

# RIEGL miniVUX<sup>®</sup>-3UAV

- **100 kHz / 200 kHz / 300 kHz Laser PRR selectable**
- **measurement rate up to 200,000 measurements/sec**
- **scan speed up to 100 scans/sec**
- **very compact & lightweight (1.55 kg / 3.4 lbs)**
- **up to 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**
- **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**

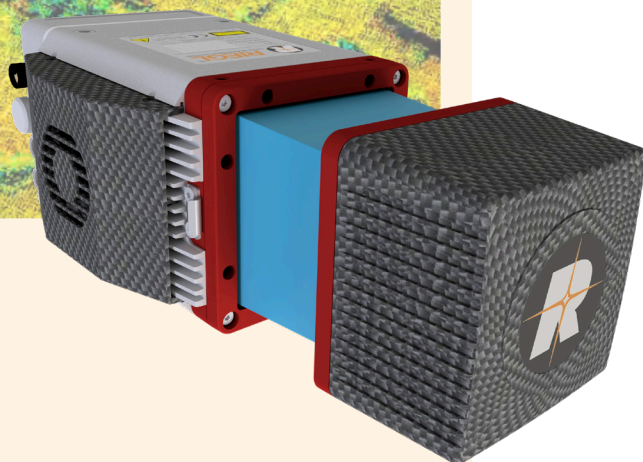
The *RIEGL* miniVUX-3UAV is an extremely lightweight airborne laser scanner, designed specifically for integration with UAS/UAV/RPAS. The sensor offers a selectable 100 kHz, 200 kHz, and 300 kHz laser pulse repetition rate (PRR). With 300 kHz PRR, it provides up to 100,000 measurements per second at 120° FoV and thus a dense point pattern on the ground for UAV-based applications that require the acquisition of small objects.

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 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 straight-forward integration with most UAS/UAV/RPAS types.

The *RIEGL* miniVUX-3UAV 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.

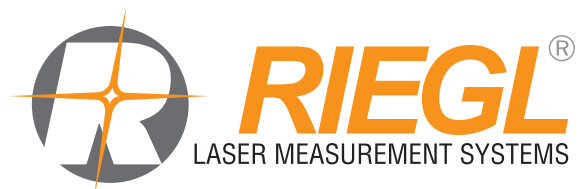
In addition to the stand-alone version of the miniVUX-3UAV, *RIEGL* also offers fully-integrated system solutions.



#### Typical applications include

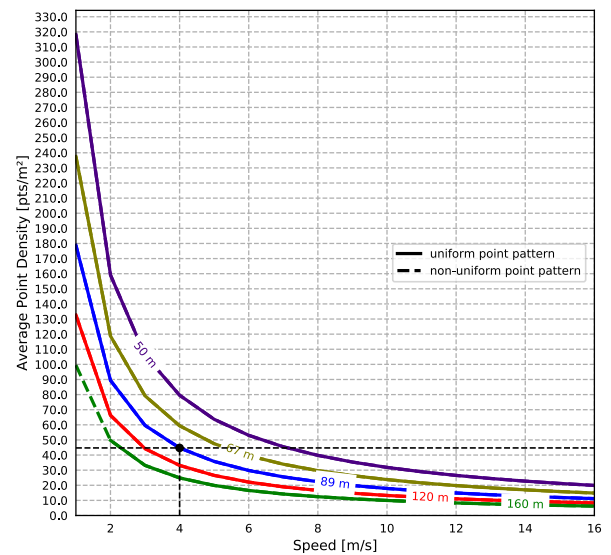
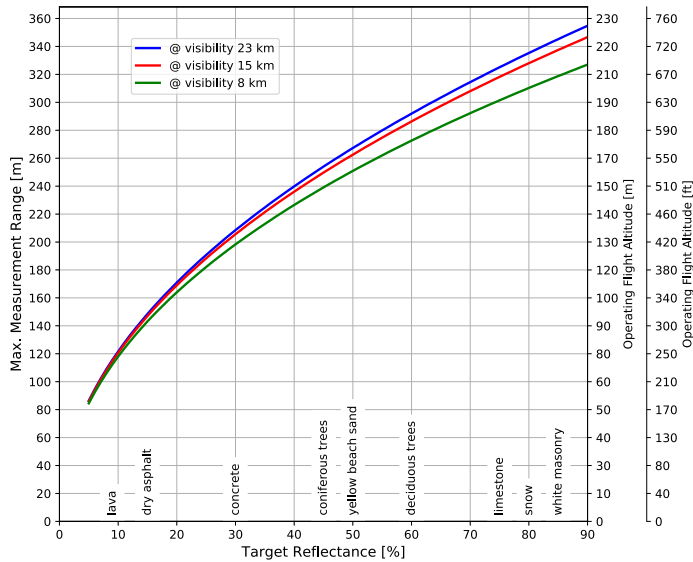
- **Agriculture & Forestry**
- **Glacier and Snowfield Mapping**
- **Archeology and Cultural Heritage Documentation**
- **Construction-Site Monitoring**
- **Landslide Monitoring**

