ORBBEC

Gemini 335Lg

Datasheet v1.0

Revision History

Version	Description	Revision Date
V1.0	● Gemini 335Lg datasheet release	2024-10-18

Contents

Glossary of terms

Terms	Descriptions
AMR	Autonomous Mobile Robot (AMR) refers to a type of robot that can navigate and perform tasks autonomously. Equipped with sensors and control systems, AMRs can move and operate in complex environments without human intervention
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.
FAKRA	FAKRA (Fachkreis Automobil) connectors are a specialized type of RF (Radio Frequency) connectors designed for automotive applications.
GMSL	GMSL (Gigabit Multimedia Serial Link) is a high-speed communication protocol developed by Maxim Integrated (now part of Analog Devices) to transmit multimedia data over a single, thin coaxial cable or shielded twisted pair (STP).
I2C	Refers to a simple bi-directional two-wire synchronous serial bus developed by Philips.
IMU	Inertial measurement unit
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
IR Flood	IR floodlights are used to illuminate the environment without a pattern

ISP	Image signal processor, which is used for image post-processing
LDM	Laser Diode Module
LRM	Laser Ranging Module
MIPI	Mobile Industry Processor Interface (MIPI) Alliance. MIPI is an open standard and specification formulated by the MIPI Alliance for mobile application processors
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 Module	Color Camera Module
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.
VCSEL	Vertical-Cavity Surface-Emitting Laser (VCSEL) is a type of semiconductor laser where the laser light is emitted perpendicular to the surface of the device.
TBD	To Be Determined. Information will become available in a later revision.

1. Product Brief

Gemini 335Lg is a superstar member of the Gemini 330 series of Depth+RGB cameras. On the basis of Gemini 335L's excellent depth effect and performance, it adds a GMSL2 serializer and FAKRA-Z connector, making it the best choice for autonomous mobile robots (AMR) and robotic arms to adapt to complex environments and maintain stable and efficient operation.

Gemini 335Lg is easy to set up and operate with the Orbbec SDK on diverse platforms, including different deserialization chips, carrier boards, deserialization boards and computing boxes. Orbbec provides complied drivers for NVIDIA Jetson AGX Orin & AGX Xavier Developer Kit.

Gemini 335Lg is supported to work in two modes for USB & GMSL(MIPI), which is controlled by toggle switch beside the 8-pin sync port. The default working mode is GMSL. Customer can get high-quality streams by GMSL2 / FAKRA while making multi-device sync possible.

- Active / passive stereo ensures reliable performance in dynamic environments
- Depth Measurement Accuracy: A Spatial Precision of less than 0.8% for depth measurements at 2m
- Wide FOV: 90° horizontal and 65° vertical
- Outdoor and indoor operating with IP65 rating
- Support industrial grade certification standards
- Support up to 15m cable length for extended reach
- Seamless multi-camera sync via GMSL
- Reliable and stable connections

Detailed Product Documentation: Gemini 330 series documentation

2. Product Specifications

Parameter	Gemini 335Lg
Use Environment	Indoor & Outdoor
Technology	Stereo Vision
Baseline	95mm
LDM Wavelength	850nm
Working Range	0.17 -20m+ [1]
Ideal Range	0.25 - 6m
Min-Z	0.25m @1280 x 800 & 1280 x 720 & 640 x 400 0.34m @848 x 480 & 848 x 100 0.30m @640 x 480 0.26m @ 640 x 360 0.19m @ 480 x 270 0.17m @ 424 x 240
Spatial Precision	≤ 0.8% (1280 x 800 @ 2 m & 90% x 90% ROI) [2] ≤ 1.6% (1280 x 800 @ 4 m & 80% x 80% ROI) [2]
Depth Resolution @ Frame Rate	Up to: Aspect ratio 16:10 1280 x 800 @ 30fps Aspect ratio 16:9 848 x 480 @ 60fps Aspect ratio 4:3 640 x 480 @ 60fps
Depth FOV	Aspect ratio 16:10 90° x 65° ± 3° @ 2m Aspect ratio 16:9 90° x 60°± 3° @ 2m Aspect ratio 4:3 81° x 65°± 3° @ 2m
Depth Filter	Cover Glass: All-Pass IR Module Filter: Visible + NIR-Pass
Sensor Type	Depth: Global Shutter RGB: Global Shutter
RGB Resolution @ Frame Rate	Up to: Aspect ratio 16:10 1280 x 800 @ 60fps Aspect ratio 16:9 1280 x 720 @ 60fps Aspect ratio 4:3 640 x 480 @ 60fps
RGB FOV	Aspect ratio 16:10 94° x 68° ± 3° Aspect ratio 16:9 94° x 62° ± 3° Aspect ratio 4:3 82° x 68° ± 3°
IMU	6 DoF; Gyroscope/Accelerometer Sample range: 50/100/200/500Hz

Depth Processing	In-camera processing using Orbbec MX6800 ASIC
Interface	GMSL2/FAKRA-Z & USB Type-C
Power Supply	FAKRA-Z: ≥0.5A @12V [3] USB Type-C: ≥1.5A @5v
HDR Depth	Support
Operating Environment	-10℃ - 50℃ @ 15fps, -10℃ -45℃ @ 30 / 60fps [4], 5% ~ 90 % RH (non-condensing)
Operating Backside Case Temperature	-10℃ - 60℃
Long Term Storage	0℃ - 60℃
Short Term Exposure	-20 ℃ - 70 ℃
Ingress Protection	IP65[5]
Supported Functions	Hardware depth & color alignment Hardware timestamp Multi-device synchronization
Dimensions (W x H x D)	124mm x 29mm x 36mm ±0.3mm
Weight	164g ±3g
Installation	Bottom：1 x 1/4-20 UNC, Depth 8mm, Max Torque: 4.0N.m Back：2 x M4 screws, Depth 6mm, Max Torque: 0.4N.m
Lifespan	5 Years: Default Operating Mode & Typical Environment [6]
Certification	Laser Safety: Class 1 & FDA EMC: CE, FCC, UKCA Environment: RoHS 2.0, REACH, WEEE, TSCA, TPCH,94/62/EC

[1] Theoretical maximum depth ranges up to 65 meters;

[2] Data is measured during factory calibration;

[3] Default configuration: laser power level 4;

[4] The Gemini 335Lg, when running at 30 fps or 60 fps, consumes significantly more power than at 15 fps, so the maximum allowable operating temperature is reduced from 50C to 45C;

[5] Gemini 335Lg requires the use of IP65-compliant cables during powered operations to achieve IP65 protection;

[6] No more than 16h working per day.

3. Product Information

3.1 Product Pictures

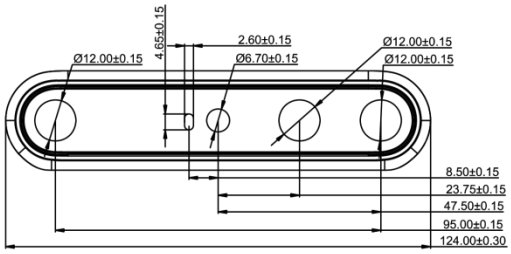
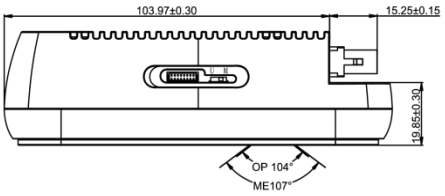
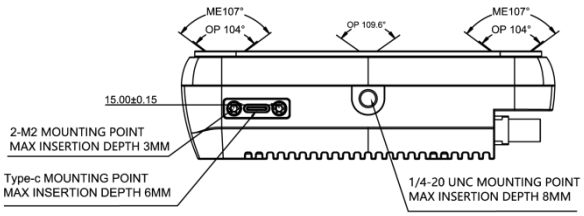
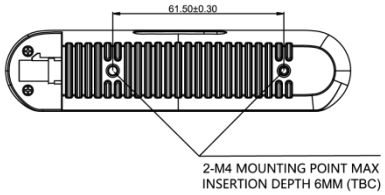
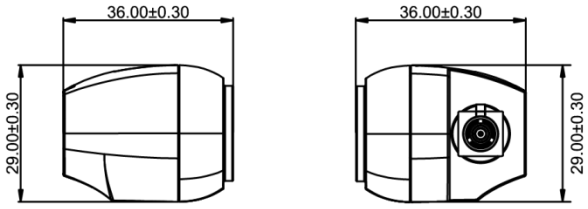
Table 3-1-1 Product pictures for Gemini 335Lg

