

Lightweight and Compact Topo-Bathymetric Airborne Laser Scanner with Online Waveform Processing and Full Waveform Recording

NEW

RIEGL VQ[®]-840-GE

- **lightweight 9.5 kg (21 lbs)**
- **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 100 scans/sec**
- **integrated inertial navigation system (optional)**
- **integrated digital camera (optional)**
- **compact, lightweight and robust housing compliant with stabilized platforms**

The **RIEGL[®] VQ-840-GE** is a fully integrated compact airborne laser scanner for combined topographic and bathymetric surveying. Its compact and very lightweight design facilitates integration into UAVs. The system can be offered optionally with an integrated and factory-calibrated IMU/GNSS system and an optional camera.

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 an elliptic scan pattern and hits the water surface at an incidence angle with low variation.

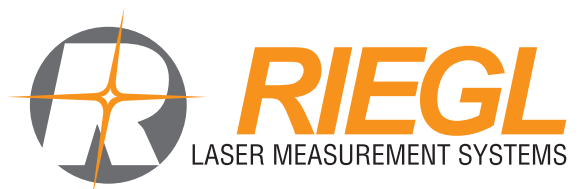
The VQ-840-GE can be complemented with an inertial navigation sensor for subsequent estimation of the instrument's location and orientation. As further option a high-resolution digital camera can be integrated to supplement the data gained by the laser scanner.

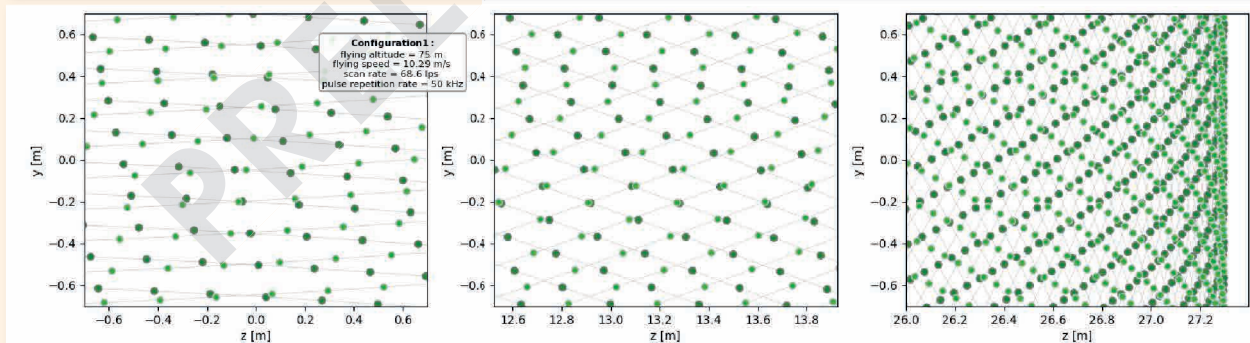
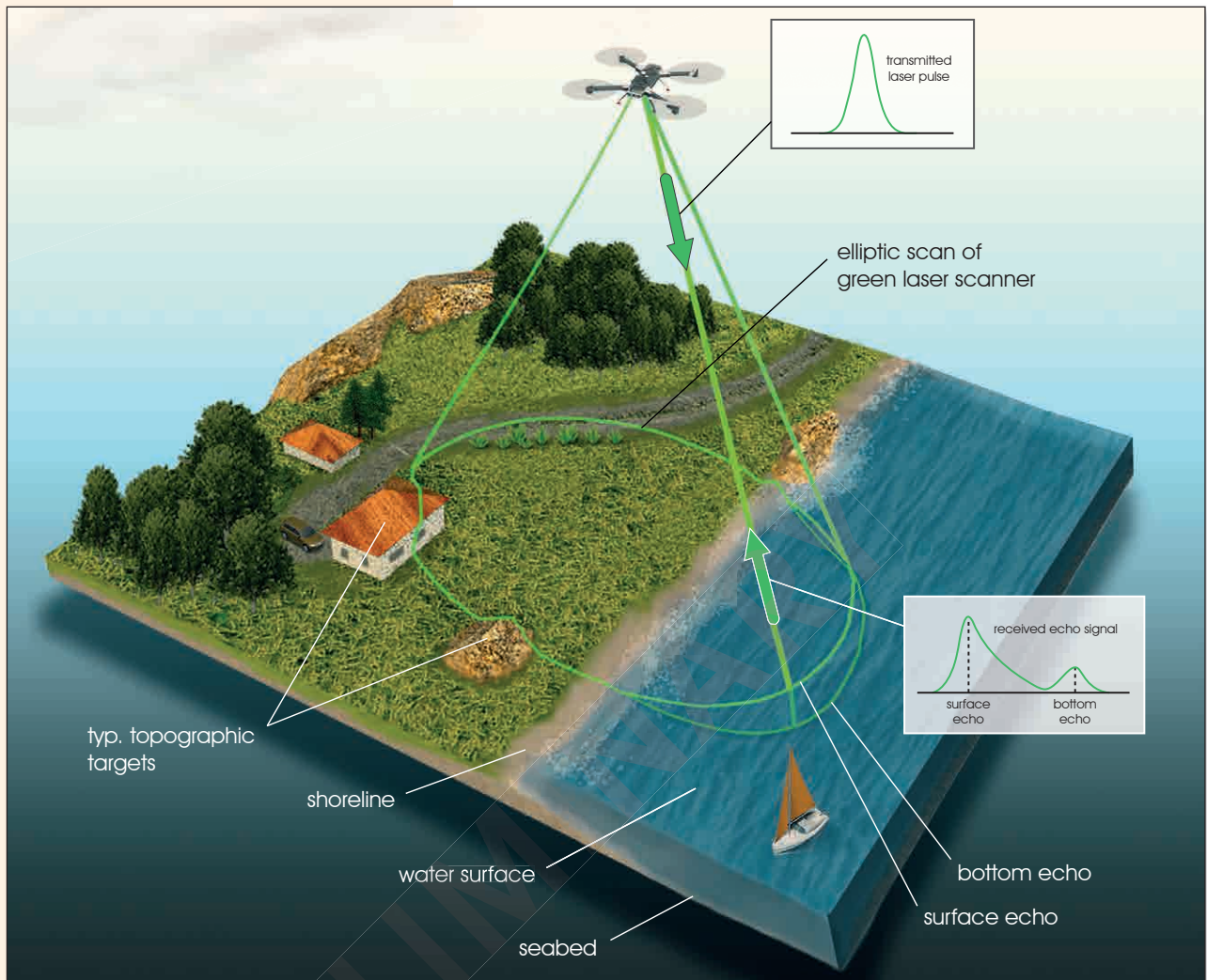
The rugged internal mechanical structure together with the dust- and splash water proof housing enables long-term operation on airborne platforms, especially UAVs.

