

RIEGL VUX-120²³

- **laser pulse repetition rate up to 2.4 MHz**
- **measurement rate up to 2,000,000 meas./sec**
- **scan speed up to 400 lines/second**
- **operating flight altitude up to 720 m / 2,350 ft**
- **Field of View up to 100°**
- **compact & lightweight (2.3 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 aircraft**
- **mechanical and electrical interface for IMU/GNSS integration**
- **interfaces for up to 2 external cameras**
- **scan data storage on internal SSD Memory**
- **removeable CFAST[®] memory card**

The **RIEGL VUX-120²³** is a lightweight and versatile airborne laser scanner offering a wide field of view of 100 degrees and an extremely high pulse repetition rate of up to 2.4 MHz. Thus, it is perfectly suited for high point density corridor mapping applications.

The measuring beam of the **RIEGL VUX-120²³** is consecutively emitted in three different directions: it alternates from strictly nadir, to +10 degrees forward, 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 2 TByte and a removeable CFAST card and is equipped with interfaces for integration of an external IMU/GNSS system. Additionally, interfaces for up to two optional external cameras are available.

The sophisticated design of the **RIEGL VUX-120²³** allows smooth integration on UAS/UAV/RPAS, small manned aeroplanes (like gyrocopters), but also on helicopters. It is offered both, as stand-alone UAV LiDAR sensor and also in various fully-integrated UAV-based laser scanning system configurations with appropriate IMU/GNSS system and optional cameras. This allows the scanner to perfectly meet all the specific requirements of the customers' applications.

Typical applications include

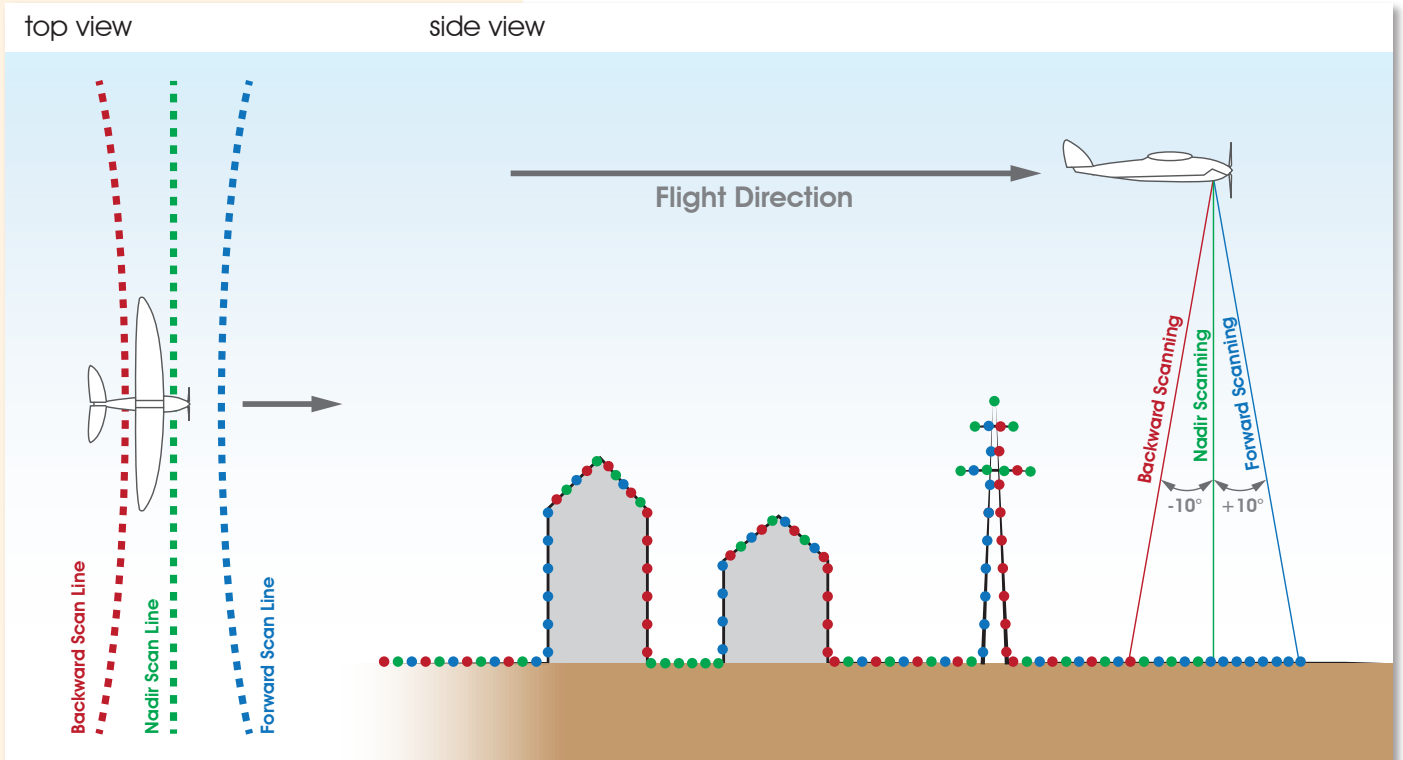
- **Corridor Mapping: Power Line, Railway Track and Pipeline Inspection**
- **Topography in Open-Cast Mining**
- **Surveying of Urban Environments**
- **Archeology and Cultural Heritage Documentation**
- **Agriculture & Forestry**



