RIEGL VQ-820-G
Repetitive surveying of inshore waters is becoming more and more essential to evaluate reservoir sedimentation, river degradation, water flow and water level dynamics, structure and zone variations of rivers and riparian areas. This can only be achieved in an effective way by employing high-resolution hydrographic airborne laser scanning.

The RIEGL VQ-820-G Hydrographic Airborne Laser Scanner is specifically designed to survey seabeds or ground of rivers or lakes. Integrated into a Complete Platform for Airborne Scanning, it can easily be installed in any type of aircraft, e.g. fixed wing or helicopter.

Laser range measurements for high resolution surveying of underwater topography, the bottom of shallow waters and riverbeds, are carried out with a narrow, visible green laser beam at 532 nm, emitted from a powerful laser source. Depending on water turbidity this particular laser wavelength allows measuring into water.

To handle target situations with complex multiple echo signals, the RIEGL VQ-820-G gives access to detailed target parameters by digitizing the echo signal and performing RIEGL’s highly developed online waveform processing.

Typical applications include
- Coastline and Shallow Water Mapping
- River Bed Profiling
- Acquiring Base Data for Flood Prevention
- Measurement for Aggradation Zones
- Habitat Mapping
- Surveying for Hydraulic Engineering
- Monitoring of Hydraulics Laboratories
- Hydro-Archaeological-Surveying
Design

The RIEGL VQ-820-G consists of an unrivaled compact and lightweight scan head connected to a powerful laser source via an armored glass fiber cable and electrical cables, allowing easy installation into existing and certified airborne scanning platforms and hatches of standard size with similar key data for Fit, Form & Function, as well as in terms of power supply requirements and weight & balance considerations - total weight is approx. 26 kg, power consumption is less than 200 W.

The scan mechanism of the VQ-820-G is based on a rotating multi-facet mirror where the scan axis is tilted by about 20° with respect to the nominal flight direction, so that the angle of incidence of the laser beam to the water surface varies only by about 1° over the entire scan range of up to 60°. This results in an arc-like scan pattern on ground.

Aiming at high resolution, the laser scanner emits a narrow beam of about 1 cm diameter with a beam divergence in the range of 1 mrad. Therefore, at the nominal flight altitude of 600 m, the spatial resolution as defined by the laser beam geometry is in the range of 60 cm. High spatial resolution is also supported by an exceptionally high net measurement rate of 200,000 measurements per second.

Echo Analysis

The incoming echoes are digitized at a sampling rate matched to the pulse width. The instrument is equipped with online waveform processing. Concurrently echo waveform data can be stored for full waveform post processing by means of the optional waveform data output. For each trigger event a so called sample block containing a certain number of samples before and after the trigger event is recorded.

For every target echo, the position, amplitude, and pulse deviation are determined. If the echo pulse is severely deteriorated by turbidity or multi-target returns, this will be signaled through an increased value of the scanner's pulse deviation reading and the corresponding waveform can then be analyzed with more sophisticated algorithms if requested.

Considering Refraction

Refraction is taken into account during post processing of the data with the Hydrography AddOns available for the well known and acknowledged RIEGL ALS software package RIPROCESS. After georeferencing the acquired pointclouds, the water surface is determined and targets below the water surface are shifted to the correct position according to refraction (beam bending and waveform compression). The water surface can be defined as a simple plane but may also be represented by a detailed model determined from the laser scan data.
Complete Platform System for Hydrographic Airborne Scanning

Main Dimensions

Complete Platform RIEGLCP-820-G

VQ-820-G scan head
VQ-820-G laser unit

IMU sensor
digital MF camera
customized mounting platform with shock absorbing elements
wire rope isolators

rear view
center view
front view

bottom view

Dimensions:
- 560 mm (length)
- 430 mm (width)
- 360 mm (height)
- 340 mm (height)
- 420 mm (height)
- 25 mm (mounting hole diameter)

4x mounting hole Ø 11 mm
Scan Head

**rear view**
- Power supply and data interface

**front view**
- Carrying handle
- Desiccant cartridge
- Nitrogen valve

**bottom view**
- M8x1.25 - 6H threads (3x at bottom, 3x at each side)

Laser Unit

**side view**
- 4x Mounting holes
  - Ø 5.2 mm

**front view**
- Power supply and data interface

**rear view**
- All dimensions in mm
Floodplain Area Alongside the Danube

A small floodplain area alongside the Danube in Lower Austria was chosen where several waterbodies of different size and depth are available. The waterbodies were partly covered with a thin layer of ice. At windless conditions, the water surface was perfectly flat.

**VQ-820-G measurements were performed from a helicopter platform at the following parameters:**

- Operating altitude: 125 m AGL
- Ground speed: 25 knots
- Laser pulse repetition rate: 138 kHz
- Scanning rate: 70 lines/second
- Resulting point density: 50 meas./square meter

Snapshot from a nadir-pointed video camera also showing the thin ice layer and several power lines going over the waterbody.