Front View		Bottom View	
Top View		Back View	
Top View Without Cap		Side View	
Rear View With Cap		Rear View Without Cap	

3.2 Product Drawings

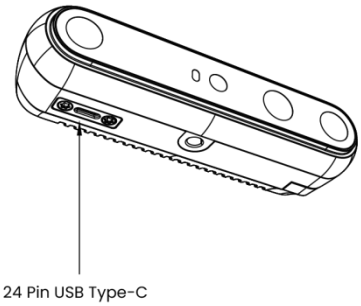
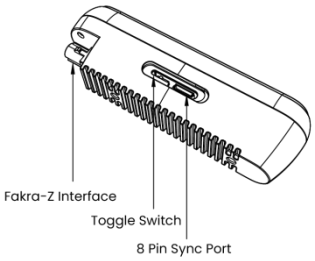
3.2.1 Product Drawings for Gemini 335Lg

Table 3-2-1 Product drawings for Gemini 335Lg

Front View	
Top View	
Bottom View	
Back View	
Side View	

3.3 Product Interfaces

Table 3-3-1 Product interfaces for Gemini 335Lg

USB Type-C	
FAKRA-Z & 8-pin Sync Port	

FAKRA (Fachkreis Automobil, a german standard) connectors are SMB based automotive-grade connectors that can operate up to 6 GHz. These connectors are embedded within a plastic housing with a locking feature that has an audible clicking noise which lets you know a connection has been made. They are available in 14 different mechanical layouts which are color coded for easy identification and mis-matching prevention. Orbbec Gemini 335Lg is equipped with FAKRA-Z connector.

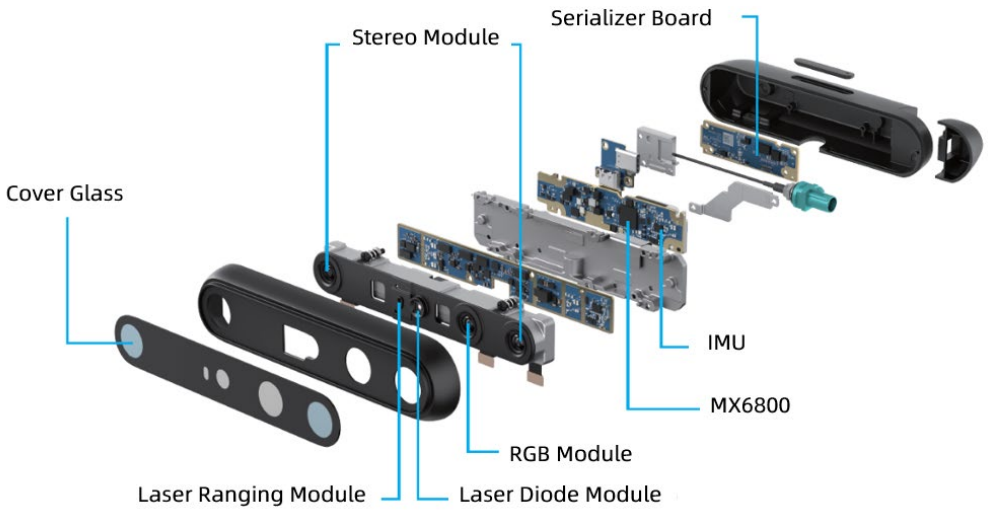
Detailed information is referred from RF Connectors - everything RF.

Top View	Side View	Back View
		

3.4 Product Components

3.4.1 Overview of Product Components for Gemini 335Lg

Table 3-4-1 Overview of product components for Gemini 335Lg

Exploded View	

3.4.2 Laser Diode Module (LDM)

The laser diode module (LDM) comprises an array of vertical cavity surface emitting lasers (VCSEL) and optical components. It enhances the depth camera system's ability to detect depth information by projecting static infrared patterns onto the scene, adding texture to low-quality scenes. Gemini 335Lg is a Class 1 Laser Product under normal conditions.

Table 3-4-2 LDM Specifications

LDM	**Gemini 335Lg**
Type	Infrared
Component	Vertical Cavity Surface Emitting Laser (VCSEL) + Optics
Laser Controller	Pulse
Wave length	850nm ±6nm
Laser Compliance*	Class 1 (IEC 60825-1:2007 Edition 2, IEC 60825-1:2014 Edition 3) FDA number: 2420619-000

Laser Power-down Temperature	73℃*
Horizontal FOV	101°
Vertical FOV	72.5°
FOV Tolerance	±3.0°

Note: * LDM is considered Class 1 when integrated into ORBBEC 's 3D Cameras.

*LDM will power down while the NTC tested temperature is ⩾73℃.

3.4.3 Infrared Module

Table 3-4-3 Infrared Module Specifications

Filter Type	Visible + NIR-Pass Filter
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%

3.4.4 RGB Module

Table 3-4-4 RGB module parameters

RGB Module	**Gemini 335Lg**
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%

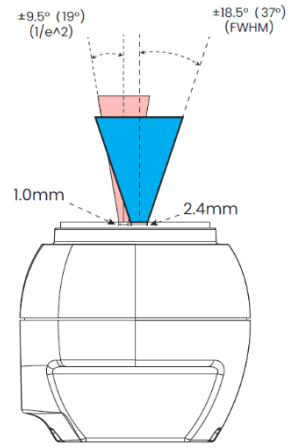
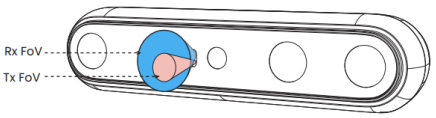
3.4.5 Laser Ranging Module (LRM)

Gemini 335Lg is equipped with a single-point laser ranging module (LRM). Essentially, it is a single-point dToF (direct time-of-flight) sensor that calculates relative distance by measuring the time it takes for light to travel from emission to reception. It is used for close-range ranging, helping the 3D camera to fill in blind spots at short distances and enhances the overall ranging performance of the depth camera.

Table 3-4-5 Gemini 335Lg LRM Ranging Accuracy Reference Value

	Distance	Value	Unit
LRM Accuracy	1mm — 100mm	±15	mm
	100mm — 200mm	±10	mm
	200 mm — 400mm	±5%	/

Table 3-4-6 Gemini 335Lg LRM FOV

Side View	Side View	Rear View
		

3.4.6 IMU

Table 3-4-7 Gemini 335Lg IMU Specifications

IMU		Gemini 335Lg
Timestamp Unit		us
Clock Source		Camera Clock
Transmission Protocol		I2C
X/Y/Z Axis		The X, Y, and Z axis point right, downward, and forward relative to the camera front
Gyroscope	Format	3 x 32-bit float
	Range	±17.45 rad/s (1000dps)
	Frequency (Hz)	50/100/200/500
Accelerometer	Format	3 x 32-bit float
	Range	± 39.2m/s² (4g)
	Frequency (Hz)	50/100/200/500*
Temperature	Format	1 x 32-bit float
	Range	-40 ~ 85℃
	Frequency (Hz)	Follows the gyroscope and accelerometer frequency

*If two Gemini 335Lg are connected to the same MAX9296A deserializer chip and IMU is streamed simultaneously, the maximum frame rate of IMU must be limited to 200 hz.

