

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

RIEGL VQ-840-G

- *designed for combined topographic and bathymetric airborne and 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 for subsequent full waveform analysis*
- *high spatial resolution due to measurement rate of up to 200 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 typical hatches in aircrafts and with stabilized platforms*

The **RIEGL® VQ-840-G** is a fully integrated compact airborne laser scanner for combined topographic and bathymetric surveying. The system can be offered optionally with an integrated and factory-calibrated IMU/GNSS system and with an optional camera.

The **VQ-840-G** is a compact and lightweight LiDAR system to be installed on various platforms including UAVs.

The scanner carries out laser range measurements for high resolution 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. To handle target situations with most complex multiple echo signals, beside the online waveform processing the digitized echo waveforms can be stored on the removable data storage card for subsequent off-line full waveform analysis.

The laser beam is deflected in an elliptic scan pattern and hits the water surface at an incidence angle with low variation.

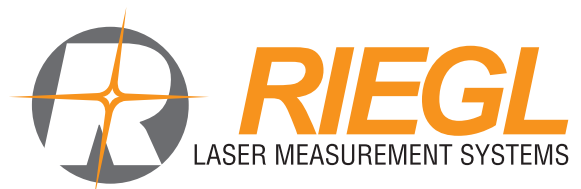
The VQ-840-G can be complemented with an inertial navigation sensor for subsequent estimation of the instrument's location and orientation. As an option a high-resolution digital camera can be integrated to supplement the data gained by the green laser scanner. The rugged internal mechanical structure together with the dust- and splash water proof housing enables long-term operation on airborne platforms.

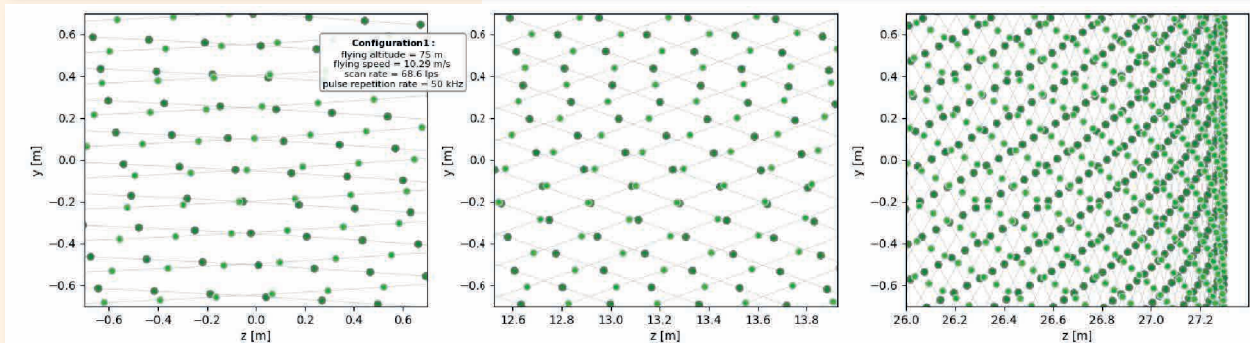
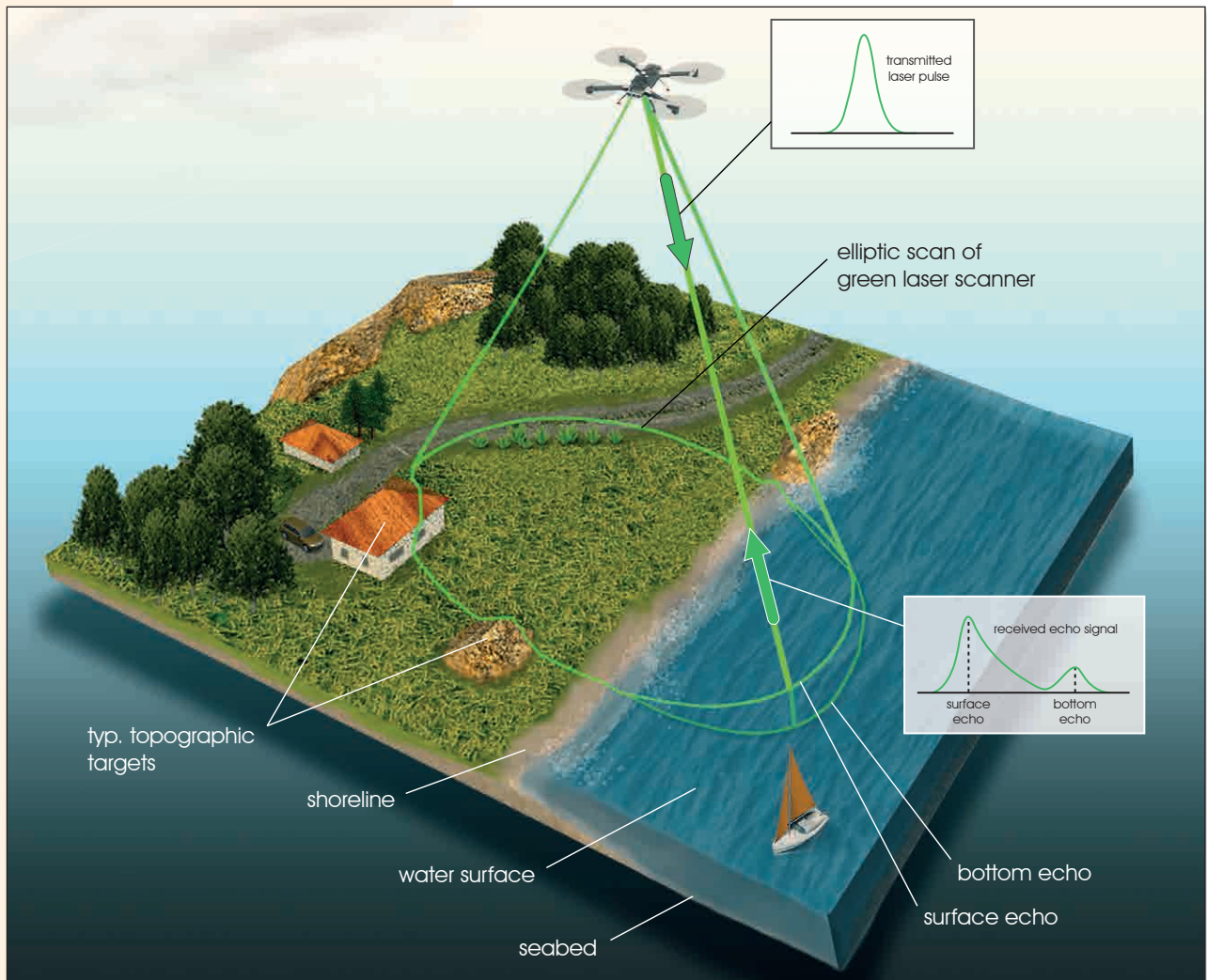
Typical applications include

