

Miniaturized UAV-based Laser Scanning System

RIEGL miniVUX-SYS[®]

- **complete miniaturized & lightweight UAV-based LiDAR system with RIEGL miniVUX-series 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), hyperspectral camera, multi-spectral camera, and thermal imaging sensor**
- **Integration Kit 600 or Integration Kit 300 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.

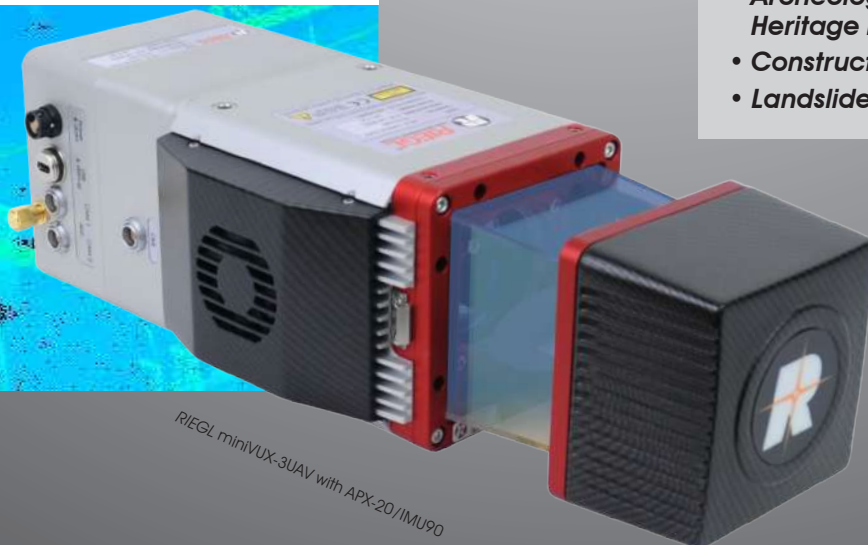
The system comprises a **RIEGL miniVUX-series** LiDAR sensor, an IMU/GNSS system (different versions available), and an optional camera system.

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**



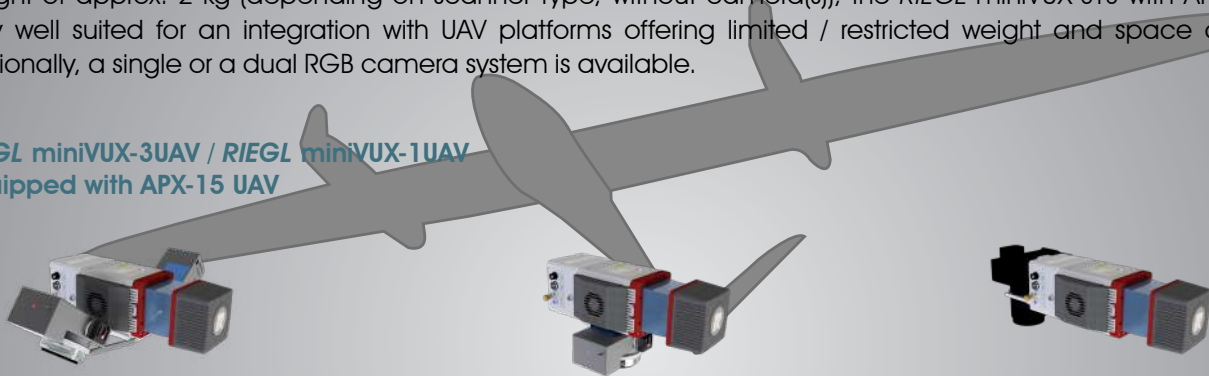
RIEGL miniVUX®-SYS – Integration Options

RIEGL miniVUX®-SYS with APX-15 UAV

(e.g. for fixed-wing UAVs)

For this miniVUX-SYS solution, the APX-15 UAV¹⁾ 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 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-3UAV / RIEGL miniVUX-1UAV equipped with APX-15 UAV



with two Sony Alpha 6000 cameras
(oblique mount)

with nadir-looking camera
e.g. Sony Alpha 6000 camera or
Sony A7R III or Sony A7R IV
(integration of other 3rd party cameras possible ²⁾)

