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 (1)

#### 1-1 Safety Information for LR-ZH Series

- **DANGER** Do not use this product for the purpose to protect a human body or a part of human body. This product is not intended for use as explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.
- **WARNING** This product is a sensor of direct current power supply type. Do not apply alternating current. Doing so may cause rupture or burnout.
- **NOTICE** Do not wire this product along with power lines or high-tension lines. Doing so may lead to product malfunctions or damage due to noise. Do not use this product outdoors or in a place where extraneous light can enter the light-receiving element directly. Use with an over current protection device which is rated 30 V or more and not more than 1 A.

#### 1-2 Safety Precautions on Laser Product

This product employs a semiconductor laser for its light source.

**Item**

- **Wavelength /Output /Pulse width**: 660 nm/1.0 mW/330 μs
- **FDA(CDRH) Part 1040.10**: Class 1 laser product
- **IEC 60825-1 (JIS C 6802)**: Class 2 laser product

Follow the instructions mentioned in this manual. Otherwise, injury to the human body (eyes and skin) may result.

- **WARNING** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- **NOTICE** Do not disassemble, remodel or repair this product. Laser emission from this product is not automatically stopped when it is disassembled.
- **Precautions on Class 2 Laser Product**
  - Do not stare into the direct or specularly reflected beam.
  - Do not direct the beam at other people or into areas where other people unconnected with the laser work might be present.
  - Be careful of the path of the laser beam. If there is a possibility that the operator may be exposed to the specular reflections, block the beam by installing a protective enclosure.
  - Install the products so that the path of the laser beam is not as the same height as that of human eye.

### Precautions on Regulations and Standards

#### 1-3 UL Certification

- **UL File No.** E301717
- **Category** NRKH, NRKH7

Be sure to consider the following specifications when using this product as a UL/c-UL Listed Product.

- Use a power supply with Class 2 output defined in NFFA70 (NEC: National Electrical Code).
- Power supply, External input and Control output circuits shall be connected to a single Class 2 source only.
- Install the product at the ambient temperature 45°C or below when using with optional cable. (OP-75721, OP-85502, OP-75722, OP-87274)

#### CE Marking

KEYENCE Corporation has confirmed, on the basis of the following specifications, that this product complies with the essential requirements of the applicable EU Directive. Be sure to consider the following specifications when using this product in a member state of the European Union.

- **EMC Directive**
  - Applicable standard: EN60947-5-2, Class A
  - Remarks: These specifications do not give any guarantee that the end-product incorporated with this product complies with the essential requirements of the EMC Directive. The manufacturer of the end-product is solely responsible for confirming the compliance of the end-product itself according to the EMC Directive.

#### FCC Regulations

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

- **Applicable regulation** FCC Part 15 Subpart B ClassA
- **This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:** (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
1. Introduction (2)

