2D Lidar

Scanning Laser Range Finder
URM-40LC-EWT

CE
RoHS

1. General
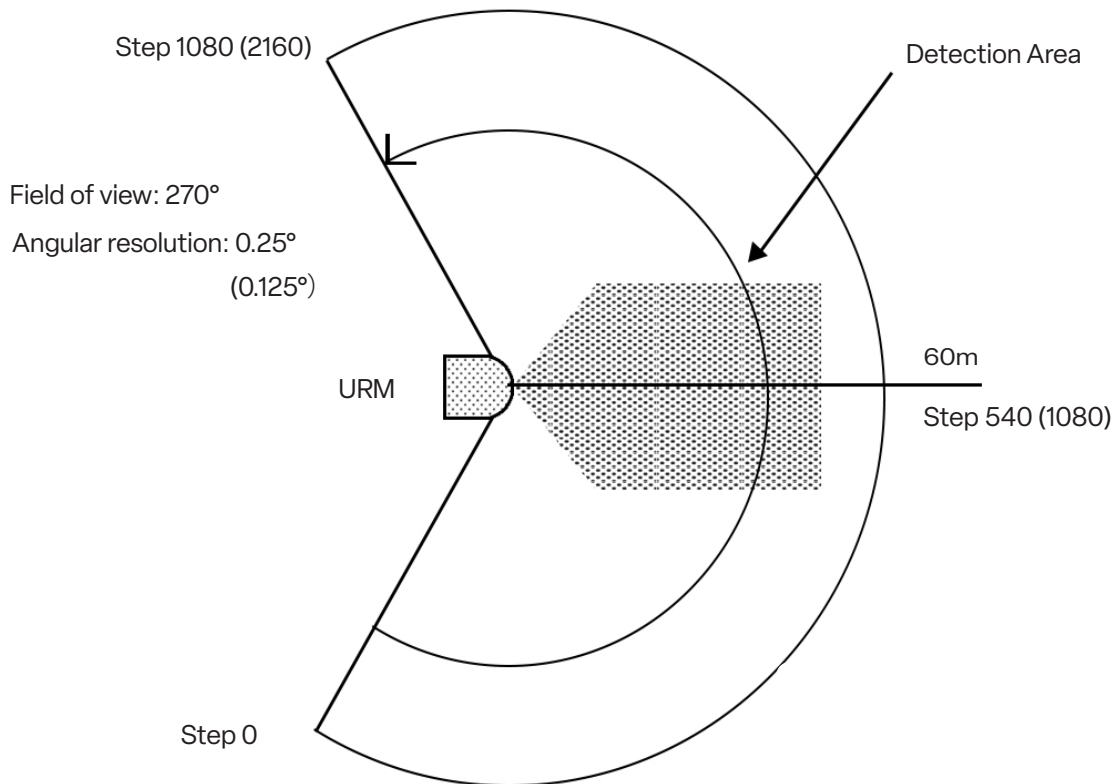
Operation principle

URM-40LC-EWT is a sensor which scans a semicircular field using a laser beam (λ= 905 nm), then calculates coordinates by measuring the distance to an object and its corresponding step angle (LXmode) and detects obstacles within the setting area (LA mode).
• Only LX mode supports the multi echo data output. In LA mode, selected single echo output data is available.
• The desired mode (LX or LA) can be selected in the configuration application.
• This product is Class 1 laser product.
• It is possible to reduce the influence of interference between multiple units of this sensor using the synchronized rotation of the motor. This function synchronizes the motor rotation to an external reference signal.
• The "detached area setting" allows to configure the area which is away from the sensor.
• There are modes 1 and 2 in LA mode. Use mode 2 when using the motor synchronization function. However, the number of areas that can be set and the number of detection outputs decrease.

