„NFB" (Nadir/Forward/Backward) Scanning UAV LiDAR Sensor

**NEW**

# RIEGL VUX®-120

- *laser pulse repetition rate up to 1.8 MHz*
- *measurement rate up to 1,500,000 meas./sec*
- *scan speed up to 400 lines/second*
- *operating flight altitude up to 730m / 2,400 ft*
- *Field of View up to 100°*
- *compact & lightweight (2 kg / 4.4 lbs)*
- *Nadir/Forward/Backward Scanning for unrivaled completeness of scan data even on vertical structures and narrow canyons*
- *cutting edge RIEGL technology providing:*
  - *echo signal digitization*
  - *multiple target capability*
  - *online waveform processing*
  - *multiple-time-around processing*
- *easily mountable to unmanned platforms (UAVs) and small manned aircrafts*
- *mechanical and electrical interface for INS/GNSS integration*
- *interfaces for up to 2 external cameras*
- *scan data storage on internal 1 TByte SSD Memory*
- *removeable CFAST® memory card up to 256 GB*

**The new *RIEGL* VUX-120 is a lightweight and versatile airborne laser scanner offering a wide field of view of 100 degrees and an extremely fast data acquisition rate of up to 1.8 MHz. Thus, it is perfectly suited for high point density corridor mapping applications.**
**The measuring beam of the *RIEGL* VUX-120 is consecutively scanned in three different directions: it alternates from +10 degrees forward, to strictly nadir, and to -10 degrees backward. This allows data acquisition with an unrivaled completeness in data capture, especially in challenging environments with vertical surfaces and narrow canyons.**

The scanner provides an internal data storage capacity of 1 TByte and is equipped with interfaces for an external IMU/GNSS system as well as to control up to two external cameras. WLAN enables direct access to the laser scanner for changing configuration settings and checking the system status.
The sophisticated design of the *RIEGL* VUX-120 allows smooth integration on UAS/UAV/RPAS, small manned aeroplanes like gyrocopters but also on helicopters. It is offered as stand-alone UAV LiDAR sensor, but also in various fully-integrated UAV airborne laser scanning system configurations with appropriate INS/GNSS system and cameras to meet the special requirements resulting from various customers' applications.

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**Typical applications include**

- *Corridor Mapping: Power Line, Railway Track and Pipeline Inspection*
- *Topography in Open-Cast Mining*
- *Surveying of Urban Environments*
- *Archeology and Cultural Heritage Documentation*
- *Agriculture & Forestry*


