HOKUYO AUTOMATIC CO.,LTD. (logo)

3D LiDAR
YLM-X001

SPECIFICATIONS

Symbol	Amended Reason			Pages	Date	Corrector	Amendment No.

Approved by	Checked by	Drawn by	Designed by	Title	YLM-X001 Specifications	
HINO	HIGASHI	TAKEGAWA	TAKEGAWA	Drawing No.	C-42-04544	1/9

1. Overview
   This is a jointly developed 3D LiDAR with Lumotive, Inc. This LiDAR allows 3D environmental recognition with Light Control Metasurface (hereinafter referred to as "LCM"), Lumotive's unique technology that can change the direction of light without any mechanical components.
   LCM enables discrete steering and non-sequential scanning order, and arbitrary dwell time per pixel and frame rate can be defined by software.

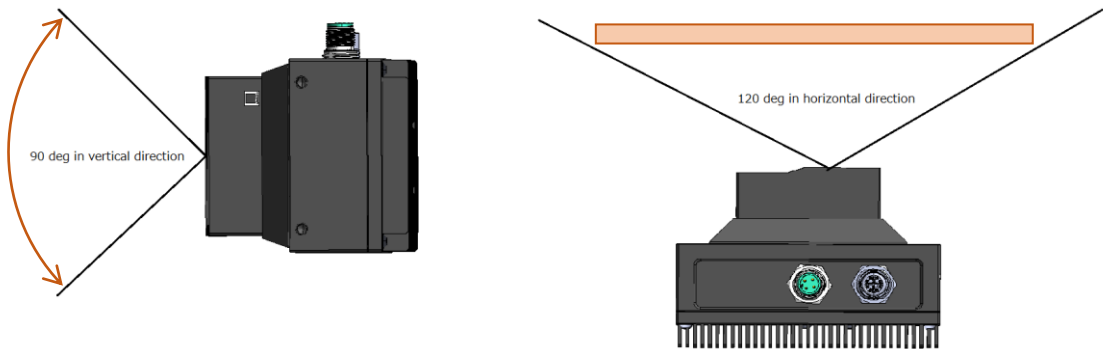Scanning image with LCM technology
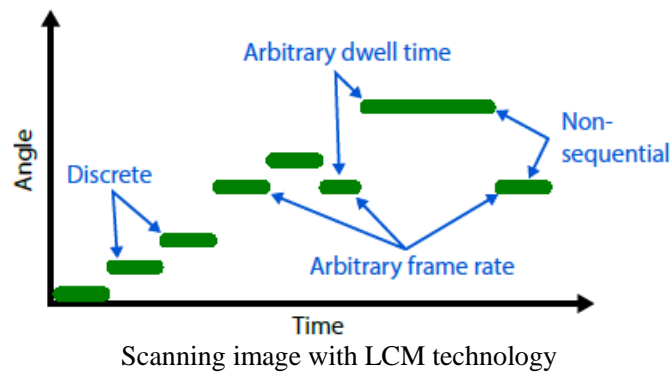
This model is a prototype in a limited quantity so that size will be different from the mass production product.

2. Composition
   2.1 Product image

   2.2 Scanning image

| Title | YLM-X001 Specifications | Drawing No | C-42-04544 | 2/9 |

2.3 Method
This is a non-coaxial LiDAR using different optical components between light-projection and light-reception. An array from VCSEL laser is vertically steered, then horizontally spread to 120 degrees by 1D diffuser. Reflected light is received by 2D ToF Image sensor and finally 3D point-cloud data can be obtained.

2.4 Basic component of LiDAR

Light projection	VCSEL Laser (λ= 905nm)
Beam-steering	LCM
Light-reception	ToF Image sensor

3. Disclaimer
・This sensor is not certified for the 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 light interference 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 by the user when operating the sensor.
・When there is a risk that this sensor is intended for use in mass-destruction weapons, weapons and equipment aimed at killing human beings, and relevant technologies, or when uses for such purposes are 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 here in may result in hazardous radiation exposure.
・Before using the sensor, make sure to read this specification thoroughly.

