Zivid 3

XL250

Technical Specification

Overview

Recommended distance	1.5 – 4.0 m recommended working distance.
Field-of-view (FOV)	2.5 m focus distance 39° square FOV
Sensor	2816 x 2816 (8 MP) 2D and 3D from same sensor Adjustable output resolution
Capture time (2D + 3D)	≳25 ms (minimum) 250 to 1500 ms (typical) Depending on camera settings and user hardware
Recommended operation conditions	0 – 45 °C 0 – 1000 lux ambient light
Mechanical and electrical	Size: 336 x 133 mm x 70 mm^3 Weight: 2700 g IP65 Ethernet, 10 GigE, M12-8P-X Power, 24 V DC, 5A, M12-5P-A, Peak 100W
3D accuracy	250 µm point precision (pre-filter noise) 450 µm global planarity trueness (flatness) 0.2 % dimension trueness (per length) [1] When measured at focus distance, 2.5 m. Test conditions apply.
Suitable applications	Depalletizing, palletizing, factory bin picking and other robot manipulation tasks
Suitable material for 3D reconstruction	Any combination of the following; Diffuse (matte, rough), specular (shiny, glossy), absorptive (black, dark), reflective (white, bright, colored), semi-transparent and translucent, transparent [2].

[1] Within full temperature range and optimal working distance. See “Operating distance and field of view” and “Accuracy specifications”.
[2] May not work reliably with extremely transparent materials, such as thin-film plastics, crystal and optical-grade glass.

Introduction

Zivid 3 is a product family of industrial structured-light 3D cameras designed for robotic machine vision applications where performance, stability and reliability are important. High-speed capture of 2D images and colored 3D point clouds with high resolution, fidelity and quality. The camera offers a lot of flexibility to optimize the quality and speed for a specific use-case.

Zivid 3 cameras have a ruggedized design, advanced calibration, and strong ambient light resilience, making them ideal for applications where the camera is far away from the scene. The field-of-view of the Zivid 3 XL250 is tailored to the volume-of-interest of its target applications, such as depalletizing and factory bin picking with large robots.

Overall, Zivid 3 is an excellent choice for machine vision professionals who demand high-quality, flexible, and reliable 3D imaging.

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Product Description

Product	Zivid 3 XL250
Model Number [3]	Z3 XL250 (Zivid 3 XL250)
Revision [4]	Rev A0
Order code (SKU)	ZVD3-XL250
3D technology	Structured light Native 3D Color
Calibration	Factory calibrated (color and 3D)
Imaging Sensor Resolution	2816 × 2816 (8 MP)
Output resolution (2D and 3D)	2816 × 2816 (8 MP) 1408 × 1408 (2 MP) 704 × 704 (0.5 MP)
3D output (point cloud / depth) [5]	Point cloud (colored) Depth map, Normal map
2D output [5]	Color / RGB image (with integrated flash) Grayscale image (with/without flash)
3D acquisition time [6]	≳15 ms (minimum) 50 to 500 ms (typical[7])
3D capture time [8]	≳25 ms (minimum) 250 to 1500 ms (typical[7])
Suitable applications	Depalletizing, palletizing, factory bin picking and other robot manipulation tasks
Suitable materials for 3D reconstruction	Any combination of the following; diffuse (matte, rough), specular (shiny, glossy), absorptive (black, dark), reflective (white, bright, colored), semi-transparent and translucent, transparent [9].

[3] The model number is found on the physical label on the product and the box it was shipped in.
[4] The product's major revision of hardware for which this datasheet is valid. The revision can be found together with the model number (M/N) on the physical label of the product.
[5] Images can be saved as `.png`, `.jpeg` and `.bmp`. Point clouds can be saved as `.zdf`, `.ply`, `.pcd` and `.xyz`.
[6] Time for camera to illuminate and acquire all images used for 3D reconstruction.
[7] The specific time depends on the appropriate camera settings used for the intended application.
[8] From capture initialized until point cloud is ready to copy. Includes processing time, assuming high-end GPU and 10GigE connectivity. Acquisition time is shorter.
[9] May not work reliably with extremely transparent materials, such as thin-film plastics, crystal and optical-grade glass.

Exposure Control

The table below describes what acquisition settings may be applied to the camera.

Exposure time (minimum per pattern projection)	200 µs (stripe engine) 900 µs (phase engine)
Aperture (A)	f/3.0
Gain (G)	1x to 16x
Projector Brightness (B) [10]	1.0x to 3.0x (3D mode) 1.0x to 3.0x (color 2D mode) 0.0x to 3.0x (grayscale 2D mode)
HDR	Available with multiple acquisitions 2D HDR w/ tonemapping 3D HDR

