

# RIEGL miniVUX<sup>®</sup>-1UAV

- **very compact & lightweight (1.55 kg / 3.4 lbs)**
- **360° field-of-view**
- **robust aluminum housing, ready to be mounted on multi-rotor, rotary-wing, and fixed-wing UAVs**
- **makes use of RIEGL's unique echo signal digitization and online waveform processing**
- **multiple target capability – up to 5 target echoes per laser shot**
- **scan speed up to 100 scans/sec**
- **measurement rate up to 100,000 measurements/sec**
- **mechanical and electrical interface for IMU mounting**
- **exceptionally well suited to measure in snowy and icy terrains**
- **user-friendly, application- and installation-oriented solutions for integration**

The **RIEGL miniVUX-1UAV** is an extremely lightweight airborne laser scanner, designed specifically for integration with UAS/UAV/RPAS.

The small and sophisticated design of the stable aluminum housing offers various integration possibilities with platforms that offer restricted space or payload capabilities. The 360° field of view allows complete acquisition of the environment.

An easy-to-remove SD storage card for data storage, and/or the option for streaming the scan data via LAN-TCP/IP interface, in combination with the modest power consumption of the scanner, enable straightforward integration with most UAS/UAV/RPAS types.

The **RIEGL miniVUX-1UAV** makes use of **RIEGL's** unique Waveform-LiDAR technology, allowing echo digitization and online waveform processing. Multi-target resolution is the basis for penetrating even dense foliage. As a further special feature, the wavelength is optimized for the measurement of snowy and icy terrain.

In addition to the stand-alone version of the miniVUX-1UAV, **RIEGL** also offers fully-integrated solutions.

#### Typical applications include

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

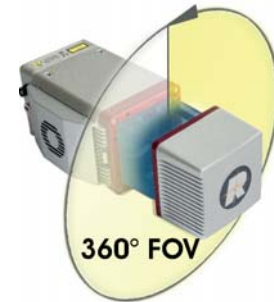
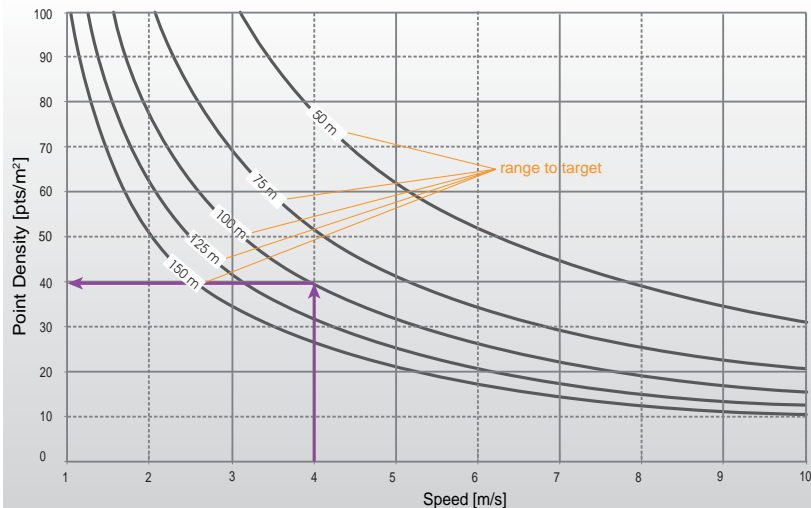