2. Configuration (Laser scanning image)

Values between brackets are relative to high resolution mode

Step 1080 (2160)

Detection Area

Field of view: 270°
Angular resolution: 0.25°
(0.125°)

60m

URM

Step 540 (1080)

Step 0

HOKUYO USA

3. Product Specs

Light Source	Laser semi-conductor (905nm), Laser Safety Class 1 (IEC60825-1:2007 and IEC60825-1:2014)
Supply voltage	DC10V to 30V
Supply current*3	Continuous current : 700mA or less (when using DC12V) Peak current: 1.3 A (typ.) (when using DC12V)
Power consumption	8.4W or less (During steady current)
Detection range and object	0.1m to 40m*1 (White Kent sheet Reflectance 90% 500mm×500mm) 0.1m to 18m*1 (Black paper Reflectance 10% 500mm×500mm) Maximum detection distance: 60m Minimum detectable size Normal mode: 65mm (5m) , 130mm (10m), 260mm (20m) High Resolution mode: 33mm (5m) , 65mm (10m), 130mm (20m)
Average Accuracy by distance	White Kent sheet Reflectance 90% 0.1m to 30m: ±20mm*1 30m to 40m: ±30mm*1
Measurement resolution	1mm
Repeat accuracy	White Kent sheet Reflectance 90% 0.lm to 20m: o < 10mm*1, 20m to 40 :o < 15 mm *1
Scanning angle	270°
Angular resolution/ Scan speed	0.25°/ 25ms (Normal mode) 0.125°/ 50ms (High resolution mode)
Interface	Ethernet 100BASE-TX (Auto-negotiation)
Outputs	5 OUTPUTS: Area Detection 1 / Synchronization output, Area Detection 2, Area Detection 3/ Synchronization master, Ready, Malfunction
Inputs	3 INPUTS: Area 1, Area 2, Area 3 / Synchronization input, (Maximum area pattern : 7 patterns)
Response time	Within 50ms (However, it differs depending upon the settings)
Start up time	Within 15 sec (start up time differs if malfunction is detected during start up)
LED display	Blue LED : Power supply and normal operation Orange LED : Area determination (About LED display refer to section 6.3)
Ambient temperature and humidity	-30℃ to +50℃, below 85%RH (Without dew, frost)
Storage temperature and humidity	-30℃ to +70℃, below 85%RH (Without dew, frost)
Ambient illuminance	100,000lx*2
Vibration resistance	10 to 55Hz double amplitude of 1.5mm for 2hrs in each X, Y, and Z direction 55 to 150Hz 98m/s2 (10G) sweep of 2min for 1hr in each X,Y and Z direction
Shock resistance	196m /s2 (20G) X,Y and Z directions each 10 times
EMC standards	(EMI) EN61326-1:2013 EN55011:2009 + A1:2010 (EMS) EN61326-1:2013 EN61000-4-2:2009 EN61000-4-3:2006 + A1:2008 + A2:2010 EN61000-4-4:2012 EN61000-4-6:2009 EN61000-4-8:2010
Protective structure	IP67 (IEC 60529: 2001)
Insulation resistance	10MΩ
Weight	Approx. 450g (Sensor only)
Case material	Optical window : Polycarbonate Body : Aluminum
Dimensions (W×D×H)	80 mm × 80 mm × 95mm (Without connector) External dimension：MC – 40 – 03392

Notes
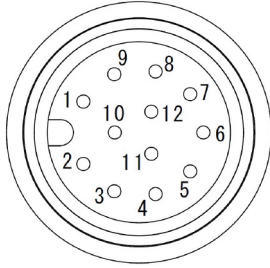   *1 Indoor environment (fluorescent lamp, 1,000 lux or less)
   *2 Detection cannot be guaranteed when direct light (such as sunlight) enters the device.
   *3 Please use a power supply with enough current capacity.
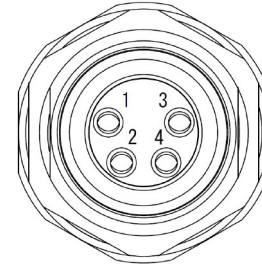
4. Connection

