Small and Lightweight Topo-Bathymetric Airborne LiDAR System
with Online Waveform Processing and Full Waveform Recording

RIEGL VUX-820-G

- *lightweight 5.4 kg (11.9 lbs)*
- *Integrated RIEGL RiLOC-F inside inertial navigation system*
- *Integrated RGB camera*
- *designed for combined topographic and bathymetric UAV-based survey*
- *high accuracy ranging based on echo digitization and online waveform processing with multiple-target capability*
- *concurrent comprehensive full waveform storage for all measurements*
- *high spatial resolution due to measurement rate of up to 100 kHz and high scanning speed of up to 50 scans/sec*
- *compact, lightweight and robust housing for easy mounting on UAV or integration into payload pods when used with crewed aircraft*
- *status information display and system parametrization via user interface*



The *RIEGL* VUX-820-G is offered as a fully integrated "all-in" package solution and comes with an integrated *RIEGL* RiLOC-F inside inertial navigation system and an integrated RGB camera to supplement the LiDAR data also with image data.

The "all-in" package also includes *RIEGL's* proprietary software licenses which are required for generating the georeferenced and refraction-corrected point cloud.

The scanner carries out laser range measurements for surveying of underwater topography with a narrow, visible green laser beam, emitted from a pulsed laser source. Subject to clarity, at this particular wavelength the laser beam penetrates water enabling measurement of submerged targets.

The distance measurement is based on the time-of-flight measurement with very short laser pulses and subsequent echo digitization and online waveform processing. The laser beam is deflected in a circular scan pattern and hits the water surface at an incidence angle with low variation.

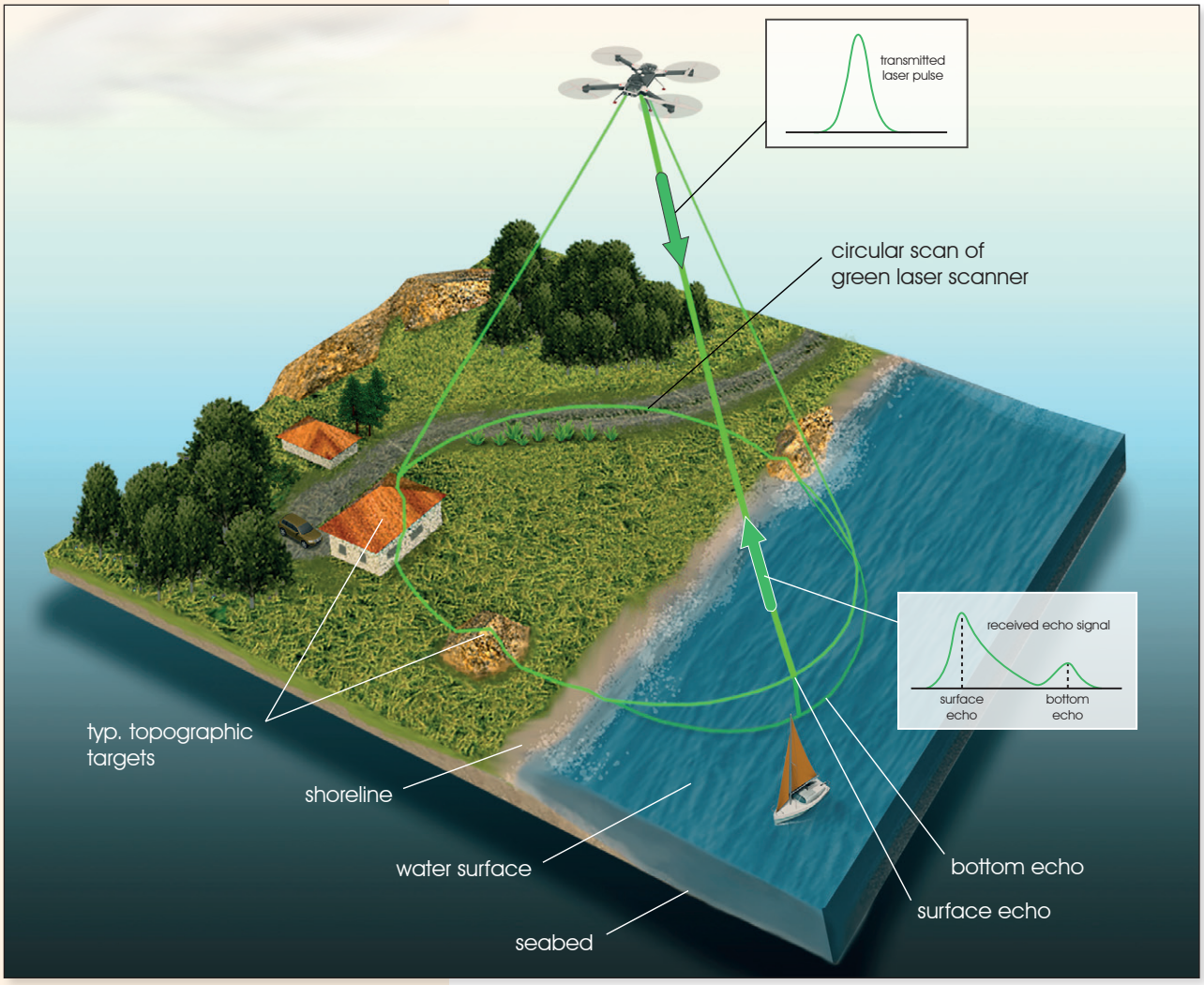
The rugged internal mechanical structure together with the dust-tight and splash-proof housing enables long-term operation on airborne platforms, especially UAVs.

