

Deptrum® Nebula 410

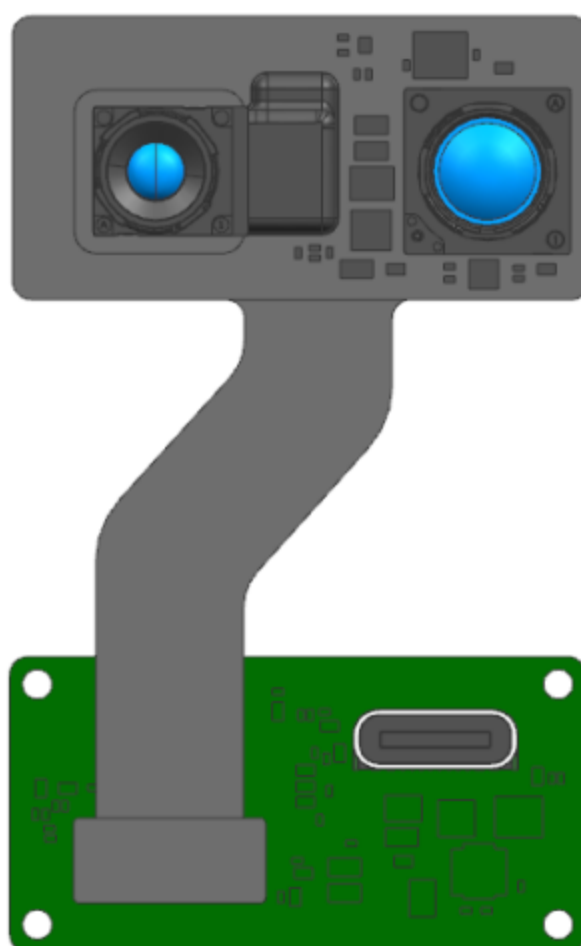
Product Specification

V1.3 - 2026/09/30

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1 Revision History

Version	Description	Date	Reviser
V1.3	Official release	2026/09/30	Hu Tao



Product Rendering (USB module, incl. FPC cable and PCBA)

2 Product Overview

Product Introduction Deptrum® Nebula 410 series depth cameras use modulated ToF fusion technology to capture the 3D structure of objects and spaces, providing users with wide-range, high-precision depth sensing. The Nebula 410 USB camera is built on Deptrum's self-developed WFP photonic chip that modulates the projected light field, combined with the proprietary sToF and mToF algorithms that fuse structured light and ToF, effectively solving the multipath interference problem of conventional ToF and significantly improving depth accuracy.¹² System Requirements Supports Windows / Linux / Android; maximum computing requirement < 1 × A53 (MODE2).	Product Features • A single module covers both short-range obstacle avoidance and long-range SLAM depth requirements • Multipath interference resistance • Low motion blur • Large FOV (up to H98° × V72°) • Compatible with 3D SLAM algorithms Applications • Commercial service robots • Outdoor robots • Mobile robot chassis
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3 Core Specifications

Nebula 410 Product Specifications		
Module Parameters	Optical Module Dimensions	31.25 mm × 15.35 mm × 8.78 mm (excl. FPC and PCBA)

¹sToF: StructureLight + iToF, a 3D algorithm suite that fuses the software-based structured-light reconstruction algorithm with the iToF 3D algorithm. Mainly used for short-range obstacle avoidance;