4. Specifications

Product name	3D LiDAR	
Model No.	YLM-X001 (Prototype)	
Supply voltage	24VDC -30%/+20%	
Current consumption	25W or less,　DC24V: 1A	
Detection range	0.5m~7m (for reflectance 10%, under 100,000lx)	
Field of view (FOV)	120°(H)×90°(V) The vertical FOV can be dynamically changed by software	
Precision	σ<0.7%	
Framerate	2~60Hz (Framerate changes depending on vertical FOV and other parameters) Ex. QVGA, vertical FOV 90°: 10Hz (default)/60°:15Hz/20°:43.5Hz	
Discrete line scanning speed	910 lines/sec	
Number of point cloud data per sec	577,220 points/sec (default: QVGA, vertical FOV 90°×10Hz)	
Angular resolution	QVGA: 0.375° VGA: 0.188° (same in both horizontal and vertical direction)	
Interface	Ethernet (1000BASE-T)	
Size	119(W)×85(D)×79(H)mm (Prototype)	
Weight	1kg	
Light source	VCSEL Laser (λ= 905nm)	
Ambient temperature	-30℃~+50℃, below 85%RH (without dew, frost)	
Storage temperature	-30℃~+70℃, below 85%RH (without dew, frost)	
Vibration resistance	10~55Hz Double amplitude 1.5mmp-p each 2hours 55~200Hz 98m/s^2(10G) Sweep 2min each 1hour in X, Y and Z directions	
Shock resistance	196m/s^2 (20G) each 10 times in X, Y and Z directions	
Protective structure	IP64	
Laser safety class	Class 1 (compliant with IEC-60825-1)	

*Important notice: The specification is subject to change as this model is developed as a prototype which is intended to designed for the product evaluation and software development purpose.
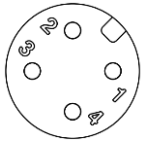
Title	YLM-X001 Specifications	Drawing No	C-42-04544	4/9

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5. Connection
5.1 Connector-pin assignment
5.1.1 Power connector
Model No.: Amphenol M12A-04PMMS-SF8001 (M12, male, A-code)

PIN number	Function
1	+VIN +24VDC
2	Unused
3	-VIN 0VDC
4	Unused

5.1.2 Ethernet connector
Model No.: Amphenol MSXS-08PFFP-SF7001 (M12, female, X-code)
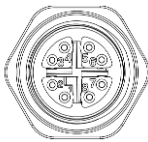
PIN number	Function
1	TX_D1+
2	TX_D1-
3	RX_D2+
4	RX_D2-
5	BI_D4+
6	BI_D4-
7	BI_D3-
8	BI_D3+

Title	YLM-X001 Specifications	Drawing No	C-42-04544	5/9

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5.2 Connection cable specification (sold separately)

5.2.1 Power cable

Model No.: Phoenix Contact SAC-4P-3,0-PUR/M12FS SH 3m (1682854)

Sensor side: M12, female, A-code, straight connector / Power side: discrete wire

PIN number	Function	Wire color
1	+VIN +24VDC	Brown
2	Unused	White
3	-VIN 0VDC	Blue
4	Unused	Black

5.2.2 Ethernet connector

Model No.: Phoenix Contact NBC-M12MSX/2,0-94F/R4AC 2m (1407472)

Sensor side: M12, male, X-code, straight connector / Host side: RJ45

M12 connector				RJ45		
PIN number	Function	Wire color		Wire color	Function	PIN number
1	TX_D1+	White/Orange		White/Orange	TX_D1+	1
2	TX_D1-	Orange		Orange	TX_D1-	2
3	RX_D2+	White/Green		White/Green	RX_D2+	3
4	RX_D2-	Green		Blue	BI_D3+	4
5	BI_D4+	White/Brown		White/Blue	BI_D3-	5
6	BI_D4-	Brown		Green	RX_D2-	6
7	BI_D3-	White/Blue		White/Brown	BI_D4+	7
8	BI_D3+	Blue		Brown	BI_D4-	8

Title	YLM-X001 Specifications	Drawing No	C-42-04544	6/9

6. Web UI (User Interface)
   The sensor is equipped with Web UI that allows basic operations such as setting FOV, starting and stopping scanning, etc., on the PC screen in a simplified manner. Please refer to the separately issued Web UI instruction manual for the operation method, settable items, etc.