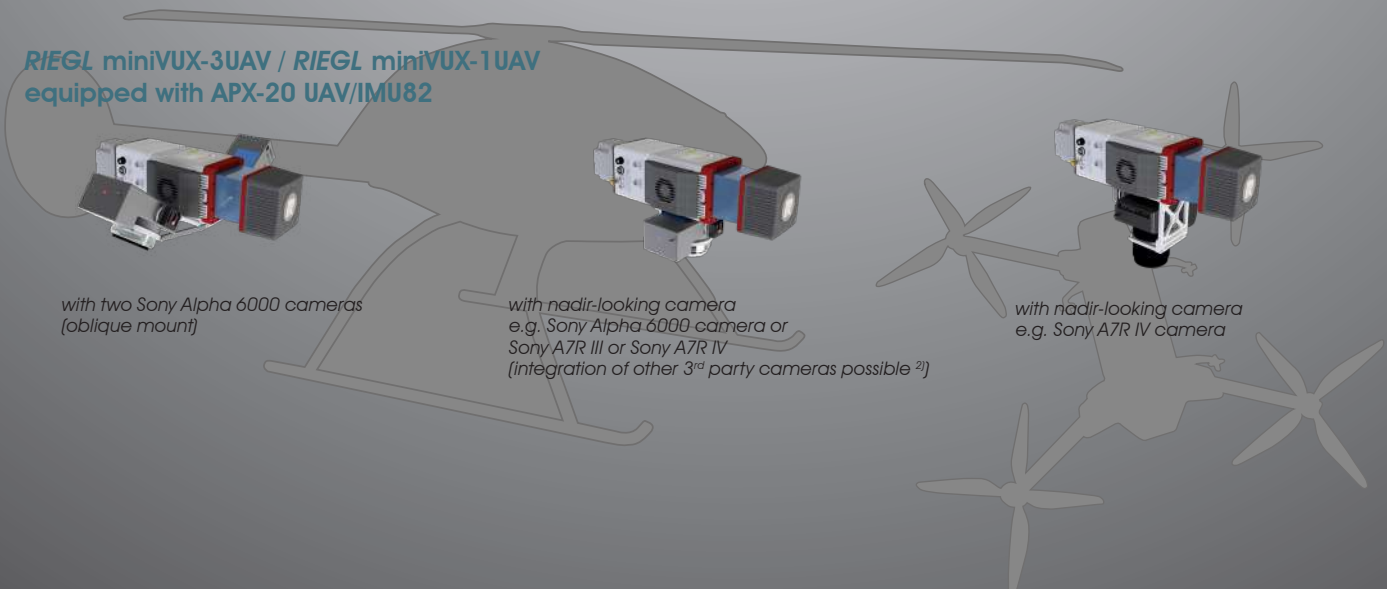
with nadir-looking camera
e.g. Sony A7R IV camera

RIEGL miniVUX®-SYS with APX-20 UAV (IMU82/IMU90)

(e.g. for fixed-wing, single-rotor or multi-rotor UAVs)

For this miniVUX-SYS solution, the higher-grade APX-20 UAV¹⁾ 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. 2.3 - 2.5 kg (depending on scanner type and IMU, 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-3UAV / RIEGL miniVUX-1UAV equipped with APX-20 UAV/IMU82

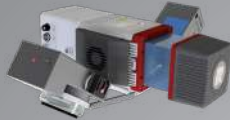


with two Sony Alpha 6000 cameras
(oblique mount)

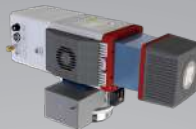
with nadir-looking camera
e.g. Sony Alpha 6000 camera or
Sony A7R III or Sony A7R IV
(integration of other 3rd party cameras possible ²⁾)

with nadir-looking camera
e.g. Sony A7R IV camera

**RIEGL miniVUX-3UAV / RIEGL miniVUX-1UAV
equipped with APX-20 UAV/IMU90**



with two Sony Alpha 6000 cameras
(oblique mount)



with nadir-looking camera
e.g. Sony Alpha 6000 camera or
Sony A7R III or Sony A7R IV
(integration of other 3rd party cameras possible ²⁾)



with nadir-looking camera
e.g. Sony A7R IV camera

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

2) Multispectral camera, hyperspectral camera, thermal imaging sensor – more information on request.



RIEGL miniVUX®-SYS – Integration Options

RIEGL Integration Kit 600 / Integration Kit 300 (e.g. for multi-rotor UAVs)

The RIEGL Integration Kit 600 – as well as the Integration Kit 300 – is an add-on to the miniVUX-SYS for its integration with your multi-rotor UAV, e.g. a DJI Matrice M600 or DJI Matrice M300 RTK. The package comes with an appropriate shock absorbing mounting-kit, power supply module, GNSS antenna, GNSS antenna mount, and necessary cabling for quick and straight forward integration.



RIEGL miniVUX-SYS with integrated APX-20 UAV/IMU90 and Sony Alpha 6000 camera, using RIEGL Integration Kit 300 for DJI Matrice M300 RTK

RIEGL Integration Kit 600 example (explosion drawing):



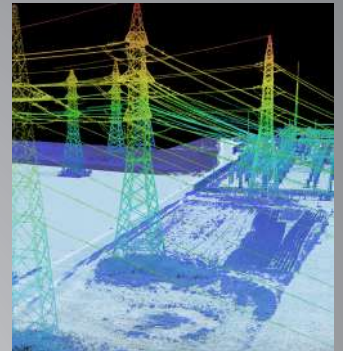
DJI Matrice M300 RTK equipped with RIEGL miniVUX-SYS using RIEGL Integration Kit 300



