ORBBEC

Gemini 305

Datasheet

Version 1.0

Revision History

Version	Description	Revision Date
V1.0	● Initial release	2026-01-06

Contents

0. Glossary

Terms	Descriptions
ASIC	Application-specific Integrated Circuit
Baseline	The distance between the optical centers of the two cameras used for depth calculation
D2C	Depth to Color maps each pixel on a depth map to the corresponding color image according to the intrinsic and extrinsic parameters of the depth camera and color camera
Depth	Depth video streams are similar to color video streams except each pixel has a value representing the distance away from the sensor instead of color information
Depth Camera	Includes depth imaging module and external interface, of which the former is generally composed of an infrared projector, infrared camera, and depth computing processor
FOV	Field of View describes the angular extent of a given scene that is captured by a camera, which can be measured in the horizontal, vertical, and diagonal
I2C	Refers to a simple bi-directional two-wire synchronous serial bus developed by Philips
IR	Light in the infrared spectrum, which ranges from 700 nm and above
IR Camera	A camera capable of seeing light in the IR spectrum
ISP	Image signal processor, which is used for image post-processing
PCBA	PCBA (Printed Circuit Board Assembly) refers to a fully assembled printed circuit board (PCB) that includes all the electronic components mounted and soldered onto it.
Point Cloud	A discrete set of data points in space
RGB Camera	A camera that captures color images and video.
ROI	Region of Interest (ROI) in image processing refers to a specific area selected from the entire image
SOM	A System on Module (SoM) provides various core components of an embedded processing system on a single printed circuit board, including the processor core, communication interfaces, and memory modules. A typical example of this is the NVIDIA Jetson series products

SBC	A Single Board Computer (SBC) is a microcomputer where all the logic circuits, timing circuits, internal memory, and external interfaces are integrated onto a single printed circuit board. A typical example is the Raspberry Pi
SoC	System on Chip, an integrated circuit (IC) that integrates all components of a computing system
UVC	USB Video Class (UVC) is a protocol standard defined for USB video capture devices and has become one of the USB.org standards
TBD	To Be Determined. Information will be provided in a later revision.

1. Product Brief

The Orbbec Gemini 305 is a RGB stereo vision camera specifically designed to meet the demand for high accuracy and stability in close-range applications. Equipped with Orbbec's latest MX6800 ASIC, it outputs depth data directly with low latency, significantly lowering the computational burden on the host system. The camera also integrates multi-camera synchronization functionality, which greatly enhancing the precision and stability of synchronization. It offers a variety of pre-defined depth presets, enabling one-click switching between "depth + color" and "dual-color" combinations. These various depth presets cater to the perception requirements of diverse applications, such as visual guidance of robotic arm visual guidance and vision foundation model (VFM) data collection. For connectivity, the camera employs a reliable USB Type-C interface with screw locking for bothpower and data transmission, combining plug-and-play ease with reliable physical connection. When used with a certified cable and the interface screw securely fastened, the system achieves an IP54, effectively protecting against dust and water splashes.

- Ultra-close Depth Imaging: 4cm @ 848 x 530 & 256 disparity search range
- Wide Color FOV: H 94° x V 68°
- Depth to Color Aligned FOV: H 88° × V 65° @ 20cm
- High Depth Accuracy: ≤ 1% (1280 x 800 @ 50cm)
- 1 Mega-pixel Color Stream at High Frame Rate: 1280 x 800 @ 60fps
- Low-Latency Direct Depth Output Down to 60 ms

- Support Dual Color Streams (Left & Right) with Consistent ISP Imaging Results
- Multi-Camera Sync in Two Methods: Hardware-Sync for High Accuracy & Software-Sync for High Flexibility
- IP54 when the interface is properly connected

2. Product Specifications

Parameter	Gemini 305
Use Environment	Indoor & Outdoor
Technology	Stereo Vision
Baseline	18mm
Operating Range[1] [2]	4 – 100cm
Ideal Range	7 – 50cm
Spatial Precision	≤ 1% (1280 x 800 @ 50cm & 90% x 90% ROI)
Depth Resolution @ Frame Rate	Up to 1280 x 800 @ 30fps 848 x 530 @ 60fps
Depth FOV	H 88° x V 65° ± 3° (1280 x 800 @ 20cm)
Depth Filter	IR-Cut
Sensor Type	Stereo Color: Global Shutter
Color Resolution @ Frame Rate	Up to 1280 x 800 @ 60fps
Color FOV	H 94° x V 68° ± 3°
Depth Processing	Orbbec MX6800 ASIC
Data Connection	USB 3.0 (recommended) & USB 2.0
Interface	USB Type- C
EMC	ESD：Class A Contact discharge: ±8kV, Air discharge: ±15kV RE：≥6 dB
Max Average Power Consumption	≤2.0W
Power Supply	DC 5V & ≥700mA
Operating Environment	-10 - 45°C @ 128 disparity search range -10 - 40°C @ 256 disparity search range
Operating Backside Case Temperature	-10℃ - 60℃
Storage Environment	Short Term: -20℃ - 70℃, 5%~90% RH (non-condensing) Long Term: 0℃ - 60℃, 5%~90% RH (non-condensing)

Protection	IP54 (only when the Type-C interface is properly connected and the screws are tightened)
Dimensions(W x H x D)	42 x 42 x 23mm
Weight	68g
Installation	Bottom:1x 1/4-20 UNC, 2x M3 Back :2x M3
Lifespan	5 Years: Default Operating Mode & Operating Environment

Notes:

[1] The depth performance of each 3D camera is validated at the production line before shipping to customers. The metrics reflect the depth performance under typical conditions. External impact factors over 3D cameras' whole lifespan may have significant impacts on their depth performance.

[2] 4cm @ 848 x 530, with the max disparity search range of 256 pixels enabled.

3. Product Information

3.1 Product Pictures

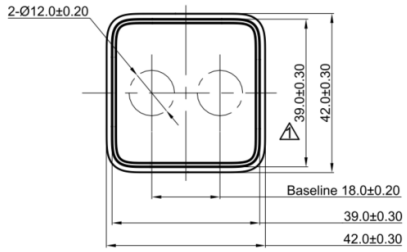
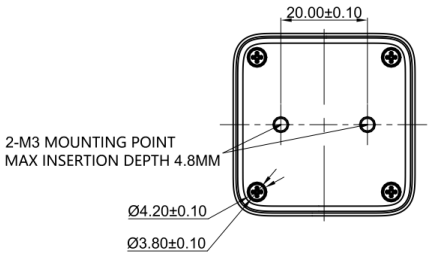
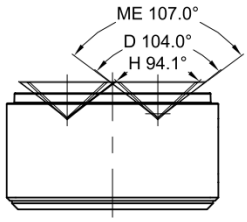
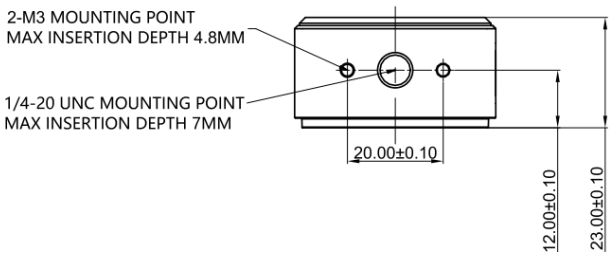
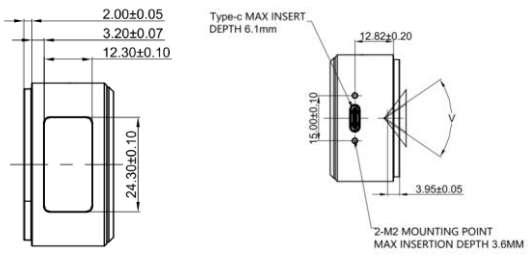
Table 3-1-1 Product pictures for Gemini 305

