KEYENCE

96M12738

* 9 6 M 1 2 7 3 8 - 4 *

All-Purpose Laser Sensor

LR-TB2000 Series

Instruction Manual

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

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

⚠ DANGER	**It indicates a hazardous situation which, if not avoided, will result in death or serious injury.**
⚠ WARNING	**It indicates a hazardous situation which, if not avoided, could result in death or serious injury.**
NOTICE	**It indicates a situation which, if not avoided, could result in product damage as well as property damage.**

1 Introduction

Safety Information for LR-TB Series

⚠ DANGER	• **This product is only intended to detect object(s). Do not use this product for the purpose to protect a human body or part of a human body.** • **This product is not intended for use as an explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.**
⚠ WARNING	**This product uses DC power. The product may explode or burn if an AC voltage is applied.**
NOTICE	• **Do not wire the cable along with power lines or high-tension lines, as the sensor may malfunction or be damaged due to noise.** • **When using a commercially available switching regulator, ground the frame ground terminal and ground terminal.** • **Do not use this product outdoors or in a location in which its light-receiving surface will come in direct contact with stray ambient light.**

Safety Precautions on Laser Product

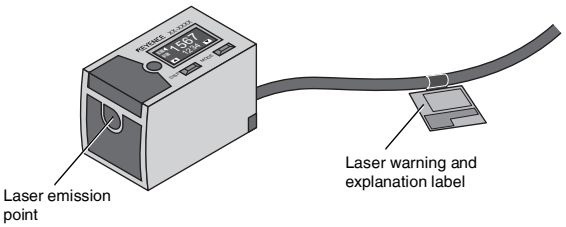
This product uses a semiconductor laser as its light source.

⚠ WARNING	• **Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.** • **Follow the instructions mentioned in this manual. Otherwise, injury to the human body (eyes and skin) may result.** • **Laser emission from this product is not automatically stopped when it is disassembled. Do not disassemble this product.** • **Precautions on Class 2 Laser Product** **- Do not stare into the direct or specularly reflected beam.** **- Do not direct the beam at people or into areas where people might be present.** **- Be careful of the path of the laser beam.** **If there is a possibility that the operator may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure.** **- Install this product so that the path of the laser beam is not as the same height as that of human eye.** • **Precautions on Class 1 Laser Product** **- Do not stare into the direct or specularly reflected beam.**

Item		Description	
Model		LR-TB2000	LR-TB2000CL
		LR-TB2000C	
Wavelength		660 nm	
Pulse width		4.3 ns	
FDA(CDRH) Part1040.10	Laser class*	Class 2 laser product	Class 1 laser product
	Output	1.0 mW	390 µW
JIS C 6802/ IEC 60825-1	Laser class	Class 2 laser product	Class 1 laser product
	Output	1.0 mW	390 µW

* The laser classification for FDA (CDRH) is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No.50.

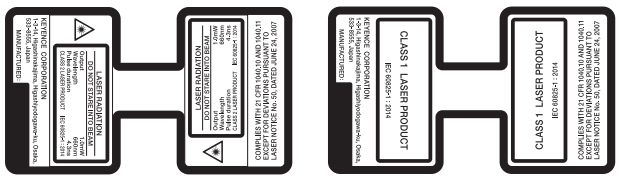
■ **Laser warning and explanation labels**



● **Laser warning and explanation labels**

• Attached to the cable

Class 2 (English) Class 1



• Included with the product

Class 2 (included with the product in each language)

* For a Class 2 laser product, select from the warning and explanation labels included in the package the appropriate warning and explanation label according to the country and region where the Class 2 laser product will be used. Then, affix the warning and explanation label over top of the existing warning and explanation label on the product.

Precautions on Regulations and Standards

■ **CSA Certificate**

LR-TB series complies with the following CSA and UL standards and has been certified by CSA (Class 2252 06 / Class 2252 86).

- Applicable standard: CAN/CSA C22.2 No.61010-1
  UL61010-1
- Use the following power supply.

CSA/UL certified power supply that provides Class 2 output as defined in the CEC (Canadian Electrical Code) and NEC (National Electrical Code), or CSA/UL certified power supply that has been evaluated as a Limited Power Source as defined in CAN/ CSA-C22.2 No. 60950-1/UL60950-1

- Use this product at the altitude of 2000 m or less.
- Use this product at the level of overvoltage category I.
- Use this product at pollution degree 3.
- Indoor use only.

■ **CE and UKCA Marking**

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

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

- Applicable standard: (BS)EN60947-5-2, Class A

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

Package Contents

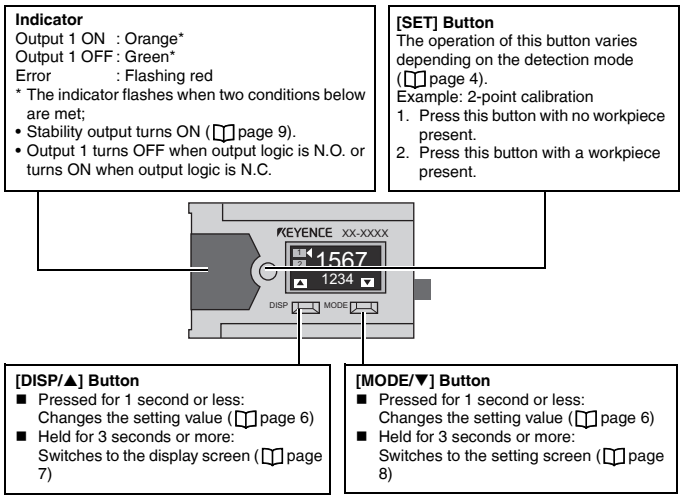
- Main unit
- Instruction manual
- Laser warning and explanation labels (LR-TB2000/TB2000C only)