4.1 Connector pin assignment
4.1.1 Power supply Input / Output connector

M12 Waterproof connector (12 core)
Maker：PHOENIX CONTACT
Type：1441707

PIN No.	Function
1	＋VIN（DC10V to 30V）
2	－VIN（0V）
3	＋COM
4	Area input 1
5	Area input 2
6	Area input 3/Synchronization master input
7	－COM
8	Detection output1 / Synchronization output
9	Detection output2
10	Detection output3 / Synchronization master output
11	Ready output
12	Malfunction output

4.1.2 Ethernet Connector

M8 Waterproof connector（4 core）
Maker：PHOENIX CONTACT
Type：1456093

PIN No.	Function
1	TX+
2	RX+
3	RX－
4	TX-

4.2 Connection cable specification (Sold separately)
4.2.1 Power cable
Type：URM-C005（5m）

PIN No.	Function	Color
1	＋VIN（DC10V to 30V）	Brown
2	－VIN（0V）	Blue
3	＋COM	White
4	Area input 1	Green
5	Area input 2	Pink
6	Area input 3/Synchronization master input	Yellow
7	－COM	Black
8	Detection output1 / Synchronization output	Gray
9	Detection output2	Red
10	Detection output3 / Synchronization master output	Purple
11	Ready output	Gray/Pink
12	Malfunction output	Red/Blue

4.2.2 Ethernet cable (Sold separately)
Type：URM-ENET003（3m）/URM-ENET005（5m）

M8 Connector		
PIN No.	Function	Color
1	TX+	Yellow
2	RX+	White
3	RX—	Blue
4	TX-	Orange

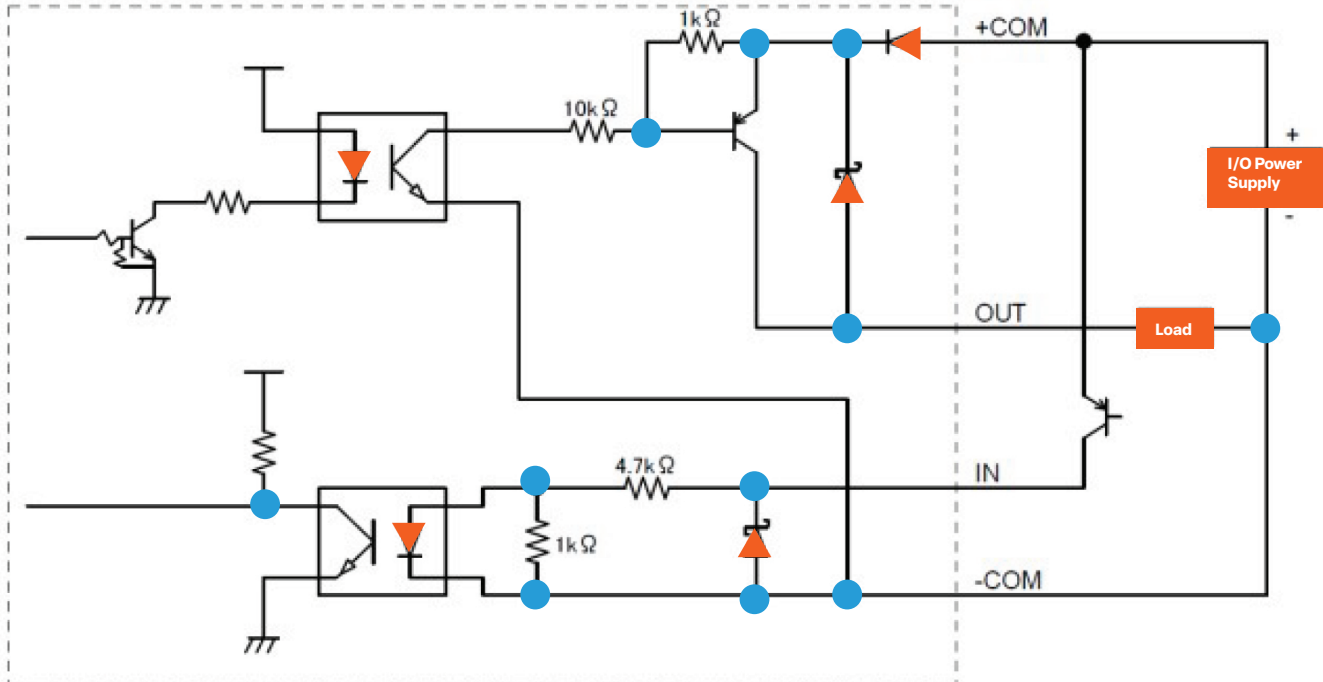| RJ45		
PIN No.	Function	Color
1	TX+	Yellow
2	TX-	Orange
3	RX+	White
4	RX-	Blue