Front View		Rear View	
Top View		Bottom View	
Left View		Right View	
Left Side View at 45°		Right Side View at 45°	

3.2 Product Drawings

3.2.1 Product Drawings

Table 3-2-1 Product drawings for Gemini 305

Name	Gemini 305
Front View	
Rear View	
Top View	
Bottom View	
Side View	

3.2.2 Product Dimensions & Weight

Table 3-2-2 Product dimensions & weight for Gemini 305

Name	Gemini 305
Width/mm	42
Height/mm	42
Depth/mm	23
Net Weight/g	68

3.3 Product Interfaces

Table 3-3-1 Product interfaces

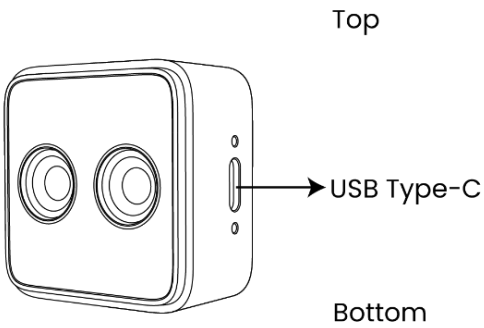
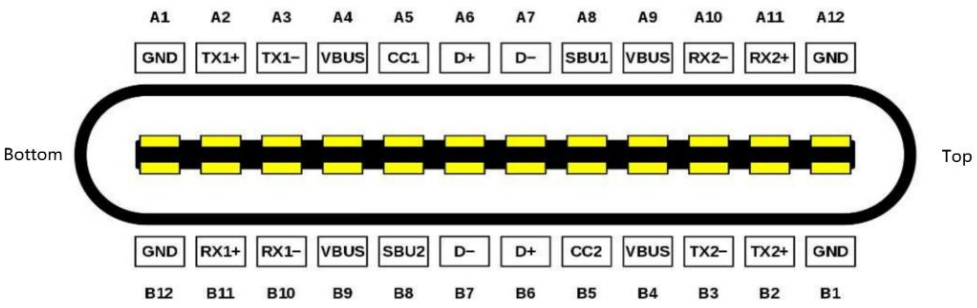
Name	Gemini 305
Gemini 305 USB Type-C	
Interface Pin Map	

Table 3-3-2 USB Type-C Interface Definition

Pin	Name	Definition	Pin	Name	Definition
A1	GND	Ground	B1	GND	Ground
A2	TX1+	High-speed Differential Signaling#1, TX, Positive	B2	TX2+	High-speed Differential Signaling#2, TX, Positive
A3	TX1-	High-speed Differential Signaling#1 TX Negative	B3	TX2-	High-speed Differential Signaling#2 TX Negative
A4	VBUS	Power	B4	VBUS	Power
A5	CC1	Port configuration	B5	CC2	Power configuration
A6	D+	USB2.0 Differential Signaling#1, Positive	B6	D+	USB2.0 Differential Signaling#2, Positive
A7	D-	USB2.0 Differential Signaling#1, Negative	B7	D-	USB2.0 Differential Signaling#2, Negative
A8	SBU	Sideband use, 1.8V(Default), 3.3V, 5V; SYNC_IN (Default) or SYNC_OUT	B8	SBU	Sideband use, 1.8V(Default), 3.3V, 5V; SYNC_IN (Default) or SYNC_OUT
A9	VBUS	Power	B9	VBUS	Power
A10	RX2-	High-speed Differential Signaling#2 RX Negative	B10	RX1-	High-speed Differential Signaling#1 RX Positive
A11	RX2+	High-speed Differential Signaling#2 RX Positive	B11	RX1+	High-speed Differential Signaling#1 RX Negative
A12	GND	Ground	B12	GND	Ground

3.4 Product Components

3.4.1 Overview of Product Components

Table 3-4-1 Overview of product components for Gemini 305

Gemini 305


3.4.2 RGB Module

Table 3-4-2 RGB module specifications

Parameters	Gemini 305
Filter Type	IR-Cut
Active Pixels	1280 x 800
Sensor Aspect Ratio	16:10
Focus Type	Fixed
Shutter Type	Global Shutter
Horizontal FOV	94°
Vertical FOV	68°
Diagonal FOV	104°
FOV Tolerance	±3.0°
Distortion	<1.5%

4. Functional Specifications

4.1 Vendor Identifier (VID) and Product Identifier (PID)

Table 4-1-1 VID & PID table

Name	Gemini 305
Model	G40351-191
PID	0x0840
VID	0x2BC5

4.2 Platform and System Requirements

Table 4-2-1 Gemini 305 Recommended Platforms and Systems

Architecture	x86/x64		ARM
OS	Windows 10/11	Ubuntu 22.04 / 24.04	Ubuntu 22.04 / 24.04 and above
USB	USB 3.0	USB 3.0	USB 3.0
CPU	Quad-core, 2.9GHz	Quad-core, 2.9GHz	Quad-core, A57
Reference model	Intel i5 / Intel i7	Intel i5 / Intel i7	NVIDIA Jetson Orin Nano / NVIDIA Jetson Orin NX / NVIDIA Jetson AGX Orin / NVIDIA Jetson Thor
RAM	8GB RAM and above	4GB RAM and above	4GB RAM and above