visit our website
www.riegl.com



RIEGL VUX-120²³ Scan Pattern „NFB“ (Nadir/Forward/Backward)

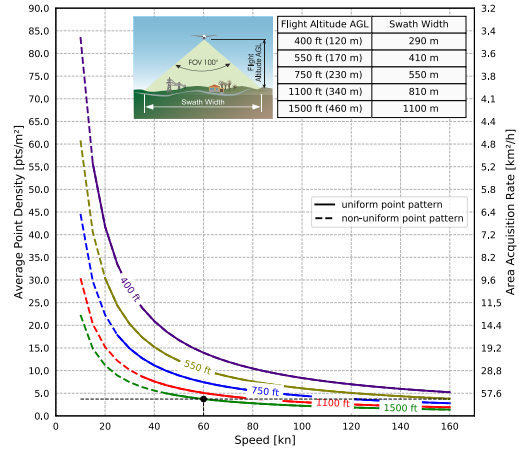
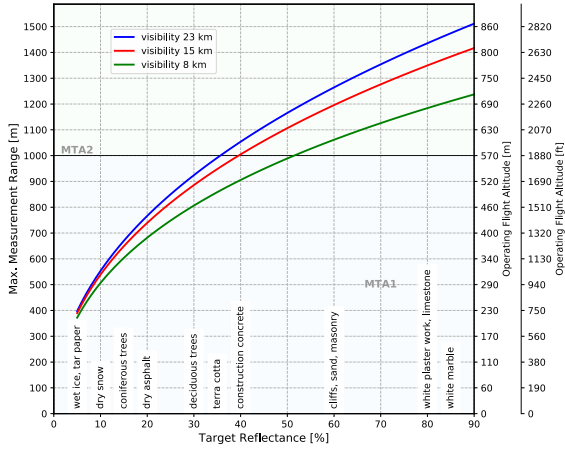


Field of View	± 50° (100°)
Forward/Backward Scan Angle in Swath Center	± 10°
Forward/Backward Scan Angle at Swath Edges	± 15°

The RIEGL VUX-120²³ 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 strictly nadir, to +10 degrees forward 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 (e.g. 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.



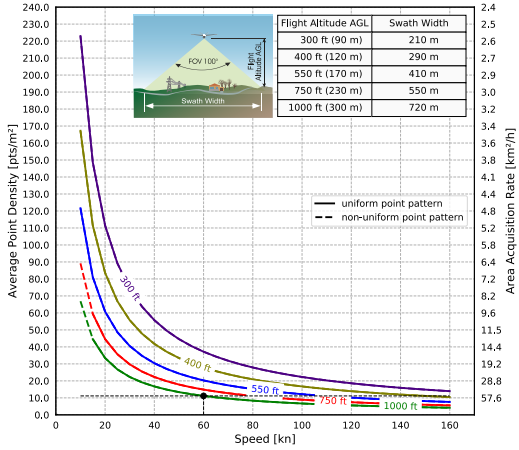
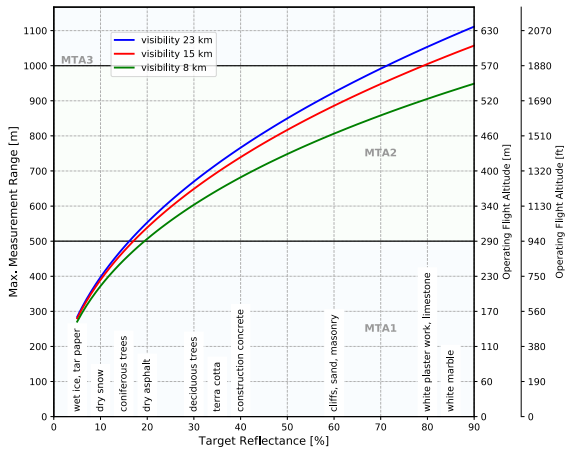
PRR = 150 kHz



Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 150,000 pulses/sec, laser power level 100%
Altitude = 1,500 ft AGL, Speed 60 kn, resulting point density ~ 4 pts/m²

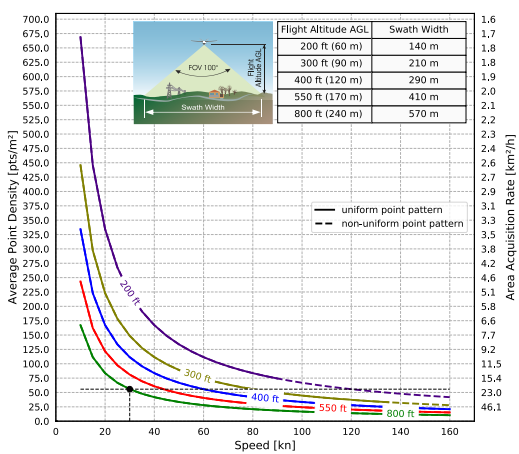
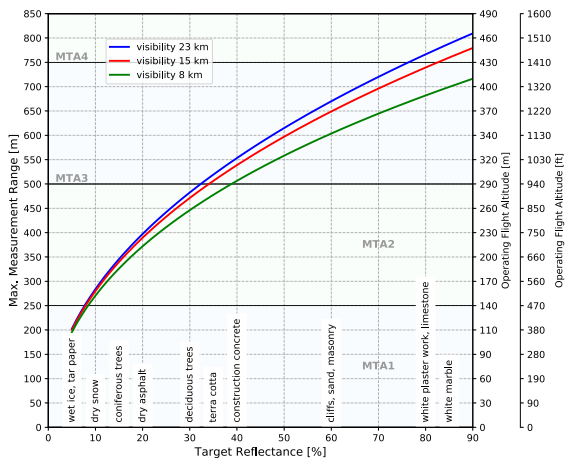
PRR = 300 kHz



Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 300,000 pulses/sec, laser power level 100%
Altitude = 1,000 ft AGL, Speed 60 kn, resulting point density ~ 11 pts/m²

PRR = 600 kHz

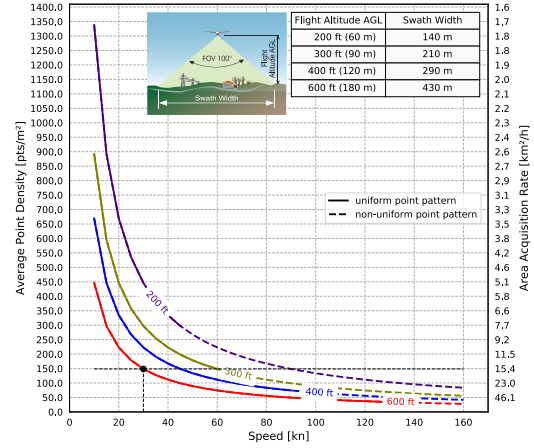
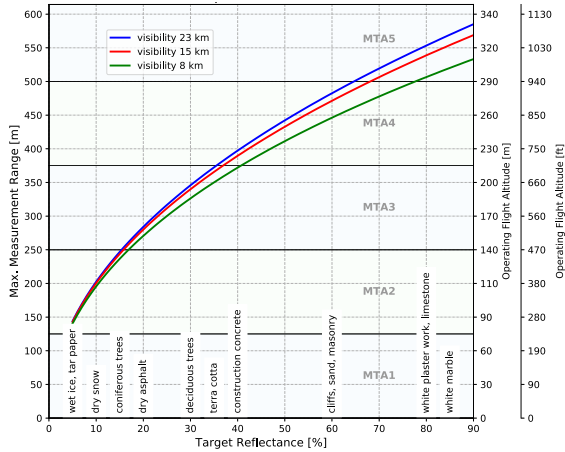


Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 600,000 pulses/sec, laser power level 100%
Altitude = 800 ft AGL, Speed 30 kn, resulting point density ~ 55 pts/m²

Maximum Measurement Range & Point Density RIEGL VUX[®]-120²³

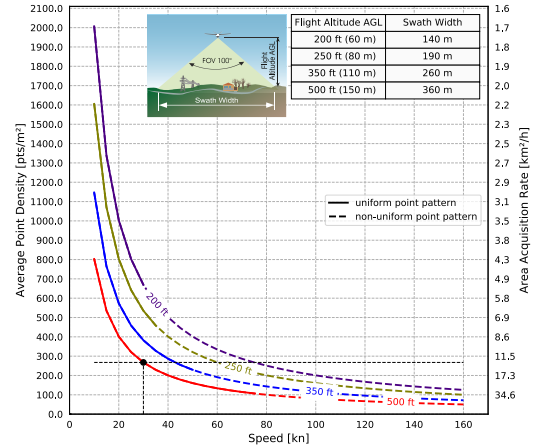
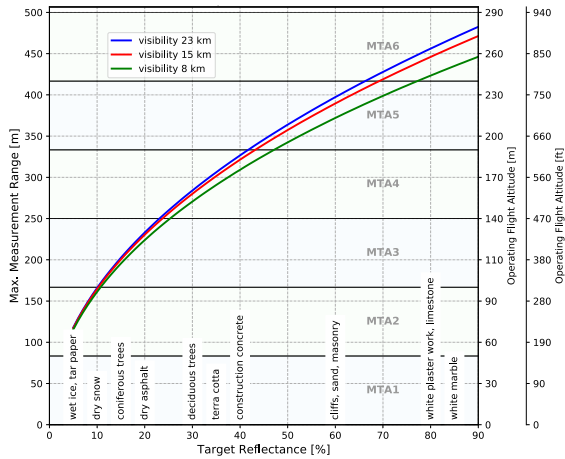
PRR = 1200 kHz



Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 1,200,000 pulses/sec, laser power level 100%
Altitude = 600 ft AGL, Speed 30 kn, resulting point density ~ 150 pts/m²

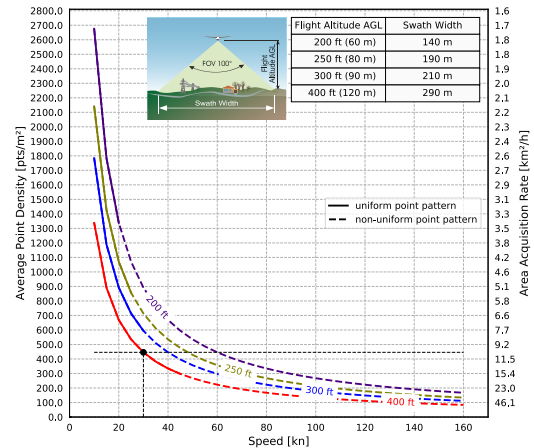
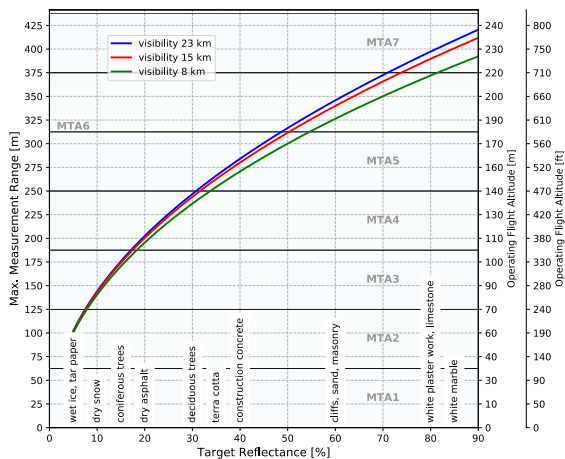
PRR = 1800 kHz



Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 1,800,000 pulses/sec, laser power level 100%
Altitude = 500 ft AGL, Speed 30 kn, resulting point density ~ 270 pts/m²

