parameter setting



In setting the upper/lower limit threshold, the threshold of the selected output is displayed.





If the Edge mode is selected, the edge appears on the display with lines. The edge is subject to the edge type selected in "EDGEDIRC." (Rising edge is selected in the figure.) Rising edge appears in purple, and falling edge in light blue.

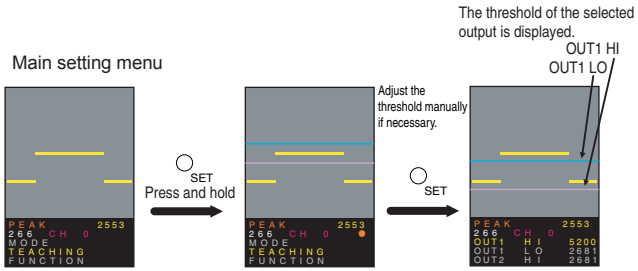
Teaching

The thresholds are specified for the three (3) types of open collector output (OUT1, 2, and 3) by teaching.

You can teach the form in the form comparing mode.

Peak detection mode/Bottom detection mode/Peak-to-peak detection mode

Main setting menu



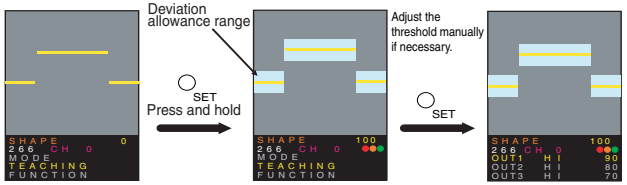
The "NOW TEACHING" message indicates the completion of teaching. The message disappears soon.

The auto-set thresholds are:
OUT1 HI 5200
OUT1 LO measurement value + approx. 5%
OUT2 HI measurement value + approx. 5%
OUT2 LO measurement value - approx. 5%
OUT3 HI measurement value - approx. 5%
OUT3 LO -200

Threshold is not displayed in the peak-to-peak detection mode.

Form comparing mode

Main setting menu



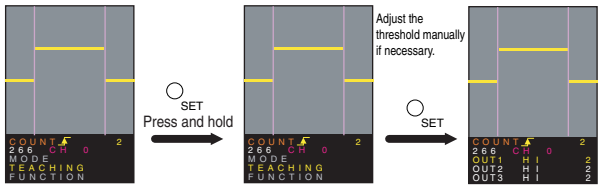
The "NOW TEACHING" message indicates the completion of teaching. The message disappears soon. The deviation tolerance selected in "TOLER Z" is displayed in light blue.

The auto-set thresholds are:
OUT1 HI 90
OUT2 HI 80
OUT3 HI 70

You can adjust the deviation tolerance in "TOLER Z."

Edge count mode

Main setting menu

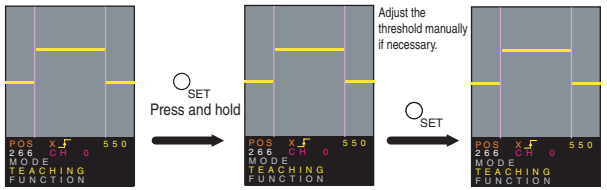


The "NOW TEACHING" message indicates the completion of teaching. The message disappears soon.

The auto-set thresholds are:
The number of edge specified by OUT1 HI teaching
The number of edge specified by OUT2 HI teaching
The number of edge specified by OUT3 HI teaching

Position X mode

Main setting menu

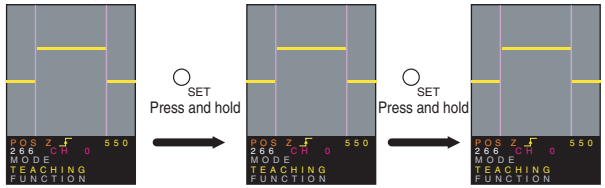


The "NOW TEACHING" message indicates the completion of teaching. The message disappears soon.

The auto-set thresholds are:
OUT1 HI 5200
OUT1 LO measurement value + approx. 5%
OUT2 HI measurement value + approx. 5%
OUT2 LO measurement value - approx. 5%
OUT3 LO measurement value - approx. 5%
OUT3 LO -200

Position Z mode

Main setting menu



The "NOW TEACHING" message indicates the completion of teaching. The message disappears soon.