4.3 Camera system Framework

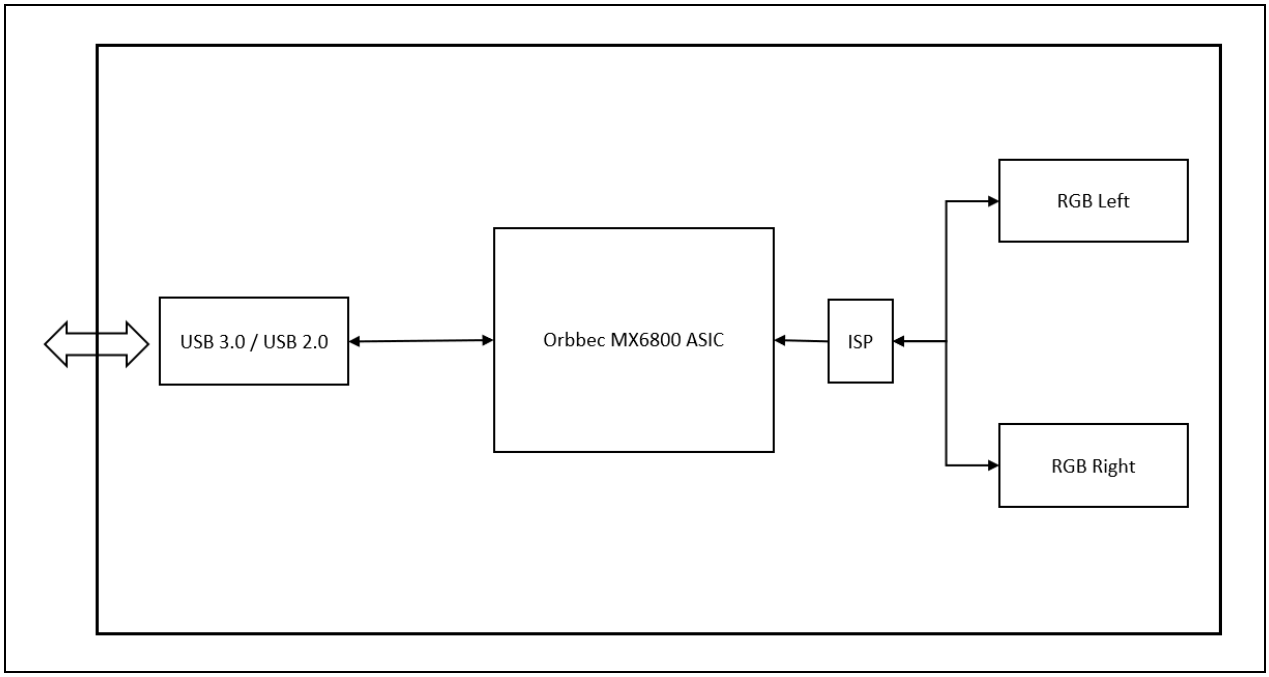


Figure 4-3-1 Gemini 305 System Block Diagram

4.4 Image Data Stream

Gemini 305 provides high-quality, multi-resolution depth data, as well as high-definition color data. The camera outputs depth data in Y16 format., and the color data in MJPEG / YUYV format. The SDK supports a comprehensive set of data conversions among MJPEG / YUYV / RGB8 / BGR8 / RGBA8 / BGRA8 / Y16 / Y8 formats. The camera outputs IR image data in Y8 format.

Gemini 305 offers two image data stream combinations: "Depth + Color" and "Dual Color." The output combination

is determined by the device's preset configuration: selecting the "Dual Color" preset outputs dual color streams, while any other preset outputs the "Depth + Color" data stream. Users can switch the data stream output with one click by changing the depth preset.

4.4.1 "Depth + Color" Combinations

Table 4-4-1 "Depth + Color" Output data streams (USB3.0)-Gemini 305

Gemini 305	Data Format	Aspect Ratio	Resolution	Frame Rate
Depth	Y16	16:10	1280 x 800	5, 10, 15, 30
			848 x 530	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30
			848 x 480	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
IR	Y8	16:10	1280 x 800	5, 10, 15, 30
			848 x 530	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30
			848 x 480	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
Color	YUYV/Y8/Y16/ MJPEG/RGB8 /BGR8/BGRA 8/RGBA8	16:10	1280 x 800	5, 10, 15, 30, 60
			848 x 530	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30, 60
			848 x 480	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60

Table 4-4-2 "Depth + Color" Output data streams (USB2.0)-Gemini 305

Gemini 305	Data Format	Aspect Ratio	Resolution	Frame Rate
Depth	Y16	16:10	1280 x 800	5, 10
			848 x 530	5, 10, 15
		16:9	1280 x 720	5, 10
			848 x 480	5, 10, 15
		4:3	640 x 480	5, 10, 15, 30

IR	Y8	16:10	1280 x 800	5, 10
			848 x 530	5, 10, 15
		16:9	1280 x 720	5, 10
			848 x 480	5, 10, 15
		4:3	640 x 480	5, 10, 15, 30
Color	YUYV/Y8/Y16/ MJPEG/RGB8 /BGR8/BGRA 8/RGBA8	16:10	1280 x 800	5, 10
			848 x 530	5, 10, 15
		16:9	1280 x 720	5, 10
			848 x 480	5, 10, 15
		4:3	640 x 480	5, 10, 15, 30

4.4.2 "Dual Color" Combinations

Table 4-4-3 "Dual Color" Output data streams (USB3.0)-Gemini 305

Gemini 305	Data Format	Aspect Ratio	Resolution	Frame Rate
Color Left	YUYV/Y8/Y16/ MJPEG/RGB8/ BGR8/BGRA8/ RGBA8	16:10	1280 x 800	5, 10, 15, 30, 60
			848 x 530	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30, 60
			848 x 480	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
Color Right	YUYV/Y8/Y16/ RGBA8/RGB8/ BGR8/BGRA8/	16:10	1280 x 800	5, 10, 15, 30, 60
			848 x 530	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30, 60
			848 x 480	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60

Table 4-4-3 "Dual Color" Output data streams (USB3.0)-Gemini 305

Gemini 305	Data Format	Aspect Ratio	Resolution	Frame Rate
Color Left	YUYV/Y8/Y16/ MJPEG/RGB8/ BGR8/BGRA8/ RGBA8	16:10	1280 x 800	5, 10
			848 x 530	5, 10, 15
		16:9	1280 x 720	5, 10
			848 x 480	5, 10, 15
		4:3	640 x 480	5, 10, 15, 30
Color Right	YUYV/Y8/Y16/ RGBA8/RGB8/ BGR8/BGRA8/	16:10	1280 x 800	5, 10
			848 x 530	5, 10, 15
		16:9	1280 x 720	5, 10
			848 x 480	5, 10, 15
		4:3	640 x 480	5, 10, 15, 30

4.5 Hardware Decimation

The Gemini 305 supports configurable hardware decimation for proportional image scaling. This process performs pixel merging and aggregation at the hardware level, reducing the image resolution in both X and Y dimensions while preserving the original aspect ratio. The camera directly outputs the resulting lower-resolution image stream. By utilizing hardware decimation, the Gemini 305 significantly reduces data transmission bandwidth and power consumption while maintaining the depth accuracy inherent to its full sensor resolution.