Perspective view of the flight strip with and without subaqueous points as well as the power lines. The point cloud of the power lines with masts gives a good impression of the very high measurement resolution.

Cross section indicating targets above water level, subaqueous points, natural land targets and power lines.
Technical Data RIEGLVQ®-820-G

Export Classification
The Hydrographic Airborne Laser Scanner VQ-820-G has been designed and developed for commercial topographic, hydrographic, and bathymetric surveying applications.

Laser Product Classification
Laser Class

NOHO 1 2 3
ENVO 1 2 3

1) (EN)HO: ...Extended Normal Occlusion Hazard Distance

Range Measurement Performance
Measuring Principle
Topography (diffusely reflecting targets)
Max. Measurement Range 16 16
natural targets D ≥ 20 %
natural targets D ≥ 60 %
Typ. Operating Flight Altitude AGL
Hydrography
Typ. Measurement Range 4 4
Typ. Operating Flight Altitude AGL
Minimum Range 5 5
Accuracy 7, 8
Precision 7, 8
Laser Pulse Repetition Rate
Max. Effective Measurement Rate
Echo Signal Intensity
Number of Targets per Pulse
Laser Wavelength
Laser Beam Divergence
Laser Beam Footprint (Gaussian Beam Definition)

3) The following conditions are assumed: target larger than the footprint of the laser beam, average ambient brightness, visibility 23 mm, perpendicular angle of incidence, ambient temperature for measurement, unobstructed atmosphere, signal to noise ratio is constant.
4) The measurement range is limited by the power density of the laser. The power density of the laser may be considerably different from the measurement range.
5) The second depth is defined as the depth at which a standard black and white disc displayed into the water is no longer visible to the human eye.
6) The following conditions are assumed: target larger than the footprint of the laser beam, average ambient brightness, visibility 23 mm, perpendicular angle of incidence, ambient temperature for measurement, unobstructed atmosphere, signal to noise ratio is constant.
7) Limitation for range measurement capability: does not consider laser safety
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) The maximum range under laboratory test conditions.
11) Soundless values
12) Measured at the NELP points, 1.0 mrad corresponds to an increase of 100 cm of beam diameter per 1000 m distance.

Scanner Performance
Scanning Mechanism
Scan Pattern
Field of View (selectable)
Scan Speed (selectable)
Angular Scan Width (selectable) between consecutive laser shots
Angle Resolution Measurement Range

Data Interfaces
Configuration
Scan Data Output
GNSS Interface

Mechanical Interfaces
Mounting of Scan Head
Mounting of IMU Sensor

General Technical Data
Power Supply Input Voltage
Power Consumption
Main Dimensions
Weight
Humidity
Protection Class Scan Head
Max. Flight Altitude (operating / not operating) 13
Temperature Range

The QV-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 6A003 of the official Dual-Use-List to be found on site: http://www.wassenaar.org. Within the European Union, Council Regulation (EC) No 428/2009 implements the export restrictions of the Wassenaar Arrangement.

Class 3B Laser Product according to IEC60825-1:2007
The following clause applies for instruments delivered to the United States. Complies with
3) CFI 10404.16 and 10404.11 except for deviations pursuant to laser Notice No. 56, dated 24 June, 2007.
The instrument must be used only in combination with the appropriate laser safety box:

100 m
600 m

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

1 500 m
2 500 m
1 200 m (3 900 ft)
1 Secchi depth
600 m (1 970 ft)
10 m
25 mm
25 mm
up to 520 kHz
up to 200000 meas/sec at 520 kHz PRR & 42° FOV
for each target, high resolution 1.6 bit intensity information is provided unlimited (digitized waveform processing)
green
1.0 mrad 12
100 mm @ 100 m, 1000 mm @ 1000 m

rotating multi-facet mirror
section of an ellipse
42°, max. 60° (with reduced measurement range)
50 - 250 scans/sec
j Δ ≥ 0.01° [for PRR 520 kHz]
0.001°

LAN 10/100/1000 MultiSec
LAN 10/100/1000 MultiSec, USB 2.0
Serial RS232 interface for data string with GNSS-time information,
TTL input for 1PPS synchronization pulse

3 x M8 thread inserts in the base plate
3 x M8 thread inserts at both sides of the housing (rigidly coupled with the internal mechanical structure)

Scan Head
Laser Unit
18 - 32 V DC
18 - 32 V DC
Typ. 65 W 13
Typ. 120 W 13
363 x 232 x 279 mm
323 x 270 x 94 mm
approx. 16 kg
approx. 9.5 kg
non-condensing
IP54, dust and splash-proof
16 500 ft (5 000 m) above MSL / 18 000 ft (5 500 m) above MSL
+10°C up to +40°C (operation) / -10°C up to +60°C (storage)

13) Laser unit can be supplied through scan head resulting in typ. 165 W
14) For standard atmospheric conditions: 1213 mbar, +18°C at sea level