4. Functional Specifications

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

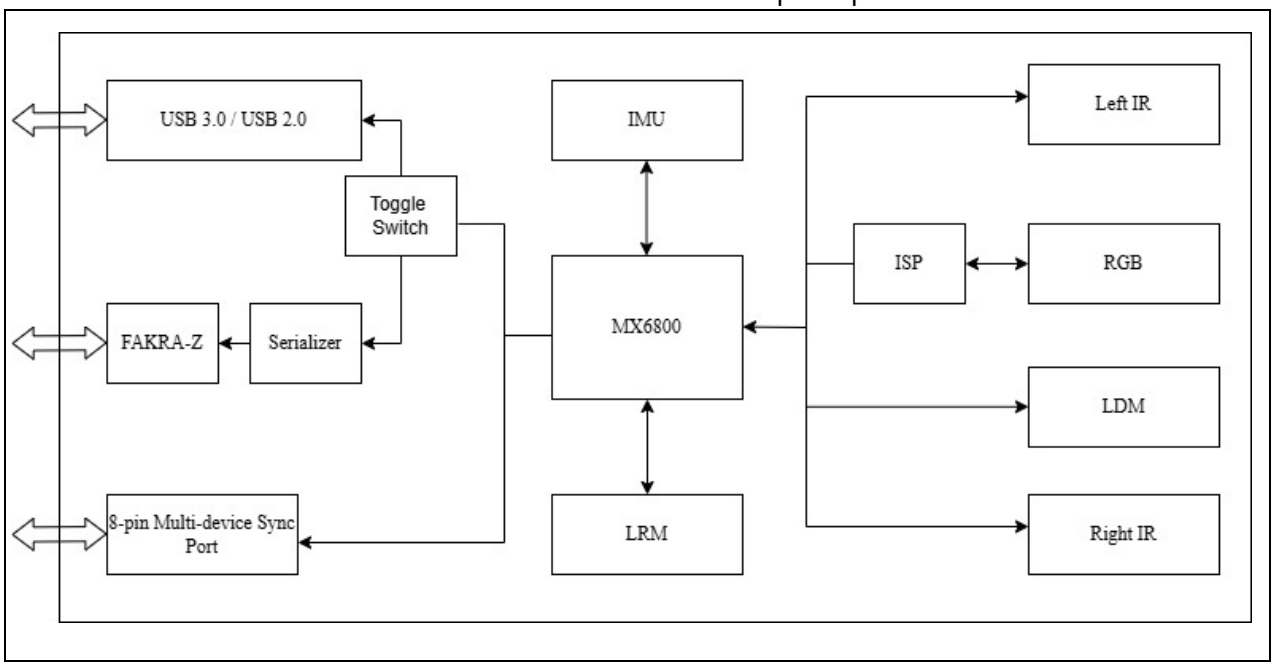
Table 4-1-1 Gemini 335Lg device ID

Model	G40055-270
PID	0x080B
VID	0x2BC5

4.2 System Schematic

Gemini 335Lg applies advanced GMSL2 protocol to transmit data, and the host must be supported to deserialize GMSL2 data. The transmission principle and typical models are shown in the table below:

Table 4-2-1 Transmission principle



4.3 Image Data Streams

Gemini 335Lg provides high-quality, multi-resolution depth stream data, as well as high-definition color stream data. The camera outputs depth stream data in Y16 format. The color stream data output by the camera is in YUYV format via GMSL, and the data output is YUYV / MJPEG via USB. The SDK supports output in YUYV / RGB8 / BGR8 / RGBA8 / BGRA8 / Y16 formats. The camera outputs IR image data in Y8 format, and the SDK also supports outputting data in Y12 & Y16 format.

Table 4-3-1 Output data streams in GMSL mode

Gemini 335Lg (GMSL Mode)	Format	Aspect Ratio	Resolution	Frame Rate
Depth	Y16	16:10	1280 x 800	5, 10, 15, 30
			640 x 400	5, 10, 15, 30
		16:9	1280 x 720	5, 10, 15, 30

			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
		Other	848 x 100	100
IR	Y8	16:10	1280 x 800	5, 10, 15, 30
			640 x 400	5, 10, 15, 30
		16:9	1280 x 720	5, 10, 15, 30
			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
		Other	848 x 100	100
RGB	YUYV	16:10	1280 x 800	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30, 60
			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60

Table 4-3-2 Output data streams in USB mode

Gemini 335Lg (USB 3.0)	Format	Aspect Ratio	Resolution	Frame Rate
Depth	Y16	16:10	1280 x 800	5, 10, 15, 30
			640 x 400	5, 10, 15, 30
		16:9	1280 x 720	5, 10, 15, 30
			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60
		Other	848 x 100	100
IR	Y8	16:10	1280 x 800	5, 10, 15, 30
			640 x 400	5, 10, 15, 30
		16:9	1280 x 720	5, 10, 15, 30
			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60

		4:3	640 x 480	5, 10, 15, 30, 60
		Other	848 x 100	100
	Y12 / Y16	16:10	1280 x 800	5, 10, 15, 25
			640 x 400	5, 10, 15, 25
RGB	YUYV / MJPEG	16:10	1280 x 800	5, 10, 15, 30, 60
			640 x 400	5, 10, 15, 30, 60
		16:9	1280 x 720	5, 10, 15, 30, 60
			848 x 480	5, 10, 15, 30, 60
			640 x 360	5, 10, 15, 30, 60
			480 x 270	5, 10, 15, 30, 60
			424 x 240	5, 10, 15, 30, 60
		4:3	640 x 480	5, 10, 15, 30, 60

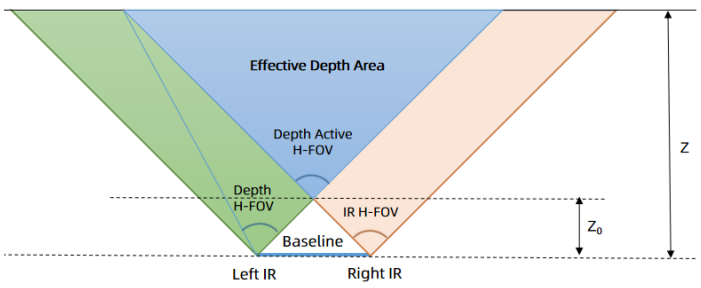
4.4 Field of View

4.4.1 Depth Working Principle

Gemini 335Lg is a depth camera that utilizes active & passive stereo 3D imaging technology. The LDM projects structured light patterns onto the target scene, while the left and right IR modules acquire the corresponding images. These images are then processed by the depth computation processor using an algorithm to produce a depth image of the scene.

Due to the same imaging FOV of the left and right IR modules, but with different assembly positions, the common FOV (Depth FOV) at different distances is also different. The formula in the following chart can be used to calculate the FOV at each distance

Table 4-4-1 FOV illustrations & formula

Illustration of Depth FOV	Formula
	$\text{Depth } H\text{-}FOV = \arctan\left(\frac{cx}{fx} - \frac{B}{Z}\right) + \arctan\frac{width\text{-}1\text{-}cx}{fx}$
	$\text{Depth Active } H\text{-}FOV = \arctan\left(\frac{cx}{fx}\right) + \arctan\frac{width\text{-}1\text{-}cx}{fx}$
	$Z_0 = \frac{B}{2 * tan(\frac{Depth\ Active\ H-FOV}{2})}$
	$\text{Depth } V\text{-}FOV = \arctan\left(\frac{cy}{fy}\right) + \arctan\frac{height\text{-}1\text{-}cy}{fy}$

Definitions:

1. cx = x coordinates of the principal point of the depth image
2. cy = y coordinates of the principal point of the depth image
3. fx = fy = Depth camera focal length
4. width = Depth image width
5. height = Depth image height
6. H-FOV = IR H-FOV
7. cx, cy, fx, fy and width, height parameters are obtained through the SDK Depth Intrinsic for the relevant camera parameters, and each depth camera parameter is not the same.
8. At different distances, the depth FOV is different. The farther the distance, the greater the depth FOV.

4.4.2 Typical Depth Intrinsics

Gemini 335Lg supports outputting multiple data streams with different image aspect ratios, and the intrinsics vary at different resolutions. Please refer to the table below for typical intrinsics parameters:

Table 4-4-2 Typical intrinsics of Gemini 335Lg

Baseline / mm	Resolution		cx / pixel	cy / pixel	fx & fy / pixel
	Width/pixel	Height/pixel			
95	1280	800	640	400	620.00
	1280	720	640	360	620.00
	848	480	424	240	410.75
	848	100	424	50	410.75
	640	480	320	240	372.00
	640	400	320	200	310.00
	640	360	320	180	310.00
	480	270	240	135	232.50
	424	240	212	120	205.40