visit our website
www.riegl.com

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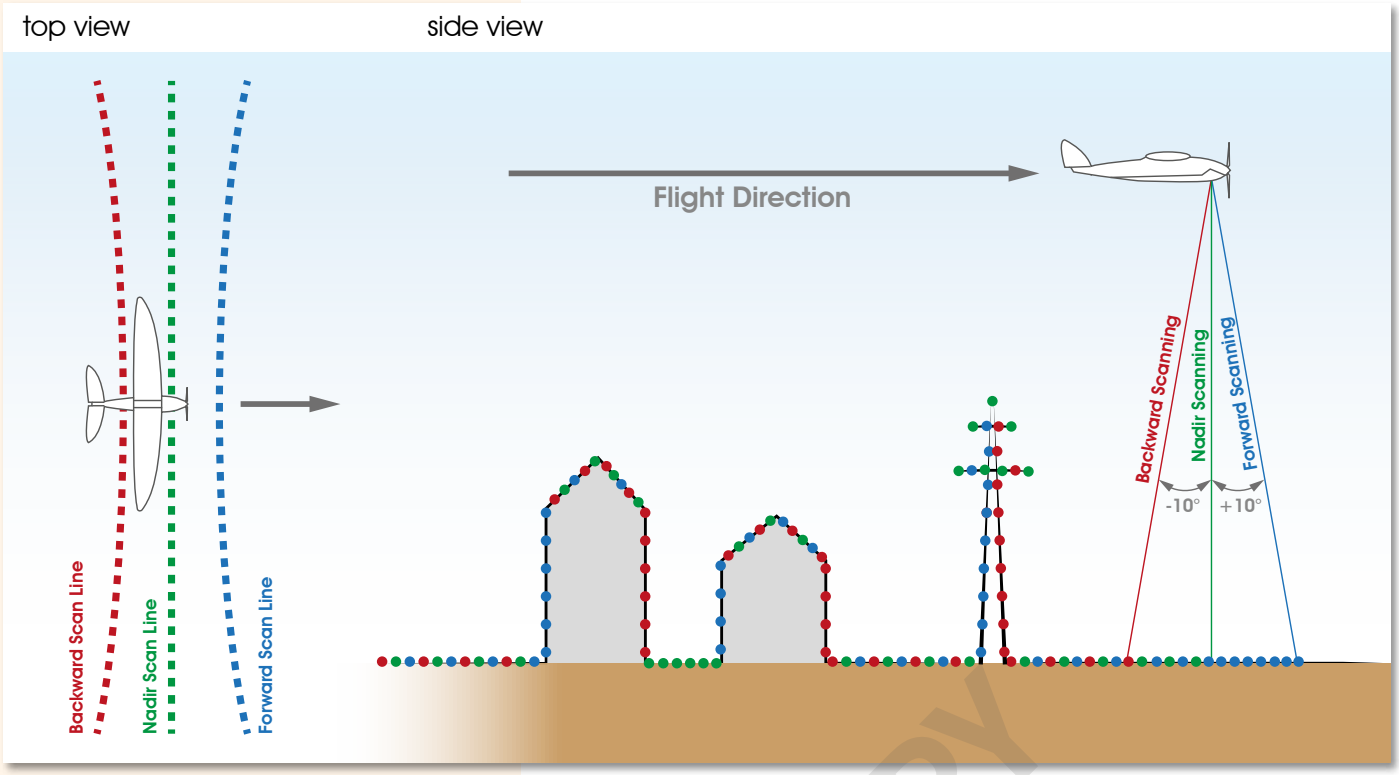
LASER MEASUREMENT SYSTEMS




| | |
|---|---|
| Field of View | ± **50° (100°)** |
| Forward/Backward Scan Angle in Swath Center | ± **10°** |
| Forward/Backward Scan Angle at Swath Edges | ± **15°** |

The *RIEGL* VUX-120 offers a sophisticated scan pattern consisting of scan lines with periodically changing directions. The scan directions in the center of the scan lines change consecutively from +10 degrees forward, to strictly nadir, and to -10 degrees backward. This scan pattern provides an almost complete 3D data set, as also vertical surfaces like the facades of buildings and objects like masts and poles are accurately sampled by laser range measurements. In addition, the nadir direction enables the reliable data acquisition down to the bottom of narrow canyons.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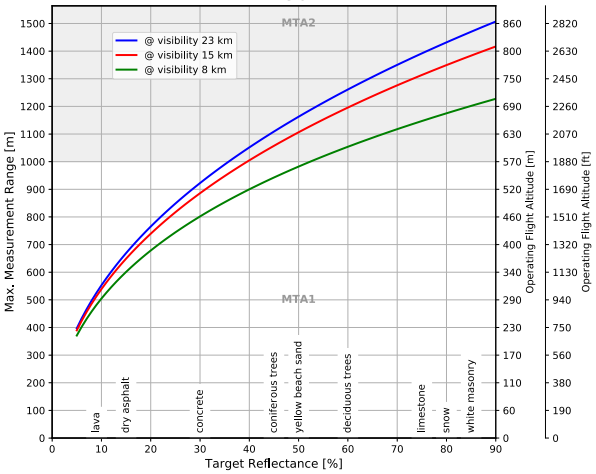
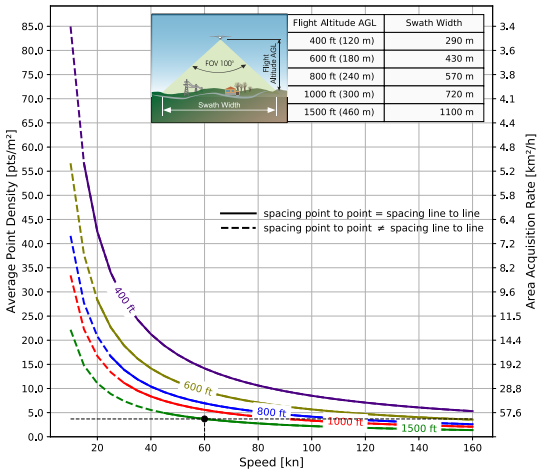
## PRR = 150 kHz