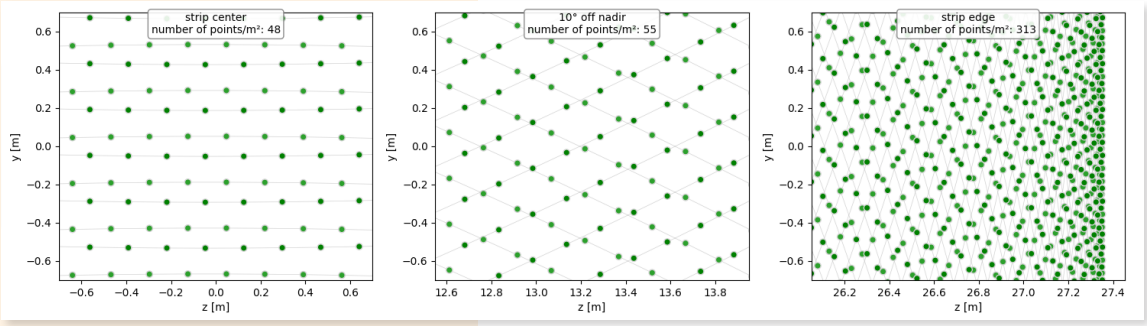
Typical applications include

- *coastline and shallow water mapping*
- *detection of submerged and floating targets*
- *river and water reservoir surveying*
- *monitoring tasks in hydro engineering and harbor management*
- *hydro archaeology*