Web UI screen sample

7. Resolution
   The default resolution of this sensor is set to QVGA (320×240 pixels (76,800)). This sensor can also be set to VGA (640×480 pixels (307,200)) by changing with software. However, the higher the resolution, the lower the frame rate due to a trade-off with other specifications such as frame rate.

8. FOV
   This sensor can be configured with up to 8 vertical FOVs via the API (3 vertical FOVs can be configured in the Web UI). The horizontal FOV is fixed at 120 degrees, but the vertical FOV can be detected up to 90 degrees by software. As with resolution, FOV is a trade-off with other specifications, so increasing the viewing angle will result in a lower frame rate.

| Title	YLM-X001 Specifications	Drawing No	C-42-04544	7/9

In conventional mechanical scanning, the scanning angle changes monotonically over time for a fixed range. In contrast, digital scanning with LCM allows random scanning of an arbitrarily set range. This scanning enables to acquire data with flexibility since it is possible to detect only a specific range in higher resolution.

Mechanical scanning
(Motor, polygon, MEMS etc)

Digital scanning
(LCM)
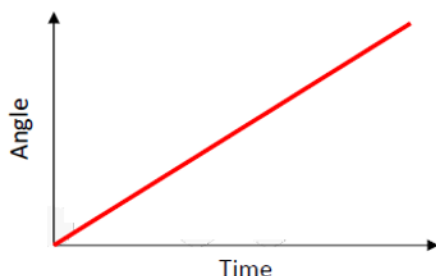
- Continuous (analog) steering
- Sequential angle order
- Fixed dwell time per pixel
- Requires calibration and feedback
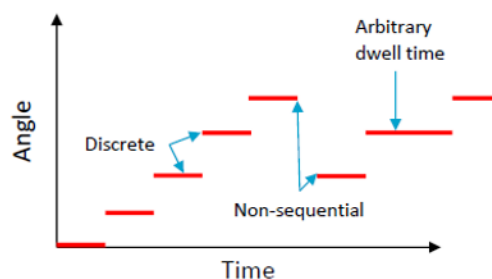
- Discrete (digital) steering
- Non-sequential, software-defined order
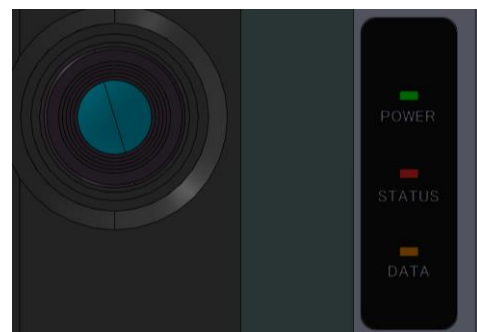- Arbitrary, software-defined, dwell time per pixel
- No calibration and feedback

9. Indicator
   Power: Green
   Status/Error(blinking): Red
   Data: Orange
   （＊Status LED has not supported yet.）

10. Ethernet setting
    IP address: 192.168.0.10
    Base port number: 10940 (10940~10947: assigned to each vertical FOV setting)

11. Cautions
    The sensor generates heat due to high processing rate.
    The generated heat is concentrated at the back side of the sensor. Please mount heatsinks or any appropriate component to release the generated heat.

Title	YLM-X001 Specifications	Drawing No	C-42-04544	8/9

12. Laser safety

The laser safety standard is class 1.

About Laser Safety Standard Class 1: under normal operation conditions (operations which can be foreseen rationally) it is guaranteed as safety class laser. Additional measures are not necessary to maintain laser safety.

【Note】

The built-in laser has a high luminous power output. Laser output power is adjusted at the time of production and shipment, and the laser is controlled to ensure safe output during operation. Controls and adjustments done outside of the specified procedures may result in exposure to hazardous laser radiation. To avoid accidental exposure to laser radiation, do not disassemble or modify the product.

The laser safety class 1 is not directly harmful to human body, but please do not look directly into the laser beam as much as possible.