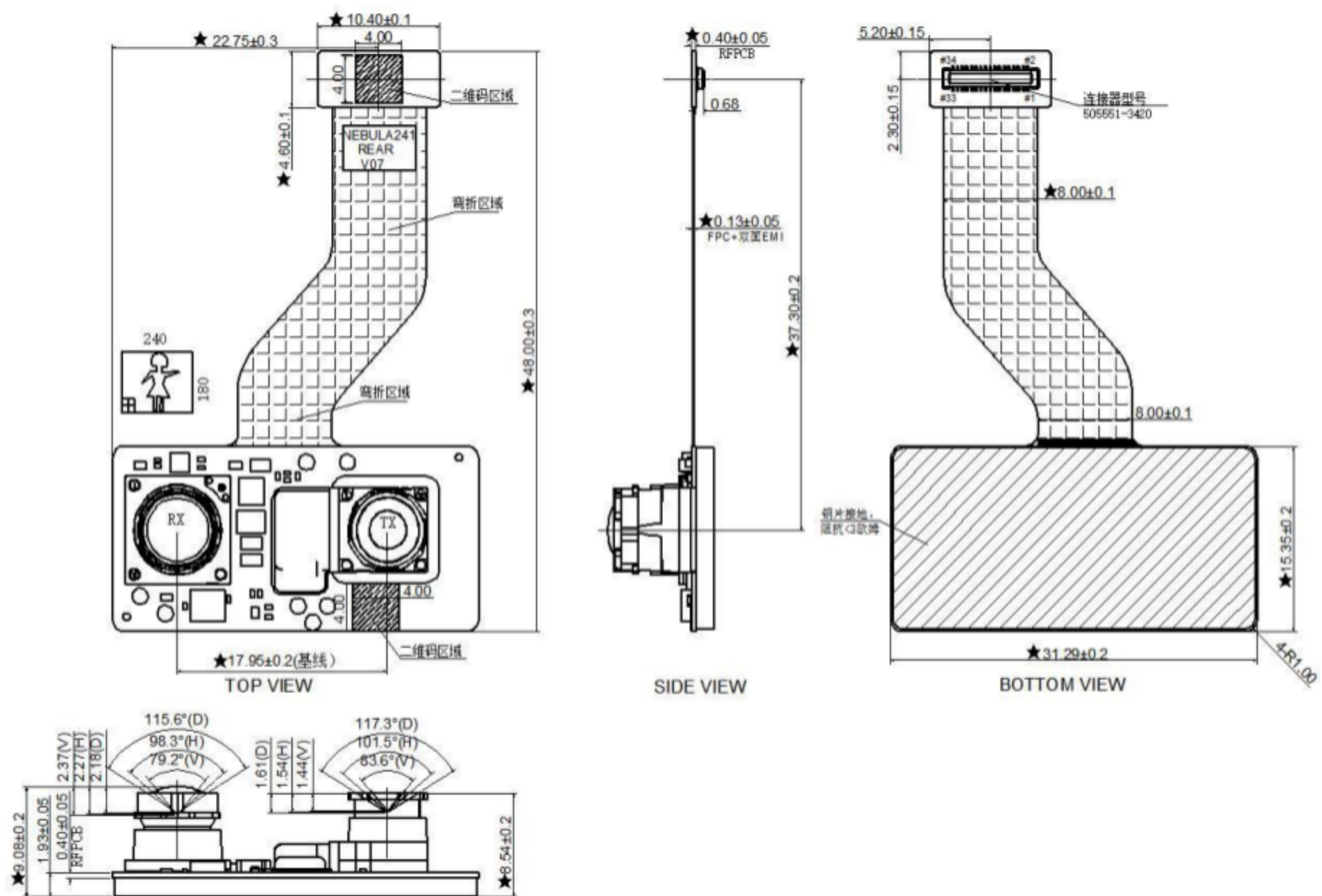
²mToF: modulated ToF, a speckle-based iToF technology implemented by modulating the projected light field with the WFP photonic chip; mainly used for long-range SLAM;

	Baseline	17.95 mm
	Operating Temperature	-10°C ~ +45°C
	Operating Humidity	0% ~ 95% RH, non-condensing
	Average Power Consumption (10 fps)	≤ 1.4 W (MODE1 / MODE2); ≤ 1.15 W (MODE0) ³
	Power Supply Requirement	≥ 1.5 A @ 5 V DC; 2 A supply current capability recommended
	Communication Protocol	USB 2.0 (Type-C)
Depth Image Performance (white-wall test, MODE1)⁴	Operating Distance	3 cm ~ 8 m
	Operating Illuminance	0 ~ 100,000 lux @ 2.5 m
	Resolution / Frame Rate	≥ 248 × 180 @ 10 fps
	Depth Accuracy	< 5 mm @ [3 cm ~ 25 cm]; < 1.5% @ (30 cm ~ 60 cm); < 1% @ (60 cm ~ 8 m]
	Depth Trueness	< 1 cm @ [3 cm ~ 25 cm]; < 1.5% @ (30 cm ~ 60 cm); < 1% @ (60 cm ~ 8 m]
	FOV	Max FOV: H98° × V72° (±3°) ⁵
	Spatial Angular Resolution	≤ 2.5° @ 6 m, 90% reflectivity white wall ⁶

