

RIEGL VUX-1[®]

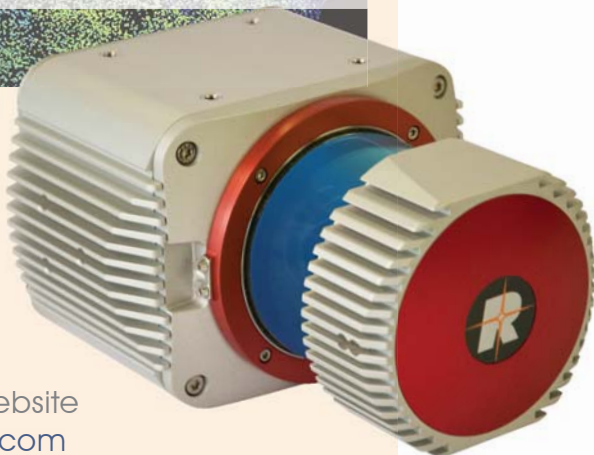
- 10 mm survey-grade accuracy
- scan speed up to 200 scans / second
- measurement rate up to 500,000 meas./sec (@ 550 kHz PRR & 330° FOV)
- operating flight altitude up to more than 1,000 ft
- field of view up to 330° for practically unrestricted data acquisition
- regular point pattern, perfectly parallel scan lines
- cutting edge RIEGL technology providing:
 - echo signal digitization
 - online waveform processing
 - multiple-time-around processing
- multiple target capability - practically unlimited number of target echoes
- compact (227x180x125 mm), lightweight (3.6 kg), and rugged
- easily mountable to professional UAS / UAV / RPAS
- mechanical and electrical interface for IMU mounting
- electrical interfaces for GPS data string and Sync Pulse (1PPS)
- LAN-TCP/IP interface
- scan data storage on internal 240 GByte SSD Memory

The **RIEGL VUX-1** is a very lightweight and compact laser scanner, meeting the challenges of emerging survey solutions by UAS/ UAV/RPAS, gyrocopter and ultra-light aircraft, both in measurement performance as in system integration. With regard to the specific constraints and flight characteristics of UAS, the **RIEGL VUX-1** is designed to be mounted in any orientation and even under limited weight and space conditions. Modest in power consumption, the instrument requires only a single power supply. The entire data set of an acquisition campaign is stored onto an internal 240 GByte SSD and/or provided as real-time line scan data via the integrated LAN-TCP/IP interface.

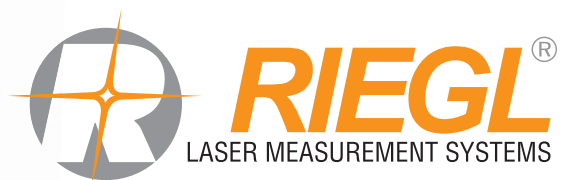
The Airborne Laser Scanner **RIEGL VUX-1** provides highspeed data acquisition using a narrow infrared laser beam and a fast line scanning mechanism. High-accuracy laser ranging is based on **RIEGL's** unique echo digitization and online waveform processing, which enables achieving superior measurement results even under adverse atmospheric conditions, and the evaluation of multiple target echoes. The scanning mechanism is based on an extremely fast rotating mirror, which provides fully linear, unidirectional and parallel scan lines, resulting in excellent regular point pattern distribution.

Typical applications include

- Power Line, Railway Track, and Pipeline Inspection
- Terrain and Canyon Mapping
- Surveying of Urban Environments
- Topography in Open-Cast Mining
- Precision Agriculture
- Archaeology and Cultural Heritage Documentation
- Construction-Site Monitoring



visit our website
www.riegl.com



Technical Data RIEGL VUX®-1

Laser Product Classification

Class 1 Laser Product according to IEC60825-1:2007

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, multiple-time-around-processing

