



OS1-Max - PRELIMINARY DATASHEET

Long Range High-Resolution Imaging Lidar

FIRMWARE VERSION: 4.0

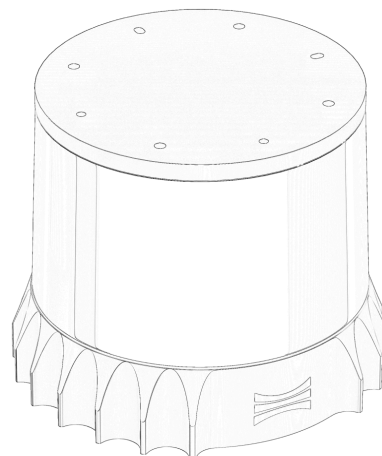
HARDWARE VERSION: REV8.0

SUMMARY

The long range OS1-MAX delivers 200 m range on a dark 10% target and a wide 44.4° vertical field-of-view delivering an industry-leading combination of price, performance, reliability, size, weight, and power. The OS1-MAX is designed for all-weather environments and can be easily integrated into long range industrial applications, autonomous vehicles, off-highway, and 3D mapping vehicles.

HIGHLIGHTS

- 200m Range
- 21 million points per second
- Automotive-grade functional safety
- Dual Return mode
- Calibrated reflectivity
- Fixed resolution per frame
- Multi-sensor crosstalk suppression
- Open source ROS and C++ drivers
- Ouster SDK for software development



OPTICAL PERFORMANCE

Max Representable Range (80% Lambertian reflectivity, 1024 @ 10 Hz mode)	350 m @ 100 klx sunlight, >90% detection probability
Range (10% Lambertian reflectivity, 1024 @ 10 Hz mode)	200 m @ 100 klx sunlight, >90% detection probability
Minimum Range	0.0 m (0.3 m optional, and 0.5 m default)
Vertical Resolution	32, 64, 128 or 256 channels
Horizontal Resolution	512, 1024, 2048, or 4096 (configurable)
Rotation Rate	10 or 20 Hz (configurable)
Field of View	Vertical: 44.4° (+22.2° to -22.2°) Horizontal: 360°
Angular Sampling Accuracy	Vertical: $\pm 0.01^\circ$ / Horizontal: $\pm 0.01^\circ$
False Positive Rate	1/10,000
Range Resolution	0.1 cm Note: For <i>Low Data Rate Profile</i> the Range Resolution = 0.8cm
# of Returns	up to 2
Return Order	Strongest to Weakest, Farthest to Nearest, and Nearest to Farthest

Range Precision (Typical on Lambertian and Retroreflective targets beyond 1 m, 1024 @ 10 Hz mode, 1 standard deviation) Note: Precision is calculated based on the standard deviation of 100 measurements on a static target at a given range	Min: ± 0.5 cm, Max: ± 3 cm Improved over Rev7, to be quantified
Range Accuracy Note: Accuracy is calculated based on the error between the mean of 100 measurements on static target at a given range and the true range	± 2.5 cm for lambertian targets, ± 5 cm for retroreflective targets Measured for targets at a distance of 200 m

LASER

Laser Product Class	Class 1 eye-safe per IEC/EN 60825-1: 2014
Laser Wavelength	865 nm
Beam Diameter Exiting Sensor	19 mm
Beam Divergence	0.09° (FWHM)

LIDAR OUTPUT

Connection	UDP over gigabit Ethernet
Maximum Points Per Second	2,621,440 (32 channel) 5,242,880 (64 channel) 10,485,760 (128 channel) 20,971,520 (256 channel)
Data Rate (megabits per second) (Low Data Rate Profile, 1 return, 1024 @ 10 Hz mode)	up to 11.83 Mbps (32 channel) up to 22.32 Mbps (64 channel) up to 43.29 Mbps (128 channel) up to 85.24 Mbps (256 channel)
Data Rate (megabits per second) (Low Data Rate Profile, 2 returns, 1024 @ 10 Hz mode)	up to 22.32 Mbps (32 channel) up to 43.29 Mbps (64 channel) up to 85.24 Mbps (128 channel) up to 169.12 Mbps (256 channel)
Data Rate (megabits per second) (Single Return Profile, 1024 @ 10 Hz mode)	up to 32.81 Mbps (32 channel) up to 64.26 Mbps (64 channel) up to 127.18 Mbps (128 channel) up to 253.01 Mbps (256 channel)
Data Rate (megabits per second) (Dual Return Profile, 1024 @ 10 Hz mode)	up to 43.29 Mbps (32 channel) up to 85.24 Mbps (64 channel) up to 169.12 Mbps (128 channel) up to 336.89 Mbps (256 channel)
Data Per Point	Range, Signal, Reflectivity, Near-infrared, Channel, Azimuth angle, and Timestamp
Timestamp Resolution	< 1 μ s
Data Latency	< 10 ms
Data Integrity	End to End CRC that covers entire data packet

IMU OUTPUT

Connection	UDP over 1000Base-T, 1000Base-T1 or PoE+
Samples Per Second (1024 @ 10 Hz mode)	640
Data Per Sample	3 axis gyro, 3 axis accelerometer
Timestamp Resolution	< 1 μ s
Data Latency	< 10 ms
Additional Details	InvenSense IAM-20685HP; datasheet for more details: https://invensense.tdk.com/products/motion-tracking/6-axis/iam-20685hp/