The auto-set thresholds are:
OUT1 HI 5200
OUT1 LO measurement value + approx. 5%
OUT2 HI measurement value + approx. 5%
OUT2 LO measurement value - approx. 5%
OUT3 LO measurement value - approx. 5%
OUT3 LO -200

Sensitivity setting

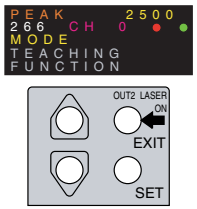
Automatic setting

When the main setting menu is displayed, press the EXIT button for 1.5 seconds and more.

The red and green output indicators light on alternatively, then the optimum sensitivity is automatically selected.

Pressing the EXIT button while each operation menu is displayed returns the display to Main setting menu.

Main setting menu



Manual setting

Selecting [SENS] in the setting menu enables to set the sensitivity manually.

External Input Setting

By setting BANK and/or SYNC IN, the bank input 1, 2, and 3 function as follows:

Setting	BANK	0 - 7		8		9	
	SYNC IN	4	0 - 3	4	0 - 3	4	0 - 3
External input	Bank input 1 (Purple)	Invalid		Bank input		Bank input	
	Bank input 2 (Orange)	External teach input				Bank input	
	Bank input 3 (Gray)	Invalid	Simultaneous input	Bank input	Simultaneous input	Bank input	Simultaneous input

Remote Bank Switch

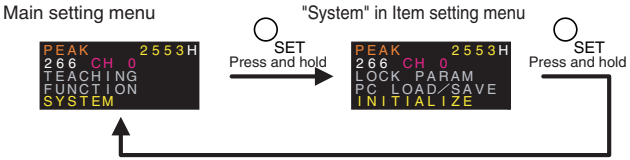
When the bank input line is set as Bank Input (refer to "External Input Setting"), the bank switch is available via connection.

Bank No.	Bank Input 1 (Purple)	Bank Input 2 (Orange)	Bank Input 3 (Gray)
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

0	NPN	Unconnected or connect to + V.
	PNP	Unconnected or connect to 0 V.
1	NPN	Connect to 0 V.
	PNP	Connect to + V.

Setting Initialization

1 Select [SYSTEM], then press SET and hold. Select [INITIALIZE], then press SET and hold. The menu returns to the initial menu.



2 Turn OFF the sensor power.

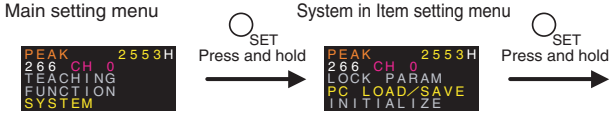
3 With pressing and , turn ON the sensor power.

4 The message "INITIALIZING" appears on the display, and the data is initialized (factory preset values).

Communication

1 With the designated connection cable (separately available), connect the sensor and your PC.

2 Select [SYSTEM], then press ○SET and hold. Select [PC LOAD/SAVE] and press ○SET and hold.



3 The message "PC LOAD/SAVE" appears in red in the display. This completes the setting.

The measurement function of sensor stops during communication. The measurement function restarts when the communication has completed.

- The communication speed is 57600 bps. To decrease the communication speed, set in [COMMUNIC]. The setting configuration is as follows:

  COMMUNIC 1: 4800bps
  2: 9600bps
  3: 19200bps
  4: 38400bps
  5: 57600bps

- The communication is available without setting the sensor. To allow this, set the software installed in PC.
- For the communication software at PC side, contact us or our sales representative.