Table 4-5-1 Gemini 305 Hardware Decimation

Resolution Before Decimation	Decimation Factor	Resolution After Decimation
1280 x 800	2	640 x 400
	3	424 x 266
	4	320 x 200

1280 x 720	2	640 x 360
	3	424 x 240
	4	320 x 180
848 x 480	2	424 x 240
640 x 480	2	320 x 240

4.6 Depth to Color Alignment

Depth to Color, a pixel-by-pixel geometric transformation of a depth image, results in the spatial alignment of a depth image with its corresponding color image through the D2C transformation, allowing us to locate any pixel of a color image by its image coordinates in the depth image after D2C by the same image coordinates. The depth information of the color pixel can be located in the depth image after D2C by using the same image coordinates. We generate a depth image of the same size as the target color image after D2C, and the image content is the depth data in the color camera coordinate system. In other words, a depth image is reconstructed that is "taken" using the origin and size of the color camera, where each pixel matches the coordinates of the corresponding pixel of the color camera.

Table 4-6-1 Gemini 305 Depth to Color Alignment by software

Depth Image before D2C	Color Image	Depth Image After D2C	Aspect Ratio
1280 x 800 / 1280 x 720 / 848 x 530 / 848 x 480 / 640 x 480	1280 x 800	1280 x 800	16:10
	848 x 530	848 x 530	
1280 x 800 / 1280 x 720 / 848 x 530 / 848 x 480 / 640 x 480	1280 x 720	1280 x 720	16:9
	848 x 480	848 x 480	
1280 x 800 / 1280 x 720 / 848 x 530 / 848 x 480 / 640 x 480	640 x 480	640 x 480	4:3

Table 4-6-2 Gemini 305 Depth to Color Alignment by hardware

Depth Image before D2C	Color Image	Depth Image After D2C	Aspect Ratio
848 x 530 / 848 x 480 / 640 x 480	1280 x 800	1280 x 800	16:10
	848 x 530	848 x 530	
848 x 530 / 848 x 480 / 640 x 480	1280 x 720	1280 x 720	16:9
	848 x 480	848 x 480	
848 x 530 / 848 x 480 / 640 x 480	640 x 480	640 x 480	4:3

4.7 Field of View

4.7.1 Definition of Depth Field of View

The image below shows the depth field of view (FOV). For a better understanding, we illustrate the angles that the depth and IR cameras "see".

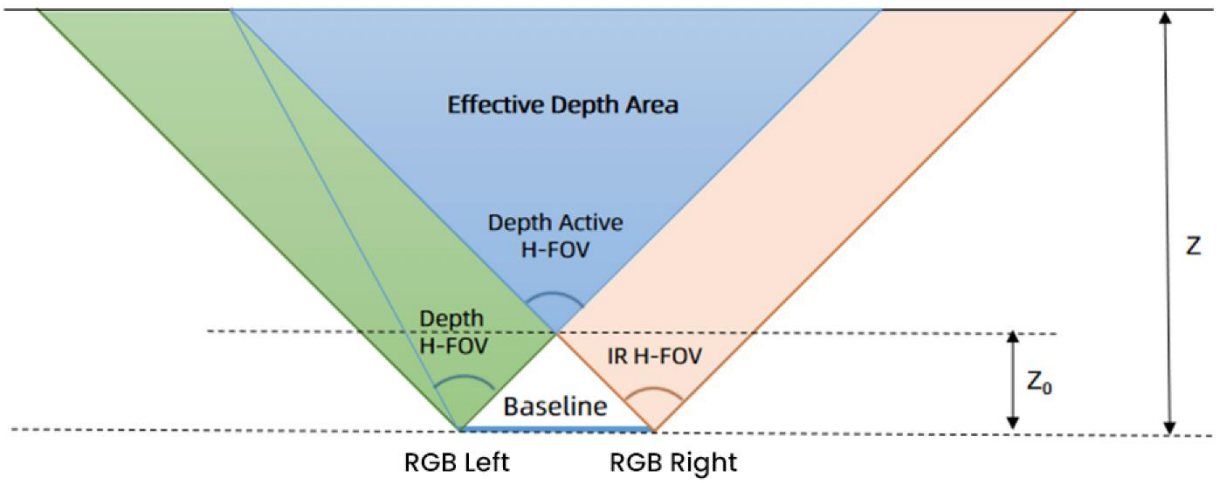


Figure 4-7-1 Depth Field of View to Depth Map illustration

Depth FOV at any depth (Z) can be calculated using the following equation:

Table 4-7-1 Depth FOV calculation formulas

Calculation Formulas	Definitions
$\text{Depth H} - \text{FOV} = \arctan\left(\frac{cx}{fx} - \frac{B}{Z}\right) + \arctan\frac{width - 1 - cx}{fx}$	1. cx = X-direction image coordinates of the principle point of the depth image 2. fx= Depth camera focal length in pixels of x-axis 3. cy= Y-direction image coordinates of the principle point of the depth image 4. fy= Depth camera focal length in pixels of y-axis 5. width= Depth image width 6. Height=Depth image height 7. Depth active H-FOV =RGB Left / Right H-FOV
$\text{Depth Active H} - \text{FoV} = \arctan\frac{cx}{fx} + \arctan\frac{width - 1 - cx}{fx}$	
$Z_0 = \frac{\text{B}}{2*\tan(\frac{\text{Depth Active H} - \text{FOV}}{2})}$	
$\text{Depth V - FOV} = \arctan\left(\frac{cy}{fy}\right) + \arctan\frac{height\text{-}1\text{-}cy}{fy}$	

Note:

1. Depth intrinsics, including cx, cy, fx, fy, width and height, are obtained through SDK APIs, and these parameters may vary across different units
2. At different depth values, the depth FOV is non-constant. The farther the depth, the greater the depth FOV.

4.7.2 Typical Depth Intrinsics

Table 4-7-2 Typical Depth Intrinsics of Gemini 305

Baseline/mm	Resolution: Width x Height		cx/pixel	cy /pixel	fx & fy/pixel
	Width/pixel	Height/pixel			
18	1280	800	640	400	620.0 & 620.0
	1280	720	640	360	620.0 & 620.0
	848	530	424	265	410.7 & 410.7
	848	480	424	240	410.7 & 410.7
	640	480	320	240	372.0 & 372.0