Laser Pulse Repetition Rate PRR ¹⁾	50 kHz	100 kHz	200 kHz	300 kHz	380 kHz	550 kHz
Max. Measuring Range ^{2) 3)}						
natural targets $\rho \geq 20\%$	550 m	400 m	280 m	230 m	200 m	170 m
natural targets $\rho \geq 60\%$	920 m	660 m	480 m	400 m	350 m	300 m
Max. Operating Flight Altitude AGL ^{1) 4)}	350 m (1150 ft)	250 m (820 ft)	180 m (590 ft)	150 m (490 ft)	130 m (430 ft)	110 m (360 ft)
Max. Number of Targets per Pulse	practically unlimited (details on request)					

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) Ambiguity to be resolved by post-processing with RIMTA software.
 4) Reflectivity $\rho \geq 20\%$, flat terrain assumed, scan angle $\pm 45^\circ$ FOV, additional roll angle $\pm 5^\circ$.

Minimum Range

Accuracy ^{5) 7)}

Precision ^{6) 7)}

Laser Pulse Repetition Rate ^{1) 8)}

Max. Effective Measurement Rate ¹⁾

Echo Signal Intensity

Laser Wavelength

Laser Beam Divergence

Laser Beam Footprint (Gaussian Beam Definition)

3 m

10 mm

5 mm

up to 550 kHz

up to 500 000 meas./sec. (@ 550 kHz PRR & 330° FOV)

for each echo signal, high-resolution 16 bit intensity information is provided

near infrared

0.5 mrad ⁹⁾

50 mm @ 100 m, 250 mm @ 500 m, 500 mm @ 1000 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 @ 150 m range under RIEGL test conditions.

8) User selectable.

9) Measured at the 1/e² points. 0.50 mrad corresponds to an increase of 50 mm of beam diameter per 100 m distance.

Scanner Performance

Scanning Mechanism

Field of View (selectable)

Scan Speed (selectable)

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

between consecutive laser shots

Angle Measurement Resolution

Internal Sync Timer

Scan Sync (optional)

rotating mirror

up to 330° (full range measurement performance)

10 - 200 revolutions per second, equivalent to 10 - 200 scans/sec

$0.006^\circ \leq \Delta \theta \leq 1.5^\circ$

0.001°

for real-time synchronized time stamping of scan data

scanner rotation synchronization

Data Interfaces

Configuration

Scan Data Output

GNSS Interface

Internal Memory

External Camera

External GNSS Antenna

LAN 10/100/1000 Mbit/sec

LAN 10/100/1000 Mbit/sec or USB 2.0

Serial RS232 interface for data string with GNSS-time information,

TTL input for 1PPS synchronization pulse

240 GByte SSD

TTL input/output

SMA connector

General Technical Data

Power Supply Input Voltage

Power Consumption ¹⁰⁾

Main Dimensions ¹⁰⁾

VUX-1 without / with Cooling Fan Device

Weight ¹⁰⁾

VUX-1 without / with Cooling Fan Device

Humidity

Protection Class

Max. Flight Altitude (operating)

Max. Flight Altitude (not operating)

Temperature Range ¹¹⁾

11 - 32 V DC

typ. 60 W

227 x 180 x 125 mm / 227 x 209 x 129 mm

approx. 3.6 kg / approx. 3.85 kg

max. 80 % non condensing @ 31°C

IP64, dust and splash-proof

16 500 ft (5 000 m) above MSL

18 000 ft (5 500 m) above MSL

0°C up to +40°C (operation) / -20°C up to +50°C (storage)

Optional Components ¹²⁾

IMU Sensor (integrated) ¹³⁾

GNSS Receiver (integrated) ¹³⁾

triaxial MEMs gyroscope & accelerometer

50 channels, GPS L1 Frequency, SMA connector for external GNSS antenna

10) without external IMU/GNSS

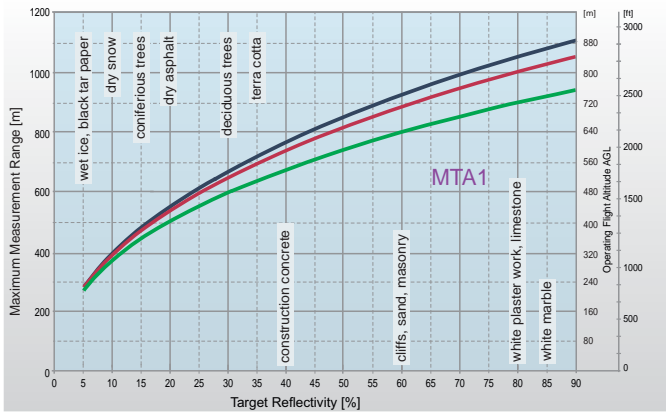
11) The instrument requires air convection with a minimum flow rate of 5 m/s for continuous operation at +15 °C and above. If the necessary flow rate cannot be provided by the moving platform, the cooling fan device (included in the scope of delivery) has to be used.

