The RIEGL VUX-1 is a very lightweight and compact laser scanner, meeting the challenges of emerging survey solutions by UAS/UAV/RPAS, gyrocopter and ultra-light aircraft, both in measurement performance as in system integration. With regard to the specific constraints and flight characteristics of UAS, the RIEGL VUX-1 is designed to be mounted in any orientation and even under limited weight and space conditions. Modest in power consumption, the instrument requires only a single power supply. The entire data set of an acquisition campaign is stored onto an internal 240 GByte SSD and/or provided as real-time line scan data via the integrated LAN-TCP/IP interface.

The Airborne Laser Scanner RIEGL VUX-1 provides highspeed data acquisition using a narrow infrared laser beam and a fast line scanning mechanism. High-accuracy laser ranging is based on RIEGL’s unique echo digitization and online waveform processing, which enables achieving superior measurement results even under adverse atmospheric conditions, and the evaluation of multiple target echoes. The scanning mechanism is based on an extremely fast rotating mirror, which provides fully linear, unidirectional and parallel scan lines, resulting in excellent regular point pattern distribution.

Typical applications include

- Power Line, Railway Track, and Pipeline Inspection
- Terrain and Canyon Mapping
- Surveying of Urban Environments
- Topography in Open-Cast Mining
- Precision Agriculture
- Archaeology and Cultural Heritage Documentation
- Construction-Site Monitoring

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## Technical Data RIEGL VUX-1

### Laser Product Classification

Class 1 Laser Product according to IEC60825-1:2007

The following clause applies for instruments delivered into the United States:

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

### Range Measurement Performance

**Measuring Principle**
- Time of flight measurement, echo signal digitization, online waveform processing, multiple-time-around-processing

<table>
<thead>
<tr>
<th>Laser Pulse Repetition Rate PRR</th>
<th>50 kHz</th>
<th>100 kHz</th>
<th>200 kHz</th>
<th>300 kHz</th>
<th>380 kHz</th>
<th>550 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Measuring Range</td>
<td>550 m</td>
<td>400 m</td>
<td>280 m</td>
<td>230 m</td>
<td>200 m</td>
<td>170 m</td>
</tr>
<tr>
<td>natural targets p ≥ 20 %</td>
<td>920 m</td>
<td>660 m</td>
<td>480 m</td>
<td>400 m</td>
<td>350 m</td>
<td>300 m</td>
</tr>
<tr>
<td>natural targets p ≥ 60 %</td>
<td>350 m</td>
<td>250 m</td>
<td>180 m</td>
<td>150 m</td>
<td>130 m</td>
<td>110 m</td>
</tr>
<tr>
<td>Max. Operating Flight Altitude AGL</td>
<td>(1150 ft)</td>
<td>(820 ft)</td>
<td>(590 ft)</td>
<td>(490 ft)</td>
<td>(430 ft)</td>
<td>(360 ft)</td>
</tr>
</tbody>
</table>

### Minimum Range

- **Accuracy**: 5 mm (1σ @ 150 m range under RIEGL test conditions)
- **Precision**: 3 mm (1σ @ 150 m range under RIEGL test conditions)

### Scanner Performance

- **Scanning Mechanism**: Rotating mirror up to 330° (full range measurement performance)
- **Scan Speed**: 10 - 200 revolutions per second, equivalent to 10 - 200 scans/sec
- **Angular Step Width Δ θ**: (selectable) 0.006° ≤ Δ θ ≤ 1.5° between consecutive laser shots
- **Angle Measurement Resolution**: 0.001°
- **Internal Sync Timer**: For real-time synchronized time stamping of scan data
- **Scan Sync (optional)**: Scanner rotation synchronization

### Data Interfaces

- **Configuration**: LAN 10/100/1000 Mbit/sec
- **Scan Data Output**: LAN 10/100/1000 Mbit/sec or USB 2.0
- **GNSS Interface**: Serial RS232 interface for data string with GNSS-time information, TTL input for 1PPS synchronization pulse
- **Internal Memory**: 240 GByte SSD
- **External Camera**: TTL input/output
- **External GNSS Antenna**: SMA connector

### General Technical Data

- **Power Supply Input Voltage**: 11 - 32 V DC
- **Power Consumption**: typ. 60 W
- **Main Dimensions**:
  - VUX-1 without / with Cooling Fan Device: 227 x 180 x 126 mm / 227 x 209 x 129 mm
  - Weight: approx. 3.6 kg / approx. 3.85 kg
- **Humidity**: Max. 80 % non condensing @ 31°C IP64, dust and splash-proof
- **Protection Class**: Max. Flight Altitude (operating) / Max. Flight Altitude (not operating) / Temperature Range
- **Optional Components**:
  - IMU Sensor (integrated)
  - GNSS Receiver (integrated)

### Notes

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) Ambiguity to be resolved by post-processing with RiMTA software.
4) Reflectivity p ≥ 20%, flat terrain assumed, scan angle ±45° FOV, additional roll angle ±5°.
5) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
6) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
7) One sigma @ 150 m range under RIEGL test conditions.
8) User selectable.
9) Measured at the 1/e² points. 0.50 mrad corresponds to an increase of 50 mm of beam diameter per 100 m distance.
10) Without external IMU/GNSS
11) The instrument requires air convection with a minimum flow rate of 5 m/s for continuous operation at +15°C and above. If the necessary flow rate cannot be provided by the moving platform, the cooling fan device (included in the scope of delivery) has to be used.
12) External IMU sensor and GNSS receiver on request
13) Available third quarter 2014
The following conditions are assumed for the Operating Flight Altitude AGL:

- ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- target size ≥ laser footprint
- average ambient brightness

Example: VUX-1 at 60,000 pulses/second
range to target = 400 m, speed = 45 kn
Resulting Point Density ≈ 1 pt/m²
The following conditions are assumed for the Operating Flight Altitude AGL:

- Ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- Target size > laser footprint
- Average ambient brightness
Dimensional Drawings RIEGL VUX®-1

front view

side view

rear view

all dimensions in mm

Dimensional Drawings RIEGL VUX®-1 with Cooling Fan Device
Multiple-Time-Around Data Acquisition and Processing

In time-of-flight laser ranging a maximum unambiguous measurement range exists, which is defined by the laser pulse repetition rate and the speed of light. In case the echo signal of an emitted laser pulse arrives later than the emission of the subsequently emitted laser pulse, the range result becomes ambiguous - an effect known as "Multiple-Time-Around" (MTA).

The RIEGL VUX-1 allows ranging beyond the maximum unambiguous measurement range using a sophisticated modulation scheme applied to the train of emitted laser pulses. The dedicated post-processing software RiMTA provides algorithms for multiple-time-around processing, which automatically assign definite range results to the correct MTA zones without any further user interaction required.

Cooling Fan Device

Lightweight structure with two axial fans providing forced air convection for applications where sufficient natural air flow cannot be guaranteed. Power supply is provided via a connector on the rear side of the RIEGL VUX-1. The cooling fan device can be mounted either on the top side or on the bottom side of the RIEGL VUX-1 and is included in the scanner’s scope of delivery.

The cooling fan device is to be mounted whenever the environmental conditions/temperatures require (see “temperature range” on page 2 of this datasheet).