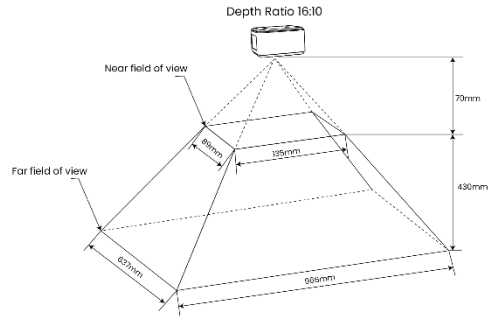
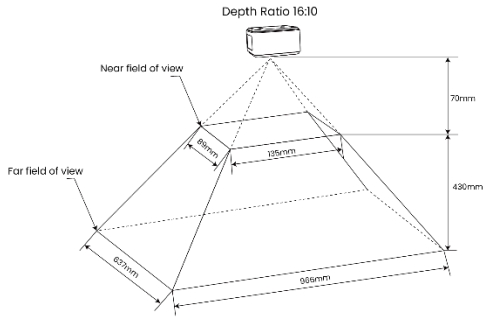
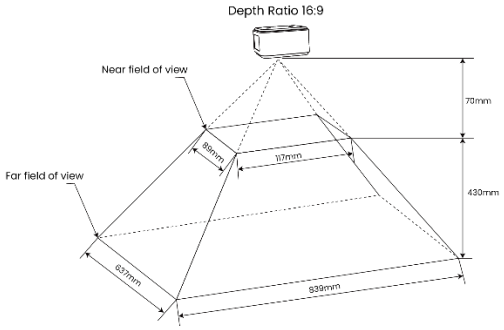
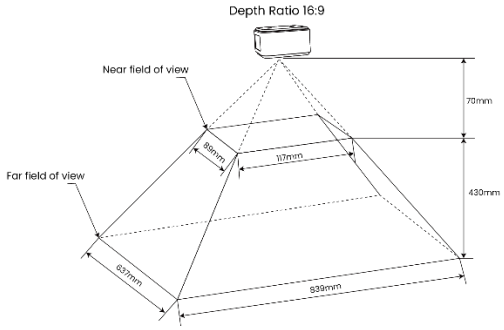
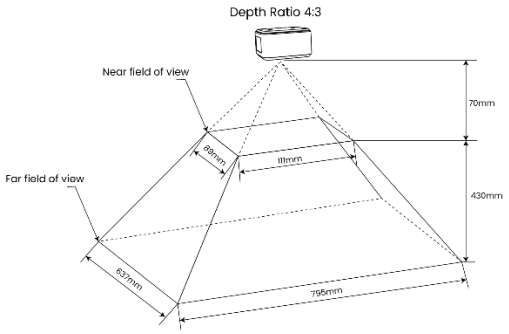
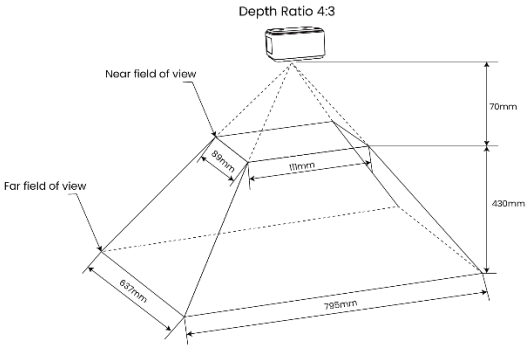
4.7.3 Overview of Stream FOV

Table 4-7-3 Stream FOV for Gemini 305

FOV	Aspect Ratio	Resolutions	Gemini 305
Depth FOV Before D2C @ 20cm	16:10	1280 x 800 / 848 x 530	H 88° V 65°
	16:9	1280 x 720 / 848 x 480	H 88° V 60°
	4:3	640 x 480	H 77° V 65°
IR	16:10	1280 x 800 / 848 x 530	H 91° V 65°
	16:9	1280 x 720 / 848 x 480	H 91° V 60°
	4:3	640 x 480	H 81° V 65°
Color	16:10	1280 x 800 / 848 x 530	H 94° V 68°
	16:9	1280 x 720 / 848 x 480	H 94° V 62°
	4:3	640 x 480	H 82° V 68°
Depth FOV After D2C @ 20cm	16:10	1280 x 800 / 848 x 530	H 88° V 65°
	16:9	1280 x 720 / 848 x 480	H 88° V 60°
	4:3	640 x 480	H 77° V 65°

4.7.4 FOV Illustrations

Table 4-6-4 Gemini 305 Depth FOV

Aspect ratio	Depth FOV Before D2C	Depth FOV After D2C
16:10		
16:9		
4:3		

4.8 Minimum-Z Depth

The Minimum-Z Depth is the minimum distance from the depth camera to the scene.

Table 4-8-1 Minimum-Z Depth for Gemini 305

Disparity search range	H / V-FOV: 88° / 65°		H / V-FOV: 88° / 60°		H / V-FOV: 77° / 65°
	1280 x 800	848 x 530	1280 x 720	848 x 480	640 x 480
256	50mm	40mm	50mm	40mm	40mm
128	90mm	60mm	90mm	60mm	55mm
64	180mm	120mm	180mm	120mm	110mm

Note:

1. The larger the disparity search range, the closer the minimum working distance becomes, and the higher the power consumption. Conversely, the smaller the disparity search range, the farther the minimum working distance extends, the lower the camera's power consumption, and the higher the ambient temperature it can withstand.
2. The disparity search range of 256 is only supported in the "Close-Range" presets.

4.9 Coordinate System

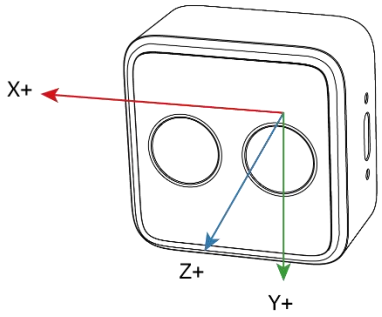
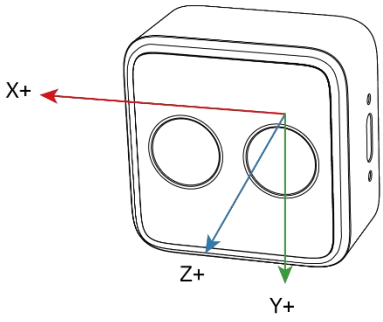
For the Gemini 305 3D camera, the plane where the 1/4 screw hole is located is defined as the bottom side, the glass cover surface is the front side and the area of the Type-C port is the left side. The positive X-axis of the coordinate system points to the right, the positive Y-axis points downwards, and the positive Z-axis points forwards.

The origin of the depth image coordinate system and the origin of the color image coordinate system is at the optical center of the left RGB module. The direction of the coordinate systems is the same: the positive X-axis points to the right, the positive Y-axis points downward, and the positive Z-axis points forward. The depth camera coordinate system origin is the default origin of the 3D camera, with coordinates (0,0,0). The reference positions of the depth origin and color origin in the 3D camera coordinate system are shown in the chart below:

Table 4-9-1 Gemini 305 Coordinate System Position Reference

Coordinate System	Origin in the 3D camera coordinate system		
	X（mm）	Y（mm）	Z(mm)
Depth	0	0	0
Color	0	0	0

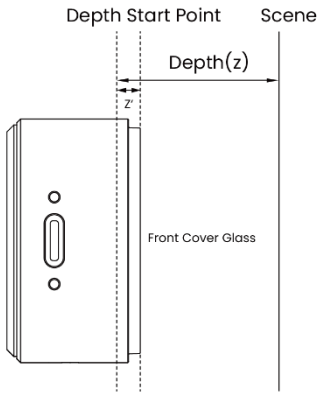
Table 4-9-2 Gemini 305 Coordinate System Schematic

	Gemini 305
Depth	
RGB	

4.10 Depth Start Point Reference

The depth start point, or ground zero reference can be described as a reference point or plane with depth = 0. For the Gemini 305 3D camera, the distance of the depth zero point to the front cover glass of the camera is listed below for both before and after the D2C alignment.