Specifications

Model	Cable	LR-TB2000	-
	Cable with connector M12	LR-TB2000C	LR-TB2000CL
Detectable distance*1		60 to 2000 mm	
Spot diameter		Approx. 4 mm	
Response time		1 ms/10 ms/25 ms/ 100 ms/1000 ms selectable	2 ms/20 ms/50 ms/ 200 ms/2000 ms selectable
Light source	Type	Red laser (660 nm)	
	Laser class	Class 2 laser product IEC60825-1,FDA(CDRH) Part1040.10*2	Class 1 laser product IEC60825-1,FDA(CDRH) Part1040.10*2
Mutual interference prevention function		4 units (when using the interference prevention function)	
Timer		OFF/OFF delay/ON delay/One-shot	
Power voltage		20 to 30 VDC, including 10% ripple (P-P), Class 2 or LPS	
Current consumption		45 mA or less (without load)*3	
I/O*4*5	Control output	NPN open collector/PNP open collector selectable 30 VDC or less, 50 mA or less, residual voltage: 2 V or less, N.O./N.C. selectable	
	External input	Transmission OFF / Tuning / Reference surface update selectable Short-circuit current: 1 mA or less for both NPN and PNP For the applied voltage, see the wiring diagrams (page 2 in the instruction manual). For the input times, see the time charts (page 3 in the instruction manual).	
Protection circuit		Protection against reverse power connection, power supply surges, output overcurrent, output surge, and reverse output connection	
Environmental resistance	Enclosure rating	IP65/IP67 (IEC60529)	
	Ambient light	Incandescent lamp/Sunlight: 100000 lux or less	
	Ambient temperature	-20 to +55°C (no freezing)	
	Ambient humidity	35 to 85%RH (no condensation)	
	Shock resistance	1000m/s^2 in X, Y, Z axis directions respectively 6 times	
	Vibration resistance	10 to 55 Hz Double amplitude 1.5 mm in the X, Y, Z axis directions respectively, 2 hours	
Material		Case: Zinc die cast (Nickel chrome plating), Indicator cover and buttons: PES, Lens cover and display: PMMA (scratch-resistant coating specifications), Cable bushing: PBT, Cable: PVC, M12 connector (only for the cable with connector M12 type): TPE, PBT, Nickel-plated brass	
Weight		Cable type: Approx. 125 g (Including cable) Cable with connector M12 type: Approx. 85 g	

*1 The range for displayable distance is from 50 to 2200.
*2 The laser classification for FDA (CDRH) is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No.50.
*3 145mA or less (with load)
*4 You can select the I/O from the following combinations.
Control output × 2, control output + external input
(For details on the setting method, see page 3 of the instruction manual.)
*5 IO-Link specification v.1.1/COM2 (38.4 kbps) is supported.
You can download a setup file from the KEYENCE website (http://www.keyence.com).
If you are using the product in an environment in which you cannot download files over the Internet, contact your nearest KEYENCE office.

Part Functions



For a more detailed explanation, see "Switching between Display Screens" (page 7).

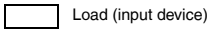
2 Installation and Wiring

Installation

- Tightening torque for the mounting holes: 0.63 N·m (M3 screw)
- If the detecting object has a mirrored surface, install the sensor in a position where specular reflection will not penetrate the optical receiver.

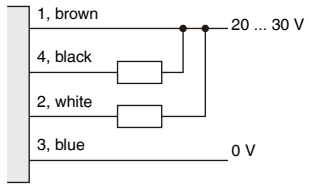
Wiring

With the LR-TB Series, you can select the functions of the I/O wires (black and white) from the combinations shown below during the initial settings. "3 Initial Settings" (page 3)
Independently isolate any I/O wires that you will not use.

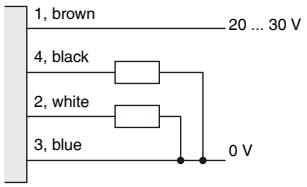


■ Out1+Out2

● **NPN**

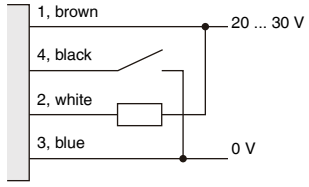


● **PNP**

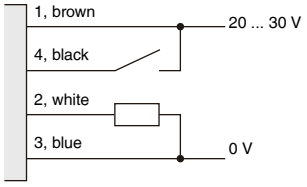


■ Input+Out1

● **NPN**

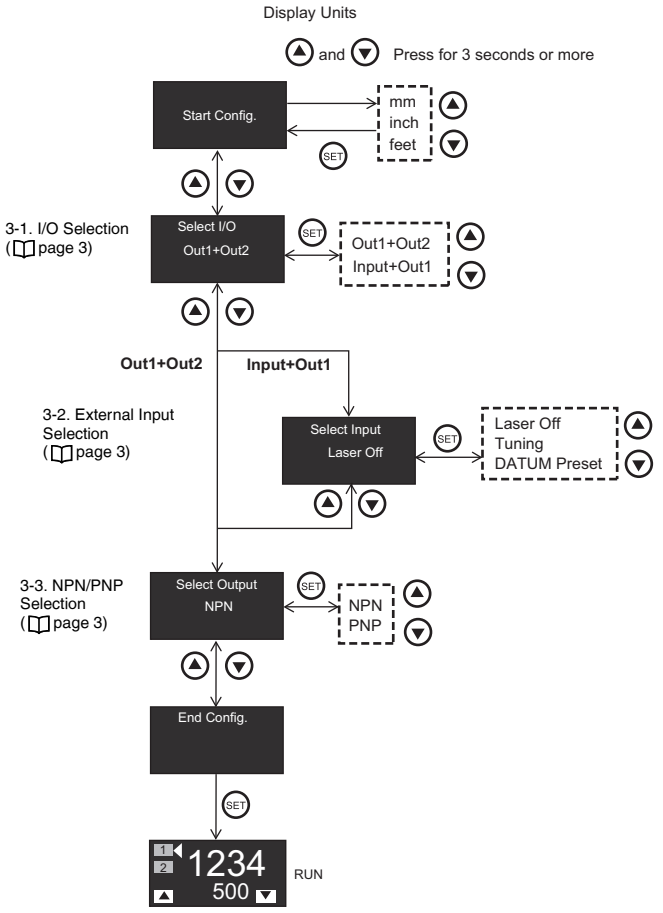


● **PNP**



3 Initial Settings

When you turn on the LR-TB Series for the first time after you purchase it or when you have initialized the LR-TB Series, the following initial settings must be configured.



- After you have finished configuring the initial settings, you will not be able to reconfigure the unit, I/O, or NPN/PNP selection. To change any of these settings, you will have to initialize the product. "Initialization" (page 7).

3-1. I/O Selection

Select from the following table the functions assigned to the I/O wires (black and white).