³The modes differ in depth performance and CPU usage. MODE0: mToF AE mode only, featuring low USB data bandwidth and the lowest compute consumption, sparse point cloud across the full range, but no structured-light or HDR support; MODE1: higher compute consumption, supports structured-light and ToF fusion as well as HDR, dense depth at close range and sparse depth at medium-to-long range; MODE2: moderate compute consumption, supports mToF HDR mode, does not include structured-light reconstruction, sparse point cloud across the full range;

Synchronization & Fusion	Synchronization	Supports master-slave mode
	Mode Support	MODE0 supports mToF AE mode; MODE1 supports sToF / mToF fusion HDR mode; MODE2 supports mToF HDR mode
System & Algorithms	System Compatibility	Supports Arm Linux
	Application Algorithm	Supports 3D SLAM algorithms based on area-array point clouds when paired with the 410

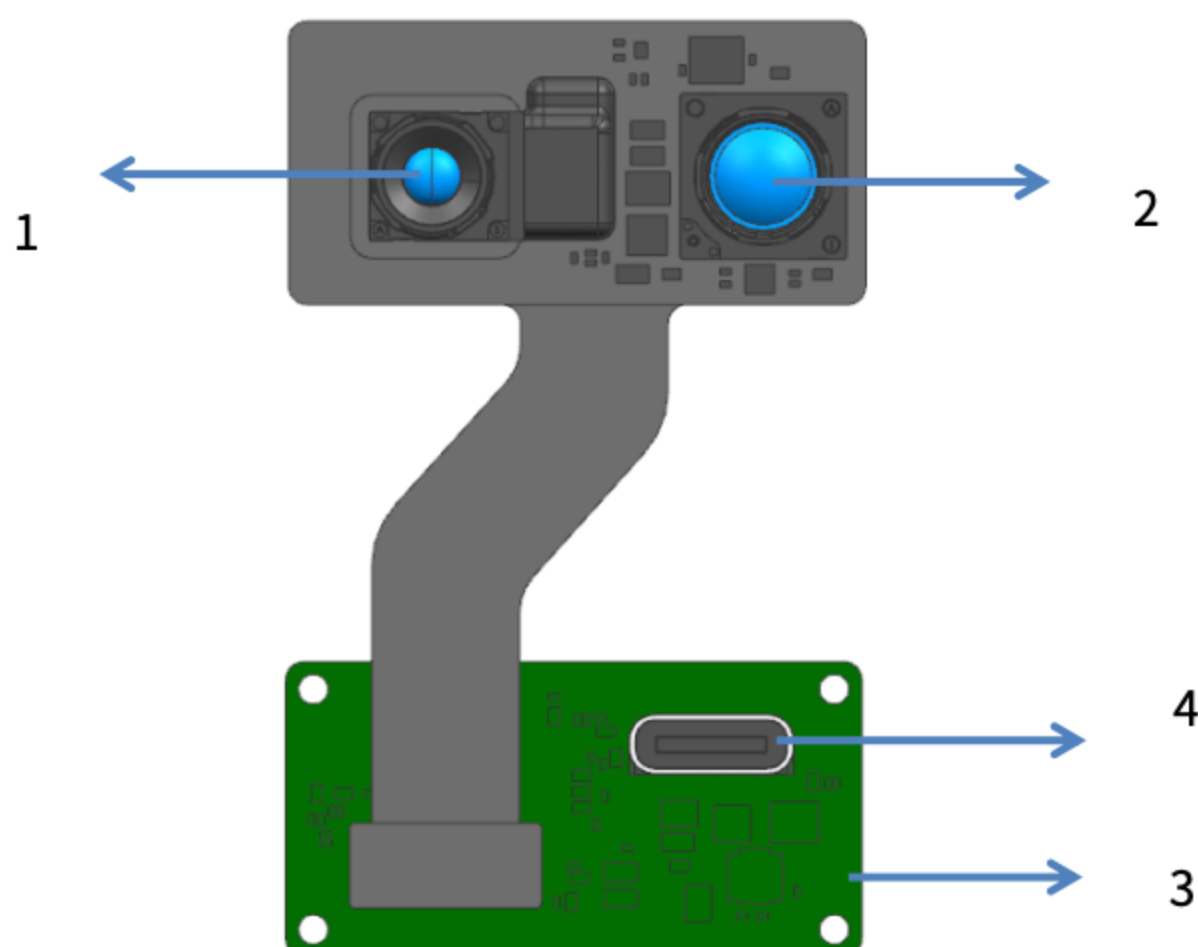
4 Module Dimensions & Structure



MIPI module dimension drawing (TOP / SIDE / BOTTOM VIEW, incl. FOV annotation and 17.95 mm baseline)

4.1 Module Description

The Nebula 410 USB module consists of an optical MIPI module (Nebula 241 MIPI and a PCBA adapter board). MIPI signals are routed out through the FPC cable and converted by the PCBA board; power and communication are provided through a USB 2.0 Type-C interface. The optical module measures 31.25 mm × 