Typical applications include

- **coastline and shallow water mapping**
- **river surveying**
- **repeated survey of water reservoirs**

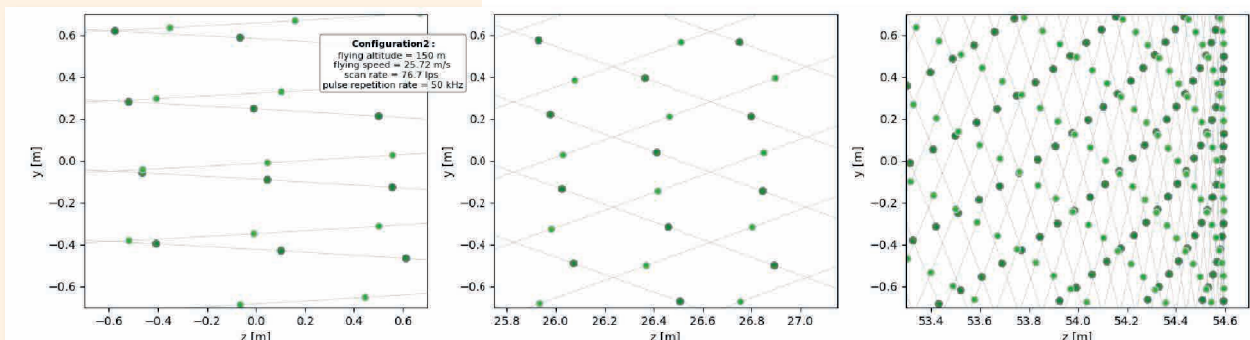
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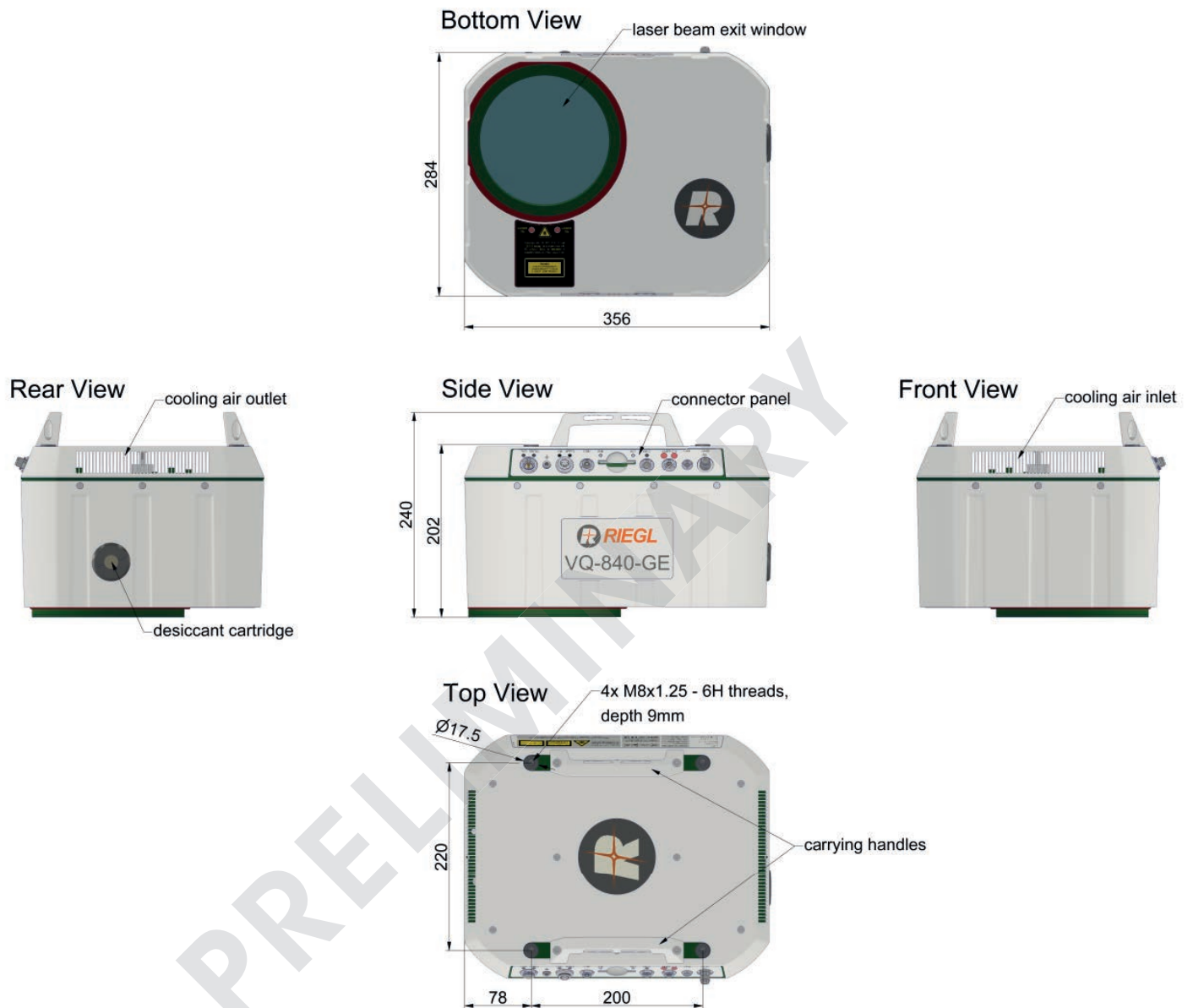
Point pattern and density for UAV applications

flying altitude 75 m, flying speed 10 m/sec, scan rate 69 lps, pulse repetition rate 50 kHz, average point density: 92 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 26 m/sec, scan rate 77 lps, pulse repetition rate 50 kHz, average point density: 18 points/sqm