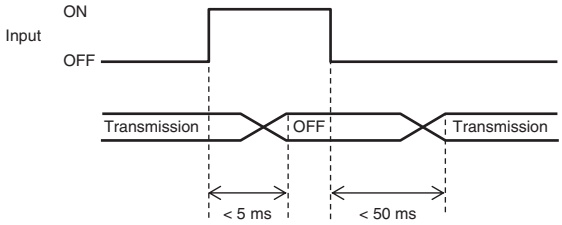
Options	Black Wire	White Wire
Out1 + Out2	Output 1	Output 2
Input + Out1	External input	Output 1

The functions assigned to output 1, output 2, and external input can be changed after you finish configuring the initial settings. "6 Detailed Settings" (page 8).

3-2. External Input Selection

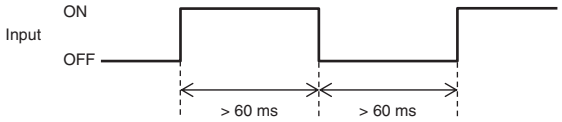
■ Transmission OFF [Laser Off]

The laser beam transmission is stopped.



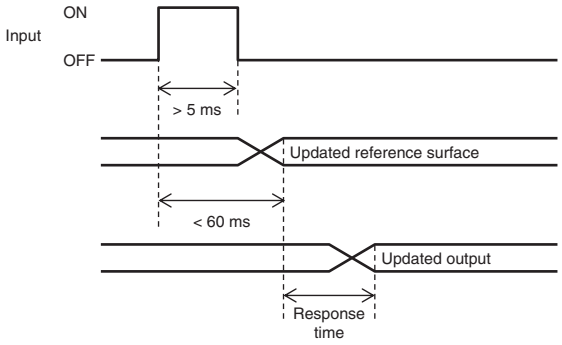
■ External Calibration [Tuning]

When selected, this external input performs the same function as pressing the [SET] button.



■ Reference surface update [DATUM Preset]

When the detection mode ("4 Detection Mode" [page 4]) is set to "DATUM mode," this external input updates the reference surface.



3-3. NPN/PNP Selection

You can select between NPN outputs or PNP outputs. For details, see "Wiring" (page 2).

4 Detection Mode

The LR-TB Series has four output modes and three detection modes.

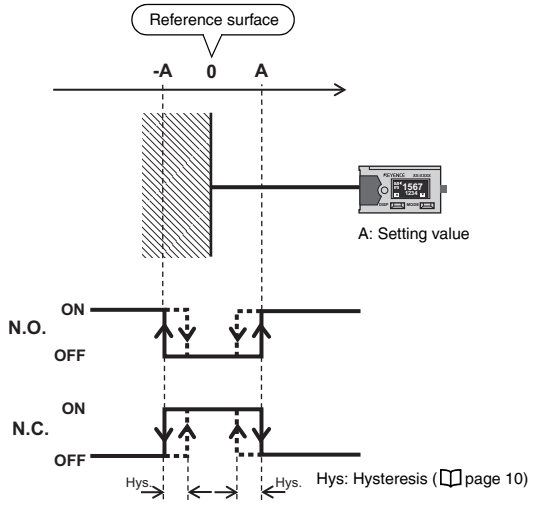
Output Mode (📖 page 9)	Detection Mode
Standard (default value) [Standard]	**4-1. DATUM mode (FGS)**
	4-2. Distance mode (BGS)
Window [Window]	**4-3. Window mode**
Stability [Stability]	(📖 page 9)
Error [Error]	(📖 page 9)

When the output modes for Out1 & Out2 are either [Standard] or [Window], the detection modes can only be set in the below combinations.
[Out1] / [Out2] = [DATUM]/ [DATUM], [Distance]/ [Distance], [Distance]/ [Window], [Window]/ [Distance], [Window]/ [Window]

4-1. DATUM Mode (FGS)

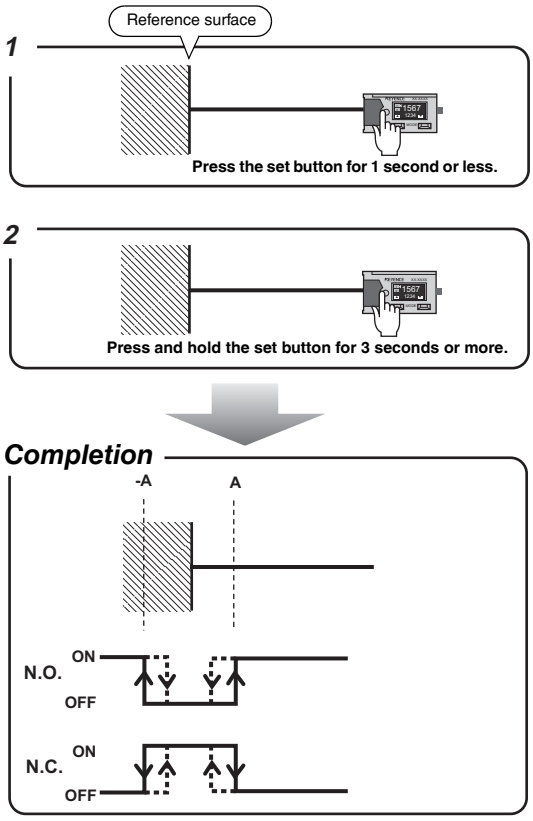
■ Operation

- In this mode, the change in position from a reference surface (which has a value of 0) is displayed.
- This mode is useful in detecting the passage of workpieces in front of a stationary background.



■ Setting

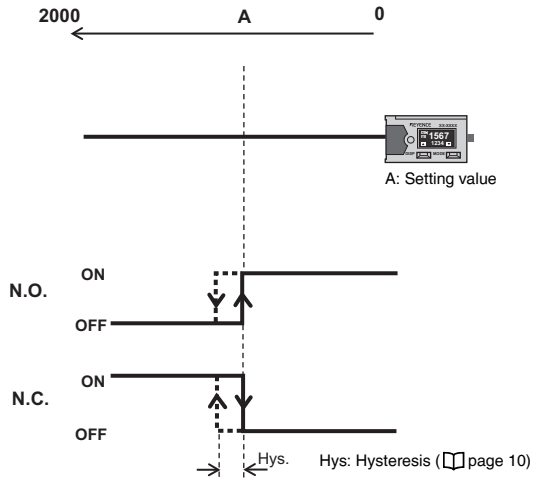
- Set the output mode to [Standard], which is the default mode. 📖"6 Detailed Settings" (page 8)
- For details on setting output 2, see 📖" 4-5. Switching Out1/Out2" (page 6).
- In DATUM mode, a "±" is displayed in front of the setting value.