12) external IMU sensor and GNSS receiver on request

13) available third quarter 2014

Maximum Measurement Range & Point Density RIEGL VUX[®]-1

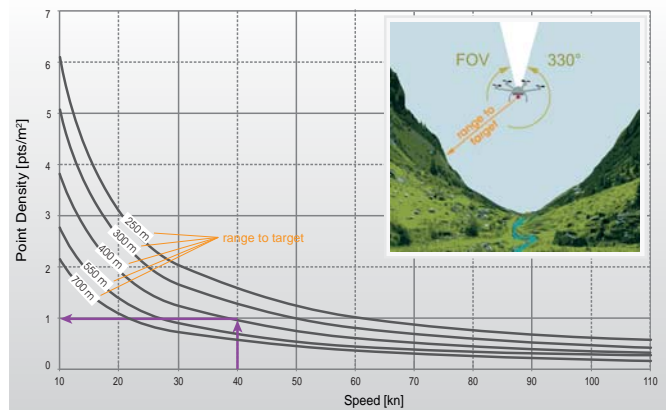
PRR = 50 kHz



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

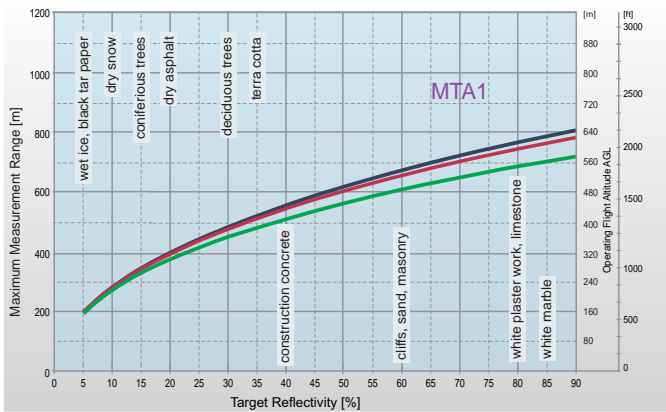
— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

PRR = 50 kHz



Example: VUX-1 at 50,000 pulses/second
range to target = 400 m, speed = 40 kn
Resulting Point Density ~ 1 pt/m²

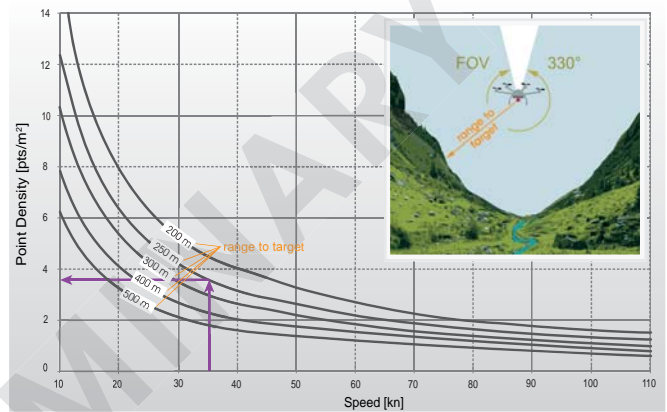
PRR = 100 kHz



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

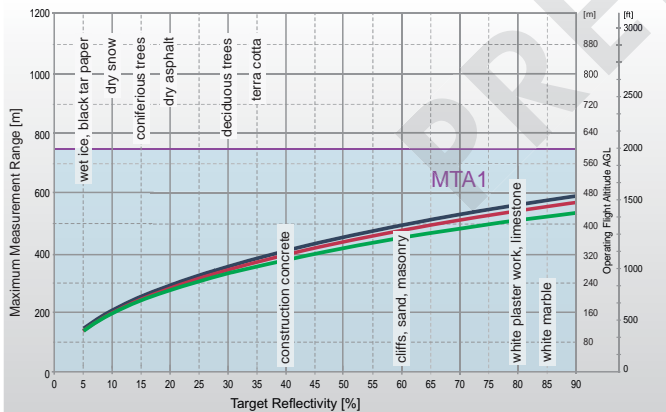
— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