Table 4-10-1 Camera Depth Start Point Illustrations

Camera	Gemini 305
Before the D2C alignment (Z')	3.95 mm
After the D2C alignment (Z')	3.95 mm
Depth Start Point	

4.11 Streaming Mode

Gemini 305 provides flexible acquisition options for IR, Depth, and RGB image data. The most commonly used mode is the streaming mode. In this mode, users configure a target frame rate, resolution, and image format for IR, Depth, and RGB respectively, and then enable the corresponding streams in sequence. The camera acquires and outputs image data according to the configured target frame rate, resolution, and image format.

Depending on the current camera configuration, users can select an appropriate frame rate for the application from the following predefined frame rate options: 5 fps, 10 fps, 15 fps, 30 fps, and 60 fps.

4.12 Triggering Mode

The Gemini 305 supports two image acquisition modes: a fixed frame rate mode and a free-run triggering mode. In free-run triggering mode, the camera passively waits for an external trigger signal (e.g., a software command via USB) to capture each frame. Upon receiving a valid trigger, it completes a single acquisition and immediately resumes waiting for the next trigger. There is no fixed time constraint between consecutive triggers, allowing the interval to be arbitrarily set to achieve virtually any acquisition frequency.

To ensure proper operation in this mode, the IR, Depth, and RGB sensors must be configured to a common fixed frame rate (e.g., 5, 10, 15, 30, or 60 fps). This setting determines the minimum allowable time between two triggers and thus the maximum effective triggering frequency. As summarized in Table 4-12-1, the camera will only respond to trigger signals that fall within this permissible range. Consequently, any trigger frequency within the valid range can be passively supported.

Table 4-12-1 Table of Supported Trigger Configurations

Set The Camera's Fixed Frame Rate(fps)	Supportable Passive Trigger Interval (ms)	Supportable Passive Trigger Frequency (Hz)
60	≥ 33.4	0 - 30
30	≥ 66.7	0 - 15
15	≥ 133.4	0 - 7.5
10	≥200	0 – 5
5	≥ 400	0 – 2.5

4.13 Multi-Camera Synchronization

For a multi-camera use case, one camera can be initialized as primary, and the rest configured as secondary. Alternatively, an external signal generator can also be used as the primary trigger with all cameras set to secondary mode. When applying an external sync pulse, the HW SYNC input requires a 100-microsecond positive pulse at the nominal camera frame rate, e.g. 33.33 ms for a 30 Hz frame rate. Inputs are high impedance, 1.8V CMOS voltage levels. However, it is important to make sure to use a high-resolution signal generator. The frequency of the signal generator needs to exactly match the sensor frame rate. For example, if the sensor is set up as 30 FPS, the

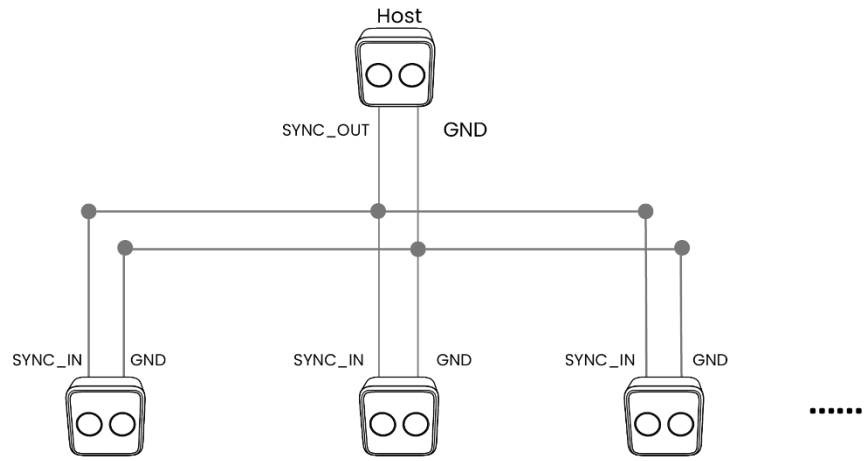
real frame rate may be 30.015 FPS. You may need to use an oscilloscope to measure the real frame rate and configure the signal generator to the same frequency. For this reason, it may be better to just use one additional camera as the primary sync signal generator.

Advantages of multi-camera setup：

- Increase camera coverage in a given space and fill in the occlusions where a single camera may have blind spots
- Capture multiple images of the same scene and scan objects from different angles
- Increase the effective frame rate to higher than 30 FPS when the cameras are running at 30 fps.

Multi-camera frame synchronization in star topology is supported, including depth image synchronization and RGB image synchronization (typical time difference ≤ 5ms across synchronized multiple cameras, when auto exposure off), using the multi-camera synchronization function.

Table 4-13-1 Topologies schematic diagram

Star Topology


4.14 Camera Functions

4.14.1 Depth Camera Functions

Gemini 305 expose the following Depth image settings.

Table 4-14-1 Depth camera control

Control	Description	Settings	Default Setting
Auto Exposure Priority	When enabled, exposure is prioritized, allowing the frame rate to be reduced.	Disabled, Enabled	Enabled
Auto Exposure	Enables or disables automatic exposure control for the depth camera.	Disabled, Enabled	Enabled
AE Max Exposure(us)	Maximum correction value for AE exposure that limits the corresponding frame rate.	1 - 199000	30458(30fps)
Mean Intensity Set Point	Mean Intensity Set Point for Gemini	0 - 255	60
AE ROI	AE ROI allows the user to specify a rectangular region. AE then performs exposure control based on the brightness of this region, enabling the target object to achieve a appropriate brightness.	T:0 - 799, B:0 -799 L:0 - 1279, R:0 -1279 (Resolution:1280 x 800)	T:0, B:799 L:0, R:1279 (Resolution:1280 x 800)
Manual Exposure(1) (us)	Sets the fixed exposure time when depth auto exposure is disabled.	1 - 199000	10000
Gain(Gain 1.0=16)	Adjusts the gain applied to the depth image when auto exposure is disabled.	16 -248	16

Note: (1) Not supported in Auto Exposure Mode

Definitions: T = Top, L = Left, B = Bottom, R = Right

4.14.2 Color Camera Functions

Gemini 305 expose the following Color image settings.