4-2. Distance Mode (BGS)

■ Operation

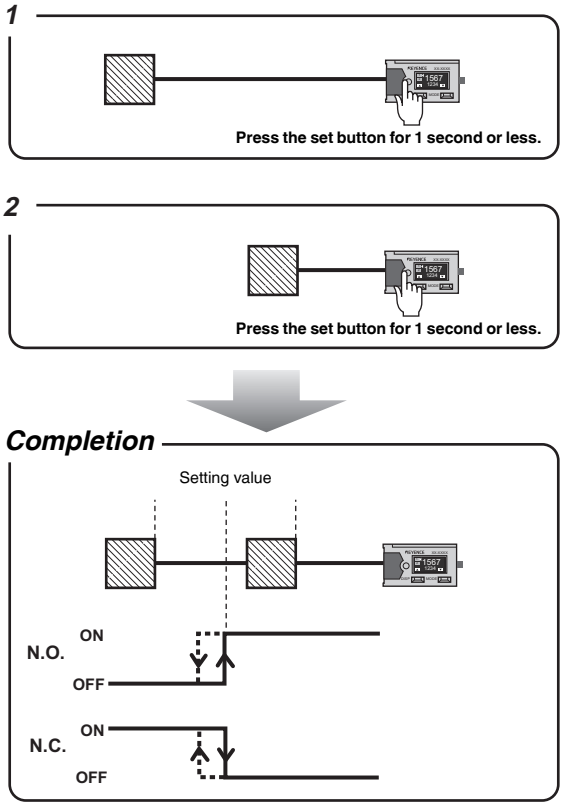
- In this mode, the distance from the sensor is displayed.



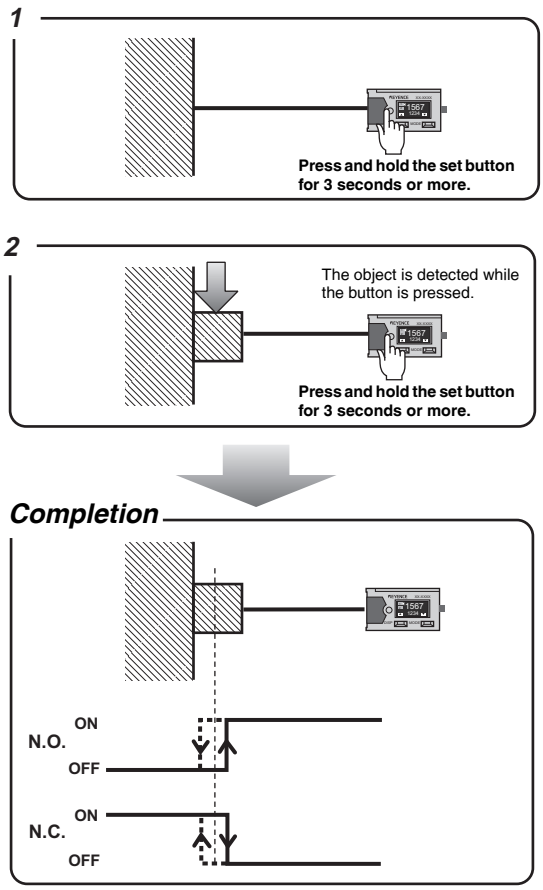
■ Setting

- Set the detection mode to [Standard], which is the default value. 📖"6 Detailed Settings" (page 8)
- For details on setting output 2, see📖" 4-5. Switching Out1/Out2" (page 6)

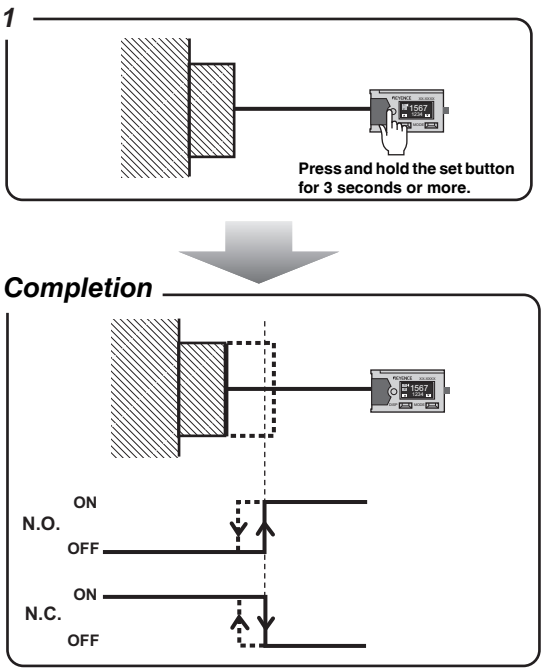
● **2-point calibration**



● **Full auto calibration**
Use this function when the movement of detected objects cannot be stopped.



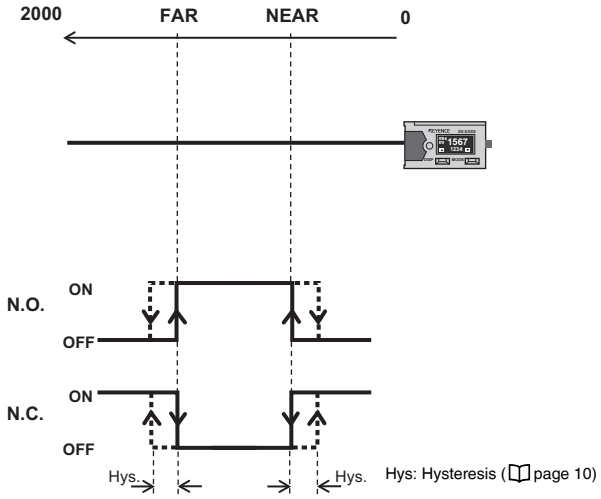
● **1-point calibration**
Use this function to enable the installation of detected objects at the upper limit that you do not want to detect.



4-3. Window Mode

■ Operation

- In this mode, the distance from the sensor is displayed.
- You can assign setting values to the upper and lower limits.