PRR = 100 kHz



Example: VUX-1 at 100,000 pulses/second
range to target = 250 m, speed = 35 kn
Resulting Point Density ~ 3.5 pt/m²

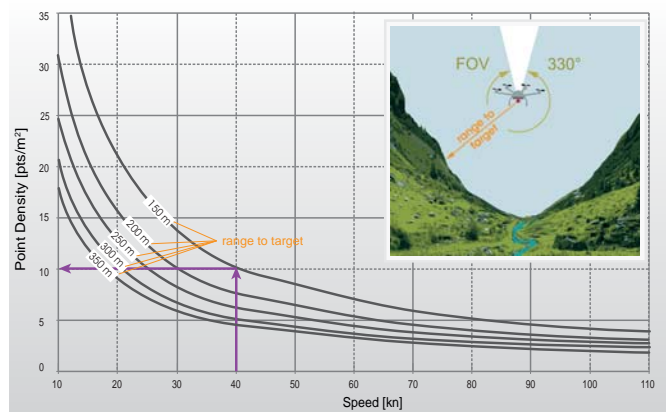
PRR = 200 kHz



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

— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

PRR = 200 kHz



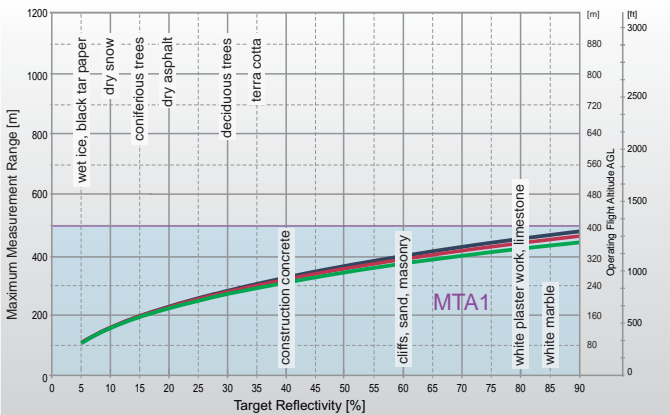
Example: VUX-1 at 200,000 pulses/second
range to target = 150 m, speed = 40 kn
Resulting Point Density ~ 10 pt/m²

The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- target size ≥ laser footprint
- average ambient brightness