- *coastline and shallow water mapping*
- *surveying for hydraulic engineering*
- *hydro-archeological-surveying*
- *river surveying*
- *repeated survey of water reservoirs*



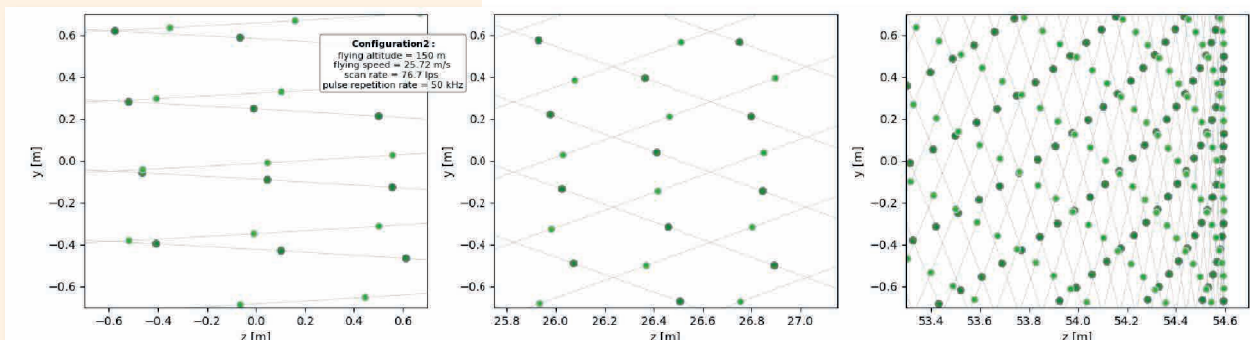
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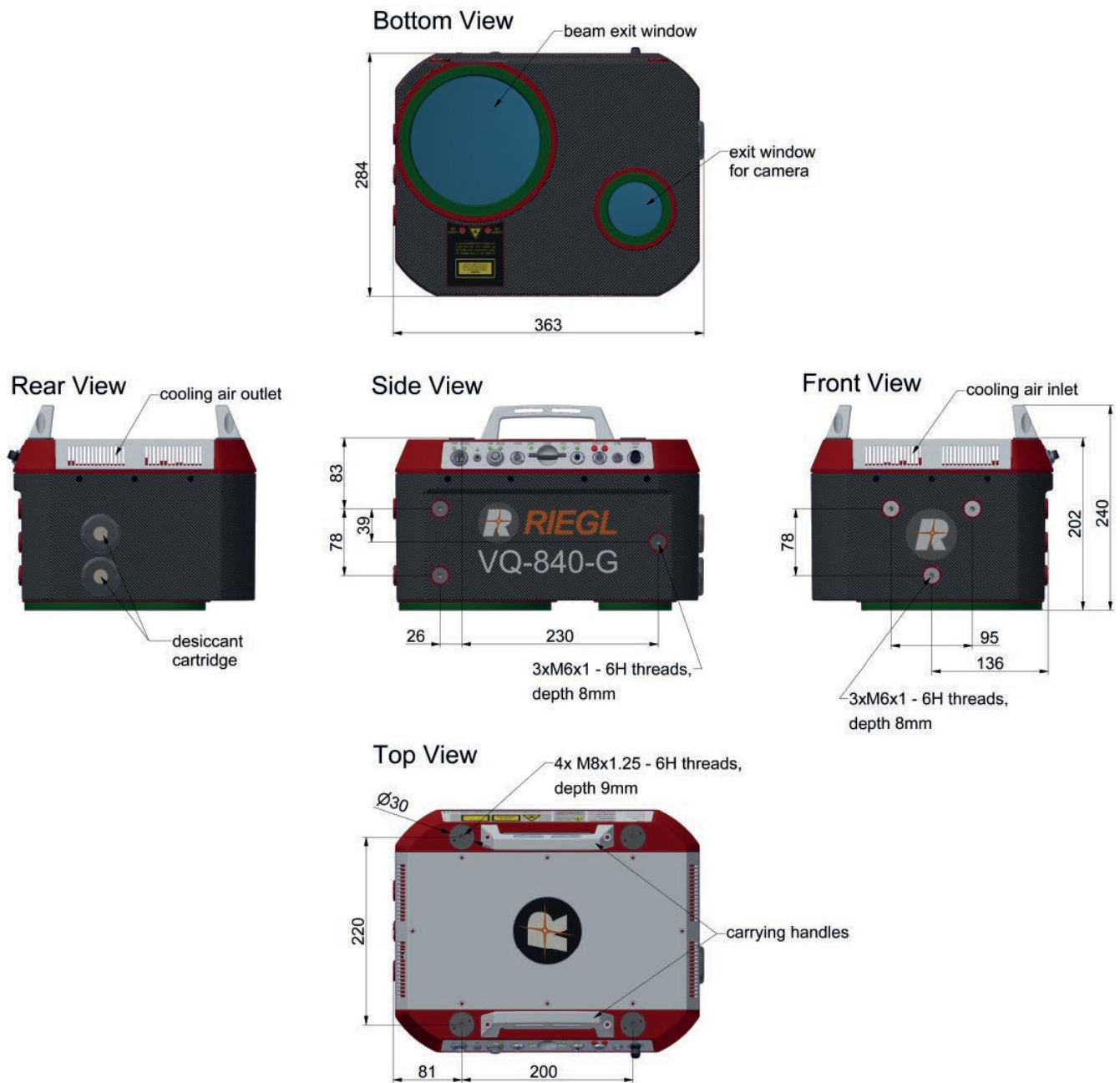
Point pattern and density for UAV applications

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

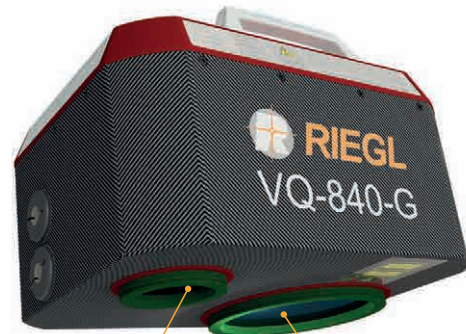
flying altitude 150 m, flying speed 26 m/sec, scan rate 77 lps, pulse repetition rate 50 kHz, average point density: 18 points/sqm
grey lines: scan trace on ground, green dots: points on the ground (dark green: forward look, light green: backward look)



dimensions in mm

RIEGL VQ-840-G Perspective View

connector panel



exit window
for camera

beam exit window

RIEGL VQ-840-G Installation Examples

Complemented by an optional IMU/GNSS system and further options like a high-resolution digital, the *RIEGL VQ-840-G* represents a fully integrated system with low weight for integration on various aircraft platforms including UAVs.