grey lines: scan trace on ground, green dots: points on the ground (dark green: forward look, light green: backward look)

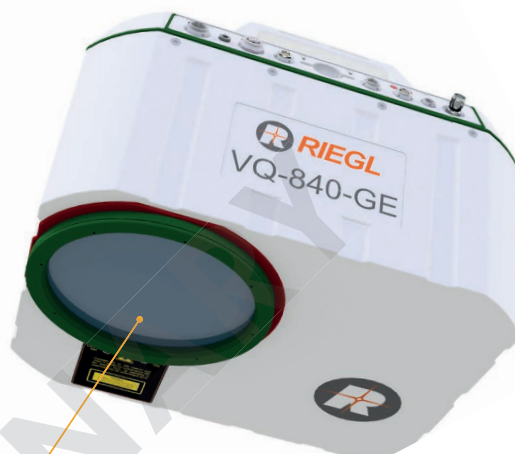


dimensions in mm

connector panel



beam exit window



PRELIMINARY

Export Classification

The Topo-Bathymetric Airborne Laser Scanner VQ-840-GE has been designed and developed for commercial topographic, hydrographic and bathymetric surveying applications.

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)

- 1) NOHD ... Nominal Ocular Hazard Distance
2) beam divergence 6 mrad, laser PRR 50kHz

The VQ-840-GE 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**.