Maximum Measurement Range & Point Density RIEGL VUX®-1

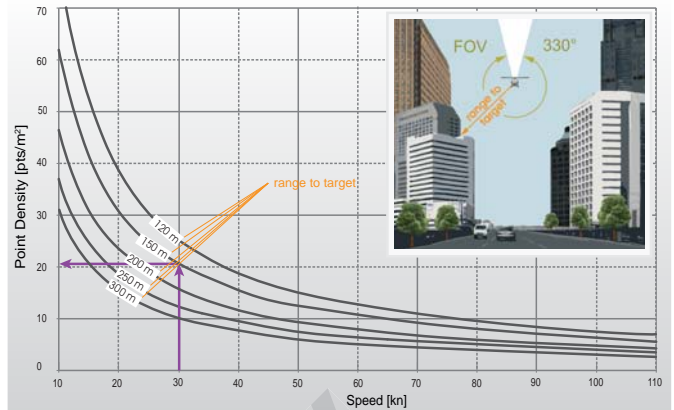
PRR = 300 kHz



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

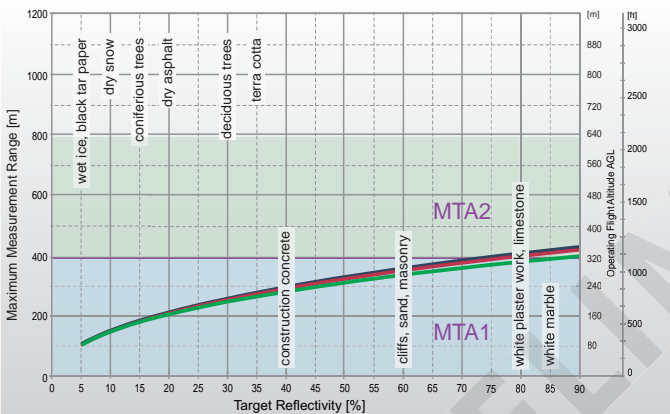
— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

PRR = 300 kHz



Example: VUX-1 at 300,000 pulses/second
range to target = 150 m, speed = 30 kn
Resulting Point Density – 21 pt/m²

PRR = 380 kHz

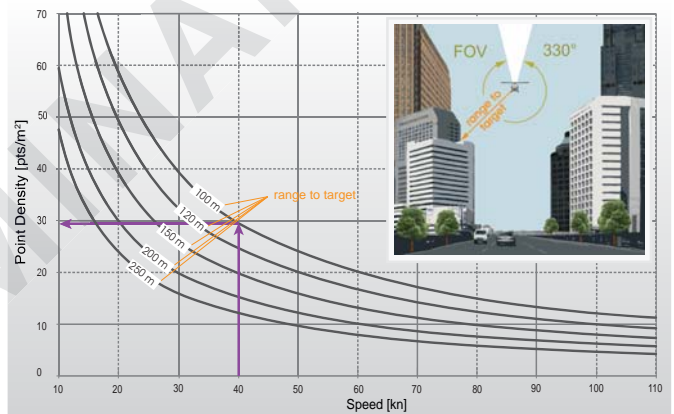


MTA1: no ambiguity / one transmitted pulse „in the air“

MTA2: two transmitted pulses „in the air“

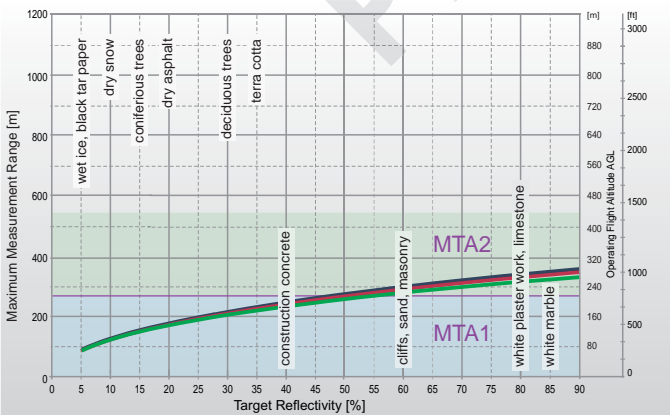
— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

PRR = 380 kHz



Example: VUX-1 at 380,000 pulses/second
range to target = 100 m, speed = 40 kn
Resulting Point Density – 29 pt/m²