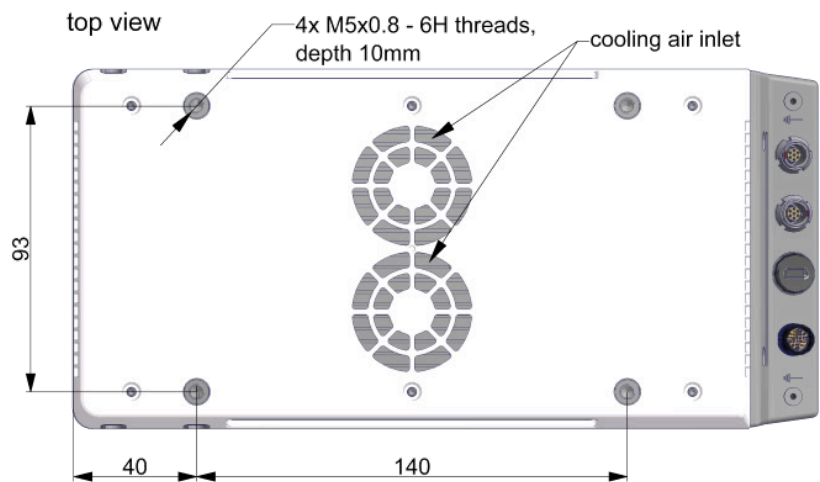
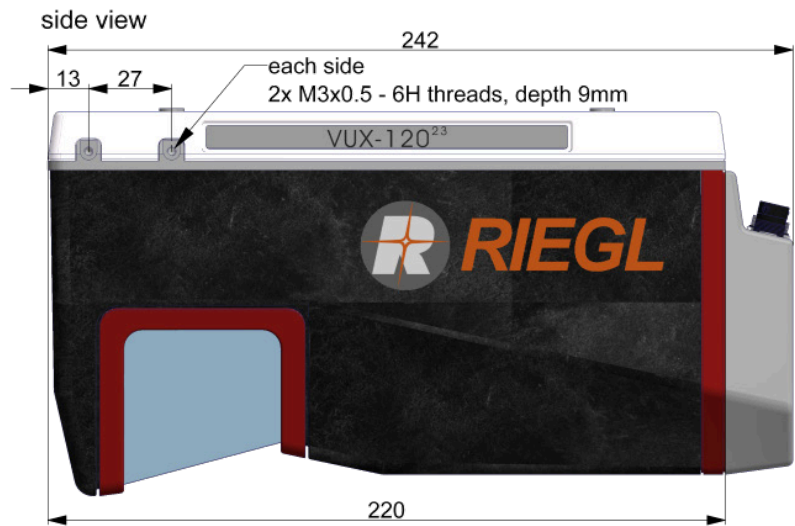
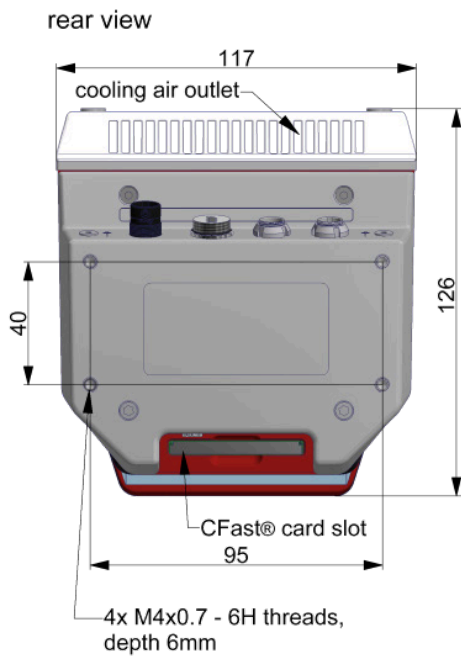
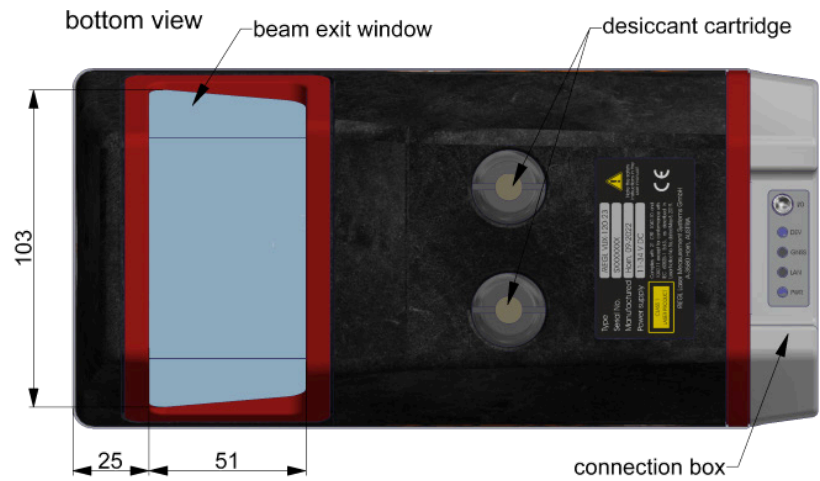
PRR = 2400 kHz