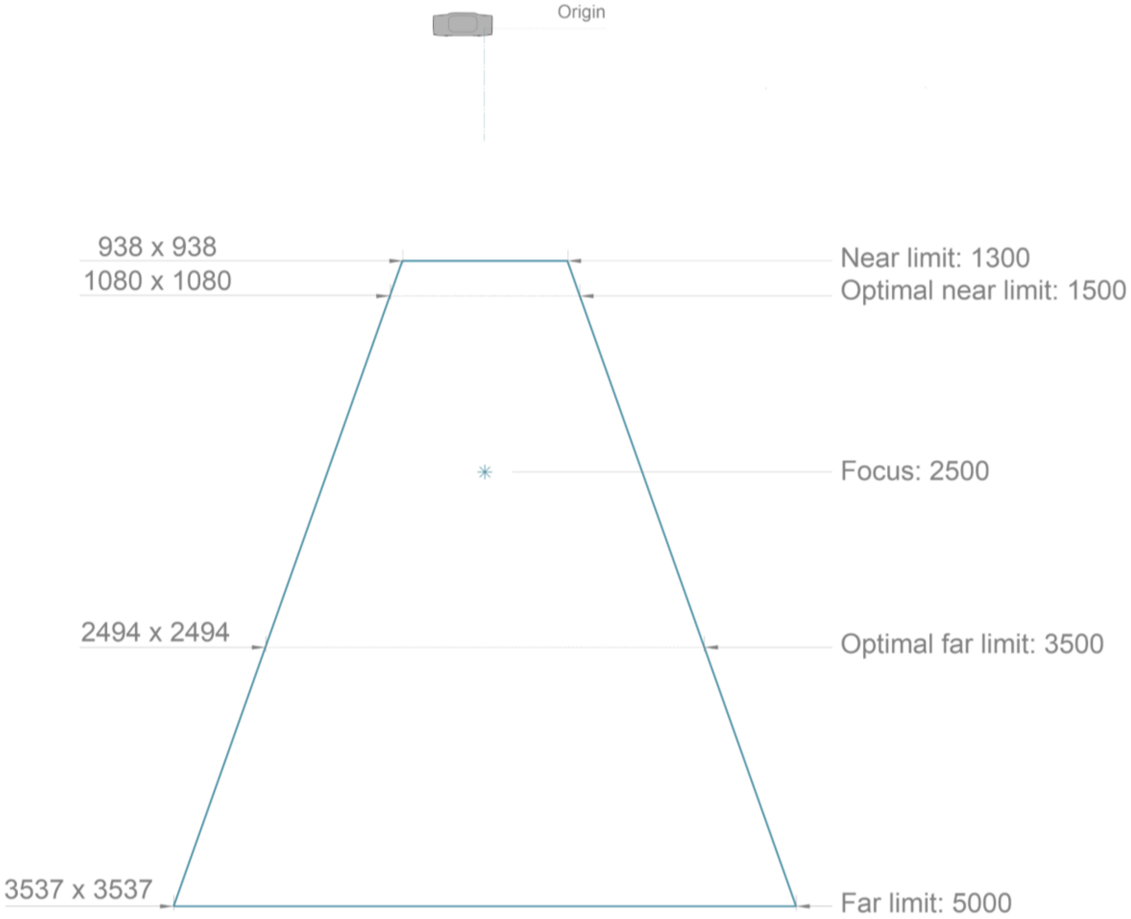
[10] Projector is always on in 3D or color mode, optional on/off in greyscale mode.

Operating distance and field of view

Parameter	Note	Value
Focus distance (mm)		2500
Working distance (mm)	Optimal	1500 to 3500
	Recommended	1500 to 4000
	Extended [11]	1300 to 5000
Recommended Clearance Distance, for given area of target scene [12] (mm)	1000 × 1000 mm^2	1600 – 1700
	1100 × 1100 mm^2	1700
	1200 × 1200 mm^2	1800
Baseline (mm)		250
Optical axis [13] (relative to camera body)	Horizontal	0.0 ± 0.35 °
	Vertical	0.0 ± 0.35 °
Field of view	Horizontal	39.0 °
	Vertical	39.0 °
Field of view (area)	1500 mm (optimal, near)	1050 × 1050 mm^2
	2500 mm (focus)	1750 × 1750 mm^2
	3500 mm (optimal, far)	2450 × 2450 mm^2
Spatial resolution (full image)	1500 mm (optimal, near)	0.37 mm
	2500 mm (focus)	0.62 mm
	3500 (optimal, far)	0.87 mm
	Per distance (z) in mm	2.49×10^{-4}

[11] Camera remains functional, but performance not guaranteed. Expect degenerated output quality.
[12] Accounts for depth-of-focus, unit-to-unit variation from assembly misalignment in optical axis and a placement margin of the camera relative to the target scene of minimum 2.5 cm in camera X and Y axis.
[13] Including unit-to-unit variation in optical axis and boresight from assembly misalignment.

FIGURE 1 – FIELD OF VIEW [14]



[14] All values in degrees or millimeters.