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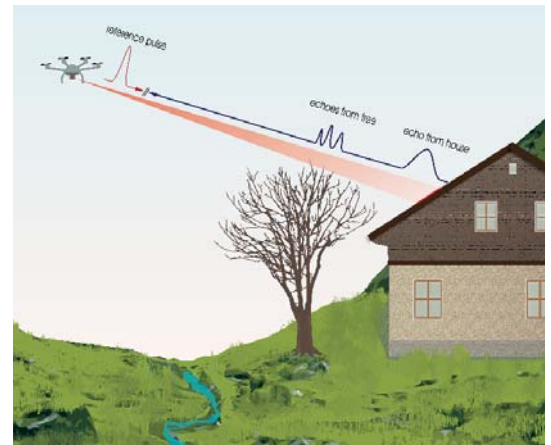
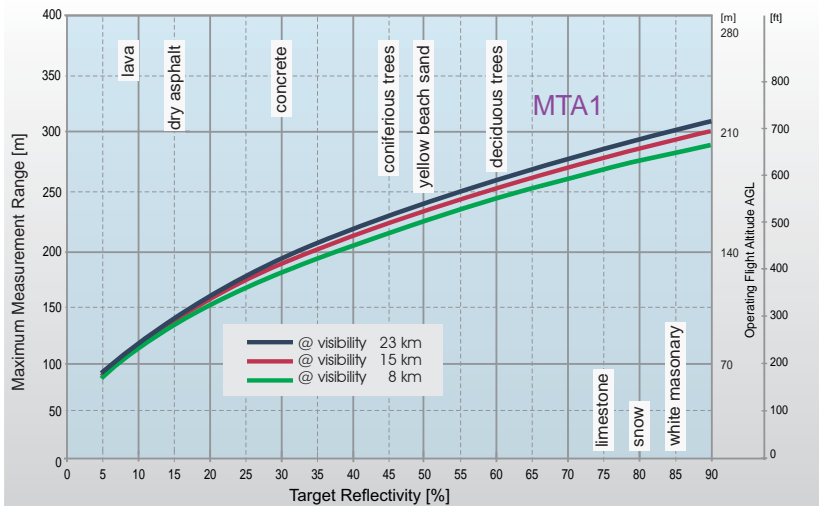


# Maximum Measurement Range vs. Target Reflectance *RIEGL* miniVUX®-1 UAV

PRR = 100 kHz



Example: miniVUX-1 UAV at 100,000 pulses/second range to target = 100 m, speed = 4 m/s Resulting Point Density ~ 40 pts/m²



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

The following conditions are assumed for the Operating Flight Altitude AGL

- target size  $\geq$  laser footprint
- average ambient brightness
- operating flight altitude given at a FOV of +/-45°

## RIEGL miniVUX-SYS System Integration Options

Besides of the stand-alone miniVUX-1 UAV LiDAR engine, *RIEGL* offers also system solutions, combining the miniVUX-1 UAV with IMU/GNSS systems of different performance and of different form factors as well as optional RGB camera systems. With regards to the IMU/GNSS system, three options are available, depending on customer's requirements and the integration environment:

### RIEGL miniVUX-SYS with APX-15 UAV<sup>1)</sup>



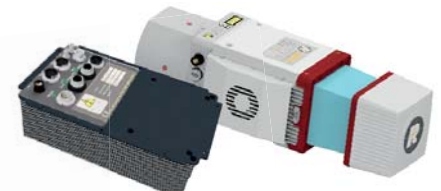
- IMU/GNSS unit integrated with LiDAR engine
- total weight approx. 2 kg
- interfaces for up to 2 cameras
- suited for integration into fixed-wing UAVs

### RIEGL miniVUX-SYS with APX-20<sup>1)</sup>



- higher-grade IMU/GNSS unit integrated with LiDAR engine
- total weight approx. 2.5 kg
- interfaces for up to 2 cameras
- suited for integration into all types of UAVs