List of Main setting menu options

Indication on LCD	Function/setting description (Press △ ▽ to select the parameter. Press and hold ○SET for 1.5 sec. or longer to confirm the setting.)	Selectable value range	Default setting
MODE	Selects the values including threshold and edge, and switches the display mode on the LCD display. PEAK: measures the distance between the peak point in the measurement range (i.e. the edge closest to the sensor) and the reference position. BOTTOM: measures the distance between the bottom point in the measurement range (i.e. the edge farthest from the sensor) and the reference position. PK-PK: measures the distance between the peak point and the bottom point in the measurement range. SHAPE: compares the shape of the measured object. EDGE COUNT: counts the edge number. EDGE POS X: measures the edge position and interval in the X-direction. EDGE POS Z: measures the edge position and interval in the Z-direction.	*1	*1
TEACHING	Performs teaching.		
FUNCTION	Adjusts the general settings.		
	BANK: Selects the bank number. 0-7 : Bank number 8 : Enables to set external input. 9 : Refer to the description in "External Input Setting."	0 – 9	9
	SYNC IN: Selects the synchronization input setting *2 0 : Captures image constantly while the synchronization input is OFF. 1 : Captures image when the synchronization input is switched from ON to OFF. 2 : Captures image constantly while the synchronization input is ON. 3 : Captures image when the synchronization input is switched from OFF to ON. 4 : No setting (Captures image independently.)	0 – 4	4
	SMPL/HLD: 0 : Hold OFF 1 : Hold ON	0 – 1	0
	COMMUNIC: Selects the communication rate *3 0 : Communication OFF (Remote monitor is available.) 1 : 4800bps 2 : 9600bps 3 : 19200bps 4 : 38400bps 5 : 57600bps	0 – 5	0
	BANK COPY: Copies the bank settings to another bank.	0 – 7	0
	LCD VIEW: Reverses the LCD display vertically. (Waveform is not reversed.) 0 : Normal display 1 : Reversed display (With external monitor, only the captured image is reversed.)	0 – 1	0
	IMG GAIN: Selects the sensitivity of the image sensor. *4 0 : Normal 1 - 63 : The measurement accuracy deteriorates with higher sensitivity.	0 – 63	0
SYSTEM	Locks the settings, or returns the settings to the factory preset values. LOCK PARAM: Locks/unlocks the settings. Under the locked condition, the set items are displayed in blue and cannot be changed. PC LOAD/SAVE: For PC configuration INITIALIZE: Returns all the settings to the factory preset values.		

*1 : The operation display changes when the settings are confirmed. For parameter descriptions including the ranges and initial values, refer to "Separate parameter setting and range for the detection modes".
*2 : When any of "0" to "3" is selected, "bank selection 3 input" is deactivated.
*3 : Remote monitoring is not available with communication function.
The communication setting is as follows: Data length=8 bit, No parity, Stop bit=1 bit.
*4 : Sensitivity setting is available for each bank.