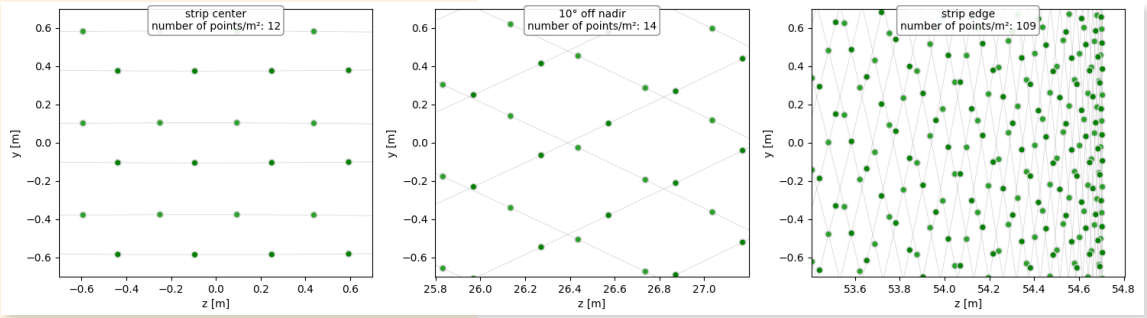
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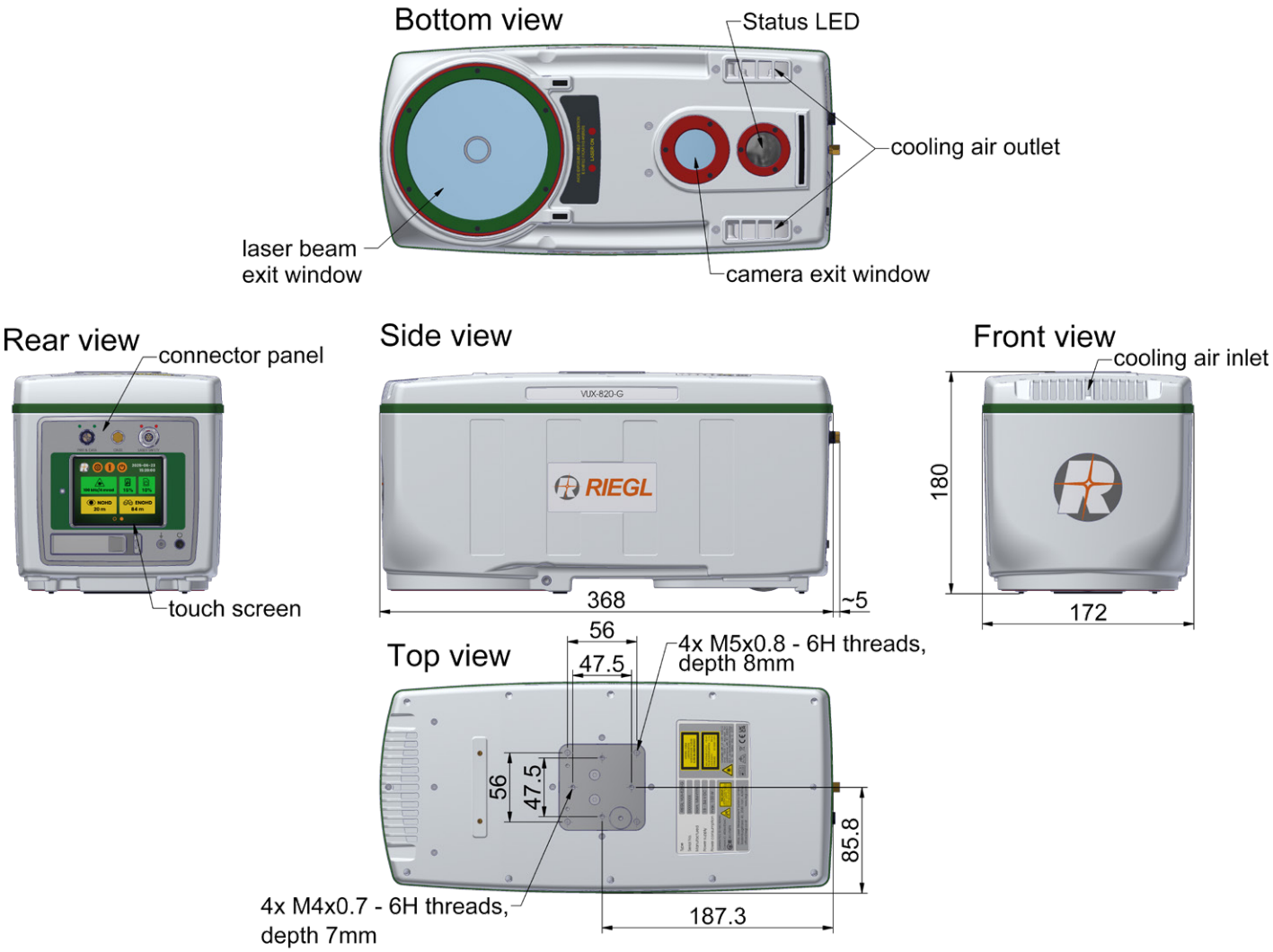


Point pattern and density for UAV applications
flying altitude 75 m, flying speed 12 m/sec, scan rate 50 lps, pulse repetion rate 50 kHz, average point density: 76 points/sqm
grey lines: scan trace on ground, green dots: points on the ground (dark green: forward look, light green: backward look)



Point pattern and density for helicopter applications
flying altitude 150 m, flying speed 24 m/sec, scan rate 50 lps, pulse repetition rate 50 kHz, average point density: 19 points/sqm
grey lines: scan trace on ground, green dots: points on the ground (dark green: forward look, light green: backward look)

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dimensions in mm

RIEGL VUX-820-G Perspective View



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Export Classification

The Topo-Bathymetric Airborne Laser Scanner VUX-820-G has been designed and developed for commercial topographic, hydrographic and bathymetric surveying applications.

The VUX-820-G is subject to export restrictions as set up by the Wassenaar Arrangement. It is classified as dual-use good according to position number 6A8j3 of the official Dual-Use-List to be found on site http://www.wassenaar.org. Within the European Union, Regulation (EU) No. 2021/821 implements the export restrictions of the Wassenaar Arrangement. The corresponding position number is **6A008j3**.

Laser Product Classification

Class 3B Laser Product according to IEC60825-1:2014
The following clause applies for instruments delivered into the United States: Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56, dated May 8, 2019.