4.4.3 Overview of Stream FOV

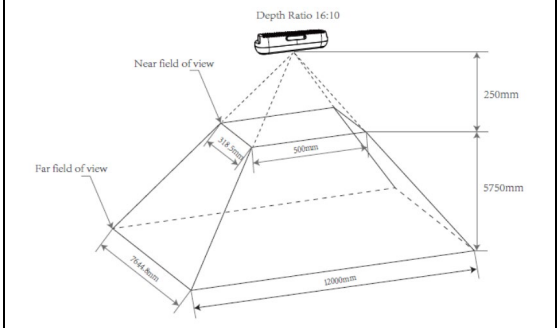
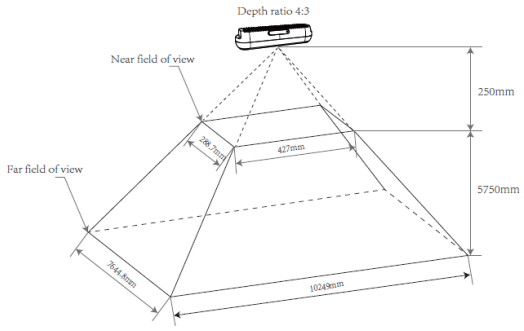
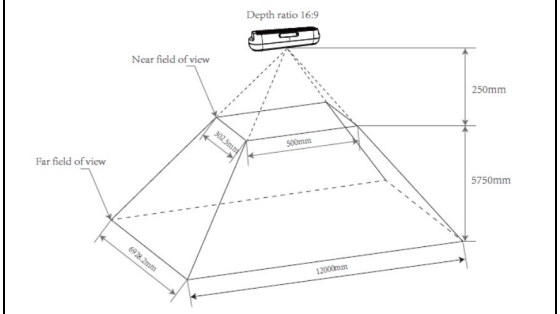
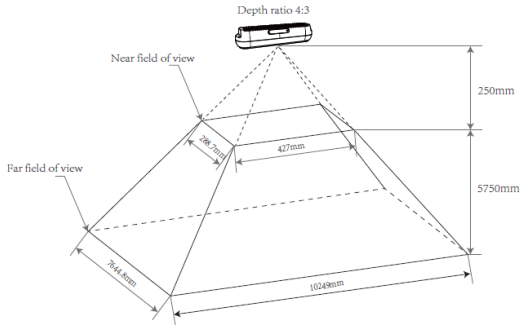
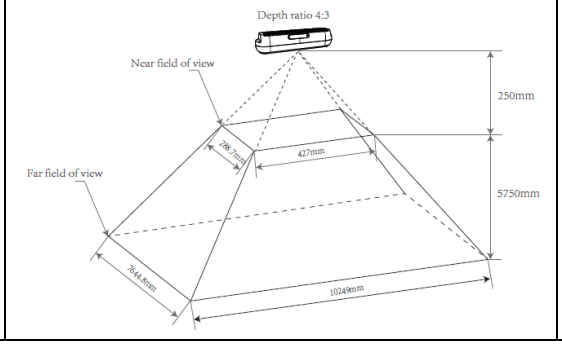
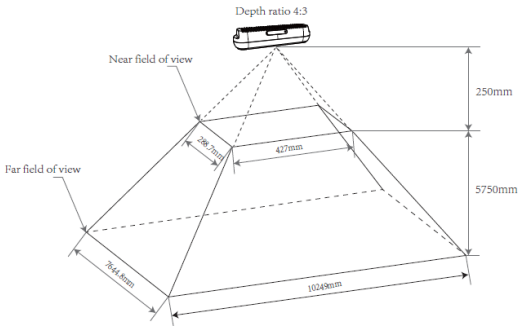
Table 4-4-3 Stream FOV

	Image Ratio	Gemini 335Lg
Depth @2m	16:10	H 90° V 65°
	16:9	H 90° V 60°
	4:3	H 81° V 65°
	848x100	H 90° V 14°
IR	16:10	H 91° V 65°
	16:9	H 91° V 60°
	4:3	H 81° V 65°
	848x100	H 91° V 14°
RGB	16:10	H 94° V 68°
	16:9	H 94° V 62°
	4:3	H 82° V 68°
D2C FOV	16:10	H 90° V 65°
	16:9	H 90° V 60°
	4:3	H 81° V 65°

4.4.4 Gemini 335Lg FOV Illustrations

Table 4-4-4 D2C FOV Illustrations

Aspect Ratio	Depth FOV	D2C FOV

16:10		
16:9		
4:3		

4.5 Coordinate Systems

For the Gemini 335Lg, 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 RGB module is positioned to the left of the LDM module.

The origin of the IMU coordinate system is situated at the physical sensor center point. The accelerometer and gyroscope coordinate systems are located at the back of the left IR. 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 is at the optical center of the left IR module, while the origin of the color image coordinate system is at the optical center of

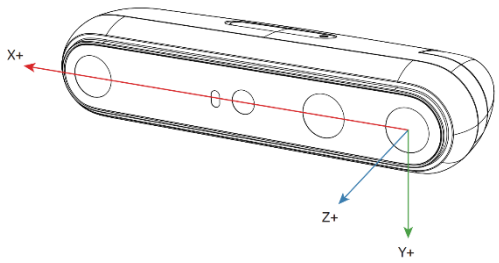
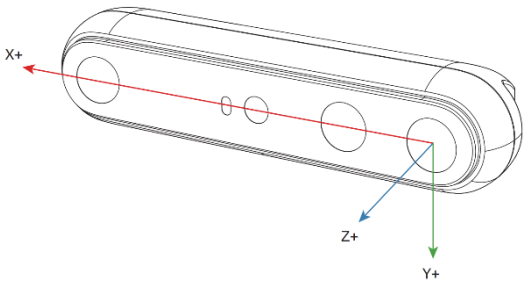
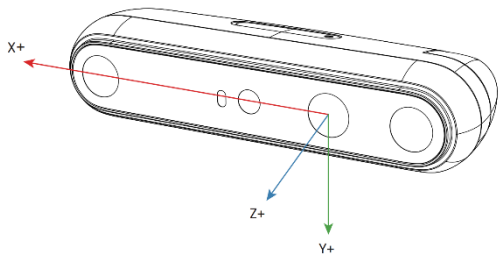
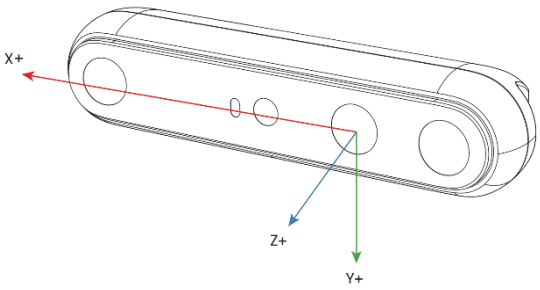
the RGB module. The direction of the coordinate systems is the same: the positive X-axis points to the right, the positive Y-axis points downward, and the positive Z-axis points forward. The depth camera coordinate system origin is the default origin of the 3D camera, with coordinates (0,0,0). The reference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

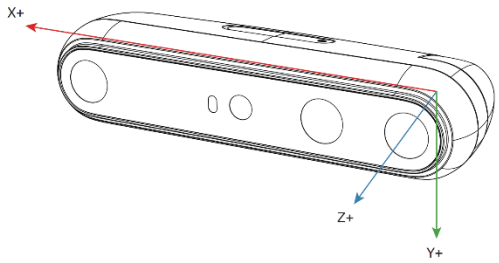
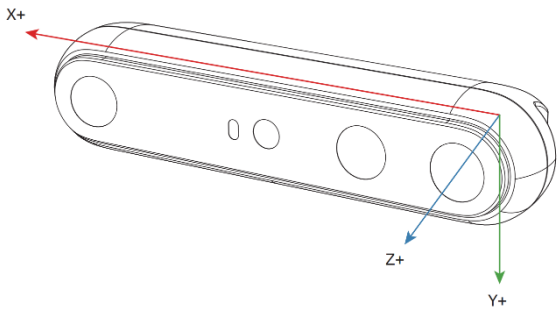
Table 4-5-1 Gemini 335Lg Coordinate System Position Reference

Camera	Coordinate System	Position in the 3D camera coordinate system		
		X（mm）	Y（mm）	Z (mm)
Gemini 335Lg	Depth	0	0	0
	Color	23.75	0	0
	IMU	7.866	1.068	-14.248

If the depth & color alignment is enabled, the depth coordinate system origin will be changed to color coordinate system origin.

Table 4-5-2 Gemini 335Lg Coordinate System Schematic

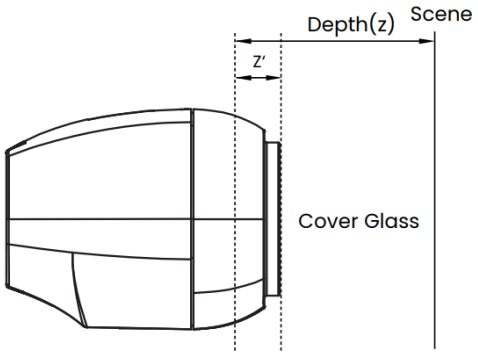
	Gemini 335Lg	Gemini 335L
Depth		
RGB		

IMU		

4.6 Depth Start Point (Ground Zero Reference)

The depth Start Point or the Ground Zero Reference can be described as a start point or plane with depth = 0. For Gemini 335Lg, the distance of the depth start point relative to the front face of the cover glass are listed in the table below.

