

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

**NEW**

## RIEGL VQ<sup>®</sup>-840-GL

**lightweight 9.8 kg (21 lbs)**

- **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 new **RIEGL<sup>®</sup> VQ-840-GL** is a fully integrated, compact airborne laser scanner for combined topographic and bathymetric surveying. The LiDAR system is now offered in a new design. Maintaining the proven form factor, the internal redesign and use of very lightweight material enables a reduced weight of less than 10kg (22lbs), making the VQ-840-GL even more suitable for UAV integration.

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-GL can be complemented with an inertial navigation sensor for subsequent estimation of the instrument's location and orientation. As a further option a high-resolution digital camera can be integrated.

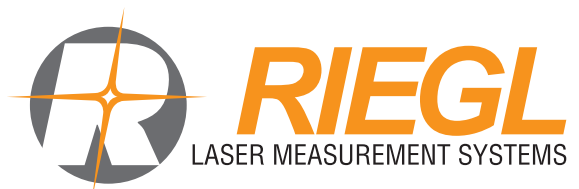
The rugged internal mechanical structure together with the dust- and splash water proof housing enables long-term operation on airborne platforms.

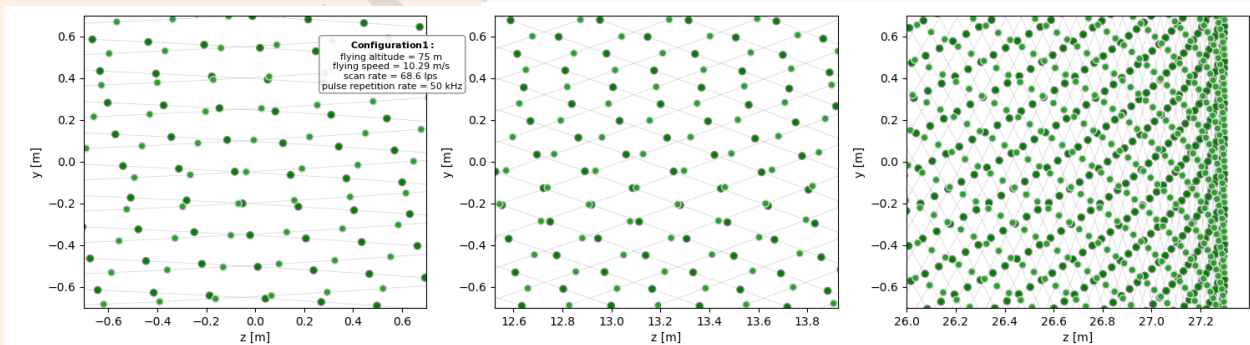
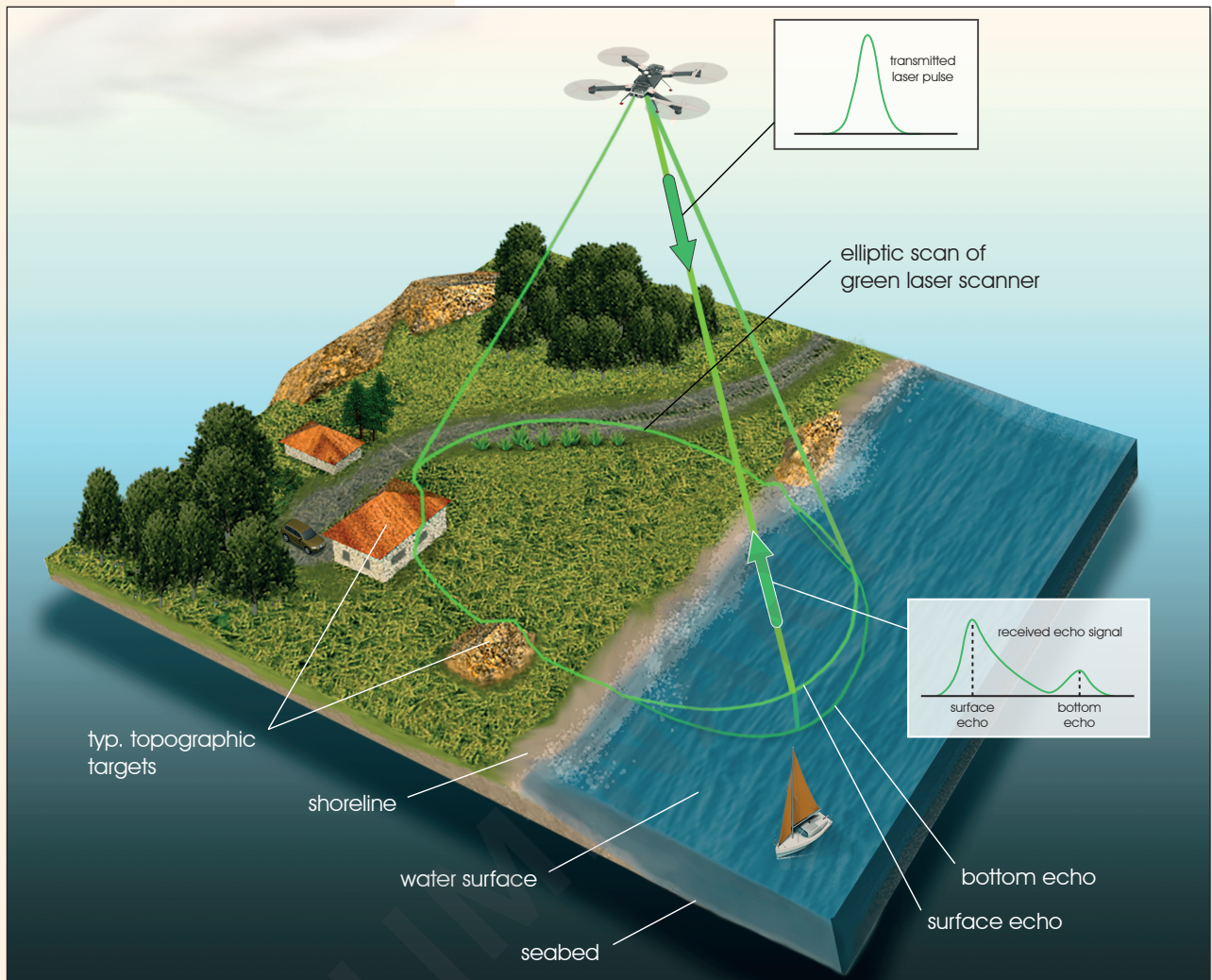
### Typical applications include