1-4 Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>M18 Threaded Mount</td>
</tr>
<tr>
<td>Model</td>
<td>LR-ZH490CB*</td>
</tr>
<tr>
<td>Detectable distance</td>
<td>25 to 490 mm (465 to 0)*</td>
</tr>
<tr>
<td>Standard detection deviation</td>
<td>25 to 170 mm : 9 mm</td>
</tr>
<tr>
<td></td>
<td>170 to 290 mm : 25 mm</td>
</tr>
<tr>
<td></td>
<td>290 to 390 mm : 40 mm</td>
</tr>
<tr>
<td></td>
<td>390 to 490 mm : 50 mm</td>
</tr>
<tr>
<td>Display resolution</td>
<td>1 to 5 (1 to 5 mm)</td>
</tr>
<tr>
<td>Spot diameter</td>
<td>Approx. 43 mm</td>
</tr>
<tr>
<td>Response time</td>
<td>1.5 ms/10 ms/50 ms selectable</td>
</tr>
<tr>
<td>Light source</td>
<td>Red laser (660 nm)</td>
</tr>
<tr>
<td>Laser class</td>
<td>Class 2 laser product (IEC60825-1)</td>
</tr>
<tr>
<td>Function</td>
<td>Indicator</td>
</tr>
<tr>
<td></td>
<td>3-digit 7-segment display (white), output indicator (yellow), 1 spot indicator (green)</td>
</tr>
<tr>
<td>Timer</td>
<td>OFF/ON delay/Off delay/One-shot</td>
</tr>
<tr>
<td>Power voltage</td>
<td>10 to 30 VDC, including 10% ripple (P-P), Class 2 or LPS</td>
</tr>
<tr>
<td>Power consumption</td>
<td>450 mW or less</td>
</tr>
<tr>
<td></td>
<td>(18 mA or less at 24 V, 34 mA or less at 12 V)</td>
</tr>
<tr>
<td>Control output</td>
<td>NPN open collector/PNP open collector selectable,</td>
</tr>
<tr>
<td></td>
<td>Applied voltage 30 VDC or less, Control current 100 mA or less, Residual voltage 1.2 V or less at 10 mA or less, 2 V or less at 10 to 100 mA</td>
</tr>
<tr>
<td>Protection circuit</td>
<td>Protection against reverse power connection, output overcurrent, output surge, reverse output connection</td>
</tr>
<tr>
<td>Output operation</td>
<td>Light-ON/Dark-ON selectable</td>
</tr>
<tr>
<td>External input</td>
<td>Short-circuit current NPN: 1 mA or less/ PNP: 2 mA or less</td>
</tr>
<tr>
<td></td>
<td>For input time, refer to the time chart. (Instruction manual page 5)</td>
</tr>
<tr>
<td>Enclosure rating</td>
<td>IP68(IEC60529)/IP69K(DIN40050-9)/4X, 8P, 13(NEMA45)</td>
</tr>
<tr>
<td>Ambient light*</td>
<td>Incandescent lamp: 10,000 lx or less</td>
</tr>
<tr>
<td></td>
<td>Sunlight: 20,000 lx or less at 240 mm</td>
</tr>
<tr>
<td></td>
<td>Incandescent lamp: 2,000 lx or less</td>
</tr>
<tr>
<td></td>
<td>Sunlight: 4,000 lx or less at 460 mm</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>~10 to +50°C (no freezing)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>~25 to +75°C (no freezing)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>35 to 85%RH (no condensation)</td>
</tr>
<tr>
<td>Shock resistance</td>
<td>1,000 m/s² in X, Y, Z axis directions respectively 6 times</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>10 to 55 Hz Double amplitude 1.5 mm in the X, Y, Z axis directions respectively, 2 hours</td>
</tr>
<tr>
<td>Insulating resistance</td>
<td>20 Me or more (500 VDC)</td>
</tr>
<tr>
<td>Withstand voltage</td>
<td>1,000 VAC 50/60 Hz 1 min</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 75 g</td>
</tr>
</tbody>
</table>

*1 IO-Link specification v.1.1/COM2 (38.4 kbps) is supported. (Only when PNP output is selected.) 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.

*2 Display reading used as a guide for the detecting distance. When the setting value is tuned, the readout shifts. When the value exceeds “-99”, “-FF” is displayed.

*3 When the response time is 10 ms

1-5 Package contents

- Sensor
- A connector cap is supplied with connector sensors.
- FDA warning/certification/identification label
- Laser warning/explanation labels
- Instruction Manual
- Nut
- Toothed washer

2. Installation and Wiring

2-1 I/O Circuit Diagram

* When PNP output is selected

M12 connector (4-pin) type

Brown1 | 10 to 30 VDC
Black4 | 0 V
White2 | 0 V
Black4 | PLC etc. 0 V
Brak3 | M12 connector (4-pin) type

* When NPN output is selected

M12 connector (4-pin) type

Brown1 | 10 to 30 VDC
Black4 | 0 V
White2 | 0 V
Black4 | M12 connector (4-pin) type
Brak3 |

2-2 Wiring

1 : 10 to 30 V
2 : OUT (PNP)/IN (PNP)
3 : OUT (NPN)/IN (NPN) 4 : OUT (PNP)/IN (NPN)

M12 Connector tightening torque: 0.8 Nm

* Tighten the connector by a hand, and then retighten it by using tools and so on. Insufficient tightening will degrade water-resistant performance.

2-3 Installation

- If detection is unstable
  - When detecting transparent targets, move the sensor as close as possible to the workpiece, and move the workpiece as far away as possible from the background for increased stability.
  - Tilt the optical axis of the sensor as much as possible in reference to the background surface. (10° or more)

- For thin objects or transparent objects, use of “Universal Change Detection” is recommended. (See “Universal Change Detection” (page 3))

- If the sensor is affected by ambient light, install a light blocking plate, or change the installation location.

- For thin objects or transparent objects, use of “Universal Change Detection” is recommended. (See “Universal Change Detection” (page 3))

- If the sensor is affected by ambient light, install a light blocking plate, or change the installation location.
3. Settings (1)

3-1 Part names and functions

- **SET**: Calibration
  - UP
  - DOWN
  - L.D.D.ON
  - MODE

DTM: This lights up when datum calibration is performed.
1 spot: This turns off when no light is returned, multiple reflections occur, or if detection is not stable after initiating "Universal Change Detection".