Table 4-6-1 Depth Start Point Illustrations

Reference Point Position (Z')	**4.080mm**
	

4.7 Streaming Mode

Gemini 335Lg offers users flexible methods for acquiring IR, Depth, and RGB image data, with the most common being the specific frame rate trigger mode. In this mode, users set a target frame rate, resolution, and image format for each type of data, and then activate the corresponding data streams in sequence. The camera captures and outputs image data at the user-defined target frame rate, resolution, and image format. The user can select a specific frame rate for the current scene from

predefined fixed frame rate values of 5fps/6fps, 10fps, 15fps, 30fps, and 60fps, depending on the camera's currently configured depth mode and resolution, and capture image data at that frame rate.

4.8 Triggering Mode

Gemini 335Lg supports image data acquisition methods based on specific frame rates, as well as a free trigger mode that supports arbitrary frequencies. In this mode, the camera waits for an external input trigger signal and only completes an image data acquisition after receiving a valid external trigger signal, as configured by the camera. The camera then continues to wait for the next external trigger signal. As there is no set time limit between two consecutive triggers, but only a single acquisition time greater than that of the camera, it is possible to control the time interval between two consecutive triggers to achieve any desired frequency. This allows for passive acquisition of trigger image data. The camera can be triggered through a soft signal sent by the host computer via USB command or an external device through the 8-Pin synchronous interface. This allows for passive trigger mode at any frequency.
In free trigger mode, the camera's IR, Depth, and RGB fixed frame rates must be set to a uniform value of 5fps/6fps, 10fps, 15fps, 30fps, or 60fps upon request. This is necessary to determine the minimum time interval between two consecutive active triggers. Table 5-6-1 shows the relationship between the fixed frame rate, the minimum time interval, and the upper frequency limit for passive triggering. In summary, the camera will only respond to trigger signals within the allowable range. This means that the trigger frequency can be any value within the valid frequency range for passive triggering.

Table 4-8-1 Table of Arbitrary Frame Rates Allowed to be Passively Triggered

Set The Camera's Fixed Frame Rate (fps)	Min interval between consecutive triggers (ms)	Supported Trigger Frequency (Hz)
60	≥33.3	0 - 30
30	≥ 66.6	0 - 15
15	≥ 133.3	0 - 7.5
10	≥100	0 – 5
5	≥ 400	0 – 2.5

4.9 Multi-device Synchronization

Gemini 335Lg is designed to be used in a system that needs multi-devices, often the streams from different cameras need to be synchronized. There are two methods that users can choose to HW sync multiple Gemini 335Lg cameras and other devices. One is sending sync signal through GMSL2 GPIO; the other is through the 8-pin connector with sync cable. The benefit of GMSL sync is simpler wiring & more stable system.

Table 4-9-1 Topologies schematic diagram

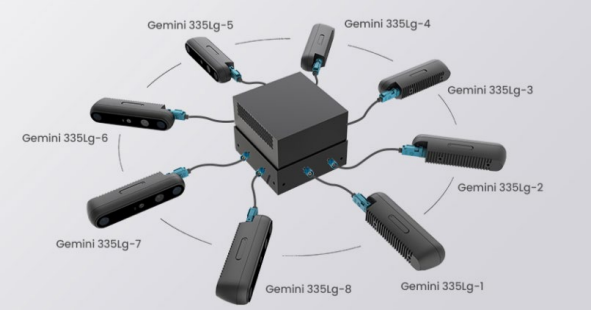
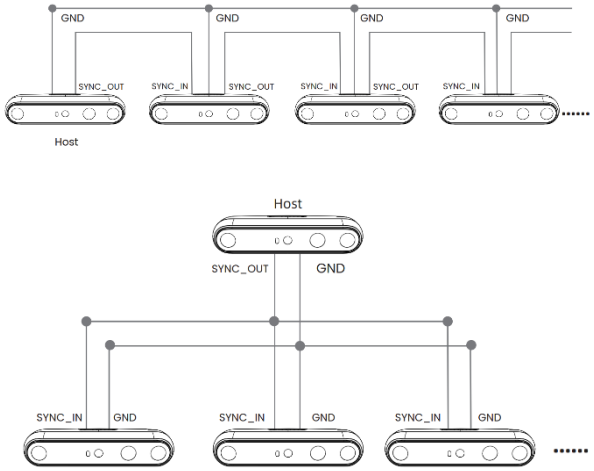
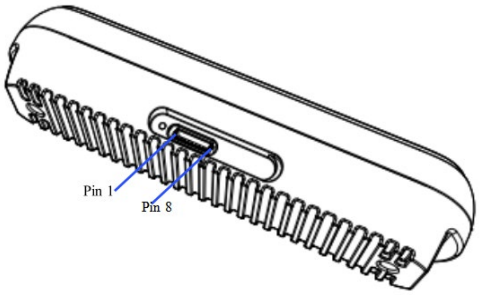
Sync Via GMSL2 FAKRA	Sync Via 8-pin Port
	

Table 4-9-2 8-pin Synchronization Interfaces of Gemini 335Lg

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: 20 Hz / 50% duty cycle / more than 5 consecutive cycles, that is, judged as normal input signal, other signals filtered out; allowed fluctuations for frequency ± 1 Hz, duty cycle ± 2%.
Pin_6	VSYNC_IN	Synchronous trigger signal: Active high, used for the triggering/sync signal from primary device, with a duration of 1 ms.
Pin_7	TIMER_SYNC_IN	Hardware timestamp reset signal input, hardware timestamp clearing.
Pin_8	GND	Ground



Gemini 335Lg Multi-device Synchronization Pin Placement.

Detailed operating instructions for multi-camera synchronization, please refer the document of Set up cameras for external synchronization

4.10 Camera Settings

Table 4-10-1 Gemini 335Lg Depth Camera Settings

Item	Settings	Notes
Mirror	On, Off	Default Off
Flip	0°, 90°, 180°, 270°	Default 0°
Laser Power Level	0,1,2,3,4,5,6	Default 4
Laser Status	Laser On, Laser Off, Laser On-Off, Off-On, Off	Default Laser On

Auto Exposure	On, Off	Default On
AE Max Exposure	0 - 92825	Default 92825(10fps)
Mean Intensity Set Point	0 – 255	Default 60
Exposure Time	0 – 19900	Configured When AE is off
Gain	16 -248	Configured When AE is off
Depth Unit / mm	0.001 – 10	Default 1
AE Priority	On, Off	Default On
HDR	On, Off	Default Off
Disparity to Depth	Hardware, Software, Disabled	Default Hardware
Post Processing	On, Off	On

Table 4-10-2 Gemini 335Lg RGB Camera Settings

Item	Settings	Notes
Mirror (Except MJPEG)	On, Off	Default Off
Flip (Except MJPEG)	0°, 90°, 180°, 270°	Default 0°
AE Priority	On, Off	Default Off
Auto Exposure	On, Off	Default On
Auto Max Exposure	1 – 10000	Default 333
AE ROI	On, Off	Default off
Exposure / 100us	1 – 10000	Configured When AE is off
Gain	0 – 128	Configured When AE is off
Brightness	-64 – 64	Default is 0; Configured During Streamed
Auto White Balance	On, Off	Default off
White Balance / K	2800 – 6500	Default 4600; Configured when AWB is off
Sharpness	0 – 100	Default 50
Gamma	100 - 500	Default 300
Saturation	0 - 100	Default 64
Contrast	0 - 100	Default 50
Hue	-180 – 180	Default 0
Backlight Compensation	On, Off	Default Off
Powerline Frequency	Auto, 50, 60, Disabled	Default Auto

Table 4-10-3 Gemini 335Lg Other Settings

Item	Settings	Notes
Preset	Default, High Accuracy, High Density, Medium Density, Hand, Factory Calib	Default
Synchronization	Free Run, Standalone, Primary, Secondary-synced, Hardware-triggering, Software-triggering	Standalone
Trigger Out Enable	On, Off	On

5. Performance

5.1 Depth Performance

5.1.1 Depth Quality Assessment

Assessing depth quality involves quantifying various aspects of the depth data and comparing them against desired performance criteria or ground truth measurements. Some common metrics for quantitative depth quality assessment include:

- **Depth accuracy** assesses the absolute error by calculating the median deviation from depth data.
- **Spatial Precision** assesses spatial noise by calculating the root mean squared error of the depth data.
- **Temporal Precision** assesses the uniformity of depth values over time.
- **Fill Rate** assesses the percentage of valid depth pixels across an image.