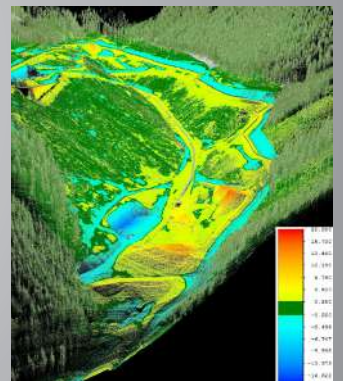
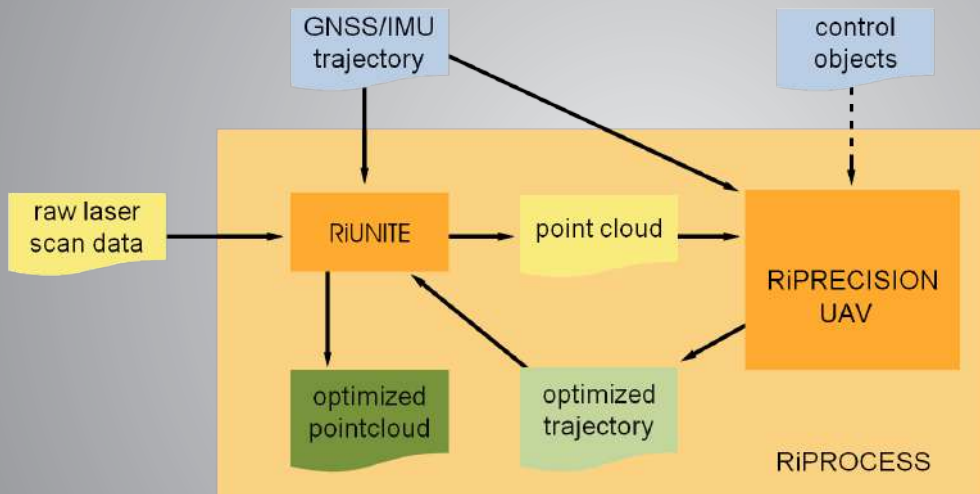
DJI Matrice M600 equipped with RIEGL miniVUX-SYS using RIEGL Integration Kit 600

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

Using RIEGL's software suites (RiPROCESS, RiUNITE) 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 (meas./sec)

Max. Measuring Range, natural targets $\rho \geq 80\%$ ¹⁾

Accuracy / Precision

Field of View

Max. Scan Speed

Max. Number of Targets per Pulse ³⁾

RIEGL miniVUX-3UAV	RIEGL miniVUX-1UAV
up to 300 kHz	100 kHz
up to 200,000	100,000
330 m	330 m
15 mm / 10 mm	15 mm / 10 mm
up to 360° ²⁾	up to 360° ²⁾
100 scans/sec	100 scans/sec
5	5

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) Selectable. Consider limitations when integrated in kinematic systems.
3) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

IMU & GNSS ⁴⁾

IMU Accuracy

Roll, Pitch

Heading

IMU Sampling Rate

Position Accuracy (typ.)

Applanix APX-20 UAV ⁵⁾
IMU82 / IMU90

0.015°

0.035°

200 Hz

0.02 - 0.05 m

Applanix APX-15 UAV ⁵⁾

0.025°

0.08°

200 Hz

0.05 - 0.1 m

4) 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.

5) See technical details in the corresponding Applanix datasheet.

Interfaces

Configuration, Scan Data Output &
Communication with External Devices

GNSS Interface ⁶⁾

General IO & Control ⁷⁾

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 RS-232 interface for data string with GNSS-time information
TTL input for 1PPS synchronization pulse

2 x TTL input/output, 1 x Remote on/off, DMI (Distance Measurement Indicator)

2 x GNSS RS-232 Tx & PPS, Power, Trigger, Exposure

for SDHC/SDXC memory card 32 GByte (can be upgraded to 64 GByte)

SPI (Serial Peripheral Interface)

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

7) 1x externally available with standard interface box

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 ⁸⁾

Humidity

Protection Class

RIEGL miniVUX-3UAV, -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)

max. 80 % non condensing @ 31°C

IP64, dust and splash-proof

Technical Data RIEGL miniVUX®-SYS

RIEGL miniVUX-SYS

Main Dimensions (L x W x H) and Weight
with APX-15 UAV
with APX-20 UAV/IMU82
with APX-20 UAV/IMU90

264 x 111 x 85 mm, approx. 2.0 kg
352 x 111 x 85 mm, approx. 2.5 kg
305 x 111 x 85 mm, approx. 2.3 kg

Integration Kit 600 / Integration Kit 300

Weight

approx. 0.7 kg / approx. 0.35 kg

Camera(s) optional ⁹⁾

Weight (with lenses and mount)
Dual Oblique Camera System
Single Nadir Camera System

technical data depending on selected camera type

approx. 1.0 kg (2x Sony Alpha 6000)
approx. 0.5 kg/1.3 kg/1.3 kg (Sony Alpha 6000/Sony A7RIII/Sony A7RIV)

8) 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.

9) Possibility of use depends on system configuration.

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