Operating Flight Altitude AGL given for the following conditions:
FOV 100°, ambiguity resolved by multiple-time-around (MTA) processing,
average ambient brightness, target size ≥ laser footprint, roll angle ±5

Example: VUX-120²³ at 2,400,000 pulses/sec, laser power level 100%
Altitude = 400 ft AGL, Speed 30 kn, resulting point density ~ 450 pts/m²

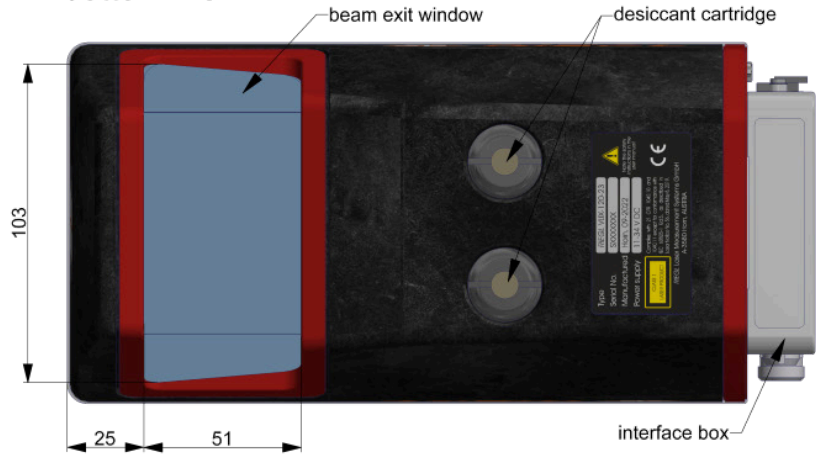
RIEGL VUX-120²³ UAV LiDAR Sensor with Connection Box



