The new RIEGL® VQ-840-G is a fully integrated compact airborne laser scanner for combined hydrographic and topographic surveying. The system is offered with an integrated and factory-calibrated GNSS/IMU system and can be complemented with an optional camera or IR rangefinder. 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 comprises an inertial navigation sensor for subsequent estimation of the instrument’s location and orientation. As an option either a high-resolution digital camera or an infrared laser rangefinder 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

The scanner is designed for combined topographic and hydrographic airborne and UAV-based survey.

- high accuracy ranging based on echo digitization and online waveform processing with multiple-target capability
- concurrent comprehensive full 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
- additional, fully integrated infrared laser rangefinder (optional)
- integrated digital camera (optional)
- compact, lightweight and robust housing compliant with typical hatches in aircrafts and with stabilized platforms

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www.riegl.com

Welcome to RIEGL Laser Measurement Systems.

Preliminary Data Sheet
RIEGL VQ-840-G Scan Pattern

Point pattern and density for UAV applications
flying altitude 75 m, flying speed 20 kts, average point density: 92 points/sqm
black lines: scan trace on ground, red crosses: points on the ground

Point pattern and density for helicopter applications
flying altitude 150 m, flying speed 50 kts, average point density: 18 points/sqm
black lines: scan trace on ground, red crosses: points on the ground
**Important Note:**

The following technical data is relevant for a RIEGL VQ-840-G Topo-Hydrographic Airborne Laser Scanner equipped with an additional optional Infrared Laser Rangefinder and is to be seen as a supplement to the Technical Data of the Basic System with Green Laser Scanner.

**Range Measurement Performance**

**Measuring Principle**

time of flight measurement, echo signal digitization, online waveform processing

<table>
<thead>
<tr>
<th>Laser Pulse Repetition Rate PRR</th>
<th>100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Measuring Range (2)</td>
<td></td>
</tr>
<tr>
<td>natural targets ρ ≥ 20 %</td>
<td>150 m</td>
</tr>
<tr>
<td>natural targets ρ ≥ 60 %</td>
<td>250 m</td>
</tr>
<tr>
<td>Max. Number of Targets per Pulse (3)</td>
<td>5</td>
</tr>
</tbody>
</table>

1) Rounded values.
2) Typical values for average conditions. Maximum range is specified for flat targets with size in excess of the laser beam diameter, perpendicular angle of incidence, and for atmospheric visibility of 23 km. In bright sunlight, the max. range is shorter than under overcast sky.
3) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

**Minimum Range**

| Accuracy (4) | 3 m   |
| Precision (5) | 15 mm |
| 10 mm         |       |
| 100 kHz       |       |
| up to 100 000 meas./sec. (100 kHz PRR & 360° FOV) for each echo signal, high-resolution 16 bit intensity information is provided near infrared |       |
| Laser Wavelength | 1.6 x 0.5 mrad |
| Laser Beam Divergence (7) | 160 mm x 50 mm @ 100 m |
| Laser Beam Footprint |       |

4) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
5) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
6) One sigma @ 50 m range under RIEGL test conditions.
7) Measured at 50% peak intensity, 1.6 mrad corresponds to an increase of 160 mm of beam diameter per 100 m distance.

**RIEGL VQ-840-G Installation Examples**

**RIEGL VQ-840-G installed on RICOPTER-M, RIEGL’s remotely piloted aircraft system with exceptional payload capacity**

**RIEGL VQ-840-G installed on GSM-4000 stabilized platform to be used in a helicopter or fixed-wing aircraft**
RIEGL VQ-840-G Technical Data of Green Laser Scanner

Export Classification
The topo-hydrographic airborne laser scanner VQ-840-G has been designed and developed for commercial topographic, hydrographic and bathymetric surveying applications.

Laser Product Classification

Laser Class
- NOHD 1) 3) 4) 15 m
- ENOHD 2) 3) 4) 75 m

Range Measurement Performance

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

<table>
<thead>
<tr>
<th>Laser Pulse Repetition Rate PRR</th>
<th>200 kHz</th>
<th>100 kHz</th>
<th>50 kHz</th>
<th>5 kHz 7)</th>
<th>0.5 kHz 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Water Depth Penetration in Secchi Depths 6)</td>
<td>0.7</td>
<td>0.8</td>
<td>1.0</td>
<td>1.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Minimum Range
- Accuracy 8)
- Precision 9) 10)

Laser Pulse Repetition Rate
- Max. Effective Measurement Rate 5)
- Echo Signal Intensity
- Number of Targets per Pulse
- Laser Wavelength
- Laser Beam Divergence
- Laser Beam Footprint (Gaussian Beam Definition)

Scanner Performance

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

IMU/GNSS (optional) Performance

IMU Accuracy 17)
- Roll, Pitch
- Heading
- IMU Sampling Rate
- Position Accuracy (typ.)
- horizontal / vertical

1) NOHD ... Nominal Ocular Hazard Distance
2) ENOHD ... Extended Nominal Ocular Hazard Distance
3) for a beam divergence of 6 mrad
4) If it can be assumed that the instrument is mounted on a moving platform
5) rounded values
6) The depth performance is specified for bright targets with size in excess of the laser beam diameter and for clear atmospheric conditions. Flight altitude 75 m above water level.
7) Waveform averaging applied
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
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.
12) Measured at the 1/e² 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 1 mrad.
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 depends on the selected laser PRR.
16) The maximum angular step width is limited by the maximum scan rate.
17) Accuracy specifications for post-processed data

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**RIEGL VQ-840-G Technical Data**

### Integrated Digital Camera (Optional)\(^1\)

**RGB Camera**
- **Sensor Resolution**: 12 MPixel
- **Sensor Dimensions (diagonal)**: 43 mm (full format)
- **Focal Length of Camera Lens**: 50 mm
- **Field of View (FOV)**: approx. 40° x 27°
- **Interface**: GigE

### Data Interfaces

- **Configuration**: GigE
- **Scan Data Output**: GigE
- **GNSS Interface**\(^2\)
- **Camera Interface**: power, RS232, 1pps, trigger exposure
- **Removable Storage Card**: CFast®, up to 512 GByte

### General Technical Data

- **Power Supply Input Voltage**: 18 - 34 V DC
- **Power Consumption**:
  - typ. 110 W
  - 160 W\(^3\)
  - max. 400 W
- **Main Dimensions (LxWxH)**: 360 mm x 285 mm x 200 mm
- **Weight**: < 15 kg (with IMU/GNSS and camera or infrared laser scanner)
- **Humidity**: non condensing
- **Protection Class**: IP64, dust and splash-proof
- **Max. Flight Altitude**\(^4\)
  - 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

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1) The camera configuration of the RIEGL VQ-840-G Laser Scanning System can be modified to the customer’s requirements.

2) to be used for external GNSS receiver

3) @ 20°C ambient temperature, 100 kHz PRR, 100 scans/sec

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

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