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



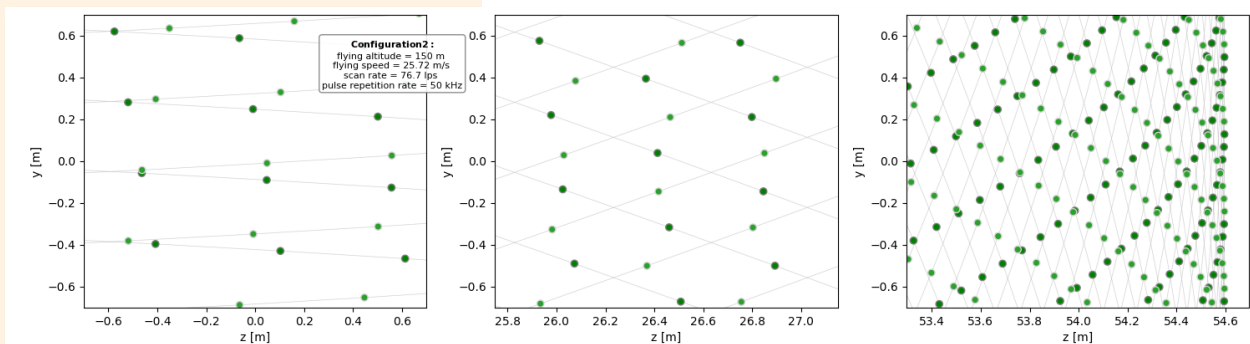
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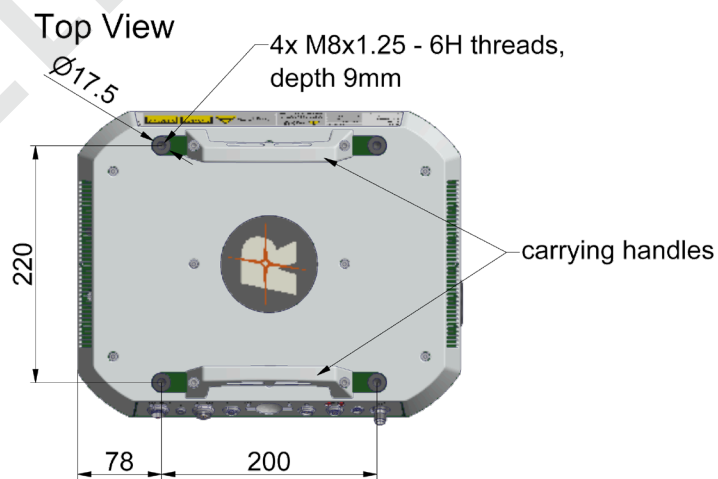
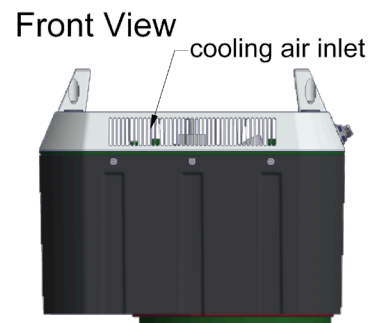
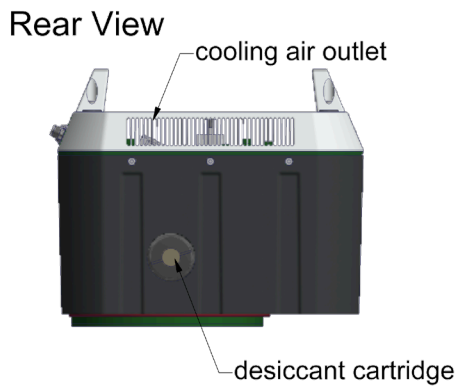
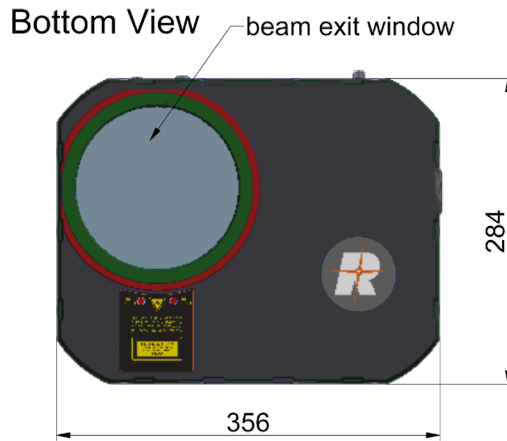
## Point pattern and density for UAV applications

flying altitude 75 m, flying speed 10m/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 26m/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)

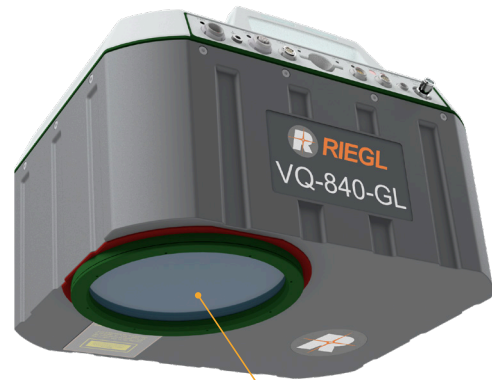


dimensions in mm



## RIEGL VQ-840-GL Perspective View

connector panel



beam exit window

## RIEGL VQ-840-GL Installation Examples

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



UAV integration example:  
*RIEGL VQ-840-GL* installed on RiCOPTER-M



*RIEGL VQ-840-GL* (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-GL has been designed and developed for commercial topographic, hydrographic and bathymetric surveying applications.

The VQ-840-GL 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

Laser Class

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 <sup>1) 3) 4)</sup>  
ENOHD <sup>2) 3) 4)</sup>

15 m  
75 m

- 1) NOHD ... Nominal Ocular Hazard Distance  
2) ENOHD ... Extended Nominal Ocular Hazard Distance

- 3) beam divergence 6 mrad, laser PRR 50kHz  
4) 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 <sup>5)</sup>	200 kHz	100 kHz	50 kHz	5 kHz <sup>8)</sup>	0.5 kHz <sup>8)</sup>
Max. Water Depth Penetration in Secchi Depths <sup>6) 7)</sup> (Flight altitude 75m above water level)	1.7	1.8	2.0	2.2	2.5