Separate parameter setting and range for the detection modes

Parameter *4	Indication on LCD	Description	Peak detection mode		Bottom detection mode		Peak-to-Peak detection mode		Shape comparison mode		Edge count mode		Position X mode		Position Z mode	
			Setting range	Initial value	Setting range	Initial value	Setting range	Initial value	Setting range	Initial value	Setting range	Initial value	Setting range	Initial value	Setting range	Initial value
OUT1 upper limit threshold	OUT1 HI	OUT1 upper limit threshold (Longer distance side)	-200 to 5200	5200	-200 to 5200	5200	0 to 5200	5200	0 to 100	90	0 to 200	1	0 to 3000	3000	-200 to 5200	5200
OUT1 lower limit threshold	OUT1 LO	OUT1 lower limit threshold (Shorter distance side)	-200 to 5200	2600	-200 to 5200	2600	0 to 5200	1600	—		—		0 to 3000	1600	-200 to 5200	2600
OUT2 upper limit threshold	OUT2 HI	OUT2 upper limit threshold (Longer distance side)	-200 to 5200	2600	-200 to 5200	2600	0 to 5200	1600	0 to 100	80	0 to 200	1	0 to 3000	1600	-200 to 5200	2600
OUT2 lower limit threshold	OUT2 LO	OUT2 lower limit threshold (Shorter distance side)	-200 to 5200	2400	-200 to 5200	2400	0 to 5200	1400	—		—		0 to 3000	1400	-200 to 5200	2400
OUT3 upper limit threshold	OUT3 HI	OUT3 upper limit threshold (Longer distance side)	-200 to 5200	2400	-200 to 5200	2400	0 to 5200	1400	0 to 100	70	0 to 200	1	0 to 3000	1400	-200 to 5200	2400
OUT3 lower limit threshold	OUT3 LO	OUT3 lower limit threshold (Shorter distance side)	-200 to 5200	-200	-200 to 5200	-200	0 to 5200	0	—	—	—	—	0 to 3000	0	-200 to 5200	-200
Hysteresis	OUT HYS	Hysteresises of OUTPUT 1 to 3	0 to 200	5	0 to 200	5	0 to 200	5	0 to 100	5	—	—	0 to 200	5	0 to 200	5
Deviation tolerance	TOLER Z	Deviation tolerance	—		—				0 to 200	15	—	—	—	—	—	—
Window size *1	WINDOW	SUBWINDOW size setting	0 to 3	0	0 to 3	0	0 to 3	0	0 to 3	0	0 to 3	0	0 to 3	0	0 to 3	0
		0: 416x472 1: 320x472 2: 224x472 3: 128x472														
Sub sampling *2	SAMPLE	SUBSAMPLE mode setting in the X-direction	0 to 1	0	0 to 1	0	0 to 1	0	0 to 1	0	0 to 1	0	0 to 1	0	0 to 1	0
		0: SUBSAMPLE OFF 1: SUBSAMPLE ON														
Shutter time	SENS	Shutter time (sensitivity) setting of the image sensor	0 to 263	100	0 to 263	100	0 to 263	100	0 to 263	100	0 to 263	100	0 to 263	100	0 to 263	100
Edge direction	EDGEDIRC	Edge direction setting	—	—	—	—	—	—	—	—	0 to 1	0	0 to 1	0	0 to 1	0
		0: Rising edge 1: Falling edge														
Edge definition *3	EDGE DEF	Edge judgment threshold	—	—	—	—	—	—	—	—	0 to 1000	128	0 to 1000	128	0 to 1000	128
Edge number 1	EDGENUM1	Setting of edge 1	—	—	—	—	—	—	—	—	—	—	0 to 31	0	0 to 31	0
		0: Origin (Zero displacement point of X- or Z-direction) Other than 0: Edge number (counted from the X-direction origin)														
Edge number 2	EDGENUM2	Setting of edge 2	—	—	—	—	—	—	—	—	—	—	0 to 31	1	0 to 31	1
		0: Origin (Zero displacement point of X- or Z-direction) Other than 0: Edge number (counted from the X-direction origin)														
Span 4 mA	SPAN 4MA	Distance setting with the analog output 4 mA	0 to 5000	0	0 to 5000	0	0 to 5000	0	—	—	—	—	0 to 3000	0	0 to 5000	0
Span 20 mA	SPAN20MA	Distance setting with the analog output 20 mA	0 to 5000	5000	0 to 5000	5000	0 to 5000	5000	—	—	—	—	0 to 3000	3000	0 to 5000	5000
Offset	OFFSET	Analog output offset (It is preset to 12 mA)	0 to 1	0	0 to 1	0	0 to 1	0	—	—	—	—	0 to 1	0	0 to 1	0
		0: Default value 1: Offset														

*1 A smaller display size can increase the response speed.

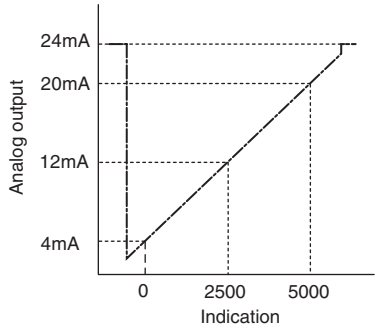
*2 Selecting "1" allows the image sampling of every other pixel in X-direction. It lowers the accuracy but improves the response speed.

*3 Adjust the threshold when the unit cannot detect edges of the object. Selecting larger value will ignore small level differences.

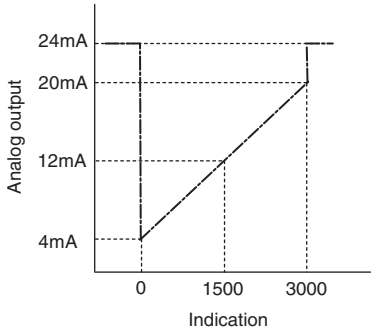
*4 Every setting item can be set for each bank.

ANALOG OUTPUT

Peak detection mode / Bottom detection mode / Peak-to-peak detection mode / Position Z mode



Position X mode



Span adjustment and offset setting are available as the peak detection mode.

The analog output is not available in the shape comparison mode and edge count mode.

Span adjustment

1 Select "SPAN 4MA."

Separate parameter setting

2 When the setting value is turned in red (adjustable), press ▲ ▼ to select "4 mA" for the output distance (indication), then press ○SET and hold to determine the setting.

3 As step 2, set "20 mA" as the output distance in "SPAN 20MA."

Offset

Specify the distance to apply the analog output 12 mA.

