

## Miniaturized UAV-based Laser Scanning System

# RIEGL miniVUX-SYS<sup>®</sup>

- **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**

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 sensor** 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**



## 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<sup>1)</sup> 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 / RIEGL miniVUX-2UAV LiDAR Sensor equipped with APX-15 UAV



with two Sony Alpha 6000 cameras  
(oblique mount)



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



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

### 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<sup>1)</sup> 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 cameras) 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 / RIEGL miniVUX-2UAV LiDAR Sensor equipped with APX-20 UAV



with two Sony Alpha 6000 cameras  
(oblique mount)



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

#### RIEGL miniVUX-1DL LiDAR Sensor equipped with APX-20 UAV

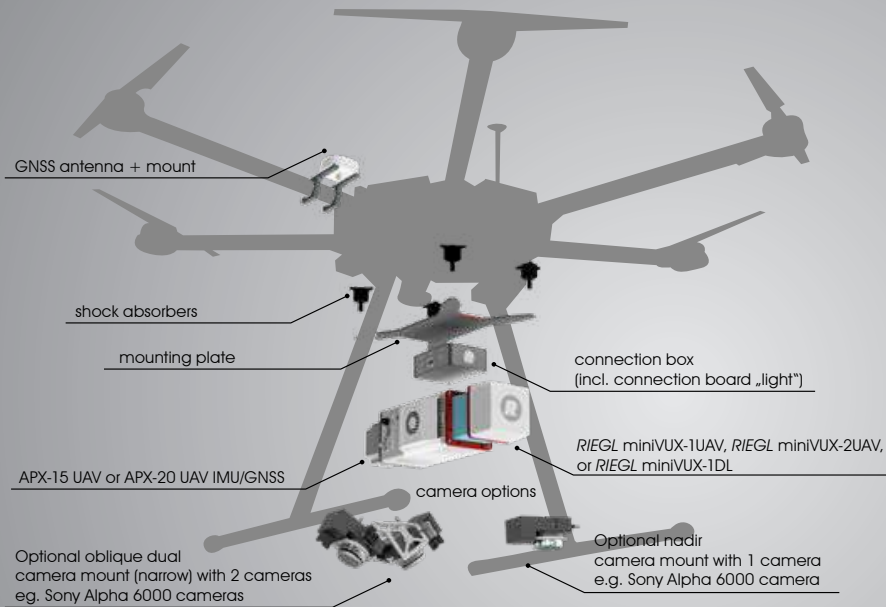


with Nadir-looking camera  
e.g. Sony Alpha 6000 camera

## RIEGL miniVUX®-SYS – Integration Options

### RIEGL Integration Kit 600 (e.g. for multi-rotor UAVs)

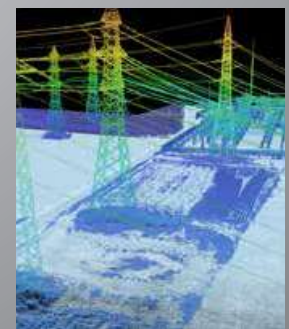
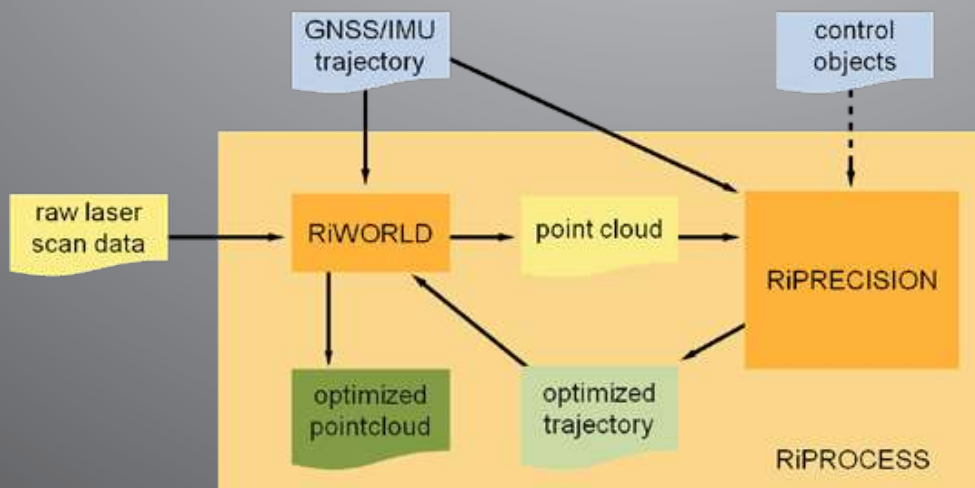
The RIEGL Integration Kit 600 is an add-on to the miniVUX-SYS for its integration with your multi-rotor UAV, e.g. a DJI Matrice M600. The package comes with an appropriate, shock absorbing mounting-kit, power supply module, and necessary cabling for quick and straight forward integration.