Detailed calculation principle can be found in document "Depth Quality Metrics". Typical depth performance for Gemini 335Lg is shown in the table below:

Table 5-1-1 Typical Depth Performance for Gemini 335Lg

Depth Accuracy	**≤±1%** (1280 x 800 @ 2 m & 90% x 90% ROI) **≤±2%** (1280 x 800 @ 4 m & 80% x 80% ROI)	
Spatial Precision	**≤ 0.8%** (1280 x 800 @ 2 m & 90% x 90% ROI) **≤ 1.6%** (1280 x 800 @ 4 m & 80% x 80% ROI)	
Temporal Precision	**≤ 0.4%** @2m	
Fill Rate	**≥99.5%** (1280 x 800 @ 2 m & 90% x 90% ROI)	

5.2 Electrical Performance

5.2.1 Power Supply

The Gemini 335Lg can be powered via USB Type-C or FAKRA-Z. In GMSLI mode, the power output should be 0.5A @ 12V or higher to make Gemini 335Lg work at default configuration. Under these conditions, the laser power level is set to 4.
When the power supply is sufficient, users can set the laser power level to 6 via the API to achieve optimal performance. At this point, the laser power is at its maximum level, and the maximum instantaneous power consumption can be up to 8.4W.
In USB mode, the power supply should be 1.5A @ 5V or higher to make Gemini 335Lg achieve optimal performance.

Table 5-2-1 Power Consumption

Mode	Power Supply for optimal performance	Power Supply for Default Configuration	Peak Power Consumption
MIPI MODE	0.7A @ 12V	0.5A @ 12V	≤ 8.4W
USB MODE	1.5A @ 5V	1.5A @ 5V	≤ 7.5W

5.2.2 Power Consumption

Power consumption varies depending on the selected working mode.

Table 5-2-2 Gemini 335Lg typical configuration & tested power consumption Reference

Item	GMSL Mode		USB Mode
Typical Configuration	Laser power level: 4 Hardware D2C: off Depth: 1280 x 800 @ 30 fps Y16 AE On RGB: 1280 x 800 @ 30 fps YUYV AE On IR: Off IMU ODR: 200Hz	Laser power level: 6 Hardware D2C: off Depth: 848 x 480 @ 60 fps Y16 AE On RGB: 1280x800 @ 60 fps YUYV AE On IR: 848 x 480 @ 60 fps Y8 AE On IMU ODR: 500Hz	Laser power level: 6 Hardware D2C: off Depth: 848 x 480 @ 60 fps Y16 Exposure time=6ms RGB: 1280x800 @ 60 fps MJPEG AE On IR: On IMU ODR: 500Hz
Average power consumption	≤ 3.5W	≤ 3.8W	≤ 2.7W

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

5.2.3 Max current in different laser power level

Gemini 335Lg can be configured with 6 laser power levels from 1 to 6. Different laser power level varies in power consumption. Detailed information can be checked in the table below.

Table 5-2-3 Max power consumption in GMLS Mode

Laser Power Level	Configuration	Max instantaneous Current	Max average Current
≤4	Depth: 1280x800 30fps Color:1280x800 30fps IR:1280x800 30fps IMU: 500Hz	≤0.4A	≤0.31A
	Depth: 848x480 60fps Color:1280x800 60fps IR:848x480 60fps IMU: 500Hz	≤0.425A	≤0.29A
5	Depth: 1280x800 30fps Color:1280x800 30fps IR:1280x800 30fps IMU: 500Hz	≤0.49A	≤0.31A
	Depth: 848x480 60fps Color:1280x800 60fps	≤0.50A	≤0.29A

	IR:848x480 60fps IMU: 500Hz		
6	Depth: 1280x800 30fps Color:1280x800 30fps IR:1280x800 30fps IMU: 500Hz	≤0.59A	≤0.31A
	Depth: 848x480 60fps Color:1280x800 60fps IR:848x480 60fps IMU: 500Hz	≤0.61A	≤0.29A

5.2.4 Storage and Powered Conditions

Table 5-2-4 Gemini 335Lg Storage and Powered Conditions

Condition	Description	Min	Max	Unit
Storage (Ambient), Not Powered	Long term storage	0	60	℃
	Short exposure represents temporary max limits acceptable for transportation conditions	-10	70	℃
	Humidity	Temperature / RH: 60℃ / 95%		
Ambient, Powered*	The camera ambient temperature when powered	-10	50	℃
LDM Protect Temperature	The LDM temperature when powered	N / A	73	℃
Backside Case Temperature, Powered	The maximum temperature of the backside case occurs when the camera is operated in an ambient temperature of 40°C	0	60	℃

5.2.5 ESD & EMC Performance

Table 5-2-5 Gemini 335Lg ESD Performance

Conditions	Power-On	Power-Off	Standards
Air Discharge	±15KV Class A	±15KV Class A	EN 61000-6-2 EN 61000-6-4
Contact Discharge	±8KV Class A	±8KV Class A	EN 61000-6-2 EN 61000-6-4

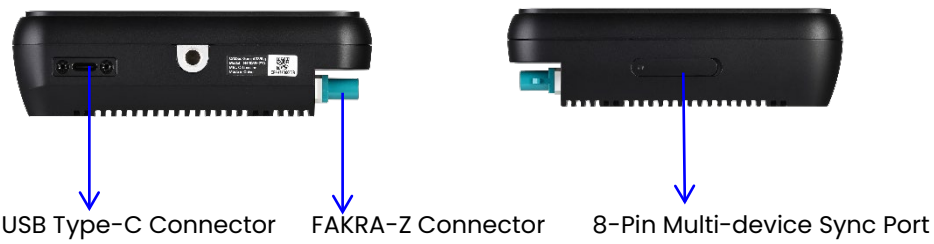
Table 5-2-6 Gemini 335Lg EMC Performance

GMSL Mode	Content	Standards
CE	/	IEC 61000-6-2 IEC 61000-6-4
RE	≤6dB Class B(via GMSL)	0.03-6Ghz,3m range(PART 15B)
CS	10V,0.15-80MHz, Class A	IEC 61000-4-6
RS	20V/m, 0.03-1G Hz 3V/m. 1 – 6G Hz (80%AM @1K Hz)	IEC 61000-4-3
EFT	±1KV, @5kHz & 100kHz, Class B	IEC 61000-4-4

5.3 Physical Performance

5.3.1 Ingress Protection

Gemini 335Lg supports IP65 rated ingress protection, customer should avoid opening the multi-device sync port cap and use cables that also support IP65 or higher for water and dust resistance.



5.3.2 Vibration & Shock Resistance

Gemini 335Lg uses the GMSL2 protocol to transmit serial data and is designed to operate normally in environments with strong vibrations and mechanical shocks.

Table 5-3-1 Vibration & Shock Performance

Item	Conditions	Standards
Vibration	3.8Grms @ 5 ~ 2000 Hz, random, 2 hr/axis	
Shock	50G / 11 ms 6 times/axis	ISO 26262

6. Firmware

6.1 Firmware Update & Cautions

Gemini 335Lg supports hardware interface update via USB or GMSL. Before updating using either mode, please ensure that the DIP switch is set to the correct position. USB update is more efficient than GMSL update, and there are no restrictions on the firmware version—you can upgrade or downgrade as needed. Please note the following considerations:

1. You can update the firmware in any working mode or preset;
2. All data streams must be closed when updating the firmware;
3. During the firmware update, please ensure that the power supply and data transmission cable connections are stable;
4. After completing the firmware update through GMSL, there is no need to reload the driver;
5. The camera will automatically restart after the firmware update is completed. You can also re-plug the cable after completion and restart it manually;

6.2 How To Update Firmware

The simplest way to upgrade the firmware is through the OrbbecSDK tools, which supports both manual update and OTA update. For detailed instructions, please refer to the documentation.

6.3 Recovery

Ensure the stability of cable during the update process to avoid upgrade failure. If the update process fails, disconnect the cable, re-insert it, and burn the product 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

The Orbbec SDK is a cross-platform software development kit that provides device parameter configuration, data stream reading, and stream processing for depth cameras, such as Orbbec Structured Light, Stereo, and iToF. It offers a range of features, including:

1. Access and control of hardware devices
2. Access, control, and data acquisition of sensors in the device
3. Control of frame synchronization and alignment
4. Point cloud data acquisition
5. Provides algorithmic capabilities such as filtering
6. Different systems and Wrapper support

Refer to the related software instructions for using Orbbec Viewer.

For SDK development, please refer to the documentation directory in the SDK development kit, which contains relevant software development instructions.