1 Place the detection object at the distance of the analog output 12 mA.

2 Select "OFFSET."

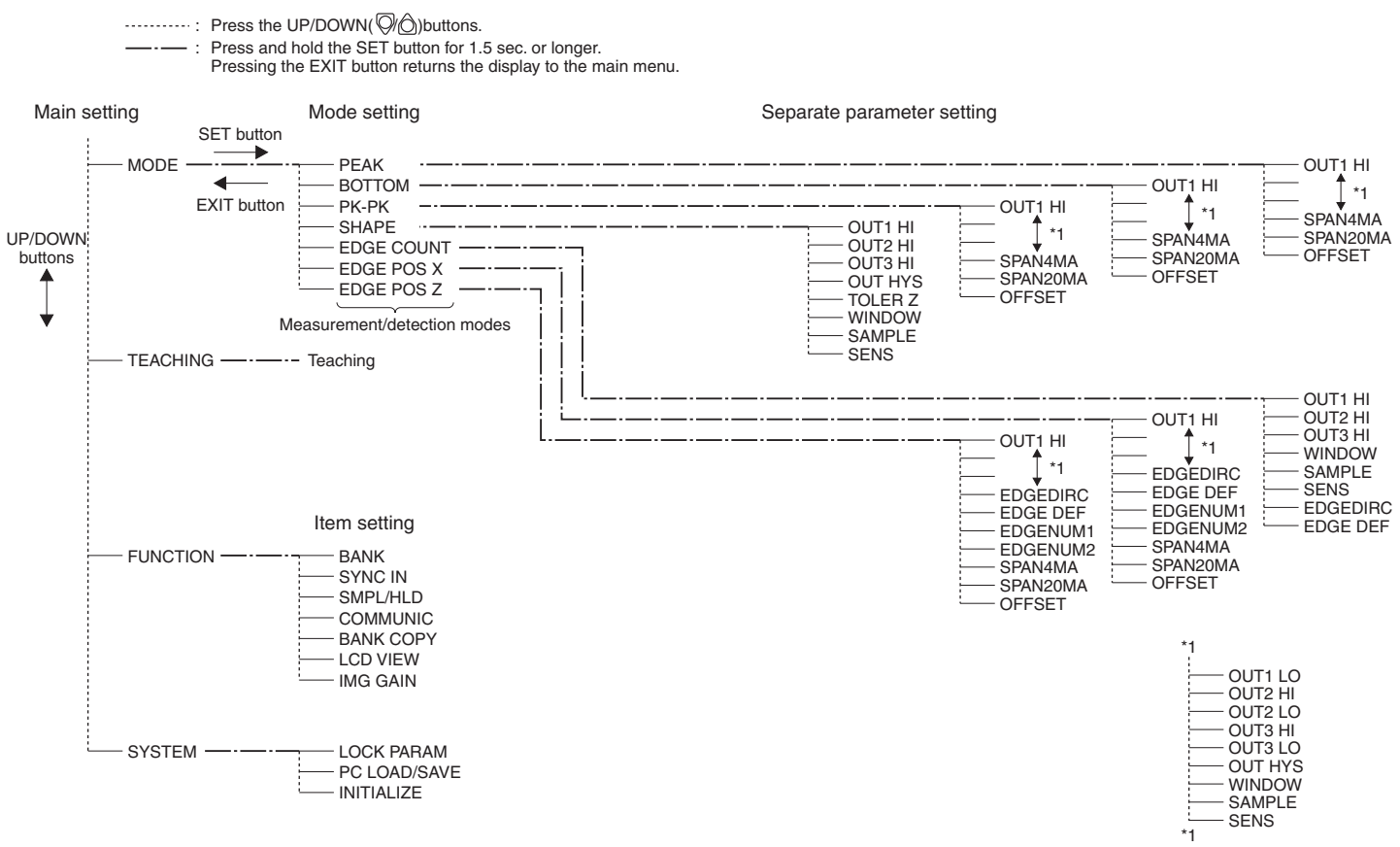
Separate parameter setting

3 When the setting value is turned in red (adjustable), press ▲ ▼ to select "1," then press ○SET and hold to confirm the setting.

If "0" is selected after performing offset, the setting returns to the default value.