UAV integration example:
RIEGL VQ-840-G installed on a UAV-based platform



RIEGL VQ-840-G (with external IMU) installed on
GSM-4000 stabilized platform to be used in a helicopter
or fixed-wing aircraft

Export Classification

The Topo-Bathymetric Airborne Laser Scanner VQ-840-G 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.

The VQ-840-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**.



NOHD ^{1) 2) 3)}

15 m

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

- 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⁾	200 kHz	100 kHz	50 kHz	5 kHz ⁷⁾	0.5 kHz ⁷⁾
Max. Water Depth Penetration in Secchi Depths ^{5) 6)} (Flight altitude 75m above water level)	1.7	1.8	2.0	2.2	2.5

Minimum Range

20 m

Accuracy ^{8) 10)}

20 mm

Precision ^{9) 10)}

15 mm

Laser Pulse Repetition Rate

50 kHz to 200 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

selectable, 3 up to 18 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 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) ¹⁴⁾

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

$0.072^\circ \leq \Delta \theta \leq 0.72^\circ$ (for PRR 50 kHz) ^{15) 16)}

between consecutive laser shots

Angle Measurement Resolution

0.001° (3.6 arcsec)

4) rounded values

10) One sigma @ 150m 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.

11) 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.

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) Measured at the $1/e^2$ points. 1.0 mrad corresponds to an increase of 100 mm of beam diameter per 100 m distance.

7) Waveform averaging applied in postprocessing, Laser PRR=50kHz

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

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

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

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

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.

General Technical Data

Power Supply Input Voltage

18 - 34 V DC

Power Consumption

typ. 110 W

max. 220 W

Main Dimensions (L x W x H)

360 mm x 285 mm x 200 mm

Weight

approx. 12 kg

<15 kg (with IMU/GNSS and camera)

Humidity

non condensing

Protection Class

IP64, dust and splash-proof

Max. Flight Altitude ¹⁷⁾

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

operating / not operating

Temperature Range

-10°C up to +40°C / -20°C up to +50°C

operation / storage

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

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

IMU/GNSS (optional)

IMU Accuracy ¹⁾

Roll, Pitch

Heading

IMU Sampling Rate

Position Accuracy (typ.)

horizontal / vertical

0.015°

0.035°

200 Hz

<0.05 m / <0.1 m

Integrated Digital Camera (optional)

RGB Camera

Sensor Resolution

Sensor Dimensions (diagonal)

Focal Length of Camera Lens

Field of View (FOV)

Interface

12 MPixel / 24 MPixel

17.5 mm (4112 x 3008 px)

16 mm

approx. 47° x 36°

GigE

Data Interfaces

Configuration

Scan Data Output

GNSS Interface ²⁾

General IO & Control

Camera Interface

Removable Storage Card

Internal Data Storage

LAN 10/100/1 000 Mbit/sec,

LAN 10/100/1 000 Mbit/sec,

high speed data link to *RIEGL* DR1560ii (optional) ³⁾

Serial RS-232 interface for data string with GNSS-time information,

TTL input for 1 PPS synchronization pulse

1x TTL input/output, 1x Serial RS-232 Interface, 1x Remote on/off

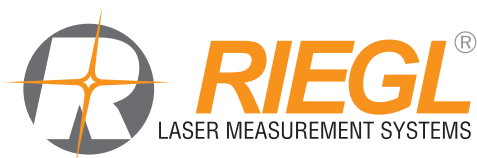
1x GNSS RS-232 Tx & PPS, Power, Trigger, Exposure

CFast®, up to 1 TByte (optional) ⁴⁾

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



RIEGL Laser Measurement Systems GmbH, Headquarters
RIEGL USA Inc., Headquarters North America

RIEGL Japan Ltd.
RIEGL China Ltd.
RIEGL Australia Pty Ltd.
RIEGL Canada Inc.

RIEGL UK Ltd.
RIEGL Asia Pacific Ltd.
RIEGL South America Spa
RIEGL Deutschland Vertriebsgesellschaft mbH

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