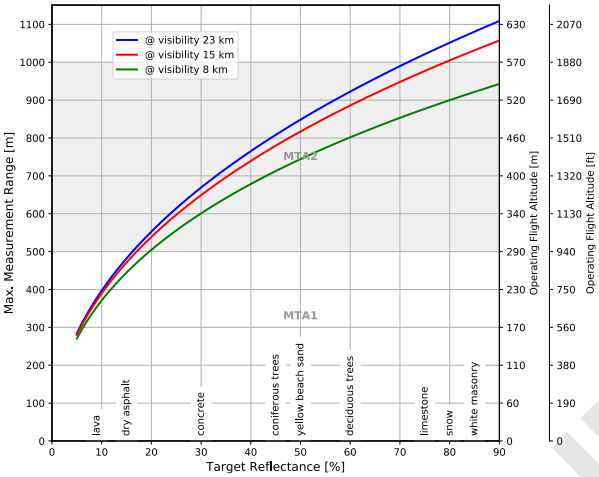


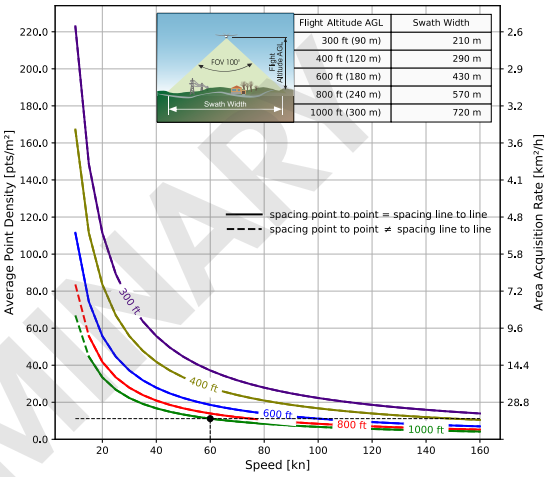




**Example:** VUX-120 at 150,000 pulses/sec, laser power level 100%
Altitude = 1,500 ft AGL, Speed 60 kn

**Result:** Point Density ~ 4 pts/m²

## PRR = 300 kHz

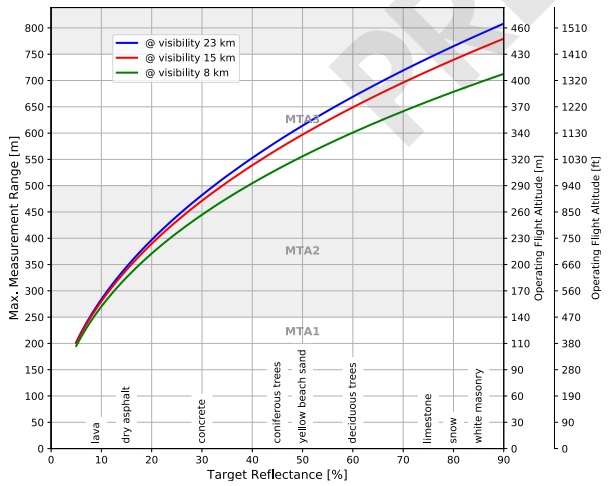


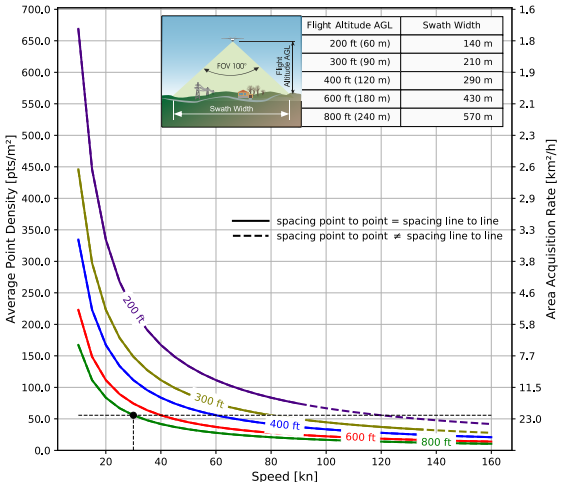




**Example:** VUX-120 at 300,000 pulses/sec, laser power level 100%
Altitude = 1,000 ft AGL, Speed 60 kn

**Result:** Point Density ~ 11 pts/m²

## PRR = 600 kHz




**Example:** VUX-120 at 600,000 pulses/sec, laser power level 100%
Altitude = 800 ft AGL, Speed 30 kn