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[www.riegl.com](http://www.riegl.com)



# Maximum Measurement Range vs. Target Reflectance *RIEGL miniVUX®-3UAV*

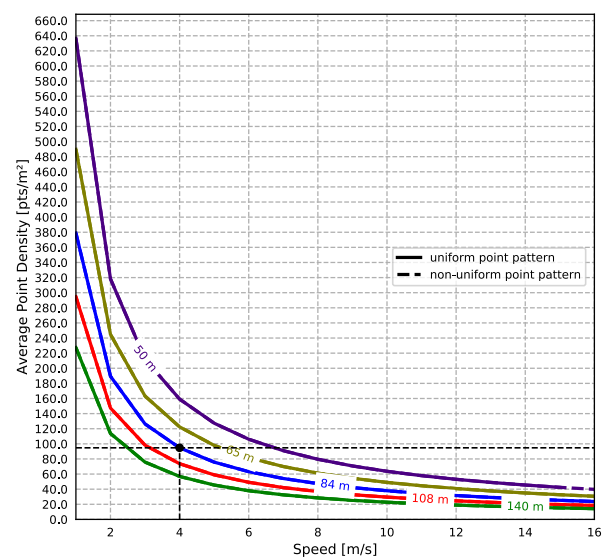
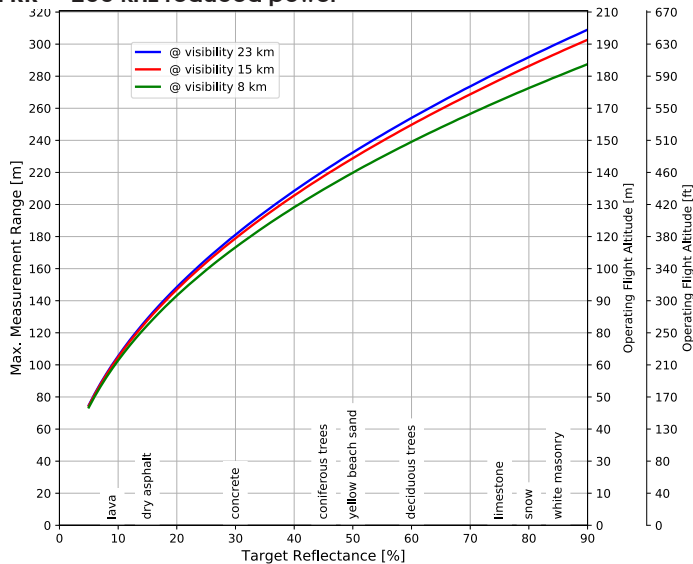
**PRR = 100 kHz**



Operating Flight Altitude AGL given for the following conditions:  
FOV of +/-45°, target size ≥ laser footprint, average ambient brightness

Example: miniVUX-3UAV at 100,000 pulses/second, speed = 4 m/s,  
range to target = ~ 90 m, resulting point density ~ 45 pts/m²