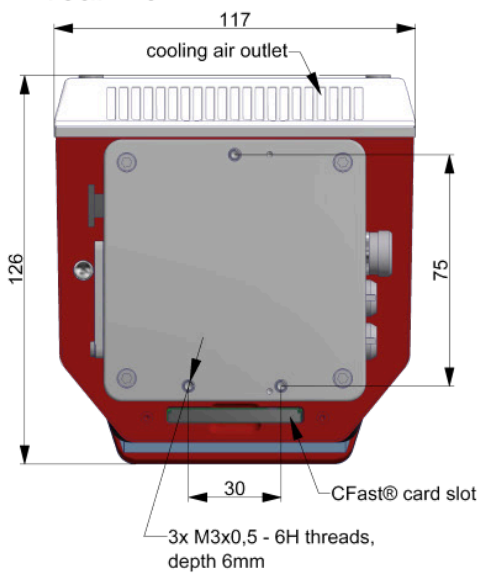
all dimensions in mm

**RIEGL VUX-120²³ UAV LiDAR Sensor
with Interface Box**

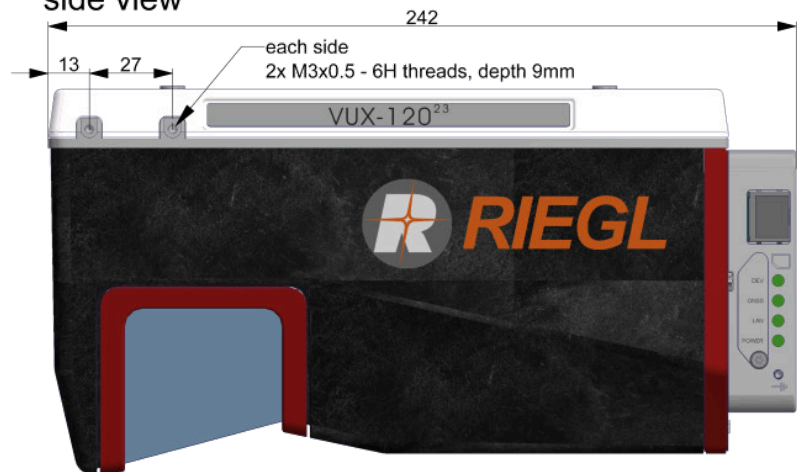
bottom view



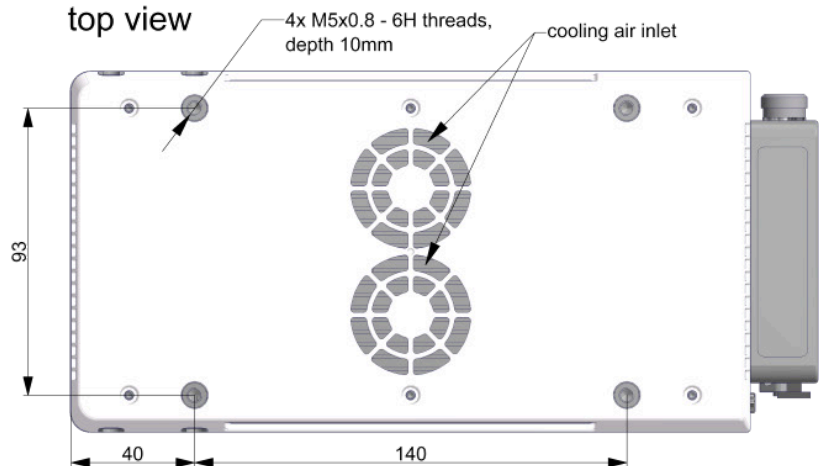
rear view



side view



top view



all dimensions in mm

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	2400 kHz
Max. Measuring Range ^{2) 3)}						
natural targets $\rho \geq 20\%$	760 m	550 m	400 m	280 m	230 m	200 m
natural targets $\rho \geq 60\%$	1260 m	920 m	670 m	480 m	400 m	350 m
natural targets $\rho \geq 80\%$	1430 m	1050 m	760 m	550 m	450 m	400 m
Max. Operating Flight Altitude AGL ^{2) 4)}						
@ $\rho \geq 20\%$	440 m (1450 ft)	320 m (1050 ft)	230 m (750 ft)	160 m (550 ft)	130 m (450 ft)	110 m (360 ft)
@ $\rho \geq 60\%$	720 m (2350 ft)	530 m (1750 ft)	380 m (1250 ft)	280 m (900 ft)	230 m (750 ft)	200 m (650 ft)
Max. Number of Targets per Pulse ⁵⁾	32	32	24	11	7	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) Considering max. effective FOV 100°, additional roll angle $\pm 5^\circ$.
 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

Accuracy ^{6) 8)}

Precision ^{7) 8)}

Laser Pulse Repetition Rate ^{1) 9)}

Max. Effective Measurement Rate ¹⁾

Echo Signal Intensity

Laser Wavelength

Laser Beam Divergence

Laser Beam Footprint (Gaussian Beam Definition)

5 m
 10 mm
 5 mm
 up to 2400 kHz
 up to 2,000,000 meas./sec. (@ 2400 kHz PRR & 100° scan angle)
 for each echo signal, high-resolution 16 bit intensity information is provided
 near infrared
 0.4 mrad ¹⁰⁾
 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/e² points. 0.4 mrad corresponds to an increase of 40 mm of beam diameter per 100 m distance.

Scanner Performance

Scanning Mechanism

Scan Pattern

Field of View (selectable)

Scan Speed (selectable)

Angular Step Width $\Delta \vartheta$ (selectable)

between consecutive laser shots

Angle Measurement Resolution

Scan Sync (optional)

rotating polygon mirror
 parallel scan lines, angular directions -10°, 0°, +10° transverses to the scan direction for forward and backward view
 $\pm 50^\circ = 100^\circ$
 50 - 400 lines/sec
 $0.0025^\circ \leq \Delta \vartheta \leq 0.32^\circ$ ^{11) 12)}
 0.001°
 scanner rotation synchronization

Data Interfaces

Configuration, Scan Data Output & Communication with External Devices

GNSS Interface

General IO & Control ¹³⁾

Camera Interfaces at connector panel

Camera Interfaces via multi purpose connector ¹⁵⁾

IMU Interface (optional)

2x LAN 10/100/1000 MBit/sec ^{13) 14)}
 Serial RS-232 interface, TTL input for 1pps synchronisation pulse, accepts different data formats for GNSS-time information
 1 x TTL input, 1x TTL output, 1 x Remote on/off
 2x power (max. 1.2 A), trigger, exposure, and GNSS RS-232 Tx & PPS
 1x trigger and exposure
 IMU data, power