**Result:** Point Density ~ 55 pts/m²

***The following conditions are assumed for definition of the Operating Flight Altitude AGL***

- ambiguity resolved by multiple-time-around (MTA) processing
- roll angle ±5°
- target size ≥ laser footprint
- average ambient brightness
- operating flight altitude given at a FOV 100°

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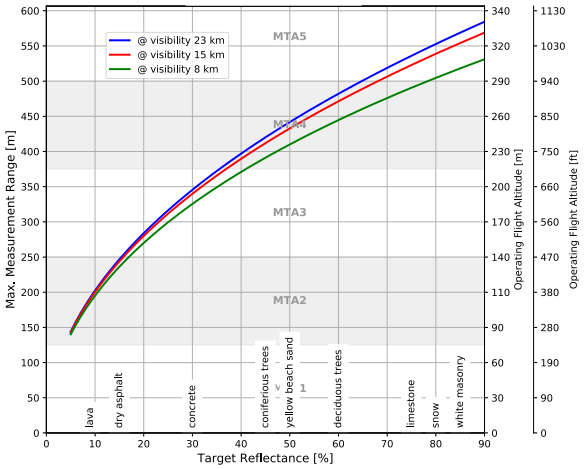
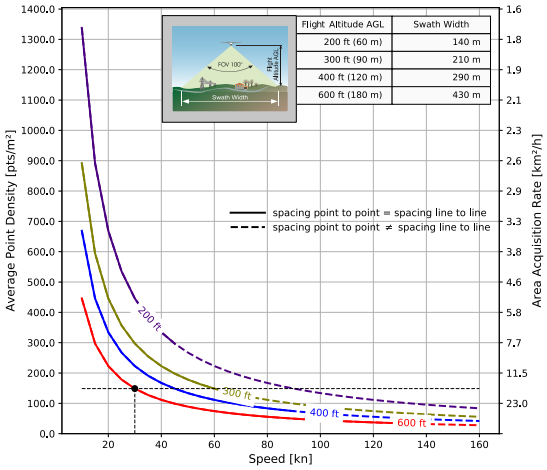
**PRR = 1200 kHz**