APPENDIX

Operation Display Block Diagram

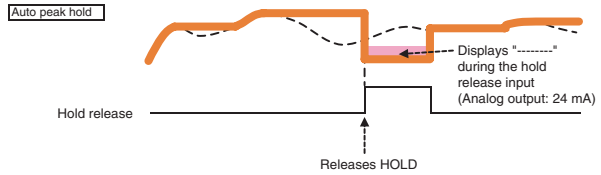


Hold Function Timing Diagram

Peak detection with the synchronization input OFF

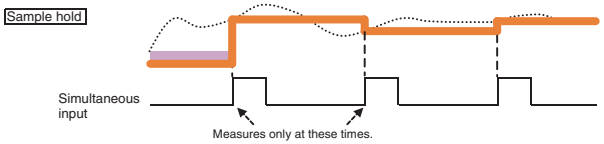
Hold OFF: Outputs the real-time measurement value.

Hold ON: Overwrites only when the measurement value is larger than the previous one.

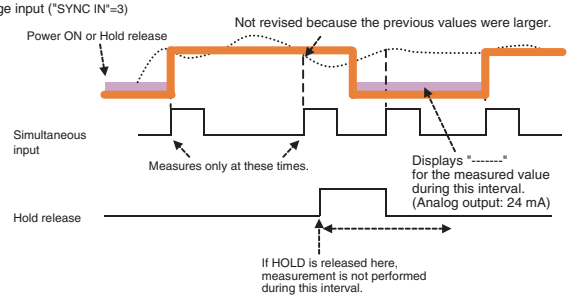


Peak detection with the synchronization input ON

Hold OFF: Outputs the real-time measurement value.
UP edge input ("SYNC IN"=3)

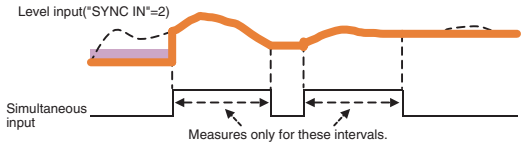


Hold ON: Overwrites only when the measurement value is larger than the previous one.
UP edge input ("SYNC IN"=3)

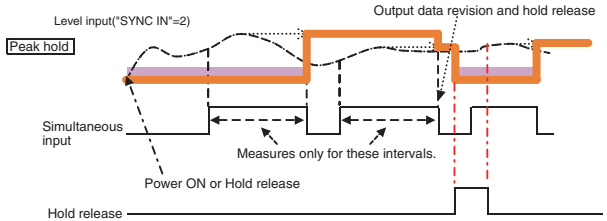


Peak detection with the synchronization input ON

Hold OFF: ("SMPL/HLD"=0) Outputs the real-time measurement value.
UP edge input

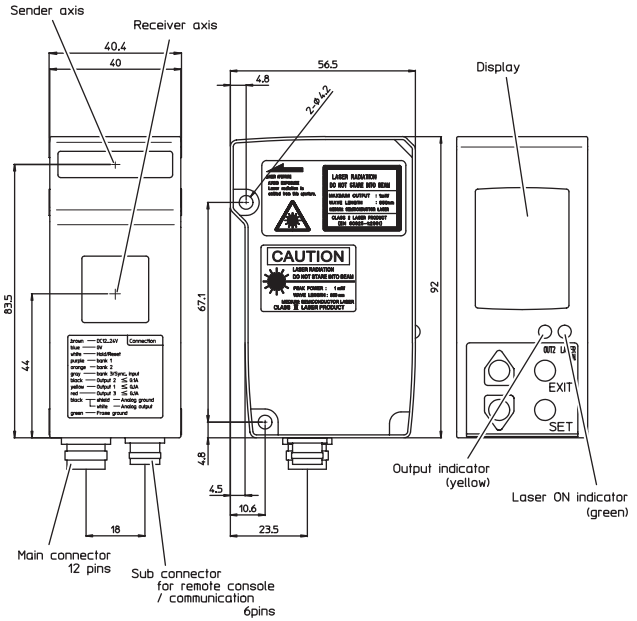


Hold ON: Overwrites only when the measurement value is larger than the previous one.



* Hold release input
NPN type: connect the hold release input line (white) to 0 V.
PNP type: connect the hold release input line (white) to + V.

Dimentional drawing



Package Descriptions

- Main unit
- Main connection cable
- Instruction manual
- Fixing screw:
  M4 x 50 mm, 2 pcs
  M4 nut, 2 pcs
  Washer for M4, 2 pcs

Optionally available

- Remote console (Cable length: 3m)
- Communication cable
- Main connection cable (Cable length: 7m)