FIGURE 2 – FIELD OF VIEW VS. DISTANCE

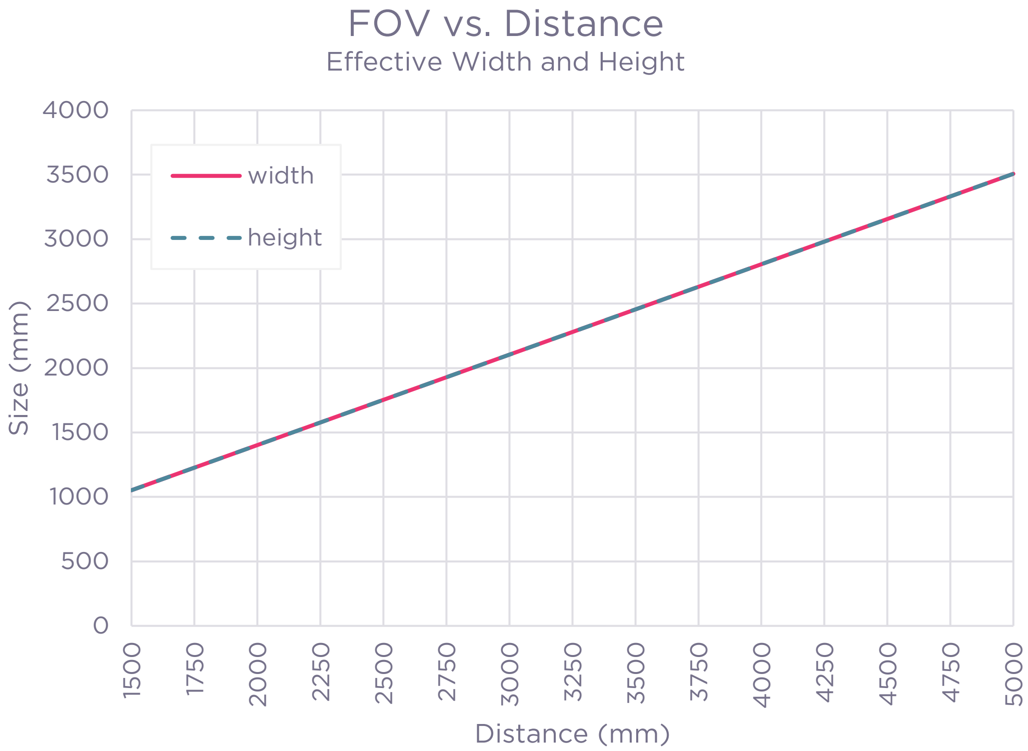


FIGURE 3 – SPATIAL RESOLUTION

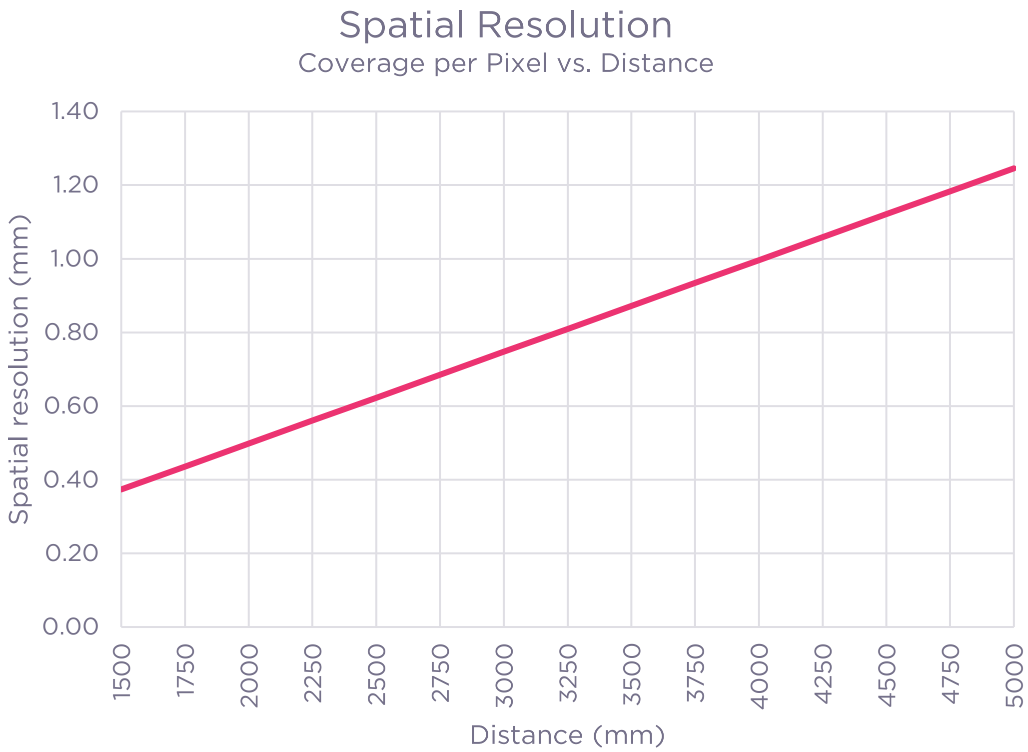


Figure 4 – Optical Angles [15]

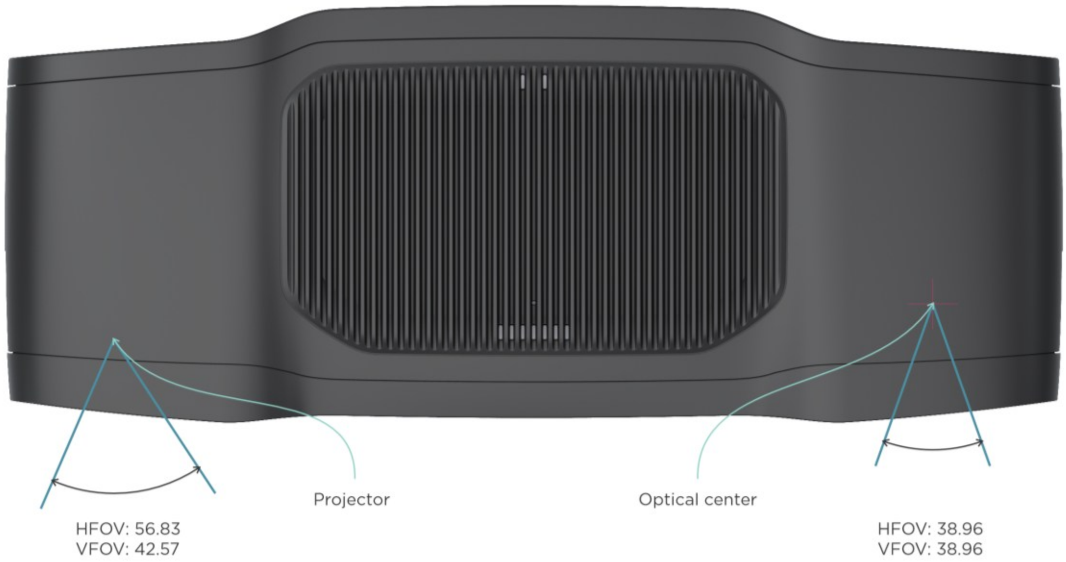


Figure 5 – Optical Center Position Relative to Mounting Holes [1515]