PRR = 550 kHz

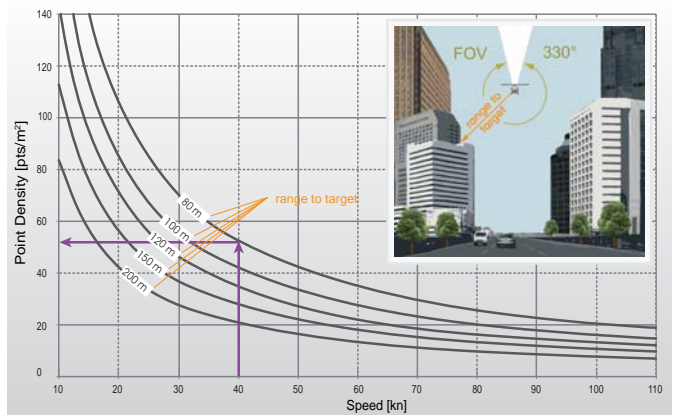


MTA1: no ambiguity / one transmitted pulse „in the air“

MTA2: two transmitted pulses „in the air“

— @ visibility 23 km
— @ visibility 15 km
— @ visibility 8 km

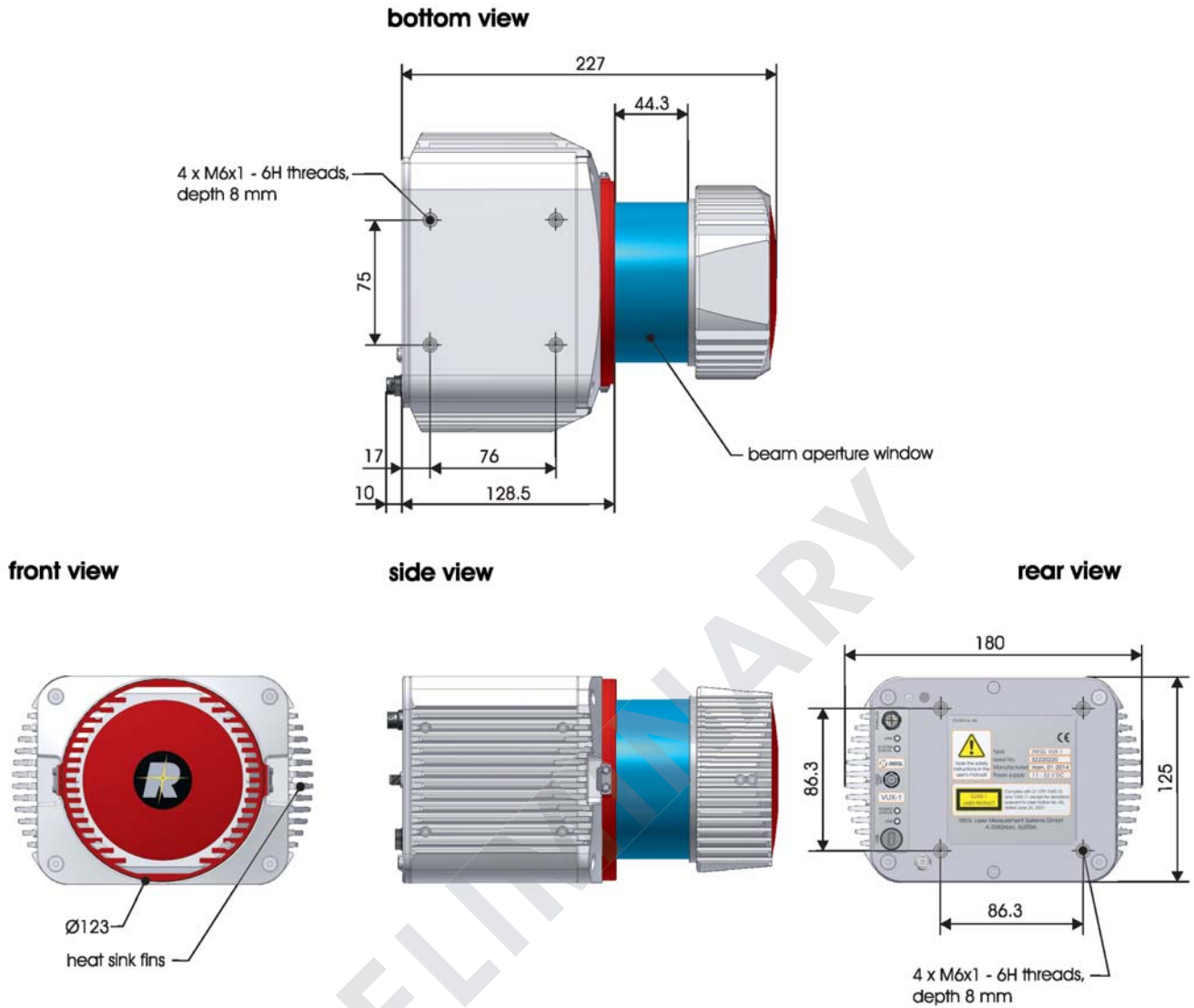
PRR = 550 kHz



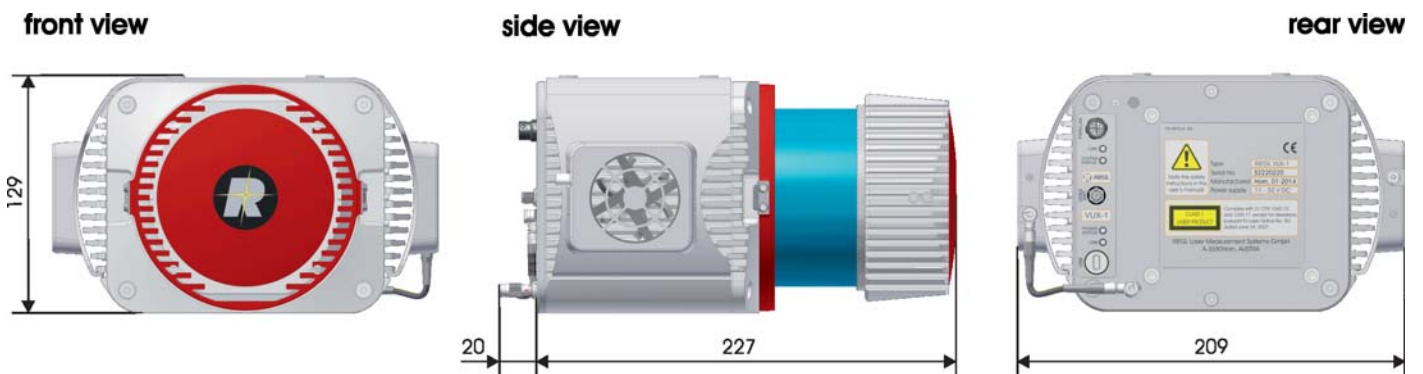
Example: VUX-1 at 550,000 pulses/second
range to target = 80 m, speed = 40 kn
Resulting Point Density – 56 pt/m²

The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- target size ≥ laser footprint
- average ambient brightness



Dimensional Drawings RIEGL VUX®-1 with Cooling Fan Device



all dimensions in mm

RIEGL VUX®-1 with Additional Equipment



Cooling Fan Device

Lightweight structure with two axial fans providing forced air convection for applications where sufficient natural air flow cannot be guaranteed. Power supply is provided via a connector on the rear side of the *RIEGL VUX-1*. The cooling fan device can be mounted either on the top side or on the bottom side of the *RIEGL VUX-1* and is included in the scanner's scope of delivery.

