The **RIEGL miniVUX-SYS** is a complete laser scanning system of low weight and compact size for flexible use in UAV-based applications on a variety of UAV/UAS/RPAS.

The system comprises a **RIEGL miniVUX-1UAV**, **RIEGL miniVUX-2UAV**, or a **RIEGL miniVUX-1DL LiDAR engine**, an IMU/GNSS system (different versions available), and an optional RGB camera system.

The measurement performance of RIEGL’s UAV LiDAR sensors in combination with the Inertial Measurement Unit and the associated GNSS receiver results in survey-grade measurement accuracy.

The miniVUX-SYS is delivered with the necessary software tools for processing and geo-referencing of the acquired scan data, and processing of the IMU/GNSS data.

**Typical applications include**
- Agriculture & Forestry
- Glacier and Snowfield Mapping
- Archeology and Cultural Heritage Documentation
- Construction-Site Monitoring
- Landslide Monitoring

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**Physical characteristics**

- **complete miniaturized & lightweight UAV-based LiDAR system with**
  - RIEGL miniVUX-1UAV,
  - RIEGL miniVUX-2UAV, or
  - RIEGL miniVUX-1DL LiDAR sensor integrated

- **different IMU/GNSS options available**

- **various mounting options for highly flexible installation**

- **prepared for remote control via low-bandwidth data link**

- **prepared for interfacing with optional RGB camera(s) and thermal imaging sensor**

- **Integration Kit 600 available for straightforward system integration with selected multi-rotor UAV types**

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Visit our website  
www.riegl.com
**RIEGL miniVUX®-SYS – Integration Options**

### RIEGL miniVUX®-SYS with APX-15 UAV
(e.g. for fixed-wing UAVs)

For this miniVUX-SYS solution, the APX-15 UAV\(^1\) IMU/GNSS unit is integrated in a small interface box which is attached to the rear part of the LiDAR sensor. Due to its compact and lightweight design and the total weight of approx. 2 - 2.8 kg (depending on scanner type, without camera(s)), the RIEGL miniVUX-SYS with APX-15 UAV is very well suited for an integration with UAV platforms offering limited/restricted weight and space conditions. Optionally, a single or a dual RGB camera system is available.

**RIEGL miniVUX-1UAV equipped with APX-15 UAV**
![Image](image1.png)

- with two Sony Alpha 6000 cameras (oblique mount)

**RIEGL miniVUX-2UAV equipped with APX-15 UAV**
![Image](image2.png)

- with nadir-looking camera
e.g. Sony Alpha 6000 camera or Sony Alpha 7R III

**RIEGL miniVUX-1DL equipped with APX-15 UAV**
![Image](image3.png)

- with nadir-looking camera
e.g. Sony Alpha 6000 camera

\(^1\) See technical details in the corresponding Applanix data sheet.

### RIEGL miniVUX®-SYS with APX-20 UAV
(e.g. for fixed-wing, single-rotor or multi-rotor UAVs)

For this miniVUX-SYS solution, the new, higher-grade APX-20 UAV\(^1\) IMU/GNSS system is used. The LiDAR sensor is equipped with a specifically designed interface box accommodating the GNSS board stack as well as the camera trigger electronics. The IMU sensor is tightly coupled with the LiDAR sensor. With its weight of approx. 2.5 - 3.3 kg (depending on scanner type, without camera(s)), the RIEGL miniVUX-SYS with APX-20 UAV is universally applicable for an integration with more or less all types of UAVs that are capable of carrying this payload weight. Optionally, a single or a dual RGB camera system is available.

**RIEGL miniVUX-1UAV equipped with APX-20 UAV**
![Image](image4.png)

- with two Sony Alpha 6000 cameras (oblique mount)

**RIEGL miniVUX-2UAV equipped with APX-20 UAV**
![Image](image5.png)

- with nadir-looking camera
e.g. Sony Alpha 6000 camera or Sony Alpha 7R III

**RIEGL miniVUX-1DL equipped with APX-20 UAV**
![Image](image6.png)

- with nadir-looking camera
e.g. Sony Alpha 6000 camera

\(^1\) See technical details in the corresponding Applanix data sheet.
RIEGL Integration Kit 600
(e.g. for multi-rotor UAVs)

The RIEGL Integration Kit 600 is an add-on to the miniVUX-SYS for its integration with your multi-rotor UAV, e.g. a DJI Matrice M600. The package comes with an appropriate, shock absorbing mounting-kit, power supply module, and necessary cabling for quick and straightforward integration.

RIEGL miniVUX®-SYS – Processing Workflow and Scan Data Examples

Using RIEGL’s software suites (RiPROCESS, RiWORLD) and dedicated processing workflows with specialized alignment tools like RiPRECISION conducting the whole procedure of scan data alignment fully automatically, processing time can be reduced to a minimum. RiPROCESS can interface the optimized, georeferenced point cloud in further post-processing tools via LAS or other data exchanges in various user-defined coordinate systems.
## Technical Data RIEGL miniVUX®-SYS