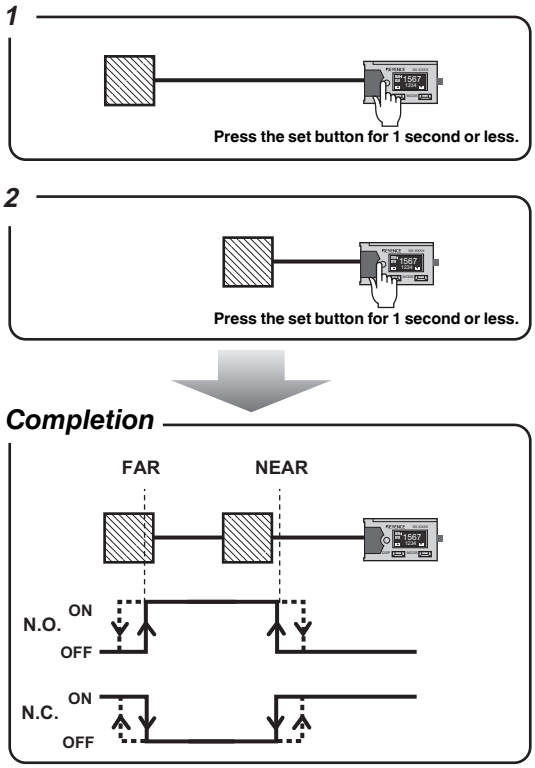


Hys: Hysteresis (page 10)

■ Setting

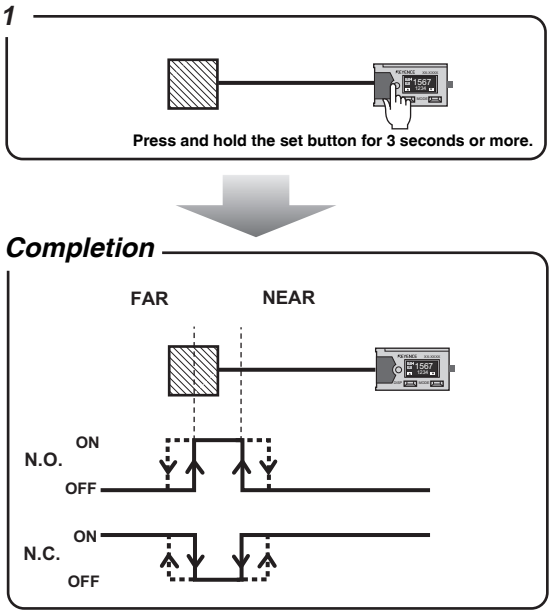
- Set the detection mode to [Window]. "6 Detailed Settings" (page 8)
- For details on setting output 2, see " 4-5. Switching Out1/Out2" (page 6).

● **2-point calibration**
Use this function to detect objects inside a range of specific upper and lower limits.

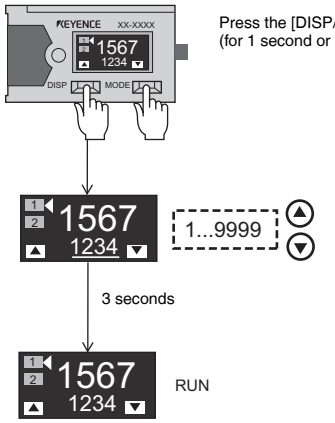


● **1-point calibration**

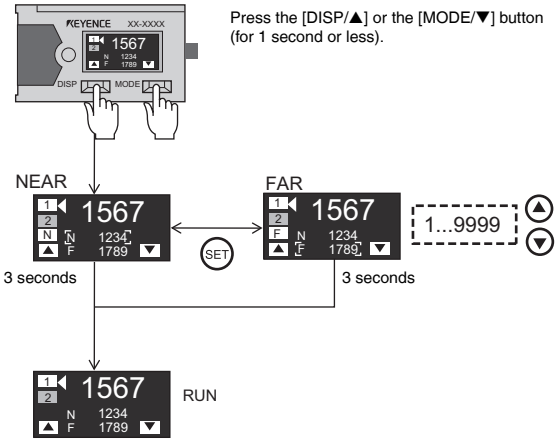
Use this function when you cannot move detected objects away from the center of the detection range.