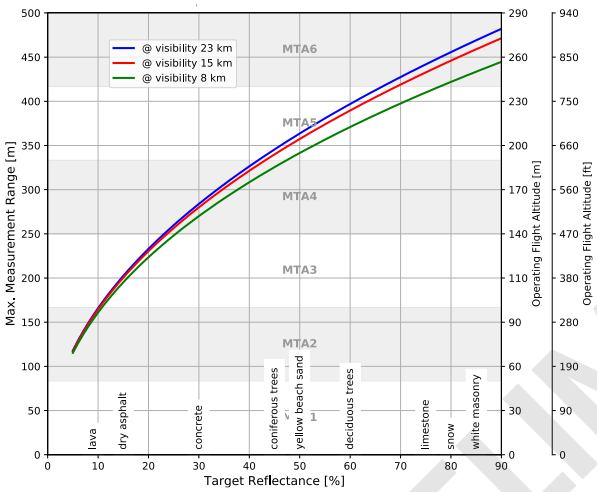


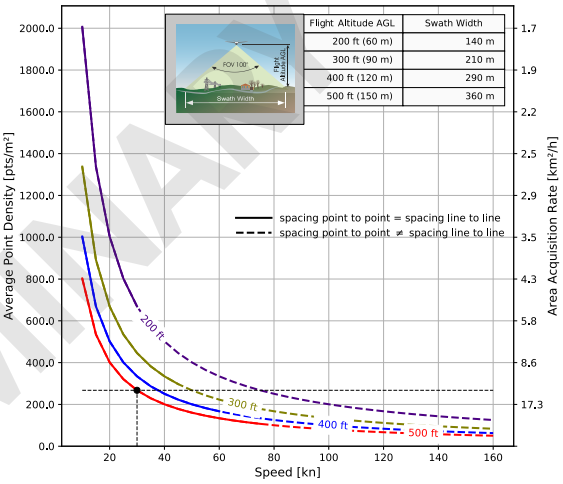




**Example:** VUX-120 at 1,200,000 pulses/sec, laser power level 100%
Altitude = 600 ft AGL, Speed 30 kn

**Result:** Point Density ~ 150 pts/m²

**PRR = 1800 kHz**




**Example:** VUX-120 at 1,800,000 pulses/sec, laser power level 100%
Altitude = 500 ft AGL, Speed 30 kn

**Result:** Point Density ~ 270 pts/m²

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***The following conditions are assumed for definition of the Operating Flight Altitude AGL***

- ambiguity resolved by multiple-time-around (MTA) processing
- roll angle ±5°
- target size ≥ laser footprint
- average ambient brightness
- operating flight altitude given at a FOV of 100°

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all dimensions in mm


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Laser Product Classification

Class 1 Laser Product according to IEC60825-1:2014
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.


## Range Measurement Performance

Measuring Principle: time of flight measurement, echo signal digitization, multiple target capability, online waveform processing, multiple-time-around-processing

| *Laser Pulse Repetition Rate PRR* [1] | *150 kHz* | *300 kHz* | *600 kHz* | *1200 kHz* | *1800 kHz* |
|---|---|---|---|---|---|
| Max. Measuring Range [2] [3] | | | | | |
| natural targets ρ ≥ 20 % | 760 m | 550 m | 400 m | 280 m | 230 m |
| natural targets ρ ≥ 60 % | 1260 m | 920 m | 670 m | 480 m | 400 m |
| natural targets ρ ≥ 80 % | 1430 m | 1050 m | 760 m | 550 m | 450 m |
| Max. Operating Flight Altitude AGL [2] [4] | | | | | |
| @ ρ ≥ 20 % | 440 m (1450 ft) | 320 m (1050 ft) | 230 m (750 ft) | 160 m (550 ft) | 130 m (450 ft) |
| @ ρ ≥ 60 % | 720 m (2350 ft) | 530 m (1750 ft) | 380 m (1250 ft) | 280 m (900 ft) | 230 m (750 ft) |
| Max. Number of Targets per Pulse [5] | 15 | 15 | 15 | 8 | 5 |

1) Rounded average PRR.
2) Typical values for average conditions and average ambient brightness. In bright sunlight, the max. range is shorter than under an overcast sky.
3) The 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. Range ambiguities have to be resolved by multiple-time-around processing.
4) Typical values for reflectivity ρ ≥ 60 %, max. effective FOV 100°, additional roll angle ± 5°.
5) If the laser beam hits, in part, more than one target, the laser's pulse power is split accordingly. Thus the achievable range is reduced.

| | |
|---|---|
| Minimum Range | 5 m |
| Accuracy [6] [8] | 10 mm |
| Precision [7] [8] | 5 mm |
| Laser Pulse Repetition Rate [1] [9] | up to 1800 kHz |
| Max. Effective Measurement Rate [1] | up to 1,500,000 meas./sec. (@ 1800 kHz PRR & 100° scan angle) |
| Echo Signal Intensity | for each echo signal |
| Laser Wavelength | near infrared |
| Laser Beam Divergence | 0.4 mrad [10] |
| Laser Beam Footprint (Gaussian Beam Definition) | 40 mm @ 100 m, 200 mm @ 500 m, 400 mm @ 1000 m |

6) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
7) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
8) One sigma @ 150 m range under *RIEGL* test conditions.
9) User selectable.
10) Measured at the $1/e^2$ points. 0.4 mrad corresponds to an increase of 40 mm of beam diameter per 100 m distance.