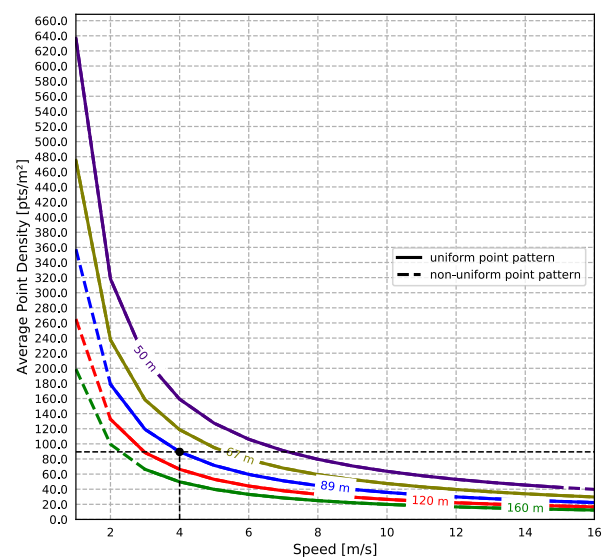
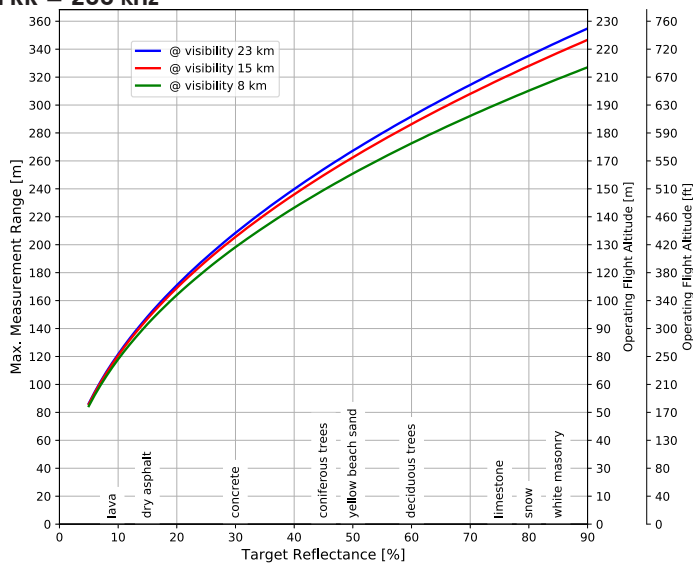
**PRR = 200 kHz reduced power**



Operating Flight Altitude AGL given for the following conditions:  
FOV of +/-45°, target size ≥ laser footprint, overcast sky, ambient brightness 10klx

Example: miniVUX-3UAV at 200,000 pulses/second, speed = 4 m/s,  
range to target = ~ 85 m, resulting point density ~ 95 pts/m²

**PRR = 200 kHz**

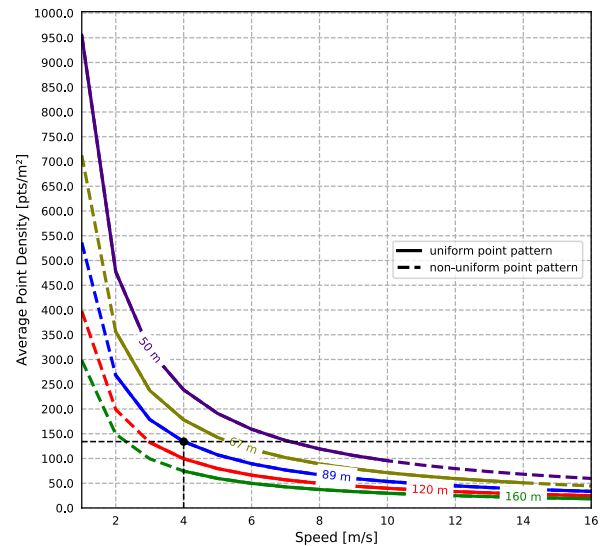
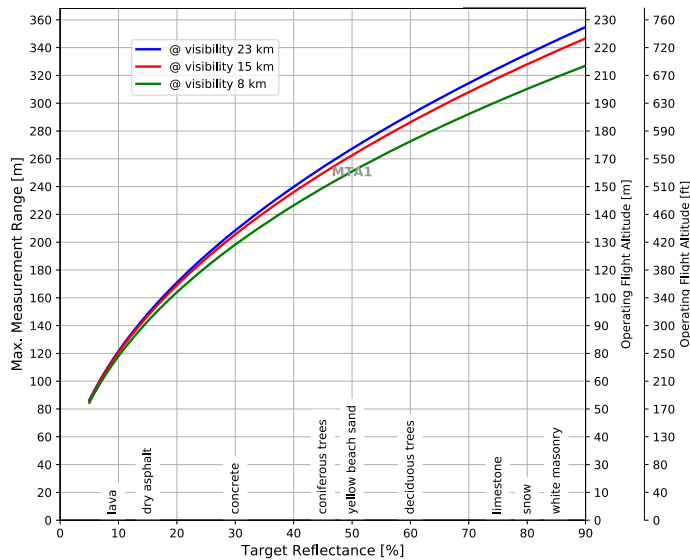