15 m

- 3) provided that the instrument is mounted 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⁾	50 kHz	100 kHz
Max. Water Depth Penetration in Secchi Depths ^{5) 6)} (Flight altitude 75m above water level)	2.0	1.8

Minimum Range

20 m

Accuracy ^{7) 9)}

20 mm

Precision ^{8) 9)}

15 mm

Laser Pulse Repetition Rate

max. 100 kHz

Echo Signal Intensity

for each echo signal, high-resolution 16 bit intensity information is provided
online waveform processing: up to 15 ¹⁰⁾

Number of Targets per Pulse

online waveform processing: up to 15 ¹⁰⁾

Laser Wavelength

532 nm, green

Laser Beam Divergence

selectable, 1 up to 6 mrad ¹¹⁾

Receiver Field of View

9 mrad

Laser Beam Footprint (Gaussian Beam Definition)

50 mm @ 50 m, 100 mm @ 100 m, 150 mm @ 150 m ¹²⁾

Scanner Performance

Scanning Mechanism

rotating scan mirror

Scan Pattern

nearly elliptic

Off Nadir Scan Angle Range

$\pm 20^\circ = 40^\circ$ perpendicular to flight direction, $\pm 14^\circ = 28^\circ$ in flight direction

Scan Speed (selectable)

10 - 100 lines/sec (lps) ¹³⁾

Angular Step Width $\Delta \theta$ (selectable)

$0.072^\circ \leq \Delta \theta \leq 0.72^\circ$ (for PRR 50 kHz) ^{14) 15)}

between consecutive laser shots

Angle Measurement Resolution

0.001° (3.6 arcsec)

4) rounded values

10) If the laser beam hits, in part, more than one target, the laser's pulse power is split accordingly. Thus, the achievable range is reduced.

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.

11) Measured at the 1/e² points. 1.0 mrad corresponds to an increase of 100 mm of beam diameter per 100 m distance.

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.

12) The laser beam footprint values correspond to a beam divergence of 1mrad.

7) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.

13) One line corresponds to a full revolution (360°) of the scan mechanism which can be split into two user defined segments.

8) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.

14) The angular step width limits depend on the selected laser PRR.

9) One sigma @ 150m rounded values

15) The maximum angular step width is limited by the maximum scan rate.

General Technical Data

Power Supply Input Voltage

18 - 34 V DC

Power Consumption

typ. 110 W

Main Dimensions (L x W x H)

max. 220 W

Weight

360 mm x 285 mm x 200 mm

Humidity

approx. 9.5 kg without optionally integrated components

Protection Class

non condensing

Max. Flight Altitude ¹⁶⁾

IP64, dust and splash-proof

operating / not operating

18 500 ft (5 600 m) above Mean Sea Level (MSL)

Temperature Range

-10°C up to +40°C / -20°C up to +50°C

operation / storage

16) for standard atmospheric conditions: 1013 mbar, +15°C at sea level

RIEGL VQ-840-GE Technical Data (Optional Components)

IMU/GNSS (optional)

IMU Accuracy ¹⁾	
Roll, Pitch	0.015°
Heading	0.035°
IMU Sampling Rate	200 Hz
Position Accuracy (typ.)	
horizontal / vertical	<0.05 m / <0.1 m

Integrated Digital Camera (optional)

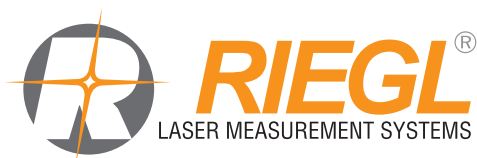
RGB Camera	
Sensor Resolution	12 MPixel
Sensor Dimensions (diagonal)	17.5 mm (4112 x 3008 px)
Focal Length of Camera Lens	16 mm
Field of View (FOV)	approx. 47° x 36°
Interface	GigE

Data Interfaces

Configuration	LAN 10/100/1 000 Mbit/sec,
Scan Data Output	LAN 10/100/1 000 Mbit/sec,
	high speed data link to <i>RIEGL DR1560ii</i> (optional) ³⁾
GNSS Interface ²⁾	Serial RS-232 interface for data string with GNSS-time information,
	TTL input for 1 PPS synchronization pulse
General IO & Control	1x TTL input/output, 1x Serial RS-232 Interface, 1x Remote on/off
Camera Interface	1x GNSS RS-232 Tx & PPS, Power, Trigger, Exposure
Removable Storage Card	CFast®, up to 1 TByte (optional) ³⁾
Internal Data Storage	2 TB SSD

1) accuracy specifications for post-processed data
2) to be used for external GNSS receiver

3) only one single option (CFast or data recorder interface) can be implemented



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