CONTROL INTERFACE

Connection	HTTPS API	
Time Synchronization	Input sources: <ul style="list-style-type: none">• IEEE1588 Precision Time Protocol (PTP); Accuracy: <1 ms error• gPTP; Accuracy: <1 ms error• NMEA \$GPRMC UART message support• External PPS; Accuracy: <1 ms error• Internal 10 ppm drift clock; Accuracy: <20 ppm error Output sources: <ul style="list-style-type: none">• Configurable 1 - 60 Hz output pulse	
Lidar Operating Modes	<ul style="list-style-type: none">• x 512 @ 10 Hz or 20 Hz• x 1024 @ 10 Hz or 20 Hz• x 2048 @ 10 Hz or 20 Hz• x 4096 @ 10 Hz	
Additional Programmability	<ul style="list-style-type: none">• Return ordering• Minimum range• Azimuth masking• Low-power standby mode	<ul style="list-style-type: none">• Multi-sensor phase lock• Queryable intrinsic calibration information:<ul style="list-style-type: none">• Beam angles• IMU pose correction matrix• On-sensor 3D zone monitoring

MECHANICAL/ELECTRICAL

Power Consumption	14 - 20 W <ul style="list-style-type: none">• 22 W peak at startup• 28 W peak if operating at -40 °C and 25.5 W for PoE+ skus Note: Ouster recommends use of a power brick (no less than 30 W) if using in extreme outdoor conditions.
Connector	- Proprietary pluggable side connector 1000Base-T - Bottom mounted proprietary connector with PoE - Bottom T1 HMTD connector
Operating Voltage	9.5 V - 51 V <ul style="list-style-type: none">• Suitable for 12 VDC to 24 VDC nominal systems• Not suitable for 48 V nominal battery based systems• Under-voltage WARNING level alert occurs at 9.5 VDC at the connector• Under-voltage ERROR level alert occurs at 9.0 VDC at the connector• Below 9.0 VDC at connector, sensor may shutdown• Over-voltage conditions/alarms occur at 51 VDC at the connector• Over-voltage lockout onset at 58 VDC (± 1 V) at the connector• Over-voltage lockout release at 55 VDC (± 1 V) at the connector
Dimensions	Diameter: 87 mm (3.42 in) Height: <ul style="list-style-type: none">• Without cap: 82 mm• With thermal cap: 87 mm
Weight	Without cap: 750 g With radial cap: 825 g With halo cap: 850 g
Mounting	Bottom: 4x M3 screws, 2x locating 2 mm pin holes Top: 4x M3 screws, 4x locating 2 mm pin holes, 1x M6 screw

OPERATIONAL

Operating Temperature	-40 °C to +85 °C (with mount) Between +75 °C and +85 °C, sensor automatically reduces range (max 30% range reduction)
Storage Temperature	-40 °C to +105 °C
Ingress Protection	IP68 (1m submersion for 1 hour, with I/O cable attached) IP69K (with I/O cable attached)
Shock	IEC 60068-2-27 (Amplitude: 100 g, Shape: 11 ms half-sine, 3 shocks x 6 directions)
Vibration	IEC 60068-2-64 (Amplitude: 10 G-rms, Shape: 10 - 1000 Hz, Mounting: 3 axis @ 48hrs/axis, per ISO-16750-3 Test VII method and ASD)
Compliance	<p>Functional Safety:</p> <ul style="list-style-type: none">- IEC61508 SIL2,- ISO26262 ASIL-B, and- ISO13849 PLd. <p>Security/Cybersecurity:</p> <ul style="list-style-type: none">- ISO 21434 Automotive- UNECE-WP 29 Automotive- IEC 62443 Industrial- ISO 27001 <p>For US</p> <p>Laser Safety:</p> <ul style="list-style-type: none">- IEC/EN 60825-1:2014 Class 1 eye safe- FDA US 21CFR1040 Notice 56 Class 1 <p>Product Safety:</p> <ul style="list-style-type: none">- UL 62368-1- CSA 22.2 No. 62368-1-19 <p>EMC: FCC Part 15 and ICES03 Class B</p> <p>For EU</p> <p>Laser Safety: IEC/EN 60825-1:2014 Class 1 eye safe</p> <p>Product Safety: EN/IEC 62368-1</p> <p>EMC:</p> <ul style="list-style-type: none">- EN 55032:2012/AC 2013/CISPR 32: 2015 Class B- EN 61000-3-2:2014- EN 61000-3-3:2013- EN 55024: 2010; CISPR 24: 2010 <p>Automotive:</p> <ul style="list-style-type: none">- GMW3097- UN-ECE Reg 10 <p>Earthmoving/Construction equipment:</p> <ul style="list-style-type: none">- ISO-13766-1:2018 <p>Industrial Trucks/Forklift:</p> <ul style="list-style-type: none">- IEC/EN-12895. <p>Agricultural equipment:</p> <ul style="list-style-type: none">- ISO 14982 <p>Note: Ouster UK (Ltd): 125 Princes Street, Edinburgh EH2 4AD, Scotland, United Kingdom Contact: Neil Calder, Phone Number: +44(0).131.563.9078</p> <div></div>

SOFTWARE

Sample Drivers	Ouster SDK, ROS, C++, Ouster Studio
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*Specifications are subject to change without notice.

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