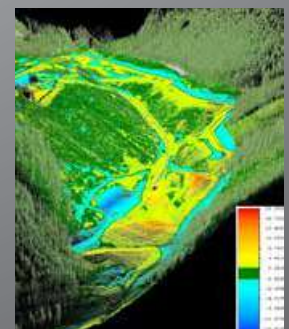
DJI Matrice M600 equipped with RIEGL miniVUX-SYS using RIEGL Integration Kit 600

## 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.



power line surveying



cut- and fill volume comparison of disposal site

## Technical Data RIEGL miniVUX®-SYS

### Scanner Performance

#### RIEGL UAV LiDAR Sensors

(for details refer to the corresponding data sheet)

Laser Pulse Repetition Rate (PRR)

Max. Effective Measurement Rate

Typ. Operating Flight Altitude AGL <sup>1)</sup>

Accuracy / Precision

Field of View

Max. Scan Speed

Max. Number of Targets per Pulse <sup>6)</sup>

#### RIEGL miniVUX-2UAV

up to 200 kHz

up to 200,000 meas./sec.

140 m (460 ft) <sup>2)</sup>

15 mm / 10 mm

up to 360° <sup>5)</sup>

100 scans/sec

5

#### RIEGL miniVUX-1UAV

100 kHz

100,000 meas./sec.

160 m (525 ft) <sup>3)</sup>

15 mm / 10 mm

up to 360° <sup>5)</sup>

100 scans/sec

5

#### RIEGL miniVUX-1DL

100 kHz

100,000 meas./sec.

160 m (525 ft) <sup>4)</sup>

15 mm / 10 mm

up to 46°, + -23° off nadir

150 scans/sec

5

1) Rounded values

2) 200 kHz Laser PRR, reflectance  $\rho \geq 60\%$ , flat terrain assumed, scan angle  $\pm 45^\circ$  FOV

3) 100 kHz Laser PRR, reflectance  $\rho \geq 60\%$ , flat terrain assumed, scan angle  $\pm 45^\circ$  FOV

4) 100 kHz Laser PRR, reflectance  $\rho \geq 60\%$ , flat terrain assumed, scan angle  $\pm 23^\circ$  FOV, additional roll angle  $\pm 5^\circ$

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 <sup>7)</sup>

IMU Accuracy

Roll, Pitch

Heading

IMU Sampling Rate

Position Accuracy (typ.)

horizontal

vertical

#### Applanix APX-20 UAV <sup>8)</sup>

0.015°

0.035°

200 Hz

< 0.05 m

< 0.1 m

#### Applanix APX-15 UAV <sup>8)</sup>

0.025°

0.08°

200 Hz

< 0.05 m

< 0.1 m

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.

8) See technical details in the corresponding Applanix datasheet.

### Interfaces

Configuration, Scan Data Output & Communication with External Devices

GNSS Interface

General IO & Control

Camera Interface

Memory Card Slot

Serial Interface to External Devices

2 x LAN 10/100/1000 Mbit/sec

WLAN IEEE 802.11 a/b/g/n

Serial RS232 interface for data string with GNSS-time information,

TTL input for 1PPS synchronization pulse.

Power Output 10 V DC, max 4.5 W <sup>9)</sup>

2 x TTL input/output <sup>10)</sup>, 1 x Remote on/off

2 x USB 2.0, Trigger, Exposure <sup>9)</sup>

for SDHC/SDXC memory card 32 GByte (can be upgraded to 128 GByte)

SPI (Serial Peripheral Interface) <sup>10)</sup>

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

10) 1 x externally available with standard interface box

## Technical Data RIEGL miniVUX®-SYS

### General Technical Data

RIEGL UAV LiDAR Sensors  
(for details refer to the corresponding data sheet)

Power Supply Input Voltage  
Consumption

Main Dimensions (L x W x H) / Weight  
with Cooling Fan  
without Cooling Fan

Temperature Range <sup>11)</sup>

RIEGL miniVUX-SYS

Main Dimensions (L x W x H) and Weight  
with APX-15 UAV  
with APX-20 UAV

Integration Kit 600

Weight

Camera(s)

Humidity

Protection Class

RIEGL miniVUX-2UAV / miniVUX-1UAV

11 - 34 V DC  
typ. 18 W @ 100 scans/sec

243 x 111 x 85 mm / approx. 1.6 kg  
243 x 99 x 85 mm / approx. 1.55 kg  
-10°C up to +40°C (operation)  
-20°C up to +50°C (storage)

264 x 111 x 85 mm, approx. 2.0 kg  
352 x 111 x 85 mm, approx. 2.5 kg

approx. 0.7 kg  
depending on selected camera type  
max. 80 % non condensing @ 31°C  
IP64, dust and splash-proof

RIEGL miniVUX-1DL

11 - 34 V DC  
typ. 43 W @ 75 revolutions/sec

232 x 111 x 123 mm / approx. 2.44 kg  
232 x 99 x 123 mm / approx. 2.4 kg  
0°C up to +40°C (operation) <sup>12)</sup>  
-20°C up to +50°C (storage)

264 x 111 x 85 mm, approx. 2.8 kg  
352 x 111 x 85 mm, approx. 3.3 kg

<sup>11)</sup> Continuous operation at ambient temperature of  $\geq 30^{\circ}\text{C}$  ( $\geq 86^{\circ}\text{F}$ ) 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.

<sup>12)</sup> Valid for the initial start-up. After a warm-up phase, operation down to  $-10^{\circ}\text{C}$  is also possible.