4.3 Input/output circuit
Input: Photocoupler input (Common Cathode, 2mA during each input ON, 0.5 mA or below during OFF)
Output: PNP Open collector output

Item	Specification
Maximum output current	50mA
Maximum voltage	30V

Example of connecting the input/output circuit

5. Control signal

5.1 Malfunction output

(1) Laser malfunction: When laser emission is not possible or laser power exceeds the safety class 1.

(2) Motor malfunction: When motor rotation is unstable.

When a malfunction occurs, output is switched to OFF, laser emission and motor rotation are stopped. Check the error code via Ethernet. Refer to troubleshooting table in section 6 for error details.

5.2 Ready Output

During normal operation, this output is ON. It is switched OFF in the following conditions:
· During unstable motor rotation.
· Contamination is detected (When contamination detection function is enabled)
· During malfunction

5.3 Synchronization output

Sensor outputs a 1ms pulse in the beginning of every scan which is synchronized with the scanning. The timing of the synchronization signal is shown in the figure below.
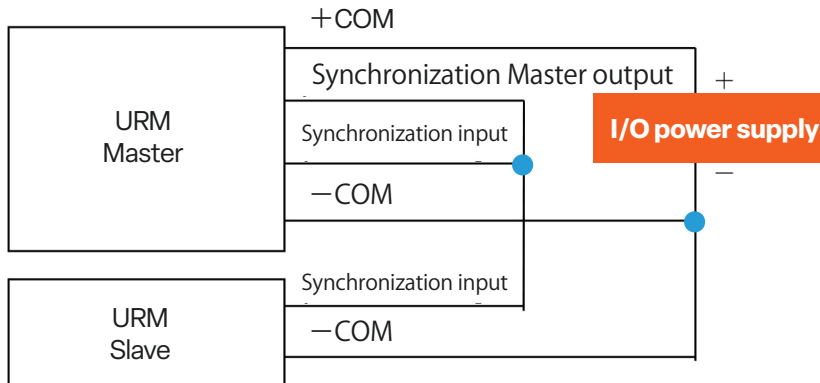