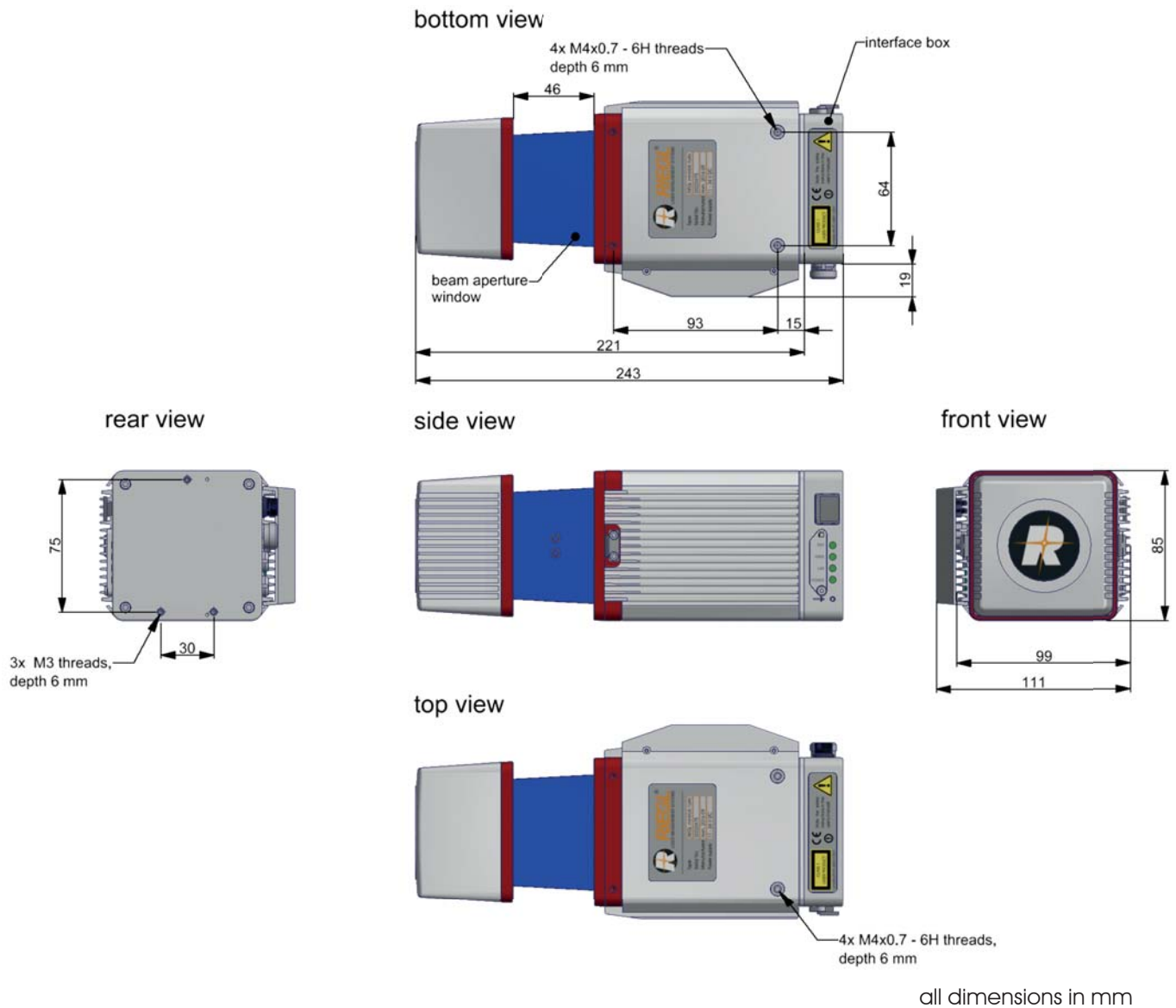
### RIEGL miniVUX-SYS with AP20<sup>1)</sup> and control unit



- higher-grade IMU/GNSS unit with separate control unit
- total weight approx. 3.6 kg
- interfaces for up to 4 cameras via control unit
- suited for integration into all types of UAVs with higher payload capacity

Please contact [sales@riegl.com](mailto:sales@riegl.com) to get more detailed information.

<sup>1)</sup> See technical details in the corresponding Applanix datasheet



## RIEGL miniVUX®-1 UAV Additional Equipment



### Cooling Fan

The RIEGL miniVUX-1 UAV is equipped with a cooling fan; a lightweight structure with an axial fan providing forced air convection. It takes care that the sensor can be operated even under conditions where sufficient natural air flow cannot be guaranteed. Power supply is provided via integrated contact pins.