The cooling fan device is to be mounted whenever the environmental conditions/temperatures require (see "temperature range" on page 2 of this datasheet).

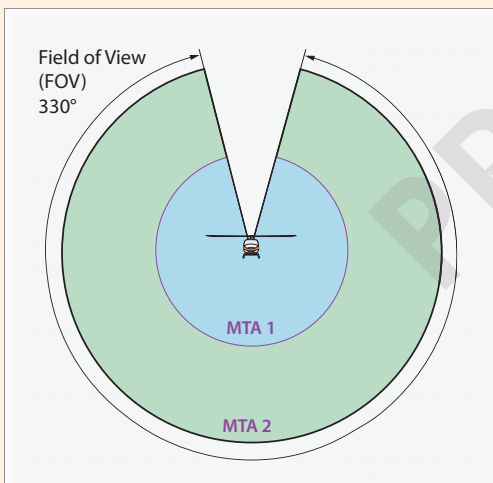


RIEGL VUX-1 with Protective Cap



RIEGL VUX-1 with external IMU-Sensor (optional)

Multiple-Time-Around Data Acquisition and Processing



In time-of-flight laser ranging a maximum unambiguous measurement range exists, which is defined by the laser pulse repetition rate and the speed of light. In case the echo signal of an emitted laser pulse arrives later than the emission of the subsequently emitted laser pulse, the range result becomes ambiguous - an effect known as „Multiple-Time-Around“ (MTA).

The *RIEGL VUX-1* allows ranging beyond the maximum unambiguous measurement range using a sophisticated modulation scheme applied to the train of emitted laser pulses. The dedicated post-processing software RiMTA provides algorithms for multiple-time-around processing, which automatically assign definite range results to the correct MTA zones without any further user interaction required.



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