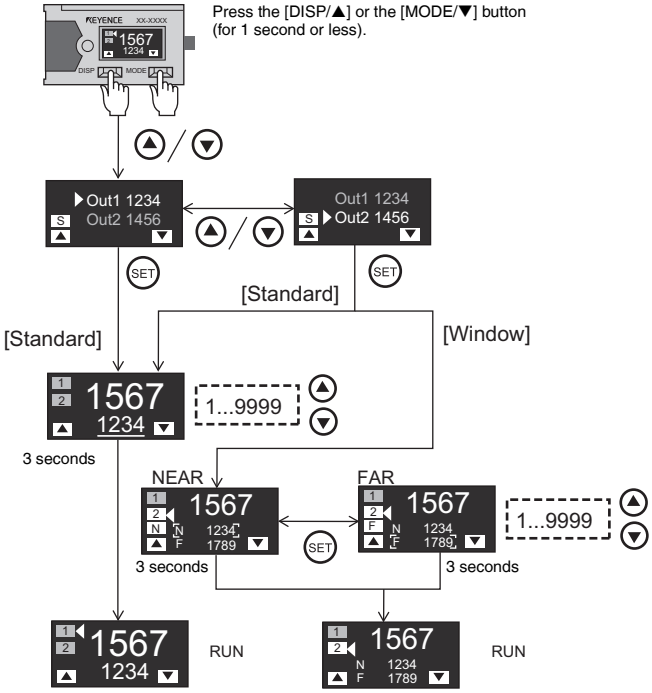
4-4. Manual Tuning



■ **When the detection mode is set to [Window]**

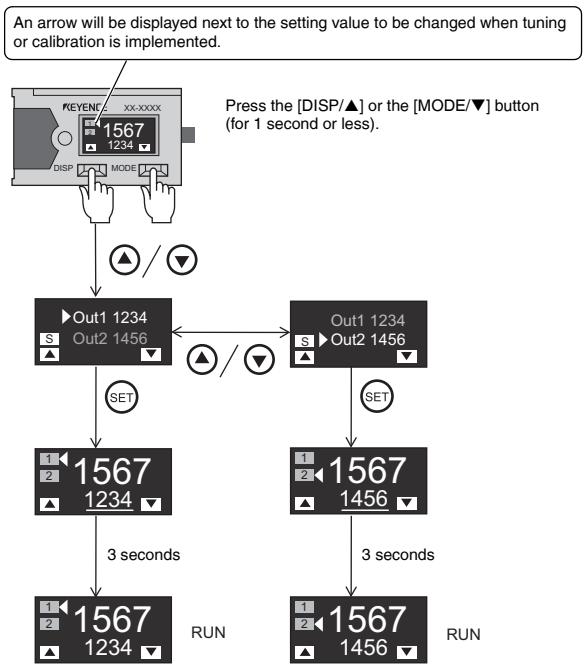


■ **When [Out2] mode is set to [Standard] or [Window]**



4-5. Switching Out1/Out2

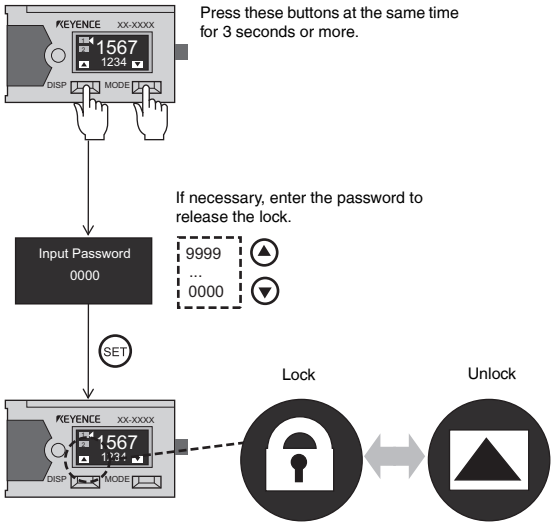
The initial [Out2] mode is [Stability]. "6 Detailed Settings" (page 8)
When [Out2] mode is set to [Standard] or [Window], the setting below could be manipulated.



5 Useful Functions

Key Lock

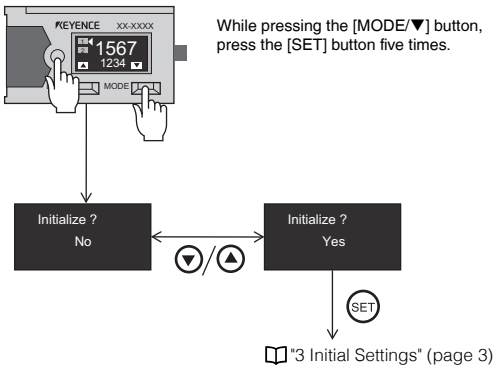
To require a password to release the key lock, see " 6-11. Password" (page 10).



Initialization

Initialization resets the product to its factory default settings. After initialization, you will have to configure the "3 Initial Settings" (page 3).

■ Using the shortcut keys to execute the initialization



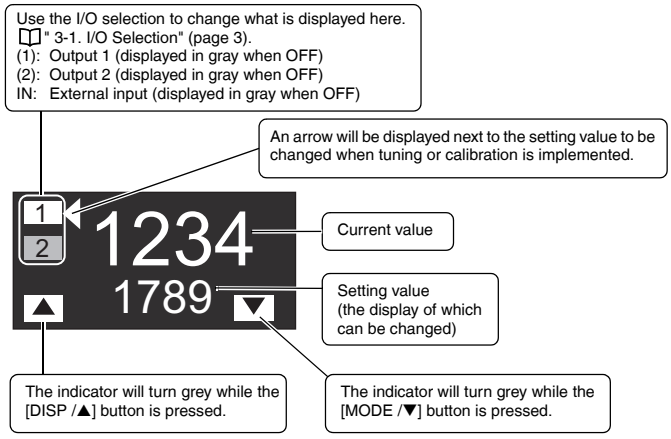
■ Using the setting menu to execute the initialization

On the "Initialize?" screen, select "Yes". "6 Detailed Settings" (page 8)

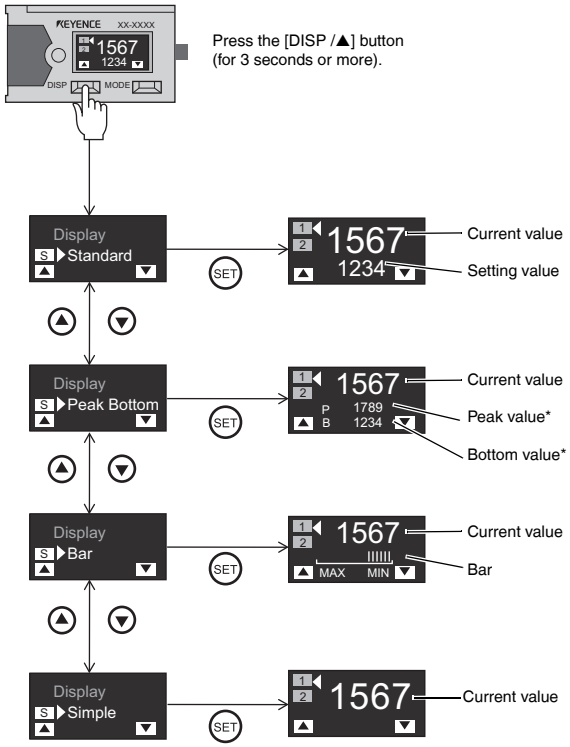
Switching between Display Screens

You can select between four different displays.

