

Gemini 2

Datasheet v1.0

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1. Product Brief

Product Overview

The compact Gemini 2 3D camera, released in 2023, is based on Active Stereo IR technology and is equipped with Orbbec's latest custom ASIC for high quality depth processing, IMU, and single cable USB 3.0 power + connectivity. The wide FOV and the wide depth sensing range makes Gemini 2 adaptable for many applications, especially for robotics. It is easy to set up and operate with the Orbbec SDK and delivers extremely accurate and reliable data in various lighting conditions from pitch black to semi-outdoor.

Product Features:

- Wide Field of View at 91° Horizontal and 66° Vertical
- High quality depth data output from 0.15m to 10m
- Up to 30 fps at 1280X800 depth resolution
- USB Type-C for power and data connectivity
- Multi-camera synchronization and IMU supported

2. Product Specifications

Parameter	Specifications
Model	G20155-15
VID/PID	0x2BC5/0x0670
Technology	Active Stereo IR
Shutter Type	IR: Global Shutter; Color: Rolling Shutter
Wavelength	850nm

Product Specifications (continued from previous page):

Mode	Resolution	FoV	FPS	Range	Format
Unbinned Dense Default	1280 x 800	H 91° x V 66°	5, 10, 15, 30	0.15m - 10m (Optimal Range) 0.20m - 5.0m	Y16/Y14 /RLE
	640 x 400		5, 10, 15, 30		
	320 x 200		5, 10, 15, 30		
Unbinned Sparse Default	1280 x 800	H 91° x V 66°	5, 10, 15, 30	0.15m - 10m (Optimal Range) 0.20m - 5.0m	Y16/Y14 /RLE
	640 x 400		5, 10, 15, 30		
	320 x 200		5, 10, 15, 30		
Binned Sparse Default	640 x 400	H 91° x V 66°	5, 10, 15, 30, 60	(Optimal Range) 0.15m - 2.5m	Y16/Y14 /RLE
	320 x 200		5, 10, 15, 30, 60		
RGB	1920 x 1080	16:9 H 86° x V 55°	5, 10, 15, 30, 60		YUYV/ MJPEG
	1280 x 720	4:3 H 63° x V 50°	5, 10, 15, 30, 60		
	640 x 480		5, 10, 15, 30, 60		
	640 x 360		5, 10, 15, 30, 60		
<p>Depth Accuracy: ≤ 2% (1280 x 800 @ 2m & 81% ROI).</p> <p>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% of the top and bottom of the depth map).</p> <p>The root mean square of the distance sequence from all valid points in the area to the best-fit point of the fitted plane is calculated.</p> <p>Measure object reflectivity > 10%, up to 10m distance depth data, but the actual accuracy varies with the distance and the object to be measured.</p>					

Parameter	Specifications
Baseline	50mm
IMU	6 DoF; Frequency range: 50-2,000Hz; Data format: float
Mirror Mode	Supported, non-mirror by default
Processing	Internal processing using Orbbec MX6600 ASIC
Data Connection	USB 3.0 & USB 2.0 Type-C for data and power
Operating Modes	Unbinned Dense Default: High accuracy high quality depth data. Unbinned Sparse Default: Balanced depth accuracy and power consumption. Binned Sparse Default: Low power mode, supports 60fps, small blind zone.
Power Consumption	Average < 2.0W (Peak 7.0W)
Operating Environment	0° - 40°, 8%RH - 90 %RH (non-condensing), Indoor/ Semi-Outdoor
Anti-flicker	50Hz & 60Hz
Supported Functions	D2C, Multi-Camera Sync
Dimensions	90mm x 25mm x 30 mm
Weight	98g
Certifications	Class 1, RoHS, FCC, CE, Reach, KC
Installation	1 x ¼-20 UNC 2 x M3