- **Manual adjustment**

  1. Press briefly < 1s
  2. Press briefly < 1s

Completed

3s

Run Mode

Adjust sensitivity

3-2 Initial Settings (PNP/NPN Selection)

When the power is turned on for the first time after purchase, or initialization is performed, the initial setting (PNP/NPN selection) is required as shown below:

PNP

NPN

3-3 Output configuration (L.ON ↔ D.ON)

1. (Detection Status)

2. (Detection Status)

3. Operation

3-4 Sensitivity adjustment

When differentiating two distinct state (i.e. part present vs. absent)
(2-point calibration)

1. Press briefly < 1s

2. Press again < 1s

When the difference is too small

Completed

Setting value

Do-it-all detection for opaque targets
(Data calibration)

1. Press briefly < 1s

2. Press and hold > 3s

Released the button when [SET] flashes

* This function cannot be used when the background is not within the detecting area.

Completed

Setting value A

Setting value -A

When an object located closer than the background is to be detected
(Maximum sensitivity calibration, background suppression - BGS)

1. Press and hold > 3s

Released the button when [SET] flashes

Completed

Setting value

When detecting targets that are moving
(Full auto calibration)

1. Press and hold > 3s

Let the object to be detected pass by while holding down the button until [SET] flashes.

* This function cannot be used when the background is not within the detecting area.

Completed

Setting value

When detecting transparent targets, contrast changes, or opaque targets with the use of a background
(Universal Change Detection)

Press and hold the [SET] and [UP] buttons at the same time for 3 or more seconds.

Released the buttons when [SET] flashes

* This function cannot be used when the background is not within the detecting area.

** The default setting value is 90.

Completed

Universal Change Detection

"Universal Change Detection" works by storing the light receiving pattern (distance and returned light intensity) associated with a set background or reference surface. From here, the sensor is able to detect any variations from the calibrated light receiving pattern (position changes and/or intensity changes). To ensure the sensor properly detects changes in position or returned light intensity, the "DSC function" is turned ON to ignore gradual changes in the background due to buildup or vibration. The "DSC function" can be turned OFF, or the correction time can be changed. (For details, see 4-3 "DSC function" (page 5))

When using "Universal Change Detection", the display represents the degree of conformity with the calibrated light receiving pattern of the background. The display value when fixed on the set background is "100". This value decreases as the degree of conformity with the background decreases. (When detection appears to be unstable, refer to "If detection is unstable" (page 2))
3. Settings (2)

3-5 Useful functions

- **Key lock**
  
  - **Lock**
  
  - **Unlock**
  
  - **Settings (2)**

- **Initialization (return sensor to factory default settings)**
  
  - **Do not initialize**
  
  - **Initialize**
  
  - **Response time**
  
  - **Delay timer**
  
  - **Amount of time for timer**
  
  - **External input**

4. Advanced Settings (1)

- **Response time**
  
  - **Page 5  4-1**

- **Delay timer**
  
  - **Page 5  4-2**

- **Amount of time for timer**
  
  - **Page 5  4-3**

- **External input**
  
  - **Page 5  4-4**

- **Hold function**
  
  - **Page 5  4-5**

- **Shift function**
  
  - **Page 5  4-6**

- **Display**
  
  - **Page 5  4-7**

---

*1 Enabled only when "Universal Change Detection" is performed.
*2 Disabled when "Universal Change Detection" is performed.
*3 Utilized when "Datum calibration" is performed, regardless of setting.
*4 Cannot be set when "Universal Change Detection" is performed.
4. Advanced Settings (2)

4-1 Response time (SPd)

The longer the response time, the more reliable and stable the detection. When detection is unstable due to the workpieces moving at a high speed, set the response time to a smaller value.

4-2 External input (\( \nu \))

Turning the external input wire ON will enable one of the following functions to be performed.

- **Tuning (SET)**
  - This performs the same function as the [SET] button.
  - ON: 
    - >35 ms
  - OFF: 
    - >35 ms

  * “Universal Change Detection” cannot be performed.