## Scanner Performance

| | |
|---|---|
| Scanning Mechanism | rotating polygon mirror |
| Scan Pattern | parallel scan lines, angular directions -10°, 0°, +10° transvers to the scan direction for forward and backward view |
| Field of View (selectable) | ± 50° = 100° |
| Scan Speed (selectable) | 50 - 400 lines/sec |
| Angular Step Width Δ ϑ (selectable) between consecutive laser shots | 0.0033° ≤ Δ ϑ ≤ 0.32° [11] [12] |
| Angle Measurement Resolution | 0.001° |
| Scan Sync (optional) | scanner rotation synchronization |

## Data Interfaces

| | |
|---|---|
| Configuration, Scan Data Output& Communication with External Devices | 2x LAN 10/100/1000 MBit/sec |
| GNSS Interface | Serial RS232 interface, TTL input for 1pps synchronisation pulse, accepts different data formats for GNSS-time information<br>Power Output 10 V DC, max. 4.5 W [13] |
| General IO & Control | 2 x TTL input/output [14], 1 x Remote on/off |
| Camera Interface | 2 x GNSS RS-232 Tx & PPS, Power (USB 2.0), Trigger, Exposure [14] |

## General Technical Data

| | |
|---|---|
| Power Supply Input Voltage / Consumption | 11 - 34 V DC / typ. 45 W |
| Main Dimensions (L x W x H) | 225 mm x 117 mm x 126 mm (without connection box)<br>242 mm x 117 mm x 126 mm (with connection box) |
| Weight (without Interface Box / with Interface Box) | approx. 2 kg / approx. 2.2 kg |
| Humidity | max. 80 % non condensing @ 31°C |
| Protection Class | IP64, dust and splash-proof |
| Max. Flight Altitude (operating & not operating) | 18 500 ft (5 600 m) above MSL (Mean Sea Level) |
| Temperature Range | -10°C up to +40°C (operation) / -20°C up to +50°C (storage) |

11) The angular step width depends on the selected laser PRR.
12) The maximum angular step width is limited by the maximum scan rate.
13) Internally available (not available with standard interface box)
14) 1x externally available with standard interface box

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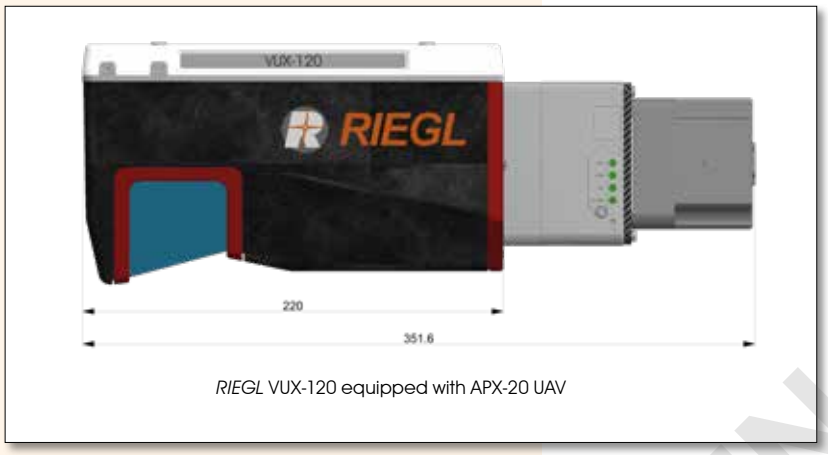
## Data Storage

| | |
|---|---|
| Internal Data Storage | Solid State Disc SSD, 1TByte |
| Memory Card Slot [1] | for CFAST® [2] memory card 120 GByte (can be upgraded to 256 GByte) |

## External IMU & GNSS (optional) [3]

| | Applanix APX-20 UAV [4] |
|---|---|
| IMU Accuracy [3] | |
| Roll, Pitch | 0.015° |
| Heading | 0.035° |
| IMU Sampling Rate | 200 Hz |
| Position Accuracy (typ.) | |
| horizontal | < 0.05 m |
| veritcal | < 0.1 m |

1) applies to IMU APX-20 UAV only
2) CFast is a registered trademark of CompactFlash Association.
3) Accuracy specifications for post-processed data
4) See technical details at the according Applanix datasheet




*RIEGL* VUX-120 equipped with APX-20 UAV

all dimensions in mm

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## *RIEGL* VUX®-120 Camera Options


*with nadir-looking camera*
*Sony Alpha 7R and 21 mm lens*
*(81° FoV coverage)*


*with nadir-looking camera*
*Sony Alpha A6000 and 12 mm lens*
*(89° FoV coverage)*

*max. front payload capacity: 700g*


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RIEGL LASER MEASUREMENT SYSTEMS

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