Minimum Range  
Accuracy <sup>9) 11)</sup>  
Precision <sup>10) 11)</sup>  
Laser Pulse Repetition Rate  
Echo Signal Intensity  
Number of Targets per Pulse  
Laser Wavelength  
Laser Beam Divergence  
Receiver Field of View  
Laser Beam Footprint (Gaussian Beam Definition)

20 m  
20 mm  
15 mm  
50 kHz to 200 kHz  
for each echo signal, high-resolution 16 bit intensity information is provided  
online waveform processing: up to 15 <sup>12)</sup>  
532 nm, green  
selectable, 1 up to 6 mrad <sup>13)</sup>  
selectable, 3 up to 18 mrad  
50 mm @ 50 m, 100 mm @ 100 m, 150 mm @ 150 m <sup>14)</sup>

## Scanner Performance

Scanning Mechanism  
Scan Pattern  
Off Nadir Scan Angle Range  
Scan Speed (selectable)  
Angular Step Width  $\Delta \theta$  (selectable)  
between consecutive laser shots  
Angle Measurement Resolution

rotating scan mirror  
nearly elliptic  
 $\pm 20^\circ = 40^\circ$  perpendicular to flight direction,  $\pm 14^\circ = 28^\circ$  in flight direction  
10 - 100 lines/sec (lps) <sup>15)</sup>  
 $0.018^\circ \leq \Delta \theta \leq 0.72^\circ$  (for PRR 50 kHz) <sup>16) 17)</sup>  
0.001° (3.6 arcsec)

- 5) rounded values  
6) 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.  
7) The depth performance is specified for bright targets with size in excess of the laser beam diameter and for clear atmospheric conditions.  
8) Waveform averaging applied in postprocessing, Laser PRR=50kHz  
9) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.  
10) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.

- 11) One sigma @ 150m rounded values  
12) 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.  
13) Measured at the 1/e<sup>2</sup> points. 1.0 mrad corresponds to an increase of 100 mm of beam diameter per 100 m distance.  
14) The laser beam footprint values correspond to a beam divergence of 1mrad.  
15) One line corresponds to a full revolution (360°) of the scan mechanism which can be split into two user defined segments.  
16) The angular step width depends on the selected laser PRR.  
17) The maximum angular step width is limited by the maximum scan rate.

## General Technical Data

Power Supply Input Voltage  
Power Consumption

18 - 34 V DC  
typ. 110 W  
max. 220 W  
360 mm x 285 mm x 200 mm

Main Dimensions (L x W x H)

Weight  
LiDAR sensor  
(without optionally integrated components)  
additional system integration components  
optionally integrated APX-20 with IMU90  
optionally integrated APX-20 with IMU82  
optionally integrated camera

approx. 9.8 kg  
  
approx. 0.23 kg  
approx. 0.50 kg  
approx. 0.50 kg  
non condensing  
IP64, dust and splash-proof

Humidity  
Protection Class  
Max. Flight Altitude <sup>18)</sup>  
operating / not operating  
Temperature Range  
operation / storage

18 500 ft (5 600 m) above Mean Sea Level (MSL)  
  
-10°C up to +40°C / -20°C up to +50°C

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

## RIEGL VQ-840-GL Technical Data (Optional Components)

### IMU/GNSS (optional)

#### IMU Accuracy <sup>1)</sup>

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) <sup>2)</sup>

#### 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

#### Scan Data Output

LAN 10/100/1 000 Mbit/sec,

LAN 10/100/1 000 Mbit/sec,

high speed data link to *RIEGL* DR1560i (optional) <sup>4)</sup>

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 240 GByte (optional) <sup>4)</sup>

2 TB SSD

#### GNSS Interface <sup>3)</sup>

#### General IO & Control

#### Camera Interface

#### Removable Storage Card

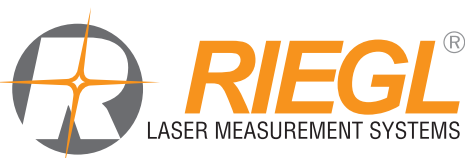
#### Internal Data Storage

1) accuracy specifications for post-processed data

2) Please note: adding optional features will enhance the overall weight of the system

3) to be used for external GNSS receiver

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



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