Table 4-14-2 Color camera control

Control	Description	Settings	Default setting
Auto Exposure Priority	When enabled, exposure is prioritized, allowing the frame rate to be reduced.	Disabled, Enabled	Enabled
Auto Exposure	Enables or disables automatic exposure adjustment.	Disabled, Enabled	Enabled

AE Max Exposure (100us)	Maximum correction value for AE exposure that limits the corresponding frame rate.	1999	303(30fps)
AE ROI	AE ROI allows the user to specify a rectangular region. AE then performs exposure control based on the brightness of this region, enabling the target object to achieve a appropriate brightness.	T:0 - 779, B:0 -779 L:0 - 1279, R:0 -1279 (Resolution:1280 x 800)	T:0, B:779 L:0, R:1279 (Resolution:1280 x 800)
Manual Exposure(1) (100us)	Sets the absolute exposure time when auto-exposure is disabled.	1 - 1999	156
Gain	Sets the amount of gain applied to the frame if auto-exposure is disabled.	16 – 128	16
Brightness	Sets the amount of brightness applied when auto-exposure is enabled.	-64 – 64	0
Auto White Balance	Enables or disables the AWB algorithm	Disabled, Enabled	Enabled
White Balance/ K	Sets the white balance when AWB is disabled	2800 – 6500	4600
Sharpness	Sets the amount of sharpening adjustment applied to the frame	0 – 100	50
Gamma	Adjusts gamma correction applied to image frames. Lower gamma values make the scene appear brighter.	100 - 500	300
Saturation	Sets the amount of saturation adjustment applied to the frame	0 - 100	64
Contrast	Sets the amount of contrast based on the brightness of the scene	0 - 100	50
Hue	Sets the amount of hue adjustment applied to the frame	-180 – 180	0
Backlight Compensation	Sets a weighting amount based on brightness to the frame	Disabled, Enabled	Disabled
Powerline Frequency	Specified based on the local power line frequency for flicker avoidance	Auto, 50, 60, Disabled	Auto

Note: (1) Not supported in Auto Exposure Mode

Definitions: T = Top, L = Left, B = Bottom, R = Right

5. Performance

5.1 Depth Performance

5.1.1 Depth Quality Assessment

Calculation of Depth Accuracy (Z-accuracy):

Depth accuracy (Z-accuracy) measures the per-pixel depth accuracy relative to the GT in a single frame depth image, excluding errors due to camera placement. GT is obtained by measuring the distance from depth origin to the reference target. Depth accuracy can be calculated using the following formula:
Depth_accuracy_Signed = Median (CP_Length – GT + PP_Dist)
where CP_Length represents the actual length between the depth origin and a fitted plane along the GT measuring direction, and PP_Dist denotes the per-pixel distance of the point cloud to the fitted plane.

Calculation of Spatial Precision:

The spatial precision is calculated as the percentage of the root mean square error (RMS Error) between each valid pixel and the optimal fitting plane compared to the true value (GT).

Calculation of Temporal Precision:

The temporal precision measures the variation in depth values over time within a ROI. The quality of a depth image can be assessed based on its temporal consistency, high-quality depth images should exhibit smooth and stable over time. This method is defined as the STD of depth values across a specific number of frames (for example, 30). The quantification of temporal noise is carried out on a per-pixel basis, followed by calculating the STD of each pixel over a specified time.

Depth Fill Rate Calculation:

The fill rate is used to calculate the proportion of valid pixels to total pixels within the target area (ROI region), primarily used to measure the completeness of depth.

5.1.2 Typical depth performance

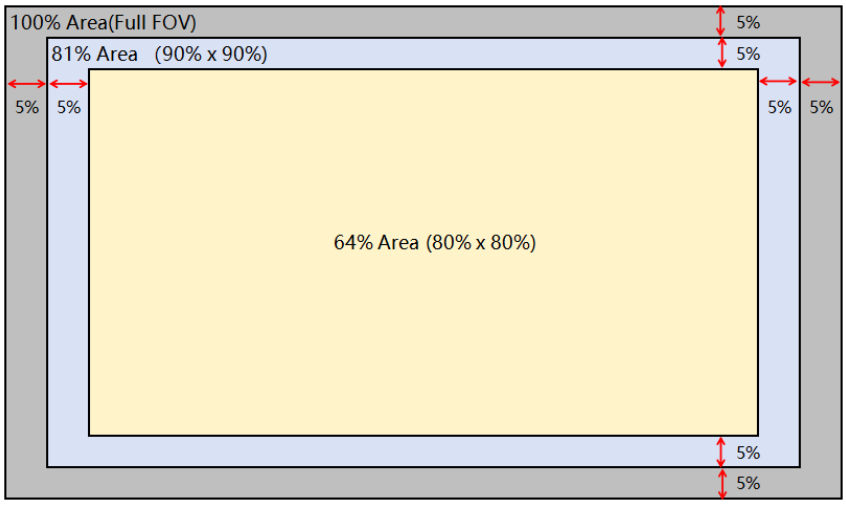
Typical depth performance for Gemini 305 is shown in the table below:

Table 5-1-1 Typical Depth Performance for Gemini 305

Depth Performance	Gemini 305
Depth Accuracy	**≤±1.8%** (1280 x 800 @ 50cm & 90% x 90% ROI)
Spatial Precision	**≤ 1%** (1280 x 800 @ 50cm & 90% x 90% ROI)
Temporal Precision	**≤ 0.5%** (1280 x 800 @ 50cm & 90% x 90% ROI)
Fill Rate	**≥99.5%** (1280 x 800 @ 50cm & 90% x 90% ROI)

Note:

1. The actual working range and accuracy may vary with the ambient illumination and the objects being measured.
2. The test object is a reflectivity > 80% plane, and the reference range is 81% FOV (81% FOV is the remaining center 81% of the depth map area after cropping 5% from the top, bottom, left and right of the depth map) or 64% FOV (64% = 80% x 80% and of a similar definition).



3. The depth performance of each 3D camera is validated at the production line before shipping to customers. The metrics reflect the depth performance under typical conditions. External impact factors over 3D cameras' whole lifespan may have significant impacts on their depth performance.
4. Depth evaluation for the Gemini 305 passive RGB stereo vision requires textured or feature-rich objects.

5.2 Electrical Performance

5.2.1 Power Supply

The Gemini 305 requires Type-C power and it is important to ensure that the power output is standard and that the maximum current of the Type-C power port is 0.7A or higher.

5.2.2 Power Consumption

Power consumption varies depending on the selected working mode.

Table 5-1-1 Gemini 305 typical configuration & tested power consumption Reference

Name	Gemini 305
Typical configuration	Max disparity search range: 128 Depth: 1280 x 800 @ 30 fps Y16 IR Left & IR Right: 1280 x 800 @ 30 fps Y8 RGB: 1280 x 800 @ 30 fps YUYV AE: On Hardware Noise Removal: on
Average power consumption	1.57 W

Table 5-1-2 Gemini 305 Max Power Configuration & tested power consumption Reference

Name	Gemini 305
Max Power Configuration	Max disparity search range: 256 Depth: 1280 x 800 @ 30 fps Y16 IR Left & IR Right: 1280 x 800 @ 30 fps Y8 RGB: 1280 x 800 @ 30 fps YUYV AE: On Hardware Noise Removal: on
Average power consumption	1.88 W

*Note: The data in the above table are laboratory measurements and are for design reference only.