General Technical Data

Power Supply Input Voltage / Consumption

Main Dimensions (L x W x H)

Weight

Humidity

Protection Class

Max. Flight Altitude (operating & not operating)

Temperature Range

11 - 34 V DC / typ. 45 W
 242 mm x 117 mm x 126 mm (with interface box)
 approx. 2.3 kg (with interface box)
 max. 80 % non condensing @ 31°C
 IP64, dust and splash-proof
 18 500 ft (5 600 m) above MSL (Mean Sea Level)
 -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) 1x externally available via multi-purpose connector

14) 1x available directly on optional interface box
 15) externally available via connection board (including 1x power camera)

Data Storage

Internal Data Storage
Memory Card Slot

Solid State Disc SSD, 2 TByte
for CFAST[®] 1) industrial memory card 480 GB (can be upgraded to 1 TByte)

External IMU & GNSS (optional)

IMU Accuracy 2)

Roll, Pitch

Heading

IMU Sampling Rate

Position Accuracy (typ.)

System Total Weight (approx.)

Applanix APX-20 UAV 3)

0.015°

0.035°

200 Hz

0.02 - 0.05 m

3.0 kg

Applanix AP+50 3) 4)

0.005°

0.010°

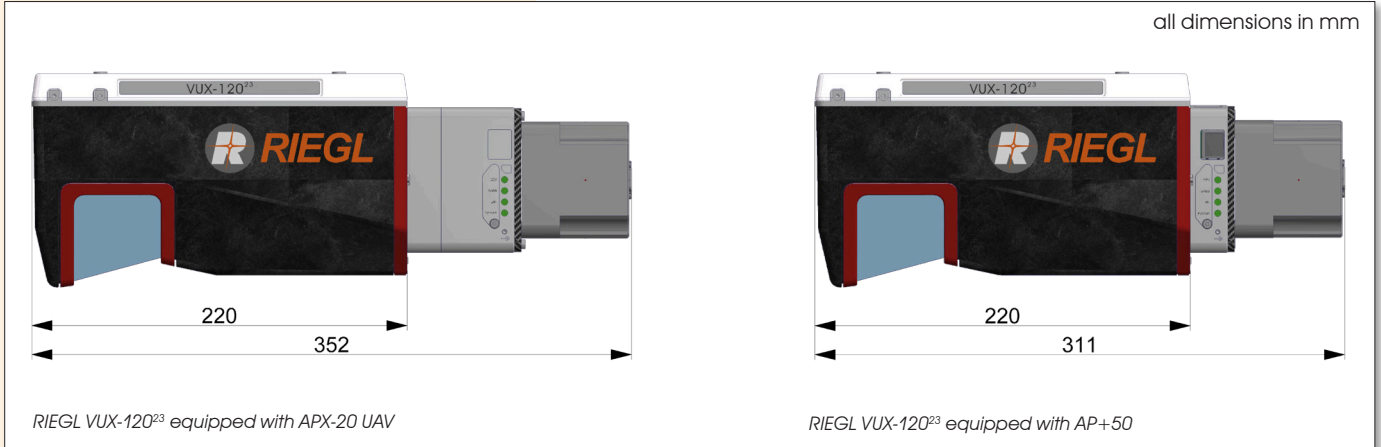
200 Hz

0.02 - 0.05 m

3.6 kg 5)

1) CFAST is a registered trademark of CompactFlash Association.
2) Accuracy specifications for post-processed data
3) See technical details at the according Applanix datasheet

4) Use of the RISYS-CU-23 Control Unit is mandatory
5) Total weight includes RISYS-CU-23 Control Unit (0.9 kg)



RIEGL VUX[®]-120²³ Camera Option



open platform set-up:
RIEGL VUX-120²³ LiDAR sensor with IMU/GNSS unit (APX-20 UAV),
and nadir RGB camera fully integrated



RIEGL Laser Measurement Systems GmbH, Headquarters
RIEGL USA Inc., Headquarters North America

RIEGL Japan Ltd.
RIEGL China Ltd.
RIEGL Australia Pty Ltd.
RIEGL Canada Inc.

RIEGL UK Ltd.
RIEGL South America Spa
RIEGL Deutschland Vertriebsgesellschaft mbH

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