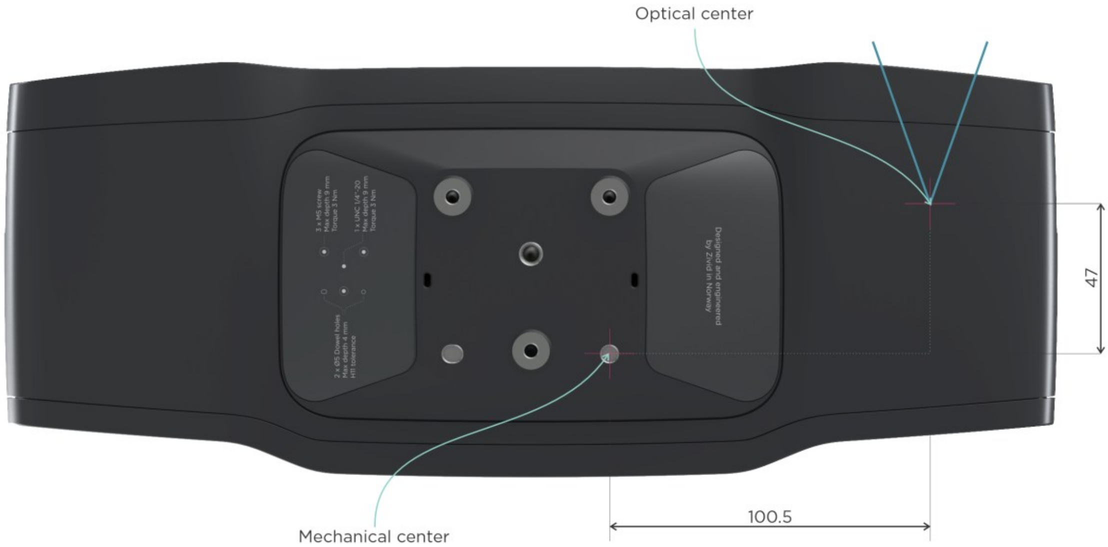
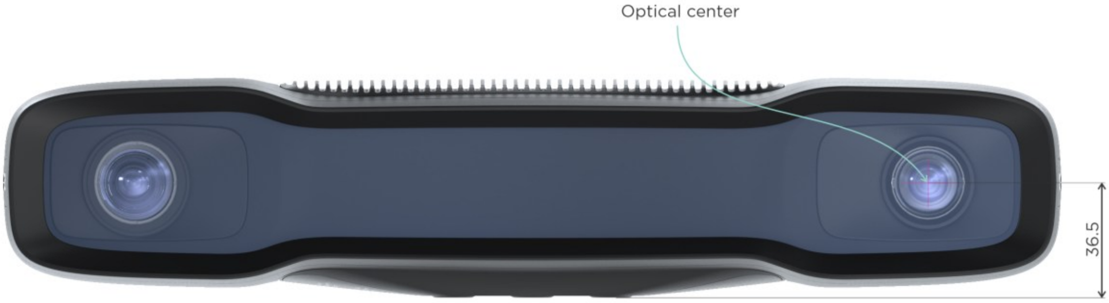


Figure 6 – Optical Center Position Relative to Base Plate [1515]



[15] All values in degrees or millimeters.

Accuracy specifications

Typical numbers are given at common conditions as described in Test conditions unless otherwise specified. Values related to precision and trueness are set to include unit-to-unit variation under the stated test conditions; most units perform better.

Property	Description	Typical
Warm-up time	The minimum recommended time needed for the camera to stabilize from an idle state assuming capturing at a constant rate. [16]	10 minutes
Point precision	1σ Euclidian distance variation for a point between consecutive measurements at focus distance, D. [17] [18]	0.25 mm
Local Planarity Precision	1σ Euclidian distance variation from a plane for a set of points within a smaller local region at focus distance, D. [17] [18]	0.45 mm
Global Planarity Trueness Error	Average deviation from a plane in field of view at focus distance, D. [19]	< 0.40 mm
Dimension Trueness Error	70-percentile dimension error in field of view at focus distance, D, and typical temperature range. [20]	± 0.15 %
	70-percentile dimension error in field of view within optimal working distance and typical temperature range. [20]	± 0.20 %
	70-percentile dimension error in field of view within optimal working distance and full temperature range. [20]	± 0.20 %

Note: The term “accuracy” is composed of a precision component and a trueness component as described in ISO 5725.

[16] Some trueness changes may be experienced during warm-up phase.
[17] Point precision is found by measuring an individual point’s capture-to-capture variation in space for all points in the point cloud over multiple consecutive measurements.
[18] Measured using the unfiltered, raw output of a single-acquisition 3D capture on a Lambertian surface. Enabling post processing filters, such as noise suppression filter, can further reduce noise to great effect.
[19] Global planarity trueness error is found by measuring the distance of all individual points in the point cloud from a flat reference surface. Can also be interpreted as flatness.
[20] Dimension trueness error is found by measuring the error of multiple calibrated reference distances in the point cloud. A reference distance can be 5 to 50 cm. The calibrated reference object is measured repeatedly across the entire field of view and operating distance, and during exposure of thermal and mechanical stress, such as temperature change, vibration, and shock. Measured in % error per length. 70-percentile means that 70% of the individual measurements in the FOV are lower than the reported value.