Operating Flight Altitude AGL given for the following conditions:  
FOV of +/-45°, target size ≥ laser footprint, average ambient brightness

Example: miniVUX-3UAV at 200,000 pulses/second, speed = 4 m/s,  
range to target = ~ 90 m, resulting point density ~ 90 pts/m²

# Maximum Measurement Range vs. Target Reflectance *RIEGL* miniVUX®-3UAV

PRR = 300 kHz



Operating Flight Altitude AGL given for the following conditions:  
FOV of +/-45°, target size ≥ laser footprint, average ambient brightness

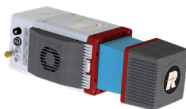
Example: miniVUX-3UAV at 300,000 pulses/second, speed = 4 m/s,  
range to target = ~ 90 m, resulting point density ~ 135 pts/m²

## RIEGL miniVUX-SYS System Integration Options

Besides of the stand-alone miniVUX-3UAV LiDAR engine, *RIEGL* offers also system solutions, combining the miniVUX-3UAV with IMU/GNSS systems of different performance and of different form factors as well as optional RGB camera systems. Additionally, a special add-on to the miniVUX-SYS allows for straight forward integration with your multi-rotor UAV, e.g. a DJI Matrice M600 / M300 RTK.

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

### RIEGL miniVUX-3UAV with RiLOC®-E



- *RIEGL*'s IMU/GNSS solution fully integrated with LiDAR engine
- total weight approx. 1.75 kg
- interfaces for up to 2 cameras
- suited for integration into multi-rotor UAVs

### RIEGL miniVUX-3UAV 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-3UAV with APX-20 UAV (IMU82 / IMU90)<sup>1)</sup>



- higher-grade IMU/GNSS unit partly integrated (IMU82) respectively fully integrated (IMU90) with LiDAR engine
- total weight approx. 2.5 kg
- interfaces for up to 2 cameras
- suited for integration into all types of UAVs

<sup>1)</sup> See technical details in the corresponding Applanix data sheet.