During malfunction, synchronization output is ON.
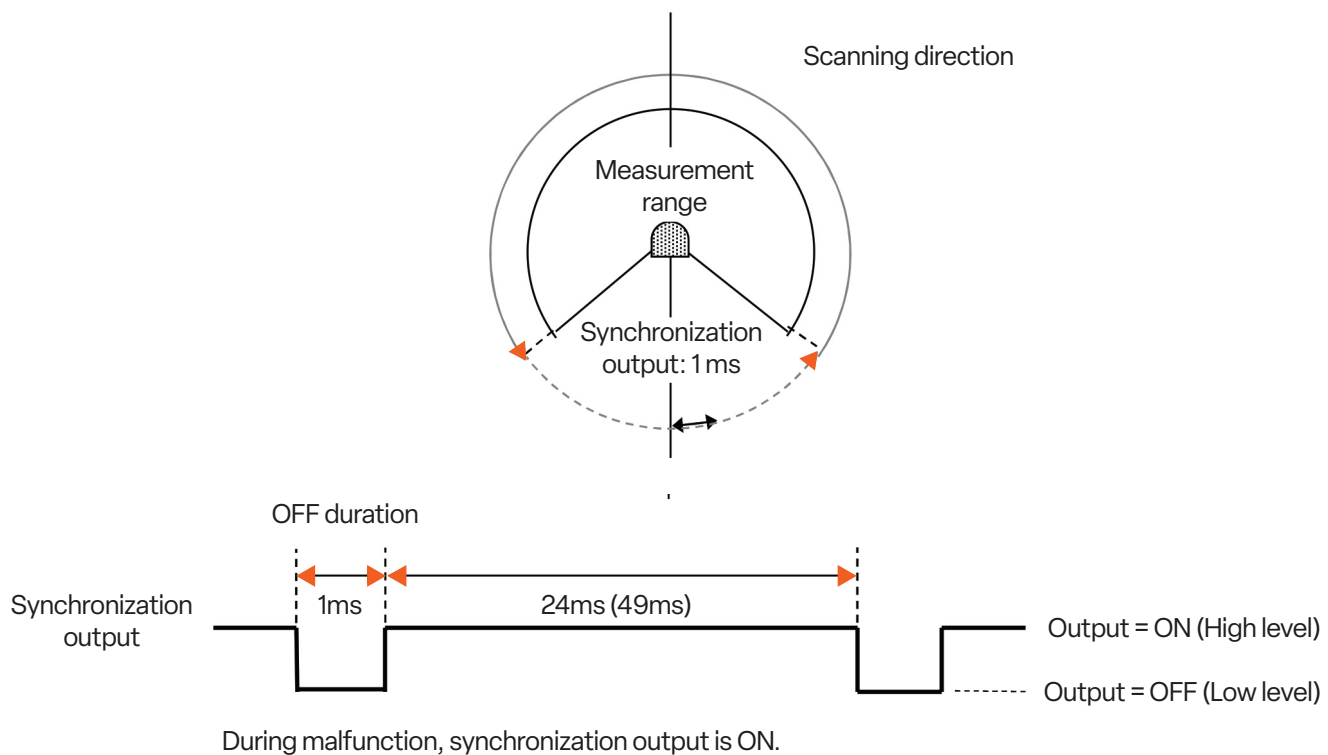
5.4 Synchronization master output

It is a reference clock signal for synchronizing the motor rotation.
Output starts immediately after power supply to the sensor and continues even in the malfunction state.

5.5 Synchronization input

It is a reference clock signal received from the master sensor for synchronizing the motor rotation.
Motor rotation of the slave sensor is controlled to synchronize with the master sensor. Synchronization is performed with the falling edge of the clock signal.

5.6 Example of wiring between sensors for motor rotation synchronization


```
                    +COM
              Synchronization Master output      +
  URM
  Master      Synchronization input       I/O power supply
              —COM                              −

              Synchronization input
  URM
  Slave       —COM
```

Synchronization output of the master sensor is connected to the synchronization input of the master itself and to the synchronization input of all slave sensors.

Motor rotation of each slave is shifted by a phase defined during the sensor setting.

Configuration of the phases is performed using the configuration application.
   Note: This function is available in LA mode 2.

5.7 Area input and selection area set

Setting of three regions is possible in one area set, and respectively corresponds to output 1, output 2, and output 3. Selection of the area number is performed using area inputs, IN 1 to 3.
However, when all of the area inputs (IN 1 to 3) are ON, the sensor will switch to emission stop mode.

Input response time: Time for 2 scans

Area Set	LA mode 1			LA mode 2	
	Area Input 1	Area Input 2	Area Input 3	Area Input 1	Area Input 2
Stop emission	ON	ON	ON	ON	ON
Area 1	OFF	ON	ON	OFF	ON
Area 2	ON	OFF	ON	ON	OFF
Area 3	OFF	OFF	ON	OFF	OFF
Area 4	ON	ON	OFF	-	-
Area 5	OFF	ON	OFF	-	-
Area 6	ON	OFF	OFF	-	-
Area 7	OFF	OFF	OFF	-	-

Note: When using the synchronization master function in LA mode 2, the maximum area number will be 3.