FIGURE 7 - POINT PRECISION VS. DISTANCE AND AMBIENT LIGHT

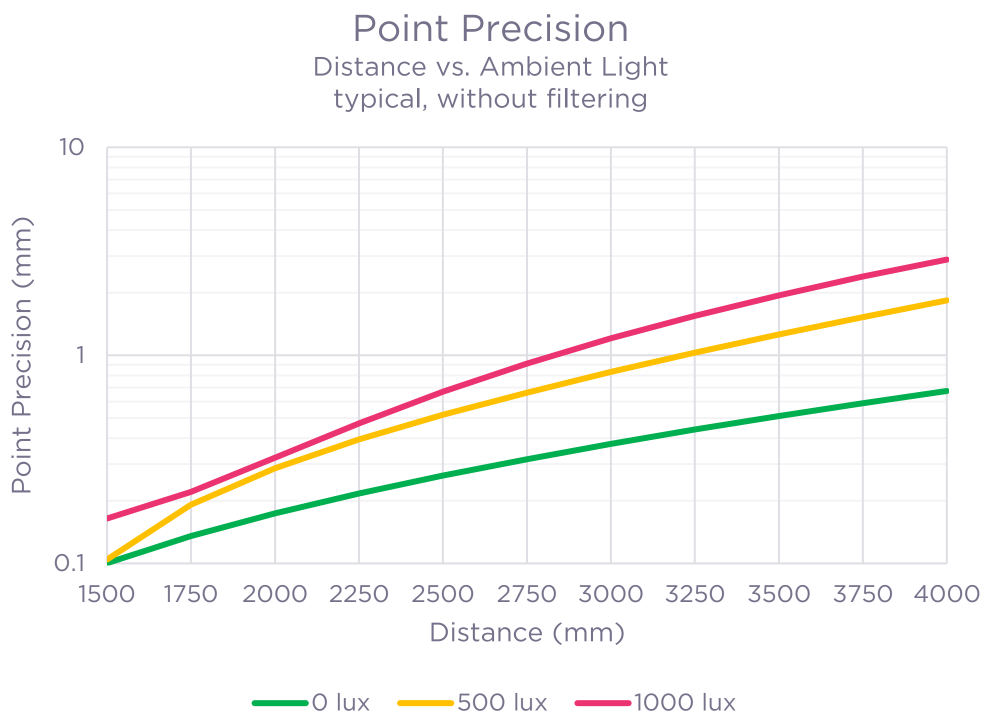


FIGURE 8 - LOCAL PLANARITY PRECISION VS. DISTANCE

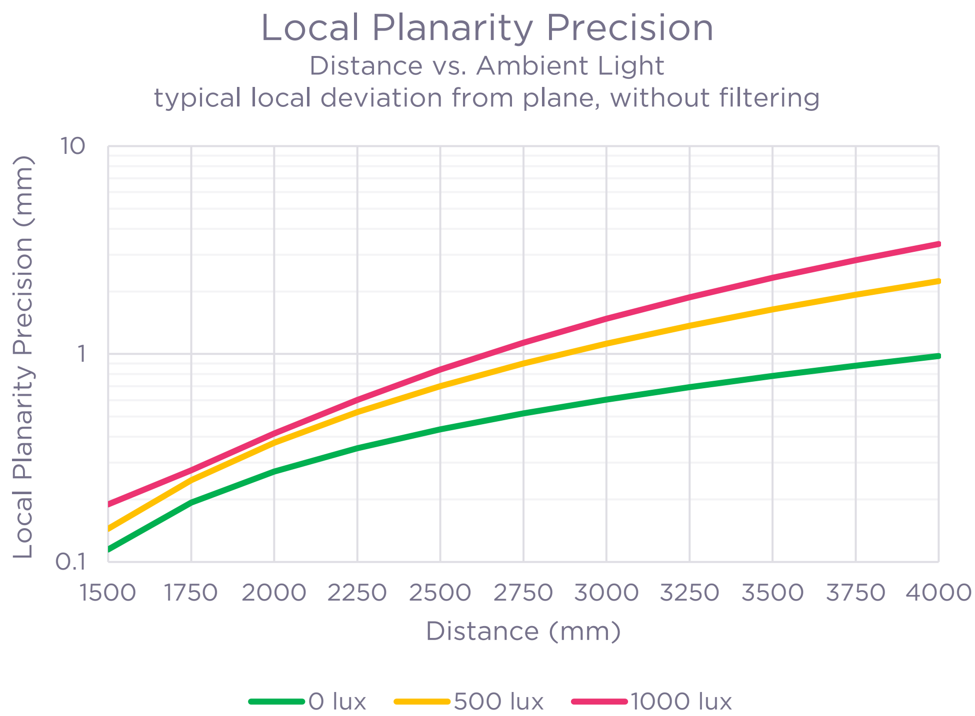


FIGURE 9 - GLOBAL PLANARITY TRUENESS VS. DISTANCE

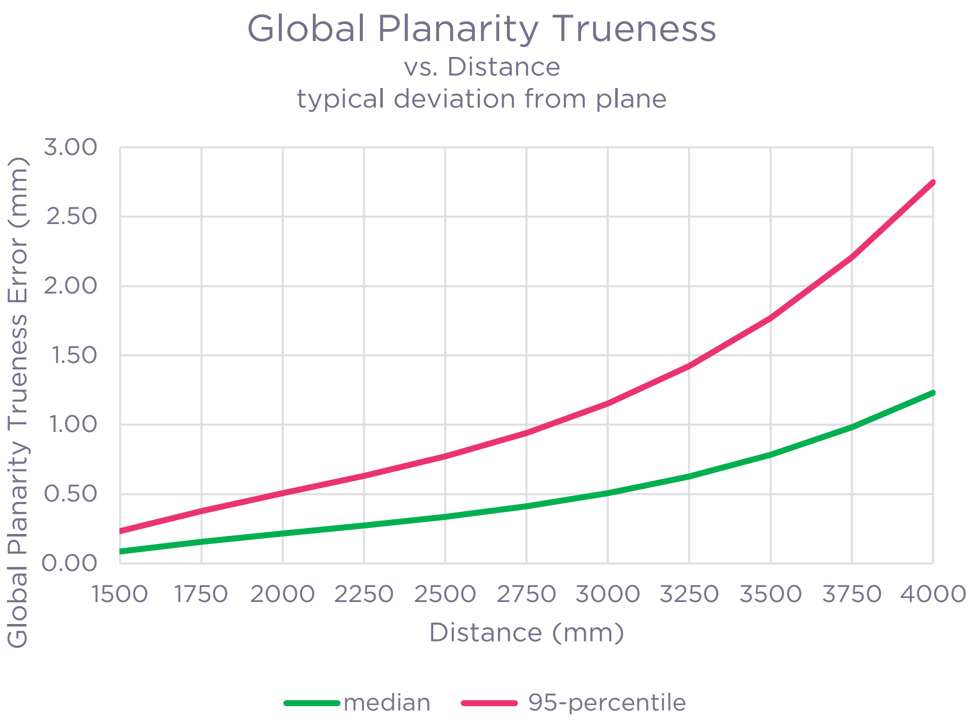


FIGURE 10 - DIMENSION TRUENESS VS. DISTANCE

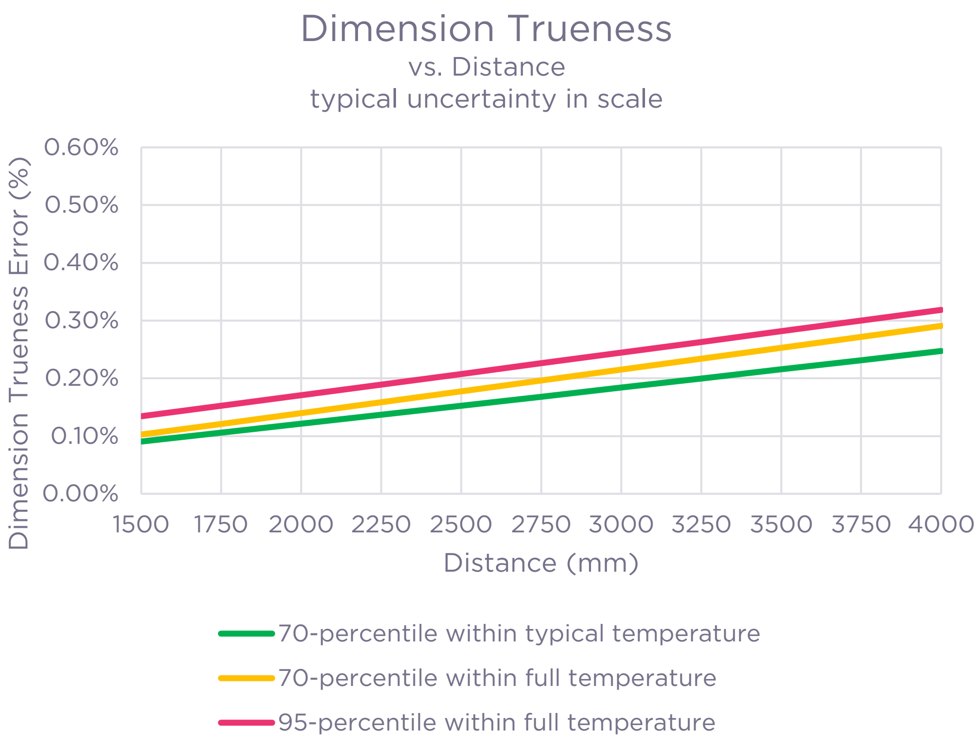