For SDK downloads and updates, please visit https://www.orbbec.com

8. Use Guidance

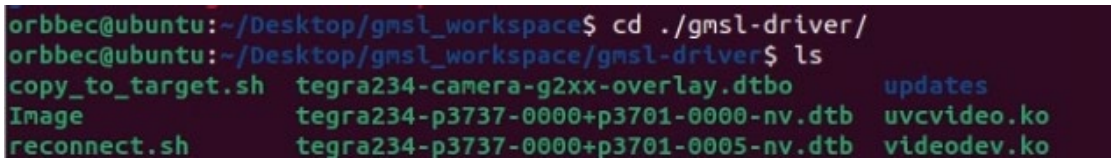
8.1 Package List

Table 8-1-1 Gemini 335Lg Package List

Package Type	Package List	Picture	Notes
Bulk	1x Gemini 335Lg		Minimum batch packaging unit: 100pcs
Box	1x Gemini 335Lg		Minimum batch packaging unit: 20pcs
	1x Tripod		
	1x Tripod Head		
	1x FAKRA-Z Cable(1m)		
	1x Quick Start Doc		

8.2 Quick Start with GMSL Mode

ORBBEC provides precompiled drivers and device tree files for the AGX Orin Developer Kit & AGX Xavier Developer Kit. Users simply can visit GitHub repository to download the driver package, extract it, and then run the copy_to_target.sh script to easily load the GMSL drivers.



9 Regulatory Compliance

Gemini 335Lg is certified as follows:

1. EMC (CE / FCC / IC / UKCA)

CE
FC
UK CA

2. Environmental Protection (RoHS / REACH / WEEE)

RoHS COMPLIANT
10

3. Laser Safety

FDA(Accession Number: 2420619-000)

10 System Integration Guide

10.1 Cable Design Guide

Table 10-1-1 Gemini 335Lg FAKRA-Z Cable Design Reference Parameters

Category	**Recommend Spec.**	**Notes**
Cable type	Coaxial cable	
Transmission frequency range	0 - 6GHz	
Characteristic impedance	50Ω ± 2Ω	Recommended
Rated current	≥ 1A	Typical POC voltage: 12V Ripple: ≤ ±10%
DC resistance	< 0.1Ω/m	
Insulation withstanding voltage	≥ 500V AC	
Insulation resistance	≥ 100MΩ	
Contact resistance	≤ 5mΩ (Initial)	
Cable length	The maximum length of commonly used cables are listed as follows: RG174：≤5m Dacar 302/RG58：≤15m	According to the documentation in ADI website, "Cables with an attenuation of 1.1dB/m can support up to a maximum length of 15m (3.2mmϕ, 6Gbps, 105℃)."
Bend radius	RG174: Static 3x cable OD Dynamic 10x cable OD Dacar 302：	OD: Out Diameter

	Static 5x cable OD Dynamic 15x cable OD	
Insertion loss (IL)	-17dB MAX @ 3GHz (6Gbps / 187.5Mbps)	Information is according to "GMSL2 Channel Specification User Guide Rev 1". Detailed information is in page 16.
Return loss (RL)	$RL(f[Hz]) = \begin{cases} -6 - (0.9\,(f \times 10^{-6})) & for\ 2\ MHz\ to\ 10\ MHz \\ -\left(14.2 + 0.28\sqrt{(f \times 10^{-6})} + 0.8\,(f \times 10^{-9})\right) & for\ 10\ MHz\ to\ 200\ MHz \\ -18.3 + 0.02\,((f \times 10^{-6}) - 200) & for\ 200\ MHz\ to\ 400\ MHz \\ 5.7 \times 10^{-3}\,(f * 10^{-6}) - 16.6 & for\ 400\ MHz\ to\ 1500\ MHz \\ -8 & for\ 1500\ MHz\ to\ 3500\ MHz \end{cases}$	
Tensile strength	≥ 110N	
Ingress protection	IP67 (recommended)	
Ambient temperature	-40 ~ 105℃	
Recommended cable and connector manufacturers	Cable: Amphenol RF, Belden wire & cable, TE Connectivity, HUBER + SUHNER, Lenoi, etc. Connector: Rosenberger, Molex, TE Connectivity, Amphenol RF, etc.	

10.2 Easy Trouble Feedback

We are committed to ensuring that you have a seamless experience with our camera products. If you encounter any issues or have any questions, you can get the log information according to the documentation “How to get debug log”. We encourage you to reach out to us and provide information through the following channels:

GitHub Issue Reporting

If you are facing technical issues or bugs, you can directly report them on our GitHub repository. This will allow our development team to quickly assess and address the issue. Please include as much detail as possible, including steps to reproduce the issue, relevant code snippets, and any error messages you encountered.

Our Github Address: https://github.com/orbbec.

Email Support

For more personalized support, or if you prefer not to use GitHub, you can contact our Field Application Engineers (FAE) and sales team via email.

Whether you have technical inquiries, need assistance with integration, or have questions, we are here to help.

11 Cautions

1. Follow the instructions carefully when operating the camera. Improper handling ma y 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 powe r and data transfer requirements, then replug it into the USB port to reconnect.

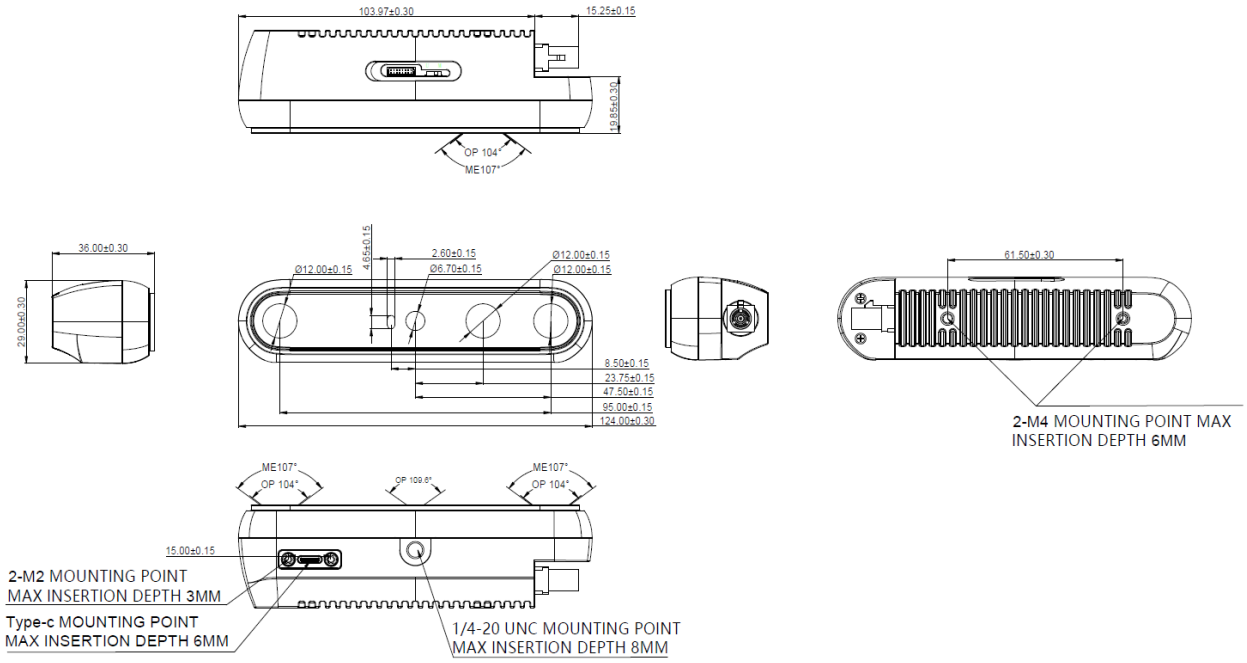
8. This product is classified as a Class 1 Laser Product under the international standard EN/IEC 60825-1, Edition 3 (2014).

Using controls, adjustments, or procedures other than those specified herein may r esult in hazardous radiation exposure.