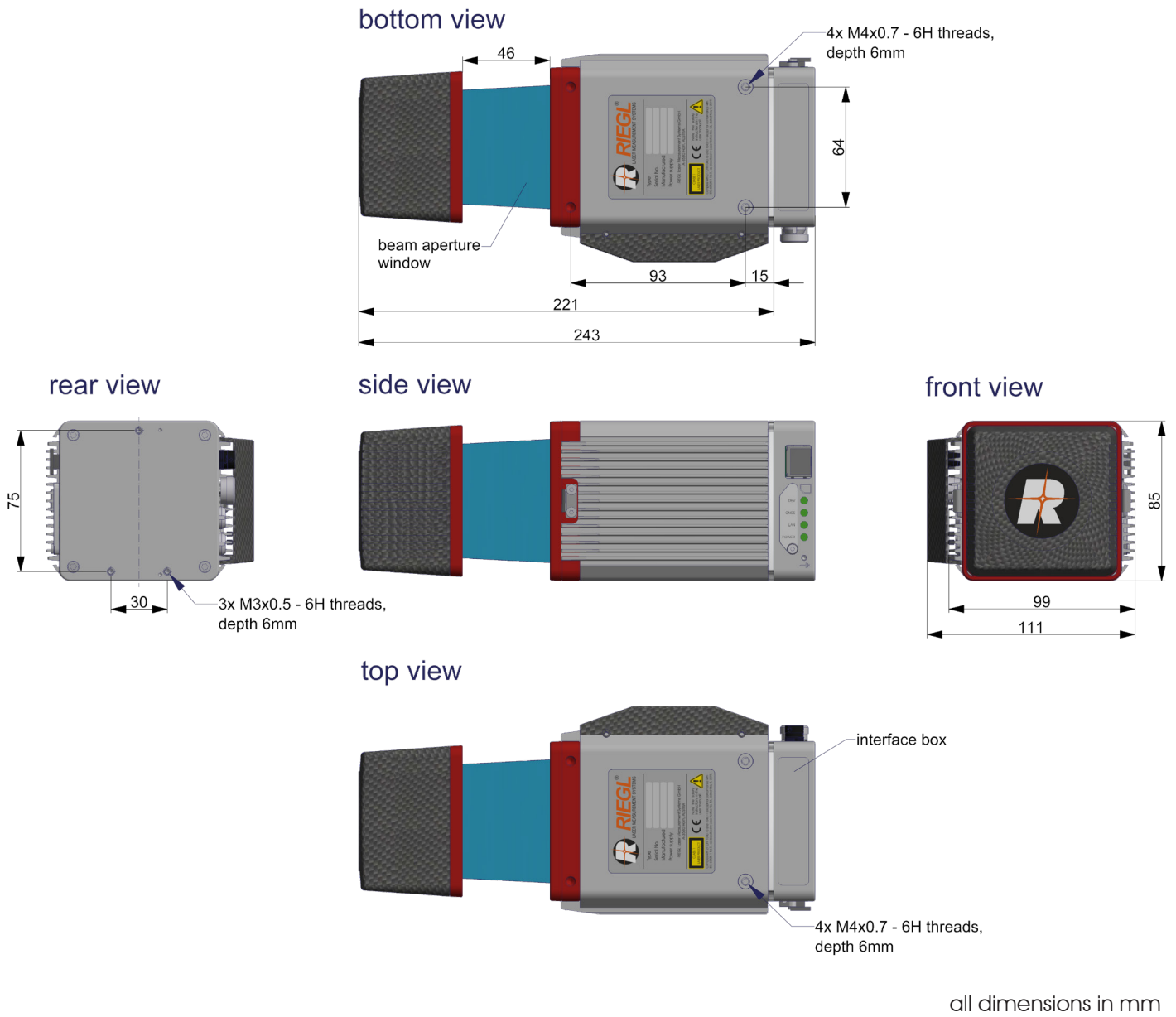
## RIEGL Integration Kit 600 / 300



- add-on to the miniVUX-SYS coming with shock-absorbing mounting-kit, power supply module and cabling
- total weight approx. 0.7 kg / 0.35 kg (without sensor and camera)
- suited for integration into multi-rotor UAVs

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

# Dimensional Drawings RIEGL miniVUX®-3UAV Stand-Alone



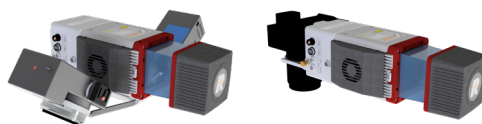
## RIEGL miniVUX®-3UAV Camera Options

### RIEGL miniVUX-3UAV LiDAR Sensor equipped with RiLOC®-E



with Sony ILX-LR1 camera or others<sup>3)</sup>

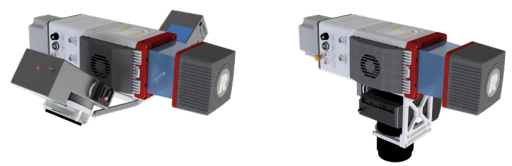
### RIEGL miniVUX-3UAV LiDAR Sensor equipped with APX-15 UAV<sup>1)</sup>