- **Transmission OFF (LoF)**
  - This turns off the laser diode.
  - ON: 
    - <2 ms
  - OFF: 
    - <20 ms

- **Adjust (AdF)**
  - Enabled only when “Universal Change Detection” is performed.
  - When enabled, this function will recalibrate the background. There is no limit to the number of times this feature can be used. The setting is reset when power is cycled.
  - ON: 
    - <35 ms
  - OFF: 
    - 100 ms
  - Output OFF: 
    - Output at the new reference surface

  * 250 ms when the response time is 50 ms

4-3 DSC function (dSC)

Enabled only when “Universal Change Detection” is performed. The DSC function works by compensating for gradual changes in the received light pattern of the background, caused by vibration or buildup, and maintains the display value at "i100". This allows the sensor to only sense instantaneous changes in position or returned light intensity when a target is present. The correction time can be changed in the settings.

- 0.25 seconds (0.25): Correct approx. every 0.25 seconds.
- 1 second (1): (Default): Corrects approx. every second.
- 3 minutes (3): Corrects approx. every 3 minutes.
- OFF (OFF): Sets the DSC function to OFF.

(Note)
When the speed of an object is very slow, the correction function may be affected by the object, and detection may not be correctly performed.
In this case, slow down the correction time, or set this function to OFF.

4-4 Hold function (HLd)

Display values can be held. The hold value is updated each time the detected value exceeds the setting value.

- **Setting procedure**
  1. Set the hold function (page 4).
  2. Switch the display screen.

4-5 Shift function (SFe)

Can be used for calibrations other than “Universal Change Detection”. Turning the shift function ON will shift the display when calibrating. In Datum calibration, the display value is shifted regardless of this function setting.

(Example of a 2-point calibration)

4-6 Clamp function (cLP)

Can be used for calibrations other than “Universal Change Detection”. Turning the clamp function ON will maintain the previous display value and output status when light is not received by the unit.

* It is invalid when datum calibration is performed or transmission is turned off.
5. Troubleshooting

5-1 Notes when using “Universal Change Detection”

- If the [1s/0] indicator is off after calibration, detection is unstable. The possible causes are shown below. Check the installation condition, and perform calibration again.
  - The distance between the sensor and the background has changed by 5% or more from the calibrated distance.
  - An insufficient amount of light has been reflected from the background.
- If the response time is changed after calibration, perform calibration again.

5-2 Error display

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Checks and Remedies</th>
<th>Control Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-C</td>
<td>Current of 100 mA or more flows through the control output</td>
<td>- Check power resistance. - Check the control output cable for contact with other cables.</td>
<td>OFF</td>
</tr>
<tr>
<td>E-s</td>
<td>System error</td>
<td>Contact the nearest sales office.</td>
<td>OFF</td>
</tr>
<tr>
<td>E-f</td>
<td>Laser diode failure</td>
<td>Normal</td>
<td>INCONSISTENT</td>
</tr>
<tr>
<td>E-E</td>
<td>Error in the EEPROM that stores sensor settings</td>
<td>Normal</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>uw</td>
<td>Excessive reflected light</td>
<td>Adjust the installation angle of the sensor.</td>
<td>Normal</td>
</tr>
</tbody>
</table>

- Insufficient reflected light
  - Verify that the detecting distance is within specifications.
  - Adjust the installation angle of the sensor. | FAR |
- detected object is too far from the display range
  - Move the target closer. | Normal |
- “Universal Change Detection” mode is being utilized.
  - Turn OFF the shift function. | Normal |
- The key lock function is enabled
  - Release the key lock function by pressing UP and DOWN at the same time (> 3s). | Normal |
- The peak value is displayed
  - Press UP and DOWN at the same time to switch screens. | Normal |
- The bottom value is displayed
  - Press UP and DOWN at the same time to switch screens. | Normal |
- No display or indicators
  - Check the power voltage and power capacity. Check the sensor power cable. | Normal |

* The settings can be rewritten up to 1 million times.

5-3 Default Settings/Values List

<table>
<thead>
<tr>
<th>Item</th>
<th>Default</th>
<th>Item</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>50 ms</td>
<td>Hold function</td>
<td>OFF</td>
</tr>
<tr>
<td>Delay timer</td>
<td>OFF</td>
<td>Shift function</td>
<td>ON</td>
</tr>
<tr>
<td>Amount of time for timer</td>
<td>10 ms</td>
<td>Clamp function</td>
<td>OFF</td>
</tr>
<tr>
<td>External input</td>
<td>OFF</td>
<td>Display</td>
<td>ON</td>
</tr>
<tr>
<td>OSC function</td>
<td>1 sec</td>
<td>Setting value</td>
<td>LR-ZH490*: 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>During &quot;Universal Change Detection&quot;: 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output operation</td>
<td>LOW</td>
</tr>
</tbody>
</table>

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E 101-3