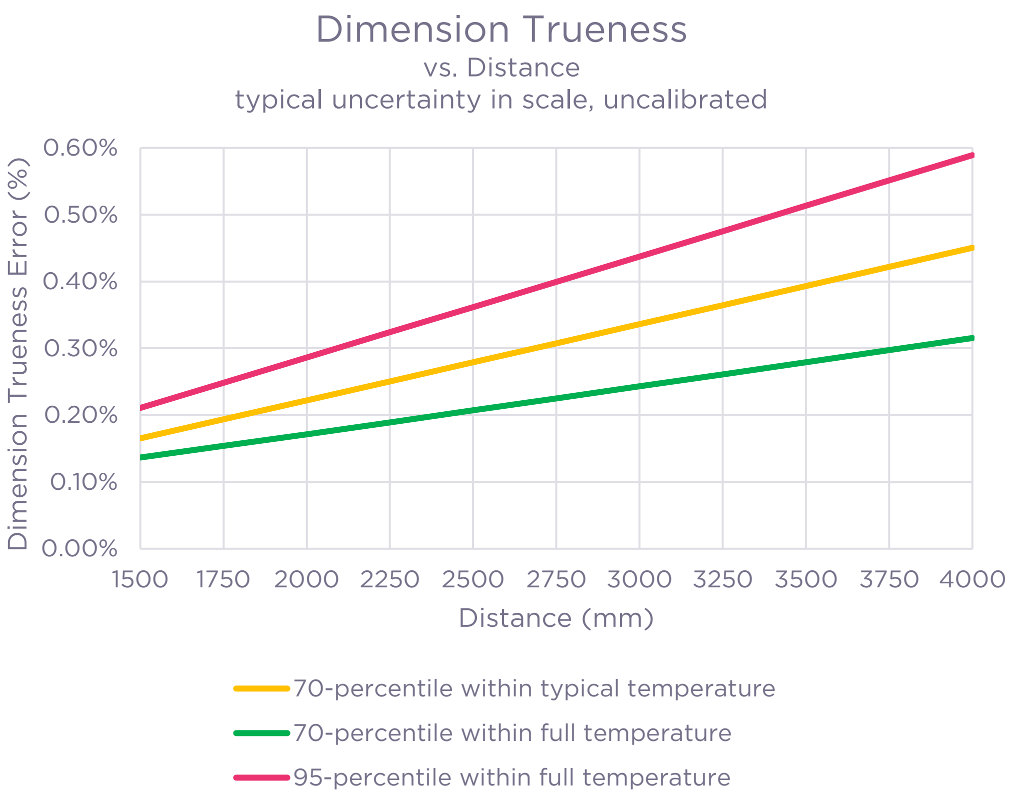


FIGURE 11 - DIMENSION TRUENESS VS. DISTANCE

The following plot assumes no initial calibration procedure has been applied during installation (i.e. hand-eye or in-field correction).



Test conditions

The following table outlines the test conditions applied to all specifications unless stated otherwise.