15.35 mm × 8.78 mm with a 17.95 mm baseline. Avoid structural deformation when installing the optical module, as it will degrade short-range depth accuracy. Dimensional data and images may differ slightly depending on the specific product configuration; please refer to the actual product. The product 3D drawing includes the safety FOV; refer to the camera 3D drawing for stacking design.



Module Layout Diagram (numbers correspond to the System Components table)

System Components	No.
ToF Camera (ToF receiving camera)	1
Dot Projector	2
PCBA	3

USB 2.0 TypeC	4
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5 Key Component Specifications

Item	Key Parameter	Specification
Sensor	Active Array Size	240 × 180
Sensor	Pixel Size	10 × 10 μm
Sensor	QE @ 940 nm	30%
Sensor	Operating temperature range	-20°C ~ +85°C
RX Lens	F/NO	1.4
RX Lens	FOV	98.3°(H) × 79.2°(V) × 115.6°(D)
RX Lens	EFL	1.09 mm
RX Lens	TTL	7 mm
TX	Optical Power	700 mW
TX	Center Wavelength	940 nm
TX	Eye Safety	Class I
TX	F/NO	2.4
TX Lens	FOV	101.1°(H) × 83.6°(V) × 117.3°(D)
TX Lens	EFL	0.695 mm
TX Lens	TTL	4.8 mm

6 Module Electrical Requirements

6.1 PIN Definition

PIN NO.	Name	Type	Description
1	VBUS	Power	5 V power supply (5 V, ≥ 1.5 A, 2 A recommended)
2	DM	I/O	Data line negative (differential)
3	DP	I/O	Data line positive (differential)
4	SBU1 / SBU2 ⁷	I/O	Sync signal Trg in / out (1.8 V, 5 mA)
5	GND	Power	Ground