The cooling fan is easy to demount by the customer when it might be necessary due to restricted space conditions. In that case, please note, that continuous operation of the sensor requires forced air convection. Thus, the scanner will turn off, if the environmental conditions/temperatures exceed the temperature range given for the sensor.



### Protective Cap

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

# Technical Data RIEGL miniVUX®-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 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

Laser Pulse Repetition Rate PRR <sup>1)</sup>	100 kHz
Max. Measuring Range <sup>2)</sup> natural targets $\rho \geq 20\%$ natural targets $\rho \geq 60\%$	150 m 250 m
Typ. Operating Flight Altitude AGL <sup>1) 3)</sup>	80 m (260 ft)
Max. Number of Targets per Pulse <sup>4)</sup>	5

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) Reflectance  $\rho \geq 20\%$ , flat terrain assumed, scan angle  $\pm 45^\circ$  FOV, additional roll angle  $\pm 5^\circ$   
4) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

Minimum Range	3 m
Accuracy <sup>5) 7)</sup>	15 mm
Precision <sup>6) 7)</sup>	10 mm
Laser Pulse Repetition Rate <sup>1)</sup>	100 kHz
Max. Effective Measurement Rate <sup>1)</sup>	up to 100 000 meas./sec. (@ 100 kHz PRR & 360° FOV)
Echo Signal Intensity	for each echo signal, high-resolution 16 bit intensity information is provided
Laser Wavelength	near infrared
Laser Beam Divergence <sup>8)</sup>	1.6 x 0.5 mrad
Laser Beam Footprint	160 mm x 50 mm @ 100 m

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 @ 50 m range under RIEGL test conditions.  
8) Measured at 50% peak intensity, 1.6 mrad corresponds to an increase of 160 mm of beam diameter per 100 m distance.

## Scanner Performance

Scanning Mechanism	rotating mirror
Field of View (selectable)	up to 360°
Scan Speed (selectable)	10 - 100 revolutions per second, equivalent to 10 - 100 scans/sec
Angular Step Width $\Delta \theta$ (selectable) between consecutive laser shots	$0.05^\circ \leq \Delta \theta \leq 0.5^\circ$
Angle Measurement Resolution	0.001°

## Interfaces

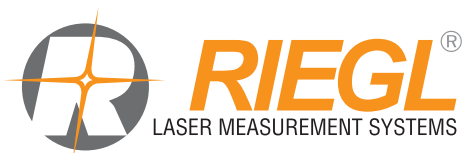
Configuration, Scan Data Output & Communication with External Devices	2 x LAN 10/100/1000 Mbit/sec WLAN IEEE 802.11 a/b/g/n Serial RS232 interface for data string with GNSS-time information, TTL input for 1PPS synchronization pulse. Power Output 10 V DC, max 4.5 W <sup>9)</sup>
GNSS Interface	2 x TTL input/output <sup>10)</sup> , 1 x Remote on/off
General IO & Control	2 x USB 2.0, Trigger, Exposure <sup>10)</sup>
Camera Interface	for SDHC/SDXC memory card 32 GByte (can be upgraded to 128 GByte)
Memory Card Holder	SPI (Serial Peripheral Interface) <sup>9)</sup>
Serial Interface to External Devices	

9) Internally available (not available with standard interface box)  
10) 1x externally available with standard interface box

## General Technical Data

Power Supply Input Voltage / Consumption	11 - 34 V DC / typ. 16 W @ 100 scans/sec
Main Dimensions (L x W x H) / Weight with Cooling Fan without Cooling Fan	243 x 111 x 85 mm / approx. 1.6 kg 243 x 99 x 85 mm / approx. 1.55 kg
Humidity	max. 80 % non condensing @ 31°C
Protection Class	IP64, dust and splash-proof
Temperature Range <sup>11)</sup>	-10°C up to +40°C (operation) / -20°C up to +50°C (storage)

11) 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.



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