■ Display screen



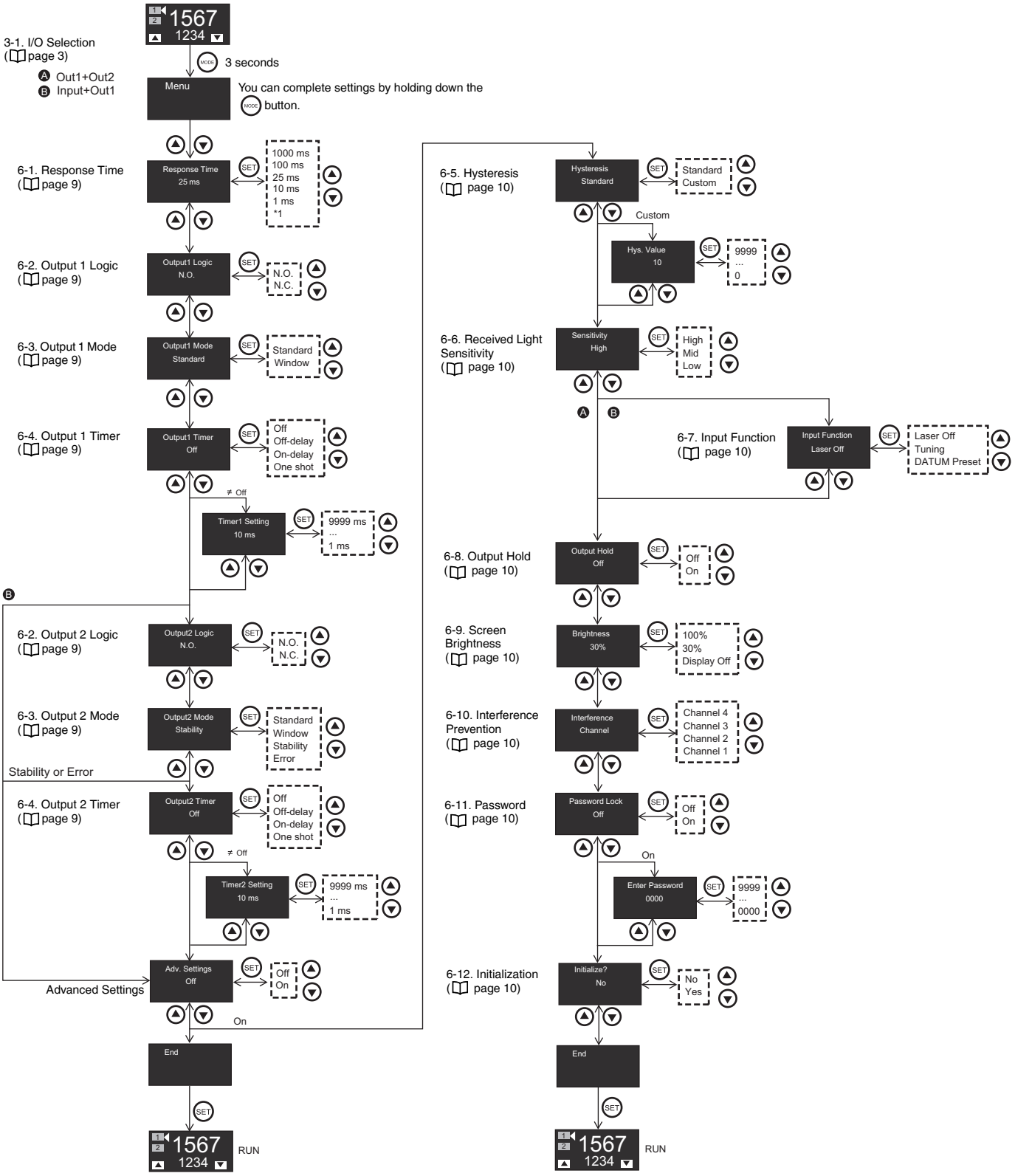
■ How to switch the display



* When the output changes from ON to OFF, the bottom value is reset to the current value.
When the output changes from OFF to ON, the peak value is reset to the current value.

6 Detailed Settings

The values shown on the display screen are the initial values.



*1 The LR-TB2000CL has the following response times.
2000 ms
200 ms
50 ms
20 ms
2 ms

6-1. Response Time

Longer response times lead to more stable detection.

■ LR-TB2000/TB2000C

Detecting distance [mm]	Repetition Accuracy[mm] (Typical) (Under stable temperature) White Paper (Reflectivity: 90%) Response Time [ms]				
	1	10	25	100	1000
1000	±9	±4	±3	±3	±3
2000	±25	±7	±6	±3	±3

Detecting distance [mm]	Repetition Accuracy[mm] (Typical) (Under stable temperature) Gray Paper (Reflectivity: 18%) Response Time [ms]				
	1	10	25	100	1000
1000	±26	±7	±6	±3	±3
2000	±69	±21	±13	±6	±4

■ LR-TB2000CL

Detecting distance [mm]	Repetition Accuracy[mm] (Typical) (Under stable temperature) White Paper (Reflectivity: 90%) Response Time [ms]				
	2	20	50	200	2000
1000	±10	±5	±3	±3	±3
2000	±26	±8	±7	±5	±3

Detecting distance [mm]	Repetition Accuracy[mm] (Typical) (Under stable temperature) Gray Paper (Reflectivity: 18%) Response Time [ms]				
	2	20	50	200	2000
1000	±26	±9	±6	±3	±3
2000	±71	±22	±15	±9	±5

6-2. Output Logic

Select N.O. or N.C. for the output logic. For details, see "4 Detection Mode" (page 4).

6-3. Output Mode

■ Standard [Standard]

The output is activated according to the detecting distance. For details, see "4 Detection Mode" (page 4).

■ Window [Window]

The output is activated according to the detecting distance. For details, see " 4-3. Window Mode" (page 5).

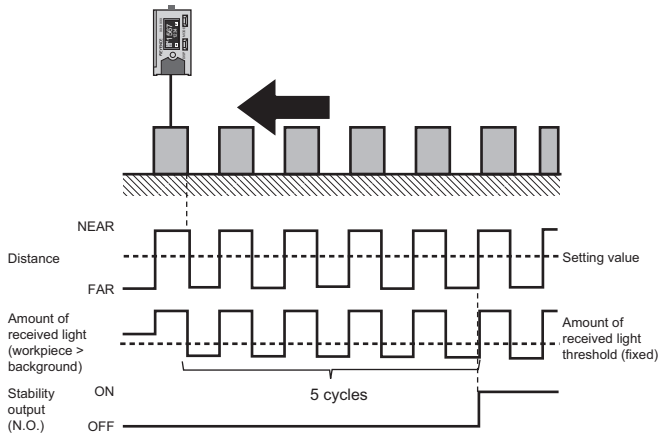
■ Stability [Stability]

This function can be used to check whether there has been a decrease in the amount of light received due to problems such as dirt on the detected surface.

- **When the I/O selection is [Out1 + Out2]**
  Output is activated if the amount of light received falls below the threshold (fixed value) during the observation period.