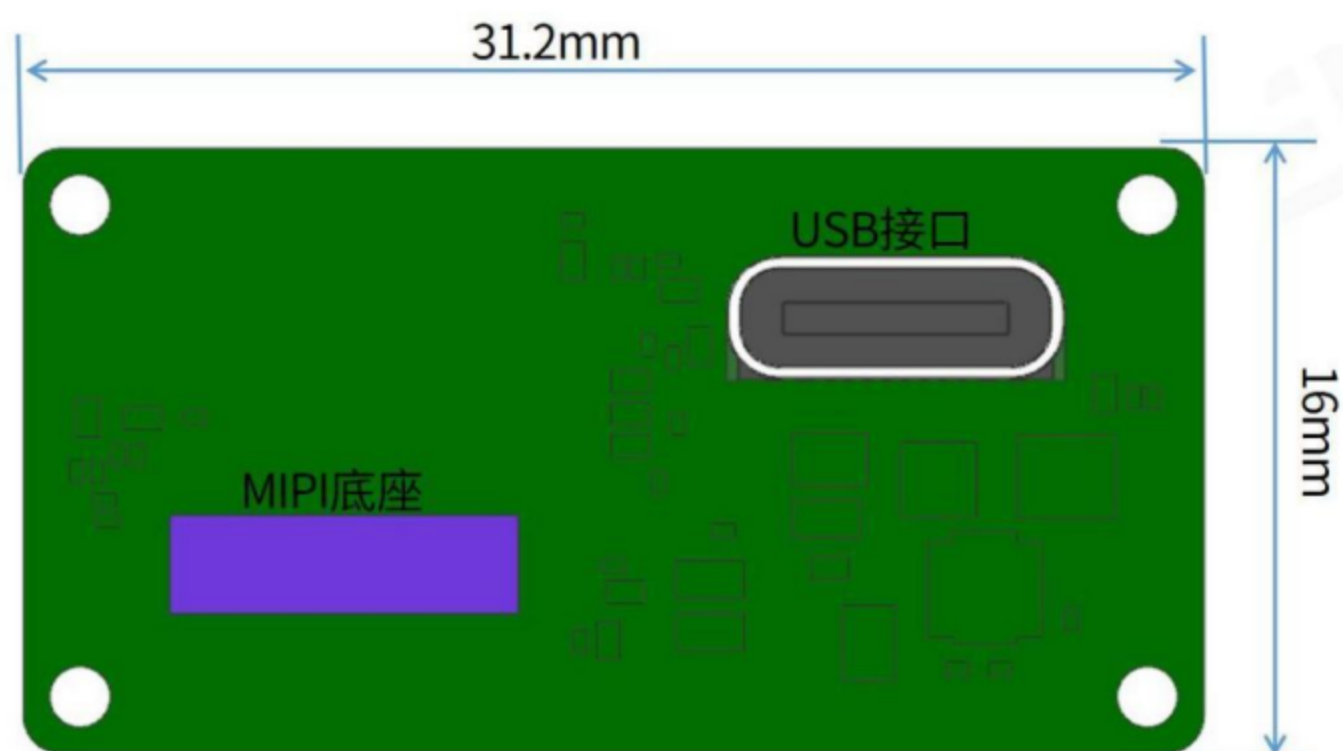
7 Environment & Reliability

Item	Parameter	Specification
Operating Environment	Temperature	-10°C ~ +45°C
	Humidity	0% ~ 95% RH, non-condensing
	Illuminance	0 ~ 40,000 lux (indoor / outdoor)
Storage Environment	Temperature	-40°C ~ +65°C
	Humidity	10% ~ 90% RH, non-condensing

8 Certification

Item	Specification
Laser Eye Safety	Class 1 laser safety
Environmental Certification	RoHS 2.0

9 PCBA Dimensions & Structure



PCBA dimension drawing (31.2 mm × 16 mm, incl. USB connector and MIPI socket)

10 Software Development

Customers can use the Deptrum Stream SDK for secondary development to obtain point cloud data. The SDK supports Windows / Linux / Android platforms and x86_64 and ARMv7 / ARMv8 architectures, with specific performance optimizations for embedded architectures. For detailed usage, refer to the documentation included with the SDK.

11 Disclaimer

The device application information and similar content described in this publication are provided for your convenience only and may be superseded by updated information. It is your responsibility to ensure that your application complies with the applicable technical specifications. Shenzhen Deptrum Technology Co., Ltd. makes no representations or warranties of any kind, express or implied, written or oral, statutory or otherwise, including but not limited to representations or warranties regarding use, quality, performance, merchantability, or fitness for a particular purpose. Deptrum assumes no liability arising from this information or its use. Deptrum products shall not be used as critical components in life support systems without the written approval of Shenzhen Deptrum Technology Co., Ltd. No license is conveyed, implicitly or otherwise, under any Deptrum intellectual property rights.

12 Technical Support

You can obtain support through the following channels:

- Email support: please send specific questions to support@deptrum.com
- FAE support: please contact our sales team for FAE support access

13 Precautions

- Do not heat this product with any other heat source.
- Do not drop or strike this product, as this may damage internal components and degrade accuracy; improper handling may damage internal elements.
- Do not attempt to modify or disassemble this device in any way, as this may damage the module and degrade accuracy.
- The module heats up after a period of use, which is normal; heat dissipation may be applied to the back of the module.

- Do not store the module in a high-temperature, high-humidity environment, as this may degrade module accuracy or cause depth reconstruction failure.