5.2.3 Storage and Powered Conditions

Table 5-1-3 Gemini 305 Storage and Powered Conditions

Condition	Description	Min	Max	Unit
Storage (Ambient), Not Powered	Long term storage	-10	60	℃
	Short exposure represents temporary max limits acceptable for transportation conditions	-20	70	℃

	Humidity	Temperature / RH: 40℃ / 90%		
Ambient, Powered	The camera ambient temperature when powered [1]	-10	45	℃
Backside Case Temperature, Powered	The maximum temperature of the backside case occurs when the camera is operated in an ambient temperature of 45°C	0	60	℃

Notes:

[1] For the Gemini 305, the allowable operating temperature range varies depending on the disparity search mode setting: when the disparity search mode is set to 128, the operating temperature range is -10 °C to 45 °C; when the disparity search mode is set to 256, the operating temperature range is -10 °C to 40 °C.

[2] If users require operation over a wider temperature range, additional thermal management measures need to be evaluated.

5.2.4 ESD Performance

Table 5-2-3 Gemini 305 ESD Performance

Conditions	Powered-On	Powered-Off	Certification Standards
Contact Discharge	±8KV Class A	±8KV Class A	EN 61000-6-2
Air Discharge	±15KV Class A	±15KV Class A	

5.3 Physical Performance

5.3.1 Ingress Protection

Table 5-1 Gemini 305 Ingress Protection Information

IP Rating	Protection Ability	Conditions	Reference Standard
IP54	① Prevents solid objects from entering the camera. ② Cannot completely prevent dust from entering the inside of the camera, but the dust that does enter does not affect normal operation.	When the Type-C receptacle is mated with a cable rated for IP54 protection and the connector is fully seated. The unmated receptacle is not ingress-protected. Do not operate or unplug under wet conditions.	IEC 60529:2013

6. Firmware

6.1 Firmware Update & Cautions

Gemini 305 supports update the firmware via online or location, you can upgrade or downgrade as needed.

Please note the following considerations:

1. You can update the firmware in any operating mode or preset;
2. All data streams must be closed when update the firmware;
3. During the firmware update, please ensure that the power supply and cable connections are stable;
4. The camera will automatically reboot after the firmware update is completed. You can also re-plug the cable after completion and reboot it manually.

6.2 How to Update Firmware

The simplest way to update the firmware is through the Orbbec Viewer tool, which supports both manual updates and online updates. For detailed instructions, please refer to the documentation: TBC

6.3 Recovery

Ensure the stability of cable during the update process to avoid any failure. If the update process fails, disconnect the cable, re-connect it, and update the firmware again. If re-burning is unsuccessful, the product may be damaged.

Orbbec assumes no liability for any damages or losses resulting from the use of this product.

7. SDK

Orbbec SDK is a flexible and modular platform for easy camera setup and runs on multiple platforms with a rich set of APIs. It supports camera access, device setup and configuration, data stream reading, processing, and viewing, RGB-D registration, and frame synchronization.

Its functions include:

- Access and control of camera devices
- Control of frame synchronization and alignment
- Acquisition of point cloud data
- Orbbec Viewer for camera testing and evaluation

Please visit Orbbec SDK for the latest SDK.

7.1 Temperature Sensor and Recording

The temperature of camera core components can be obtained, including ASIC temperature, ISP temperature and RGB sensor temperature, through API commands.

8. Use Guidance

8.1 Packing List

Table 8-1-1 Gemini 305 Package List

Packaging Type	Packaging List	Gemini 305	Notes
Bulk	Camera		Minimum batch packaging quantity: 200pcs
Box	Camera		Minimum batch packaging quantity: 30pcs
	1x USB-C to USB-A cable (1m)		
	1x Quick Start Guide		

8.2 Initialization and Operation

- Connect Gemini 305 via the USB cable to the host PC
- Download Orbbec SDK from Orbbec SDK
- Use Orbbec Viewer to validate that images can be streamed from all sensors with the following settings:
    - Depth stream: 1280 x 800(default configuration)
    - Color stream: 1280 x 800(default configuration)

The detailed quick start guide refers to the documentation: TBC

If for any reason that the camera is not responding or not being detected, please unplug the cable from the camera and replug the cable into the host PC for resetting the camera state.

9. Regulatory Compliance

These products are certified as follows:

9.1 EMC Regulatory Compliance

CE-Declaration	FCC part 15 Declaration of Conformity
CE	FC

9.2 Environment Regulatory Compliance

RoHS 2.0, REACH, WEEE, TSCA, TPCH, 94/62/EC

RoHS	REACH	WEEE
RoHS COMPLIANT	REACH compliant	
TSCA	**TPCH**	**94/62/EC**
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	PASS	PASS

10. System Integration Guide

Use outside of the specified conditions could cause the device to fail and/or function incorrectly. These conditions are applicable for the environment immediately around the device under all operational conditions. When used with an external enclosure, active temperature control and/or other cooling solutions are recommended to ensure the device is maintained within these ranges.

10.1 Installation Recommendations

1. When using external housing around the camera for dust proofing, use foam inserts or rubber gaskets between the front of the camera and the external housing.
2. Avoid external forces applied to the camera chassis during installation process.
3. Disassembling chassis will void the warranty.
4. For the detailed installation reference solution, please refer to Document: TBC

10.2 Heat Dissipation

1. Avoid direct heat source around the camera.
2. Maximizing the space inside the external housing may help lower operating temperature.

10.3 Cable Design Guide

1. It is recommended to use the included USB Type-C cable. If there is a need for longer cable, please select a USB-IF certified cable that supports both power and data (< = 3.0 m length is recommended).
2. For the detailed cable design guide reference solution, please refer to Document: TBC

11. Cautions

1. Follow the instructions carefully when operating the camera. Improper handling may lead to damage to the internal components.
2. Do not drop the camera or expose the camera to mechanical stress.
3. Do not attempt to modify the camera as such modifications may cause permanent damage or performance degradation.
4. The temperature of the camera may rise during long periods of use.
5. Do not touch the lens. Fingerprints on the lens may affect image quality.
6. Keep the product beyond the reach of children or animals to avoid accidents.
7. If the computer does not recognize the camera, verify that the cable meets the power and data transfer requirements, then replug it into the USB port to reconnect.

Safety and Handling Instructions:

●Avoid powering on the product if any external damage was observed.

●Do not attempt to open any portion of this product. There are no user serviceable parts.

●To maintain compliance and safety standards, do not modify or service the product. Unauthorized modifications or servicing could result in emissions surpassing the Class 1 safety level.

●Only update the camera firmware with official releases that match the specific module SKU and revision to ensure proper functionality and safety.

Appendix A Gemini 305 2D Mechanical Diagram