The RIEGL VUX-1UAV is a very lightweight and compact laser scanner, meeting the challenges of emerging survey solutions by UAS/UAV/RPAS both in measurement performance as well as in system integration. With regard to the specific constraints and flight characteristics of the UAS, the RIEGL VUX-1UAV 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 RIEGL VUX-1UAV 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.

Typical applications include:
- Agriculture & Forestry
- Archaeology and Cultural Heritage Documentation
- Corridor Mapping: Power Line, Railway Track, and Pipeline Inspection
- Topography in Open-Cast Mining
- Construction-Site Monitoring
- Surveying of Urban Environments
- Resources Management

• 10 mm survey-grade accuracy
• scan speed up to 200 scans / second
• measurement rate up to 500,000 meas./sec (@ 550 kHz PRR & 330° FOV)
• operating flight altitude more than 1,000 ft
• field of view up to 330° for practically unrestricted data acquisition
• regular point pattern, perfectly parallel scan lines
• cutting edge RIEGL technology providing:
  - echo signal digitization
  - online waveform processing
  - multiple-time-around processing
• multiple target capability - practically unlimited number of target echoes
• NEW Smart Waveform Data Output optional
• compact (227x180x125 mm), lightweight (3.5 kg), and rugged
• easily mountable to professional UAS / UAV / RPAS
• mechanical and electrical interface for IMU mounting
• electrical interfaces for GPS data string and Sync Pulse (1PPS)
• LAN-TCP/IP interface
• scan data storage on internal 240 GByte SSD Memory

visit our website
www.riegl.com
Technical Data RIEGL VUX®-1UAV

**Laser Product Classification**

Class 1 Laser Product according to IEC 60825-1:2014

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.

**Range Measurement Performance**

**Measuring Principle**

time of flight measurement, echo signal digitization, online waveform processing, multiple-time-around-processing

**Laser Pulse Repetition Rate PRR**  
<table>
<thead>
<tr>
<th>PRR (kHz)</th>
<th>Full Power (m)</th>
<th>Reduced Power (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>550</td>
<td>920</td>
</tr>
<tr>
<td>100</td>
<td>400</td>
<td>660</td>
</tr>
<tr>
<td>200</td>
<td>280</td>
<td>480</td>
</tr>
<tr>
<td>300</td>
<td>230</td>
<td>400</td>
</tr>
<tr>
<td>380</td>
<td>200</td>
<td>350</td>
</tr>
<tr>
<td>550</td>
<td>170</td>
<td>300</td>
</tr>
</tbody>
</table>

**Max. Measuring Range**

1. 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.
2. Ambiguity to be resolved by post-processing with RiMTA software.
3. Reflectivity ρ ≥ 20%, flat terrain assumed, scan angle ±45° FOV.
4. If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

**Minimum Range**

<table>
<thead>
<tr>
<th>Range (m)</th>
<th>Accuracy (mm)</th>
<th>Precision (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

**Scanner Performance**

**Scanning Mechanism**

rotating mirror

**Field of View (selectable)**

up to 330° (full range measurement performance)

**Scan Speed (selectable)**

10 - 200 revolutions per second, equivalent to 10 - 200 scans/sec

**Angular Step Width Δθ (selectable)**

0.006° ≤ Δθ ≤ 1.5°

**Angle Measurement Resolution**

0.001°

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 / Consumption**

11 - 34 V DC / typ. 60 W

**Main Dimensions**

227 x 180 x 125 mm / 227 x 209 x 129 mm

**Weight**

approx. 3.5 kg / approx. 3.75 kg

**Humidity**

max. 80 % non condensing @ 31°C

**Protection Class**

IP64, dust and splash-proof

**Max. Flight Altitude (operating / not operating)**

16 500 ft (5 000 m) above MSL / 18 000 ft (5 500 m) above MSL

**Temperature Range**

-10°C up to +40°C (operation) / -20°C up to +50°C (storage)

**Optional Components (integrated)**

**Embedded GNSS-Inertial System**

high performance multi-channel, multi-band GNSS receiver, solid-state MEMS IMU

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14) 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 (included in the scope of delivery) has to be used.
Maximum Measurement Range & Point Density RIEGL VUX®-1UAV

PRR = 50 kHz

Example: VUX-1UAV at 50,000 pulses/second
range to target = 400 m, speed = 6 km
Resulting Point Density ~ 6.5 pts/m²

PRR = 100 kHz

Example: VUX-1UAV at 100,000 pulses/second
range to target = 250 m, speed = 8 kn
Resulting Point Density ~ 15.5 pts/m²

PRR = 200 kHz

Example: VUX-1UAV at 200,000 pulses/second
range to target = 180 m, speed = 10 kn
Resulting Point Density ~ 34 pts/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
• operating flight altitude given at a FOV of ±45°

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
• operating flight altitude given at a FOV of ±45°

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**Maximum Measurement Range & Point Density**

**RIEGL VUX-1UAV**

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**PRR = 300 kHz**

**MTA1:** no ambiguity / one transmitted pulse “in the air”

**PRR = 380 kHz**

**MTA1:** no ambiguity / one transmitted pulse “in the air”

**MTA2:** two transmitted pulses “in the air”

**PRR = 550 kHz**

**MTA1:** no ambiguity / one transmitted pulse “in the air”

**MTA2:** two transmitted pulses “in the air”

---

**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
- operating flight altitude given at a FOV of ±45°

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Data Sheet
**Maximum Measurement Range & Point Density**  
**RIEGL VUX®-1UAV**

**PRR = 550 kHz reduced power**

- **Example:** VUX-1UAV at 550,000 pulses/second reduced power range to target = 50 m, speed = 6 kn  
  Resulting Point Density ~ 570 pts/m²

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**Dimensional Drawings**  
**RIEGL VUX®-1UAV**

**RIEGL VUX®-1UAV with Cooling Fan Device**

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**Data Sheet**  
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Additional Equipment for RIEGL VUX-1UAV

Cooling Fan
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-1UAV. The cooling fan can be mounted either on the top side or on the bottom side of the RIEGL VUX-1UAV and is included in the scanner’s scope of delivery.

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

Protective Cap
To shield the glass tube of the RIEGL VUX-1UAV from mechanical damage and soiling, a protective cap is provided to cover the upper part of the instrument during transport and storage.

Options for RIEGL VUX-1UAV Integration
RIEGL provides user-friendly, application- and installation-oriented solutions for integration of the VUX-1UAV LiDAR sensor:

- **RIEGL VUX-SYS**
  Complete airborne laser scanning system for flexible use in UAS/UAV/RPAS, helicopter, gyrocopter and ultra-light aircraft installations comprising the RIEGL VUX-1UAV, an IMU/GNSS unit and a dedicated control unit.

- **RICOPTER**
  Ready to fly remotely piloted aircraft system with RIEGL VUX-SYS integrated

- **RIEGL VP-1**
  Small and lightweight pod with integrated RIEGL VUX-SYS to be mounted on standard hard points and typical camera mounts of manned helicopters

Details to be found on the relevant datasheets and infosheets.

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-1UAV 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.