5.8 Example of Detection output

Example of area configuration is as follows.
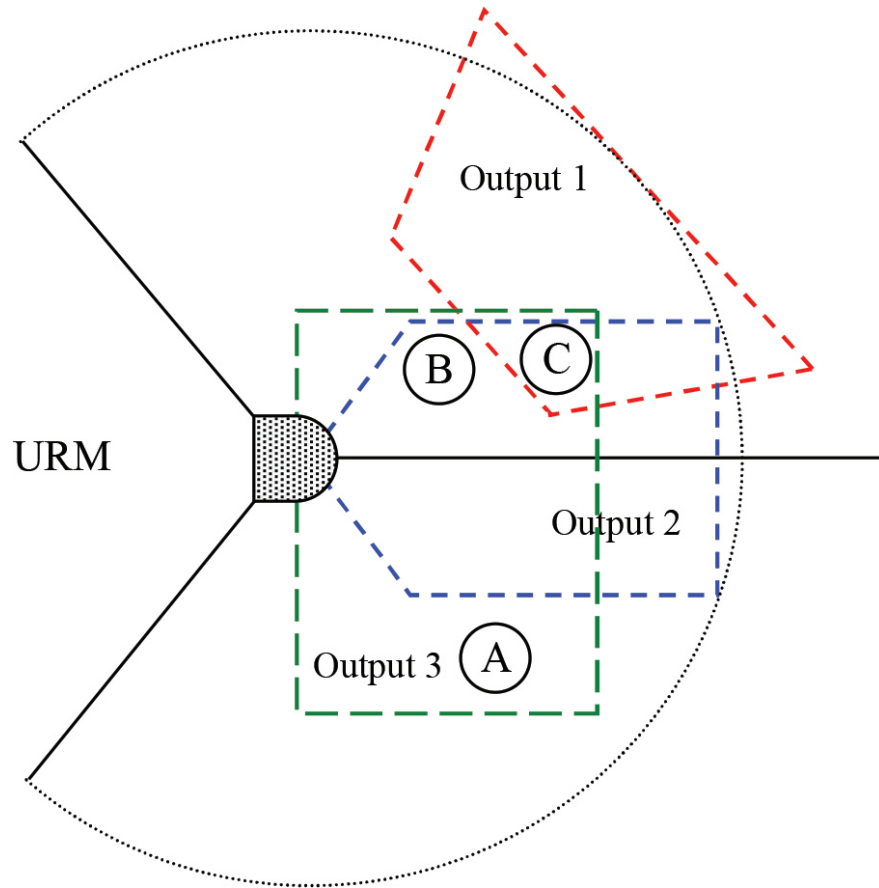
The state of the outputs when the object is present at the positions A, B, C of the sample area is shown in the table below.

Position of object to be detected	Detection Output 1	Detection Output 2	Detection Output 3
A	Non-detection	Non-detection	Detection
B	Non-detection	Detection	Detection
C	Detection	Detection	Detection

Note: If area set without area configured is selected, the detection output will be in detection state. When using synchronization master function, the detection output will be only 1 and 2. (LA mode 2)

6. Troubleshooting

6.1 Error code table

Malfunction error can be obtained from STAT line of the II Command response in SCIP communication protocol. The error codes that can be obtained from the STAT line are as follows.

ID	Message	Meaning
000	no error.	Normal operation
051	system setup failed.	Sensor processing system error
052	internal chip access failed	Same as above
100		
200	encoder error.	Encoder error
201		
250	motor startup failed.	Motor error
251	motor rotation error.	Unstable motor rotation
300	laser too high.	Laser error
301	laser too low.	Same as above
302	laser no echo.	Same as above

6.2 About distance values

The meaning of the distance value x of each step measured in SCIP communication is as follows.