### Scanner Performance

<table>
<thead>
<tr>
<th>RIEGL UAV LiDAR Sensors</th>
<th>up to 200 kHz</th>
<th>100 kHz</th>
<th>100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Pulse Repetition Rate (PRR)</td>
<td>up to 200,000 meas./sec.</td>
<td>100,000 meas./sec.</td>
<td>100,000 meas./sec.</td>
</tr>
<tr>
<td>Max. Effective Measurement Rate</td>
<td>160 m (460 ft)</td>
<td>160 m (525 ft)</td>
<td>160 m (525 ft)</td>
</tr>
<tr>
<td>Typ. Operating Flight Attitude AGL</td>
<td>15 mm / 10 mm</td>
<td>15 mm / 10 mm</td>
<td>15 mm / 10 mm</td>
</tr>
<tr>
<td>Accuracy / Precision</td>
<td>up to 360°</td>
<td>up to 360°</td>
<td>up to 46°, +23° off nadir</td>
</tr>
<tr>
<td>Field of View</td>
<td>100 scans/sec</td>
<td>100 scans/sec</td>
<td>150 scans/sec</td>
</tr>
<tr>
<td>Max. Scan Speed</td>
<td>100 kHz</td>
<td>100 kHz</td>
<td>100 kHz</td>
</tr>
<tr>
<td>Max. Number of Targets per Pulse</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

1) Rounded values
2) 200 kHz Laser PRR, reflectance $p \geq 60\%$, flat terrain assumed, scan angle $\pm45^\circ$ FOV
3) 100 kHz Laser PRR, reflectance $p \geq 60\%$, flat terrain assumed, scan angle $\pm45^\circ$ FOV
4) 100 kHz Laser PRR, reflectance $p \geq 60\%$, flat terrain assumed, scan angle $\pm23^\circ$ FOV, additional roll angle $\pm5^\circ$
5) Selectable. Consider limitations when integrated in kinematic systems.
6) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

### IMU & GNSS

<table>
<thead>
<tr>
<th>IMU Accuracy</th>
<th>Roll, Pitch</th>
<th>Heading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applanix APX-20 UAV</td>
<td>0.015°</td>
<td>0.025°</td>
</tr>
<tr>
<td>Applanix APX-15 UAV</td>
<td>0.035°</td>
<td>0.08°</td>
</tr>
<tr>
<td>IMU Sampling Rate</td>
<td>200 Hz</td>
<td>200 Hz</td>
</tr>
<tr>
<td>Position Accuracy (typ.) horizontal</td>
<td>&lt; 0.05 m</td>
<td>&lt; 0.05 m</td>
</tr>
<tr>
<td>vertical</td>
<td>&lt; 0.1 m</td>
<td>&lt; 0.1 m</td>
</tr>
</tbody>
</table>

7) In addition to the APX-15 UAV and the APX-20 UAV IMU/GNSS system, also a AP20 IMU/GNSS system with external control unit is optionally available. Corresponding details provided on request.

### Interfaces

<table>
<thead>
<tr>
<th>Configuration, Scan Data Output &amp; Communication with External Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x LAN 10/100/1000 Mbit/sec</td>
</tr>
<tr>
<td>WLAN IEEE 802.11 a/b/g/n</td>
</tr>
<tr>
<td>Serial RS-232 interface for data string with GNSS-time information</td>
</tr>
<tr>
<td>TTL input for 1PPS synchronization pulse</td>
</tr>
<tr>
<td>Power Output 10 V DC, max. 4.5 W</td>
</tr>
<tr>
<td>General IO &amp; Control</td>
</tr>
<tr>
<td>2 x TTL input/output, 1 x Remote on/off</td>
</tr>
<tr>
<td>Camera Interface</td>
</tr>
<tr>
<td>2 x GNSS RS-232 Tx &amp; PPS, Power (USB 2.0), Trigger, Exposure</td>
</tr>
<tr>
<td>Memory Card Slot</td>
</tr>
<tr>
<td>for SDHC/SDXC memory card 32 GByte (can be upgraded to 64 GByte)</td>
</tr>
<tr>
<td>SPI (Serial Peripheral Interface)</td>
</tr>
<tr>
<td>General Technical Data</td>
</tr>
</tbody>
</table>

#### RIEGL miniVUX-2UAV / miniVUX-1UAV

- Power Supply Input Voltage: 11 - 34 V DC
- Consumption: typ. 18 W @ 100 scans/sec
- Main Dimensions (L x W x H): 243 x 111 x 85 mm / approx. 1.6 kg
- Without Cooling Fan: 243 x 99 x 85 mm / approx. 1.55 kg
- Integration Kit: 264 x 111 x 85 mm, approx. 2.0 kg
- Weight: 352 x 111 x 85 mm, approx. 2.5 kg
- Temperature Range: max. 80 % non condensing @ 31°C IP64, dust and splash-proof

#### RIEGL miniVUX-1DL

- Power Supply Input Voltage: 11 - 34 V DC
- Consumption: typ. 43 W @ 75 revolutions/sec
- Main Dimensions (L x W x H): 264 x 111 x 85 mm, approx. 2.8 kg
- Without Cooling Fan: 352 x 111 x 85 mm, approx. 3.3 kg
- Temperature Range: max. 80 % non condensing @ 31°C IP64, dust and splash-proof

<table>
<thead>
<tr>
<th>Camera(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>optional, technical data depending on selected camera type</td>
</tr>
</tbody>
</table>

8) See technical details in the corresponding Applanix datasheet.

9) Internally available (not available with standard interface box)

10) 1x externally available with standard interface box

11) Continuous operation at ambient temperature of ≥ 30°C (≥ 86°F) requires a minimum amount of air flow at approx. 3 m/s. For applications where a 3 m/s air flow along the cooling fins cannot be guaranteed, the cooling fan has to be used.

12) Valid for the initial start-up. After a warm-up phase, operation down to -10°C is also possible.

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