with two Sony Alpha 6100 cameras (oblique mount)

with nadir-looking RGB camera(s)<sup>3)</sup>

### RIEGL miniVUX-3UAV LiDAR Sensor equipped with APX-20 UAV (e.g. IMU82)<sup>1)</sup>



with two Sony Alpha 6100 cameras (oblique mount)

with nadir-looking RGB camera(s)<sup>3)</sup>

integration of other 3<sup>rd</sup> party cameras possible<sup>2)</sup>

1) See technical details in the corresponding Applanix data sheet.  
2) Multispectral camera, hyperspectral camera, thermal imaging sensor – more information on request.  
3) Versatile camera options (e.g. Sony Alpha 6100, Sony A7R III, Sony A7R IV, Sony ILX-LR1).



## 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.

**CLASS 1  
LASER PRODUCT**

## 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	200 kHz reduced power	200 kHz	300 kHz
Max. Measuring Range <sup>2)</sup>				
natural targets $\rho \geq 20\%$	170 m	150 m	170 m	170 m
natural targets $\rho \geq 60\%$	290 m	250 m	290 m	290 m
natural targets $\rho \geq 80\%$	330 m	280 m	330 m	330 m
Typ. Operating Flight Altitude AGL <sup>1) 3)</sup>				
natural targets $\rho \geq 20\%$	100 m (330 ft)	85 m (280 ft)	100 m (330 ft)	100 m (330 ft)
natural targets $\rho \geq 60\%$	160 m (525 ft)	140 m (460 ft)	160 m (525 ft)	160 m (525 ft)
Max. Number of Targets per Pulse <sup>4)</sup>	5	5	5	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) Flat terrain assumed, scan angle  $\pm 45^\circ$  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

2 m

### Accuracy <sup>5) 7)</sup>

15 mm

### Precision <sup>6) 7)</sup>

10 mm

### Laser Pulse Repetition Rate <sup>1)</sup>

100 kHz / 200 kHz / 300 kHz (selectable)

### Max. Effective Measurement Rate <sup>1)</sup>

up to 200 000 meas./sec. (@ 200 kHz PRR reduced power & 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)

360° @ 100 kHz, 200 kHz reduced power

180° @ 200 kHz

120° @ 300 kHz

### Scan Speed (selectable)

10 - 100 scans/sec<sup>9)</sup> @ 100 kHz, 200 kHz reduced power

20 - 100 scans/sec<sup>9)</sup> @ 200 kHz

30 - 100 scans/sec<sup>9)</sup> @ 300 kHz

### Angular Step Width $\Delta \phi$ (selectable)

0.018° ≤  $\Delta \phi$  ≤ 0.36°

between consecutive laser shots

### Angle Measurement Resolution

0.001°

- 9) equivalent to revolutions per second

## 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

### GNSS Interface <sup>10)</sup>

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

### General IO & Control <sup>11)</sup>

2 x TTL input/output, 1 x Remote on/off

### Camera Interface

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

### Memory Card Slot

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

- 10) internally available (not available with standard interface box)

- 11) 1x externally available with standard interface box

## General Technical Data

### Power Supply Input Voltage / Consumption

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

### Main Dimensions (L x W x H) / Weight

with Cooling Fan

243 x 111 x 85 mm / approx. 1.6 kg

without Cooling Fan

243 x 99 x 85 mm / approx. 1.55 kg

### Humidity

max. 80 % non condensing @ 31°C

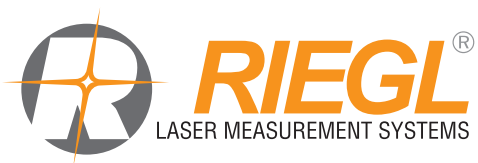
### Protection Class

IP64, dust and splash-proof

### Temperature Range <sup>12)</sup>

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

- 12) 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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**RIEGL USA Inc., Headquarters North America**

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