3. Product Information

3.1 Product Images



Product Picture



Rear View

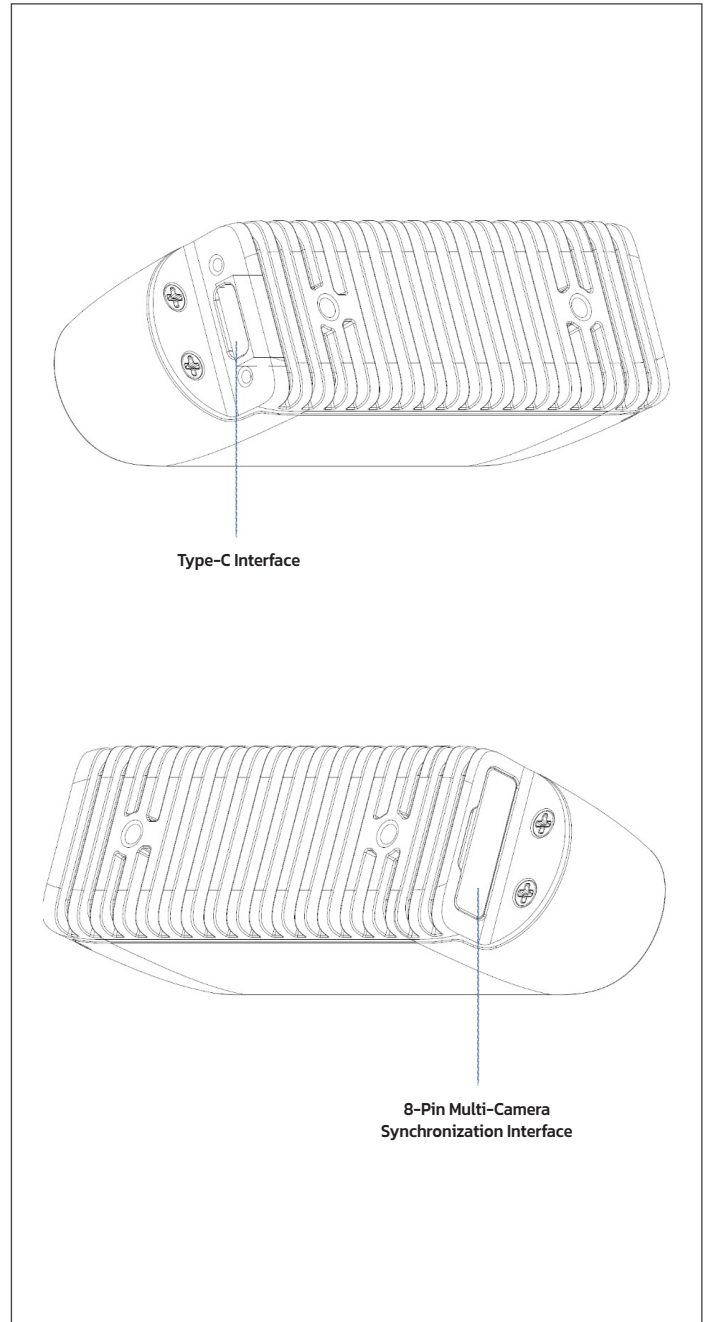
3.2 Product Components



Gemini 2 Components

3.3 Product Interfaces

The hardware interfaces of Gemini 2 camera are shown in the figure below.



4. Software Development Kit (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.

Included functions:

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

Please check <https://orbbec3d.com/developers/orbbec-sdk/> for the latest SDK.

Temperature sensor and recording

The temperature of camera core components — including laser temperature, IR sensor temperature, and IMU sensor temperature — can be obtained through API commands.

5. Camera Setup and Operation

Packing List

- Orbbec Gemini 2 device
- USB Type-C to USB Type-C data + power cable

Initialization and Operation

- Connect Gemini2 via the cable to the host PC.
- Download Orbbec SDK from <https://orbbec3d.com/developers/orbbec-sdk/>
- Use Orbbec Viewer to validate that images can be streamed from all sensors with the following settings:
 - Depth camera: Unbinned Dense Default, 1280x800
 - RGB Camera: 1080p
 - IMU enabled
- If for any reason that the camera is not responding or not being detected, please unplug all cables from the camera and replug to the host PC to reset the camera state.

6. Installation 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.

a. 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 the application of external forces to the camera chassis during the installation process.
3. Disassembling chassis and mounting brackets will void the warranty.

Installation Guide (continued from previous page):

b. Heat Dissipation

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

c. Transmittance Requirements

The current light transmission of the Gemini 2 front cover glass lens is as follows:

1. RGB (420~650nm) transmittance rate $\geq 91\%$
2. IR LDM (858 ± 20 nm) transmittance rate $\geq 92\%$
3. LDP (940nm ± 30) transmittance rate $\geq 92\%$

Before changing the structural design of the camera, the protective lens in front of the camera lens must meet the requirements above.