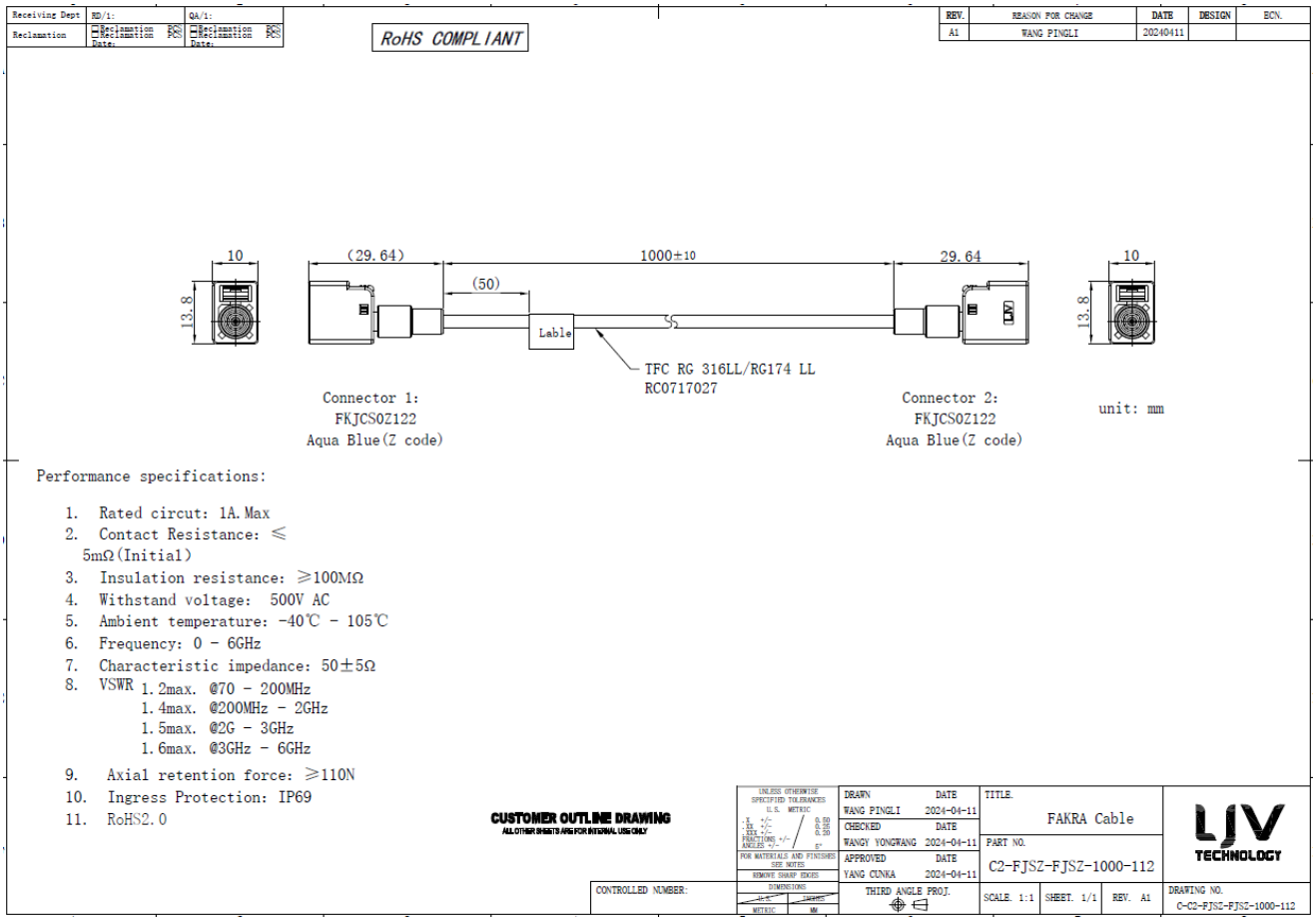
Safety and Handling Instructions:

- 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 serviceabl e parts.
- Be cautious of invisible laser radiation. Avoid direct exposure to the beam.
- To maintain compliance and safety standards, do not modify or service the prod uct. Unauthorized modifications or servicing could result in emissions surpassing the C lass 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.

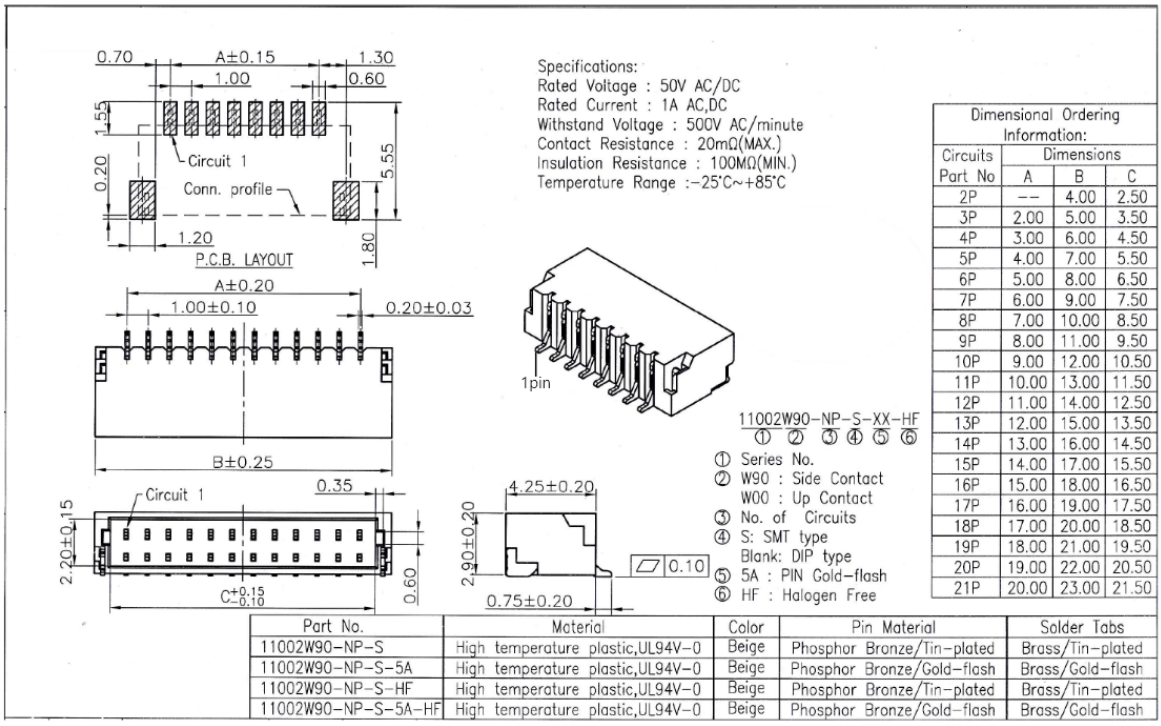
Appendix A- Drawings of Camera



Appendix B- Drawings of Cable In Box



Appendix C- Multi-Camera Synchronization Interface Schematic



Specifications:
Rated Voltage : 50V AC/DC
Rated Current : 1A AC,DC
Withstand Voltage : 500V AC/minute
Contact Resistance : 20mΩ(MAX.)
Insulation Resistance : 100MΩ(MIN.)
Temperature Range :-25°C~+85°C

Dimensional Ordering Information:			
Circuits	Dimensions		
Part No	A	B	C
2P	--	4.00	2.50
3P	2.00	5.00	3.50
4P	3.00	6.00	4.50
5P	4.00	7.00	5.50
6P	5.00	8.00	6.50
7P	6.00	9.00	7.50
8P	7.00	10.00	8.50
9P	8.00	11.00	9.50
10P	9.00	12.00	10.50
11P	10.00	13.00	11.50
12P	11.00	14.00	12.50
13P	12.00	15.00	13.50
14P	13.00	16.00	14.50
15P	14.00	17.00	15.50
16P	15.00	18.00	16.50
17P	16.00	19.00	17.50
18P	17.00	20.00	18.50
19P	18.00	21.00	19.50
20P	19.00	22.00	20.50
21P	20.00	23.00	21.50

11002W90-NP-S-XX-HF
① ② ③ ④ ⑤ ⑥
① Series No.
② W90 : Side Contact
W00 : Up Contact
③ No. of Circuits
④ S: SMT type
Blank: DIP type
⑤ 5A : PIN Gold-flash
⑥ HF : Halogen Free

Part No.	Material	Color	Pin Material	Solder Tabs
11002W90-NP-S	High temperature plastic,UL94V-0	Beige	Phosphor Bronze/Tin-plated	Brass/Tin-plated
11002W90-NP-S-5A	High temperature plastic,UL94V-0	Beige	Phosphor Bronze/Gold-flash	Brass/Gold-flash
11002W90-NP-S-HF	High temperature plastic,UL94V-0	Beige	Phosphor Bronze/Tin-plated	Brass/Tin-plated
11002W90-NP-S-5A-HF	High temperature plastic,UL94V-0	Beige	Phosphor Bronze/Gold-flash	Brass/Gold-flash