Detection Mode	Observation Period
DATUM	Negative setting value < detected value < positive setting value
Distance	Detected value < setting value
Window	LOW-side setting value < detected value < HIGH-side setting value

Example) Chart during DATUM mode



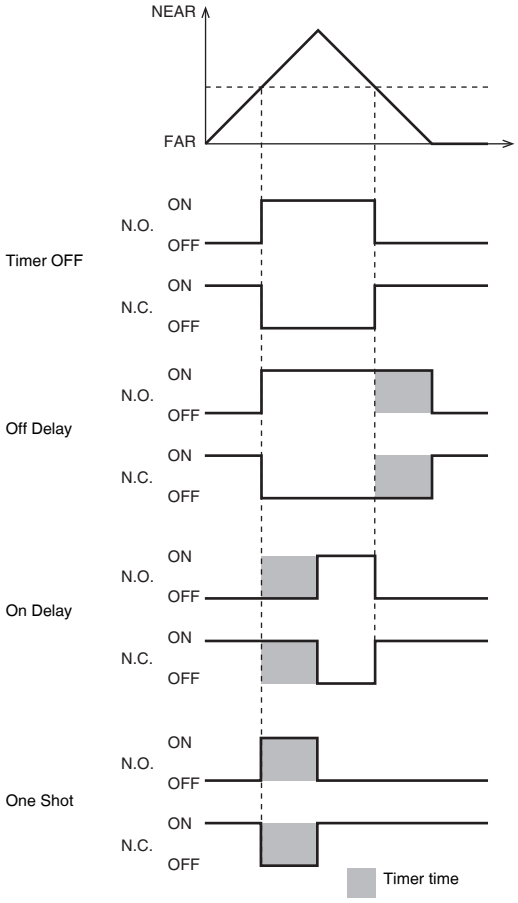
■ Error [Error]

Output is activated when an error occurs. When the error is cleared, the output is also automatically reset. For causes of errors, see " Error Display" (page 10).

6-4. Timer

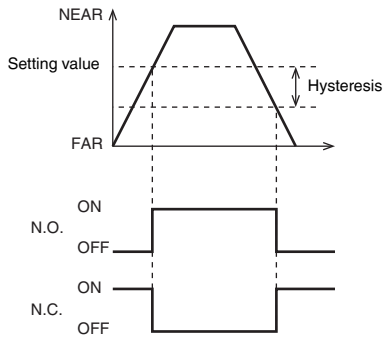
This function can be used to delay the timing with which the sensor output is switched.

- Off delay [Off-delay]
- On delay [On-delay]
- One shot [One shot]

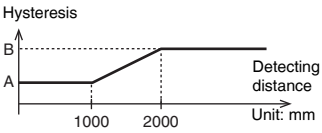


6-5. Hysteresis

Hysteresis is the difference between the value at which the output turns ON and the value at which the output turns OFF.



- With [Standard], the hysteresis varies depending on the response time and the detecting distance.



Response Time (ms)	A(mm)	B(mm)
25 to 2000	15	20
10, 20	30	40
1, 2	60	80

- With [Custom], you can specify an arbitrary value regardless of the detecting distance.
- For details on the operation differences between the detection modes, see "4 Detection Mode" (page 4).

6-6. Received Light Sensitivity

By lowering the received light sensitivity level, you can reduce the number of times that malfunctions such as the following occur.

- Detections of dirt and mist between the sensor and the detected object.
- Detections of translucent objects when passing through translucent objects to detect the target.

You cannot change the received light sensitivity when "6-1. Response Time" (page 9) is set to [1ms/10ms]/[2ms/20ms].

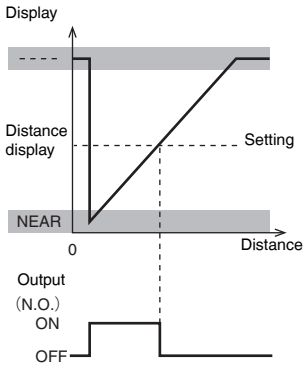
6-7. Input Function

For details, see "3-2. External Input Selection" (page 3).

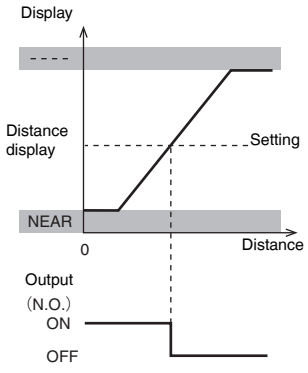
6-8. Output Hold

This function holds the display value and the output status that were in use immediately prior to the LR-TB Series becoming unable to receive light.

■ When Output Hold is OFF



■ When Output Hold is ON



6-9. Screen Brightness

You can set the operation to perform when no button operations are performed for a set length of time.

Item	Description
100%	The display brightness is always kept at 100%.
30% (default value)	After a certain length of time elapses, the display brightness is set to 30%.
Display Off	After a certain length of time elapses, the display is turned OFF.

- If you use the LR-TB Series for a long period of time, the display brightness will decrease.
- If you set this to [100%], the display brightness will decrease at a faster rate.

6-10. Interference Prevention

With the LR-TB Series, you can prevent the effect of mutual interference by changing the laser emission channel. If you are using multiple LR-TB Series units in close proximity to each other, set each one to have a different laser emission channel.

6-11. Password

If you set this to [ON], you can set a personal identification number that must be entered to release the " Key Lock" (page 7). You can set the personal identification number to a value from 0 to 9999.

6-12. Initialization

Initialize the sensor settings. You can also use the shortcut keys to execute the initialization. "Initialization" (page 7)
After initialization, you will have to configure the "3 Initial Settings" (page 3).

7 Other

Error Display

Error Display	Cause and Remedy
NEAR*	The detected object is not within the detectable range (the detected object is too close).
- - - -*	Light reflected from the detected object could not be received. • The amount of light received from the detected object is low. • The detected object is not within the detectable range of the LR-TB (the detected object is too far away).
Over Current	An overcurrent is flowing through the output wire. • Check whether the output wire is connected correctly. • Check whether the output wire is in contact with other wires.
Laser Error	A laser diode error has occurred. • If you cannot fix the problem by restarting the product, the product must be replaced.
EEPROM Error	1) Settings have been rewritten more than 1,000,000 times. • The memory has reached the end of its service life. 2) A recording memory error has occurred. • If you cannot fix the problem by restarting the product, the product must be replaced.
System Error	An internal system error has occurred. • If you cannot fix the problem by restarting the product, the product must be replaced.

* When Output mode is set to [Error], while "Near" or "- - - -" is on display, the output would not switch.

Output When an Error Occurs

Error Display	Output ON or OFF	
	N.O.	N.C.
NEAR	ON	OFF
- - - -	OFF	ON
Over Current*1	OFF	OFF
Laser Error*2	OFF	ON
EEPROM Error*2	The same as during normal operation	
System Error*2	OFF	ON

*1 When Output mode is set to [Error], despite the setting of N.O. or N.C., LR-T would remain OFF to protect the output circuit.
*2 When Output mode is set to [Error], LR-T would turn ON with N.O. and turn OFF with N.C.

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