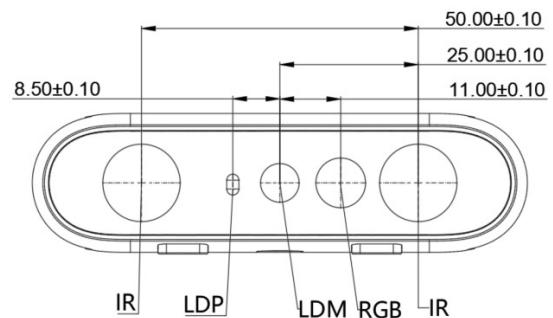
d. Cable Design Guide

It is recommended to use the included USB Type-C cable. If a longer cable is needed, please select a USB certified cable that supports both power and data (1-1.5m length is recommended).

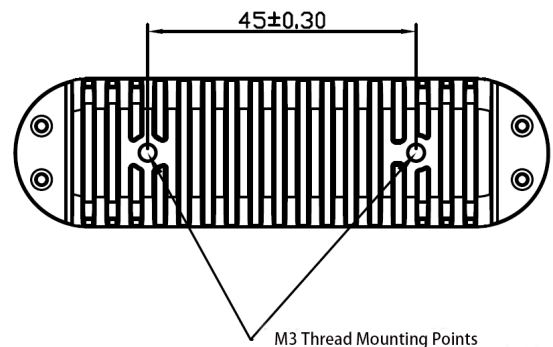
7. Safety and Handling

1. Follow the instructions to operate the camera. Improper operation may cause damage to internal components.
2. Do not drop or hit the camera with external force.
3. Do not attempt to modify the camera as such modifications may cause permanent damage or inaccuracy.
4. The temperature of the camera may increase during long periods of continuous usage.
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 camera is not recognized by the computer, check if the cable meets the power/data transfer requirements and reinsert the USB cable for reconnection.
8. This product uses a Class 1 laser. Looking at the laser for more than 20s is not recommended.

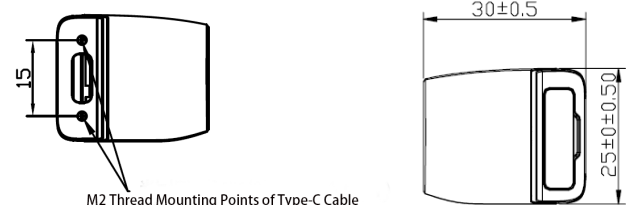
8. Product Drawings



Front View



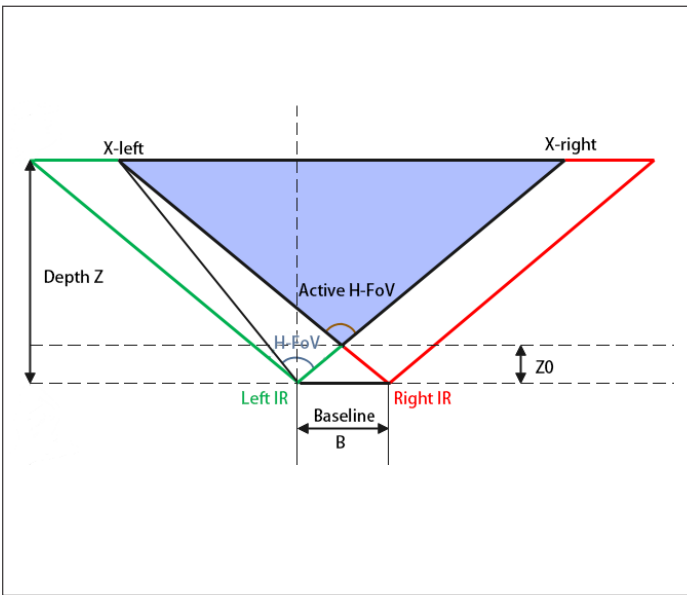
Bottom View



Side View

9. Principles of Depth Field of View

The image below shows the depth camera field-of-view, or the angles that the sensors “see”. This diagram shows the IR camera.