Range of Distance Value	Meaning	
$35 \le x \le 60{,}000$	Distance	Measured distance (mm)
x = 262,140 (3FFFC)	No echo	No object is detected or the level is below a threshold value. (Level value will be 0)
x = 262,142 (3FFFE)	Short distance error	When distance to object is 34 mm or below (LX mode) Within the limited detection capacity zone (LA mode)
x = 262,143 (3FFFF)	Long distance error	When detected object is 60,001 mm or above

Note: In the data table of Area Designer, the value displayed will differ when there is no echo or error. For detail please refer to user's manual.

6.3 Relation table between LED display and output signals

Sensor State	Power supply and operation LED display (Blue)	Output LED display (orange)	Synchronization master output	Synchronization output	Ready output	Malfunction output	Detection output
During start up	Blink	ON	After power supply always output ON	Tr = ON (Hi)	Tr = OFF (Low)	Tr = ON (Hi)	Tr = OFF (Low)
During operation	ON	Detection ON No detection OFF		1ms per cycle Tr = OFF (Low)	Tr = ON (Hi)	Tr = ON (Hi)	Tr = OFF (Low) Tr = ON (Hi)
Malfunction	Blink (Interval of 1sec)	ON		Tr = ON (Hi)	Tr = OFF (Low)	Tr = OFF (Low)	Tr = OFF (Low)
Sleep	Blink (Interval of 4sec)	OFF		Tr = ON (Hi)	Tr = OFF (Low)	Tr = ON (Hi)	Tr = OFF (Low)
Initialization of IP	ON	ON		Tr = ON (Hi)	Tr = OFF (Low)	Tr = ON (Hi)	Tr = OFF (Low)

*Orange LED is always OFF during LX mode.

*Immediately after power supply ON, output will be in unstable state.

*It is only possible to inverse detection output with application software.

(Default: During detection Tr = OFF (Low))

7. Multi-echo function

This sensor provides a maximum of three echoes (1st, 2nd, last) for each step (one direction). It also provides distance value and level value for each step. (For LX mode only) Multiple echoes are generated when the laser beam is split by reflection on surface of transparent objects, reflection on object's edge and reflection from small particles such as rain, mist, dust and fog. Thus, distance and level value obtained from the multiple reflections in the same direction is called multi echo. However, if the distance between two object is too close or the object has low reflectance, the sensor may not detect it as multi echo.

8. Optical window contamination warning function

When this function is enabled using the configuration application, and the optical window is contaminated above a certain level, Ready output will be switched to OFF (Low). The sensor will continue to operate and there will be no malfunction stop.

Contamination detection can be set in the following two modes:

8.1 Contamination detection (Partial)

Within the specified angle (configurable by the user), the optical window contamination is detected using the internal contamination detection sensors and short distance measurements.

8.2 Contamination detection (All)

The contamination of the entire optical window is detected using the internal contamination sensors.

9. Ethernet setting

10.1 Default value

IP default value: 192.168.0.10
Port number: 10940

10.2 About changing IP address

It is possible to reset or change IP address using a dedicated application (IP Discovery). For more details, please refer to the user's manual.

10. Disclaimer

- This sensor is not certified for functional safety.
- This sensor cannot be used for human body detection as per the machinery directives.
- Sensor emits laser for measurement. Sensor's operation may become unstable under the influence of strong interference light or when emitted lights are not reflected back from the object.
- Sensor's operation may become unstable due to rain, snow and fog or due to dust pollution on the optical window.
- Rules and regulations related to safety should be strictly followed when operating the sensor.
- When there is a risk that this sensor is used for mass-destruction weapons, weapons and equipment aimed at killing human beings, and relevant technologies, etc., or when its usage for those purposes has become clear, sales may be prohibited in accordance with the Foreign Exchange and Foreign Trade Act, and the Export Trade Control Order (Japanese law). Moreover, regarding export of products, the formalities according to laws/Export Trade Control Order are implemented in order to maintain international peace and safety.
- Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Before using the sensor, please read this specification and user's manual thoroughly.

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