Parameter	Description	Typical
Working distance (D)		1500 – 4000 mm
Ambient temperature (Ta)	Typical temperature	15 – 30 °C
	Full temperature range	0 – 45 °C
Ambient light (La)		0 – 2000 lux
Gain (G)		1.0 x
Projector Brightness (B)		3.0 x
3D Engine	3D engine (reconstruction algorithm) used during measurement	Stripe and Phase
Sampling mode	Sampling mode for sensor pixels used during measurement	Full and By2x2
Capture time	Acquisition time used during measurement	> 50 ms
	Capture time used during measurement	> 100 ms
Duty Cycle	Capture-to-Idle time ratio	5 – 20 %
Other		81% center crop (90% × 90%) Single acquisition only (no HDR) 10 min warm-up Applied in-field correction

Physical specifications

Size	336 x 133 mm x 70 mm^3
Weight	2700 g
Flatness tolerance of mounting surface [21]	±0.05 mm
Cable strain limit	125 N
Ingress Protection	IP65 [22]
Shock, vibrations and accelerations	5 g sinusoidal [23] 15 g shock [24]
Operating temperature	0 to 45°C (calibrated range) -10 to 45°C (functional range [25])
Storage temperature	-20 to 60°C
Humidity [26]	10 – 90 %, non-condensing
Eye Safety [27]	RG2
Noise, typical at 1 m distance	< 28 dB, typical use 67 dB, at maximum fan speed
Data connection	10 GigE [28] M12-8P-X (8-pin connector, X-coded) CAT6A, SF-UTP or better
Power connection	M12-5P-A (5-pin connector) Male connector
Power adapter	24 V ⎓ 5A, DC EU, US, and UK power plug options Female connector on camera side

[21] The surface which the camera is mounted to should meet this specification.
[22] The camera's fan-duct is outside the IP65 classified enclosure (the fan itself is classified as minimum IP65).
[23] IEC 60068-2-6, 10-150 Hz, 5 g, in X, Y and Z direction, 2 hour per axis. Sweep rate 1 octave/minute sweep rate.
[24] IEC 60068-2-27, 15 g / 11 ms half sine shock pulses. 3 shocks per direction, 18 shocks in total.
[25] Camera remains functional down to –10 °C, outside calibrated range. Performance not guaranteed.
[26] Relative humidity during operation and storage.
[27] IEC 62471, photobiological (eye) safety. EN 62471:2015. IEC/TR 62471-5.
[28] Slower gigabit ethernet connections, such as 1 GigE, also supported, but can reduce capture speed.

Power consumption, typical	15 W, Idle 45 W, TDP [29] 100 W, Peak
Mechanical Installation	3 x M5x0.8 screws UNC 1/4-20 Depth: 5-7 mm Max torque: 3 Nm
LED Indicators	Show power, link state/capacity and camera warnings, plus recommended user actions. Useful for quick triage at install height.

Environmental adaptation capabilities

The camera provides reliable and stable output as a function of unstable environmental factors such as varying temperature and light. The overview below highlights the key capabilities.

Warm-up and Thermal Settling
The device typically needs 10 minutes to stabilize after powered-on before reaching a steady and accurate state. If the camera is left idle after power-up it will automatically enable the Thermal Stabilization feature described below.

Thermal Stabilization feature
Heats while idle, pauses during capture. This heat mode is resumed approximately 10 s after last capture to shorten warm-up and improve accuracy at low duty cycle. A small mode-switch latency, up to 40 ms, applies when switching modes from idle to capture.

Thermal throttling
High duty cycles can trigger projector thermal throttling to prevent device from overheating. Dependent on settings and capture rate. Capture cadence should be planned accordingly.

Ambient light resilience
Camera is tested and characterized for use in ambient light conditions up to 2000 lux. Negligible impact from ambient light can be assumed up to 1000 lux. Point cloud quality can start to degrade at higher lux levels and long distances.

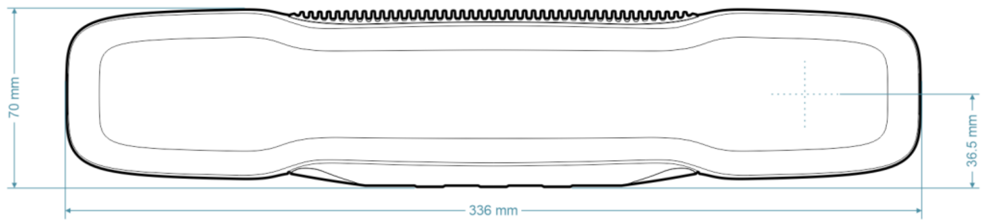
Flicker handling
Camera can be adapted to suppress and eliminate flicker effects caused by ambient light frequency (e.g. 50/60 Hz) and strobe lights (e.g. barcode flash).

[29] Thermal Design Power is the maximum power consumed while capturing 3D images in a continuous stream.

Mechanical drawings

FIGURE 12 – DIMENSIONS

All values in degrees or mm.



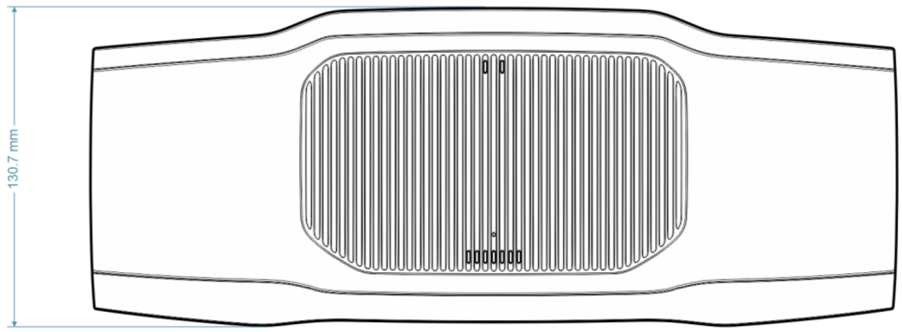
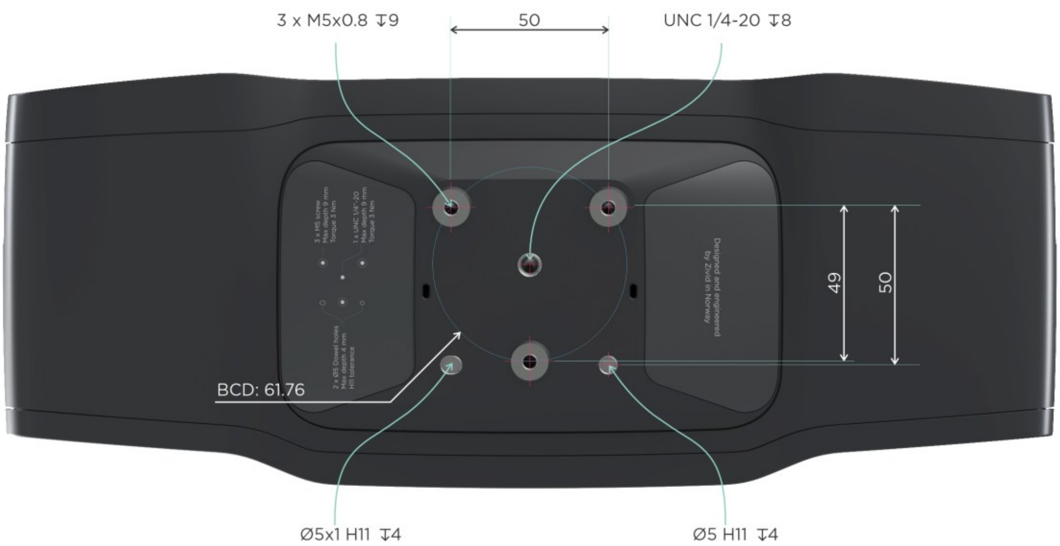