Depth Field of View (Depth FOV) at any distance (Z) can be calculated using the following equation:

$$ZO = (B/2) / \tan(\text{ActiveH-FoV} / 2)$$

$$H\text{-FoV} = \arcsin(cx/fx - B/Z) + \arcsin((\text{width} - 1 - cx)/fx)$$

$$\text{Active H-FoV} = \arcsin(cx/fx) + \arcsin((\text{width} - 1 - cx)/fx)$$

Definitions:

1. cx = X-direction image coordinates of the main point of the depth image
2. fx = Depth camera focal length
3. width = Depth image width
4. Active H-FoV = IR H-FoV

Note: cx , fx , and width parameters are obtained through the SDK Depth Intrinsic for the relevant camera parameters, and each 3D camera parameters are not the same.

10. Multi-Camera Synchronization

Advantages of multi-camera setup

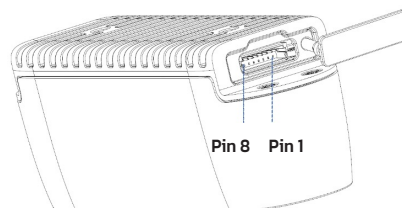
- Increase camera coverage in the given space and fill in the occlusions where a single camera may have blind spots.
- Capture multiple images of the same scene and scan objects from different angles.
- Increase the effective frame rate to greater than 30 frames per second (FPS).

Using an 8-pin connector and matching cable, a multi-camera and multi-sensor network can be designed. (Please follow the instructions in the SDK).

Multi-camera frame synchronization in two topologies, including depth image synchronization and RGB image synchronization (time difference $\leq 3\text{ms}$, when auto exposure off), using the multi-camera synchronization function.

Synchronization Interfaces of Gemini 2 Camera

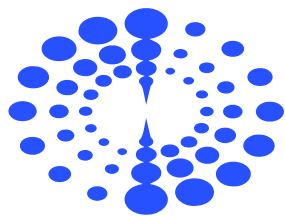
Pin	Definitions	Description
Pin_1	VCC	The default electrical level setting is 1.8V; when 3.3V or 5V drive voltage is provided on the VCC interface, the I/O level setting can be adjusted to 3.3V or 5V as required
Pin_2	GPIO_OUT	Synchronization drive signal: Active high. The high-level interval coincides with the IR exposure time. Typical application is to drive external fill light.
Pin_3	VSYNC_OUT	Synchronous trigger signal: Active high. The high level provides the triggering signal for the secondary devices.
Pin_4	TIMER_SYNC_OUT	Pulse signal source, reset hardware timestamp of secondary devices.
Pin_5	RESET_IN	Hardware reset signal: Triggers the camera to power down and automatically power up and reset. Detect the input signal: 20Hz / 50% duty cycle / more than 5 consecutive cycles, that is, judged as normal input signal, other signals filtered out; allowed fluctuations for frequency $\pm 1\text{Hz}$, duty cycle $\pm 2\%$.
Pin_6	VSYNC_IN	Synchronous trigger signal: Active high, used for the triggering/sync signal from primary device, with a duration of 1MS
Pin_7	TIMER_SYNC_IN	Hardware timestamp reset signal input, hardware timestamp clearing
Pin_8	GND	Ground



**The Pin sequence is shown with camera placed in rear view.*

11. Glossary of Terms

Term	Definition
D2C	Depth to Color function maps each pixel on depth map to the corresponding color image according to the intrinsic and extrinsic parameters of depth camera and color camera.
Depth	Depth video streams are like 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 only, of which the former is generally composed of infrared projector, infrared camera and depth computing processor.
FOV	Field of View (FoV) describes the angular extent of a given scene that is captured by a camera, which can be measured in horizontal, vertical, or diagonal.
I2C	I2C bus refers to a kind of simple bidirectional two-wire synchronous serial bus developed by Philips. It can be used for transferring information among devices connected to the bus with two wires.
IR Camera	Infrared camera.
IR Flood	IR floodlights are used to illuminate the environment.
ISP	Image Signal Processor, which is used for image post-processing.
MIPI	Mobile Industry Processor Interface (MIPI) is an open standard and specification formulated by the MIPI Alliance for mobile application processors.
PCBA	Circuit board consists of depth computing processor, memory, and other electronic devices.
Point Cloud	A point cloud is a discrete set of data points in space.
SoC	System on Chip, integrated circuit (IC) that integrates all components of a computing system.
TBD	To Be Determined. In the context of this document, information will be available in a later revision.



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