NOHD [1) 2) 3)]	19 m

1) NOHD ... Nominal Ocular Hazard Distance
2) beam divergence 6 mrad, laser PRR 50 kHz
3) provided that the instrument is operated on a moving platform

Range Measurement Performance

Measuring Principle	echo signal digitization, online waveform processing, full waveform recording, time-of-flight measurement, multiple target capability

Measurement Rate [4)]	5 kHz [7)]	50 kHz	100 kHz
Max. Water Depth Penetration in Secchi Depths [5) 6)] (Flight altitude 75 m above water level)	2.2	2.0	1.8

Minimum Range	20 m
Accuracy [8) 10)]	20 mm
Precision [9) 10)]	15 mm
Laser Pulse Repetition Rate	max. 100 kHz
Echo Signal Intensity	for each echo signal, high-resolution 16 bit intensity information is provided
Number of Targets per Pulse	online waveform processing: up to 15 [11)]
Laser Wavelength	532 nm, green
Laser Beam Divergence	selectable, 1 up to 6 mrad [12)]
Receiver Field of View	9 mrad
Laser Beam Footprint (Gaussian Beam Definition)	50 mm @ 50 m, 100 mm @ 100 m, 150 mm @ 150 m [13)]

Scanner Performance

Scanning Mechanism	rotating prism
Scan Pattern	circular
Off Nadir Scan Angle Range	$\pm$ 20° = 40°
Scan Speed (selectable)	10 - 50 lines/sec (lps) [14)]
Angular Step Width $\Delta\ \vartheta$ (selectable) between consecutive laser shots	0.036° $\leq \Delta\ \vartheta \leq$ 0.36° [15) 16)]
Angle Measurement Resolution	0.001° (3.6 arcsec)

General Technical Data

Power Supply Input Voltage	18 - 34 V DC
Power Consumption	typ. 75 W max. 110 W
Main Dimensions (L x W x H)	368 mm x 172 mm x 180 mm
Weight	approx. 5.4 kg
Humidity	non condensing
Protection Class	IP64
Max. Flight Altitude [17)] operating / not operating	18 500 ft (5 600 m) above Mean Sea Level (MSL)
Temperature Range operation / storage	-10°C up to +40°C / -20°C up to +50°C

4) rounded values
5) The Secchi depth is defined as the depth at which a standard black and white disc deployed into the water is no longer visible to the human eye.
6) The depth performance is specified for bright targets with size in excess of the laser beam diameter, for Secchi depths of 2 m to 5 m, and for clear atmospheric conditions.
7) waveform averaging applied in postprocessing, laser PRR=50 kHz at data acquisiton
8) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
9) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
10) One sigma @ 150 m rounded values
11) If the laser beam hits, in part, more than one target, the laser's pulse power is split accordingly. Thus, the achievable range ist reduced.
12) Measured at the $1/e^2$ points. 1.0 mrad corresponds to an increase of 100 mm of beam diameter per 100 m distance.
13) The laser beam footprint values correspond to a beam divergence of 1mrad.
14) One line corresponds to a full revolution (360°) of the scan mechanism which can be split into two user defined segments.
15) The angular step width limits depend on the selected laser PRR.
16) The maximum angular step width is limited by the maximum scan rate.
17) for standard atmospheric conditions: 1013 mbar, +15°C at sea level

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IMU RiLOC-F^INSIDE

IMU Accuracy [1]	
Roll/Pitch	0.005°
Yaw	0.020°
Performance specifications	0.02 - 0.03 m
IMU sampling rates	up to more than 700 Hz
IMU acceleration range	±8 g
IMU angular range	± 300°/sec
GNSS system	multi-constellations (GPS, GLONASS, Galileo, and BeiDou) up to triple-frequency

Integrated Digital Camera

RGB Camera

Sensor Resolution	5.1 MPixel
Sensor Dimensions (diagonal)	8.8 mm (2464 x 2064 px)
Focal Length of Camera Lens	7.87 mm
Field of View (FOV)	approx. 47° x 40°
Interface	GigE

Data Interfaces

Configuration	LAN 10/100/1000 Mbit/sec
Scan Data Output	LAN 10/100/1000 Mbit/sec
GNSS Interface (optional)	Serial RS-232 interface, TTL input for 1pps synchronization pulse, accepts different data formats for GNSS-time information
General IO & Control [2]	1x TTL input, 1x TTL output, 1x Remote on/off
Removable Storage Card	CFast®, up to 1 TByte
Internal Data Storage	2 TB SSD

1) accuracy specifications for post-processed data
2) externally available via connection board (including 1x power camera)

RIEGL® LASER MEASUREMENT SYSTEMS

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RIEGL USA Inc., *Headquarters North America*

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