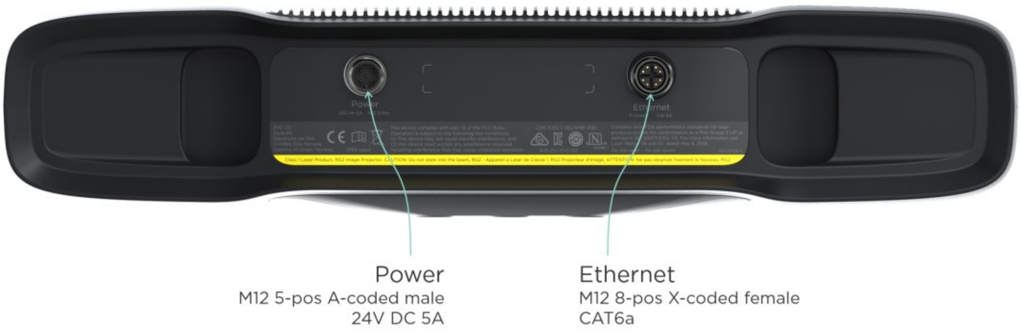
FIGURE 13 – MOUNTING OPTIONS

All values in degrees or mm.

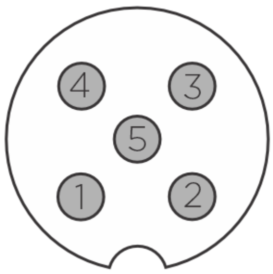


Connectors

FIGURE 14 – CONNECTORS

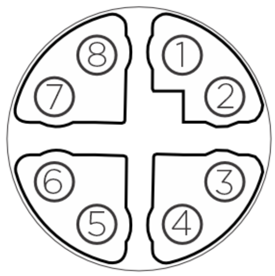


Pinout



Pin #	M12-5P-A
1	24V DC (+10% / -20%)
2	24V DC (+10% / -20%)
3	GND
4	GND
5	NC [30]

Pinout



M12-8P-X	RJ45	Color
1	1	WH/OG
2	2	OG
3	3	WH/GN
4	6	GN
5	7	WH/BN
6	8	BN
7	5	WH/BU
8	4	BU

[30] Not connected. Do not connect.

Product Identification Label

FIGURE 15 – PRODUCT LABEL

The product identification label is found on the bottom of the device. The label includes UID label (described in Figure 16 – Unique ID Label Explanation), IP rating, input power rating, eye safety classification, country of origin, and compliance information.

FIGURE 16 – UNIQUE ID LABEL EXPLANATION

1	2D code format: SKU, Revision and Serial, delimited by '$': i.e. ZVD3-XL250$A0$1234ABCD
2	Product name
3	Product revision
4	Zivid part number and revision
5	Serial Number
6	MAC-address

Product compliance and certifications

Region	Compliance	Category
International	CISPR 32 (Class B) / 35	EMC
	IEC 62368-1	Product Safety
	IEC 62471-5 (Eye Safety, Risk Group 2)	Eye Safety
	IEC 60825-1 (Laser, Class 1)	Eye Safety
EU	Low Voltage Directive - 2014/35/EU	Product Safety
	EMC Directive - 2014/30/EU	EMC
	RoHS Directive - 2011/65/EU / (EU)2015/863	Environmental
	REACH Directive - (EU)1907/2006	Environmental
	EN 60529 (product rated IP65)	Ingress Protection
US / Canada	NRTL – UL/CSA 62368-1	Product Safety
	FCC15B (Class B)	EMC
	Complies with 21 CFR 1040.10 and 1040.11 for a Class 1 projector except for conformance as a Risk Group 2 LIP as defined in IEC 62471-5:Ed. 1.0. See Laser Notice No. 56 and 57, dated May 8, 2019.	Eye Safety
South Korea	KC Approval	EMC and Product Safety
Australia / New Zealand	AS/NZS 3820	Product Safety

System Requirements

System requirements follow SDK version. For details see support.zivid.com.

OS Support	Windows, Ubuntu, NVIDIA Jetson Linux
CPU / arch	X86-64 (Intel) and ARM on Jetson Orin
GPU	Intel or NVIDIA required
APIs & Wrappers	C++, .NET, Python, ROS
Networking Link	10 GigE recommended for full performance. 5/2.5/1 GigE work at reduced speed. USB NICs can add variability. For more details see: support.zivid.com
Default IP & modes	Default: static IP Supported: static, DHCP, and link-local
Connectors & Cables	Data via M12-8P-X (8-pin, X-coded); use CAT6A, SF-UTP or better and Zivid-approved cables. Power via M12-5P-A.
Triggering	Software trigger via SDK/Studio for 2D, 3D, or 2D+3D; live capture supported.

Revision history

Ver.	Date	Notes
1.0	10/25	Datasheet created.

Zivid AS
Gjerdrums vei 10A
N0484 Oslo
Norway