High-Performance LiDAR Sensor for KINEMATIC Laser Scanning

RIEGL VUX®-1HA

- *very high measurement rate up to 1,000,000 meas./sec*
- *very high scan speed up to 250 scans / second*
- *5 mm survey-grade accuracy*

- *field of view 360° for 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 (3.5 kg), and rugged*
- *userfriendly mounting*
- *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*

***RIEGL*'s VUX-1HA High Accuracy kinematic LiDAR sensor is a very high speed, non-contact profile measuring system using a narrow laser beam and a fast line scanning mechanism, enabling full 360 degree beam deflection without any gaps.**

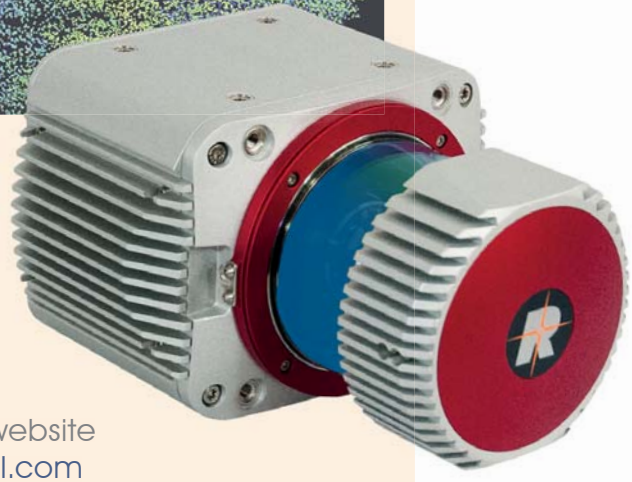
High performance pulsed laser ranging, based on *RIEGL*'s well-proven echo signal digitization technology with subsequent online waveform processing results in superior measurement capabilities even under adverse athmospheric conditions and in excellent multiple target echo discrimination.

The *RIEGL* VUX-1HA is a compact and lightweight laser scanner, mountable in any orientation and even under limited space conditions on land based vehicles, tunnel measuring devices, watercraft, etc.

The instrument needs only one power supply and provides line scan data via the integrated LAN-TCP/IP interface. The binary data stream can easily be decoded by user-designed software making use of the available software library RiVLib.

Typical applications include

- ***Mobile Laser Mapping***
- ***Tunnel Profile Measurement***
- ***Railway Applications like Clearance Analysis, etc***



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www.riegl.com

RIEGL®
LASER MEASUREMENT SYSTEMS

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-capability

Laser Pulse Repetition Rate PRR [1]	*300 kHz*	*500 kHz*	*750 kHz*		*1000 kHz*	
			full power	*reduced power* [2]	*full power*	*reduced power* [2]
Max. Measuring Range [3] [4]						
natural targets ρ ≥ 10 %	150 m	120 m	100 m	50 m	85 m	40 m
natural targets ρ ≥ 80 %	420 m	330 m	270 m	135 m	235 m	120 m
Max. Number of Targets per Pulse	practically unlimited (details on request)					

1) Rounded values.
2) Laser power optimized (reduced) for measurements of short ranges with high pulse repetition rate.
3) 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.
4) In order to reduce MTA ambiguities in mobile mapping applications it is recommended to use measurement programs with reduced laser power for short range applications and programs with reduced pulse repetition rate for long range applications.

Minimum Range	1.2 m
Accuracy [5] [7]	5 mm
Precision [6] [7]	3 mm
Laser Pulse Repetition Rate [1] [8]	up to 1000 kHz
Max. Effective Measurement Rate [1]	up to 1 000 000 meas./sec. (@ 1000 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	0.5 mrad [9]
Laser Beam Footprint (Gaussian Beam Definition)	4.5 mm @ exit, 5 mm @ 5 m, 6.6 mm @ 10 m, 13 mm @ 25 m, 25 mm @ 50 m, 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 @ 30 m range under *RIEGL* test conditions.
8) User selectable.
9) Measured at the $1/e^2$ points. 0.50 mrad corresponds to an increase of 50 mm of beam diameter per 100 m distance.

Scanner Performance

Scanning Mechanism	rotating mirror
Field of View (selectable)	360° „full circle"
Scan Speed (selectable)	10 - 250 revolutions per second, equivalent to 10 - 250 scans/sec
Angular Step Width Δ ϑ (selectable) between consecutive laser shots	0.0036° ≤ Δ ϑ ≤ 0.3°
Angle Measurement Resolution	0.001°
Internal Sync Timer	for real-time synchronized time stamping of scan data
Scan Sync (optional)	scanner rotation synchronization

Data Interfaces

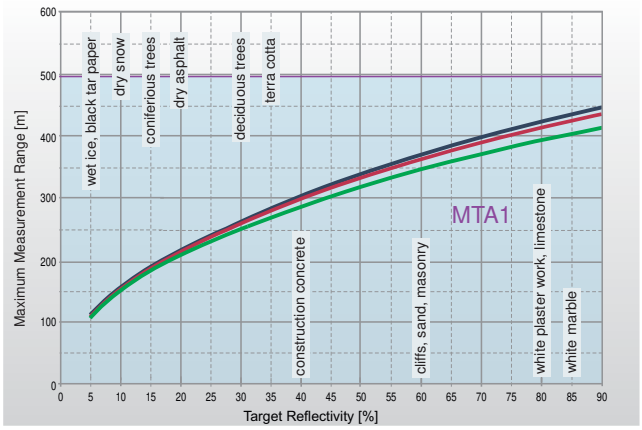
Configuration	LAN 10/100/1000 Mbit/sec
Scan Data Output	LAN 10/100/1000 Mbit/sec or USB 2.0
GNSS Interface	Serial RS232 interface for data string with GNSS-time information, TTL input for 1PPS synchronization pulse
Internal Memory	240 GByte SSD
External Camera	TTL input/output
External GNSS Antenna	SMA connector

General Technical Data

Power Supply Input Voltage / Consumption [10]	11 - 32 V DC / typ. 65 W
Main Dimensions [10]	
VUX-1HA without / with Cooling Fan Device	227 x 180 x 125 mm / 227 x 209 x 129 mm
Weight [10]	
VUX-1HA without / with Cooling Fan Device	approx. 3.5 kg / approx. 3.75 kg
Humidity	max. 80 % non condensing @ 31°C
Protection Class	IP64, dust and splash-proof
Temperature Range [11]	0°C up to +40°C (operation) / -20°C up to +50°C (storage)

10) without external IMU/GNSS, cooling fan device not in operation
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.

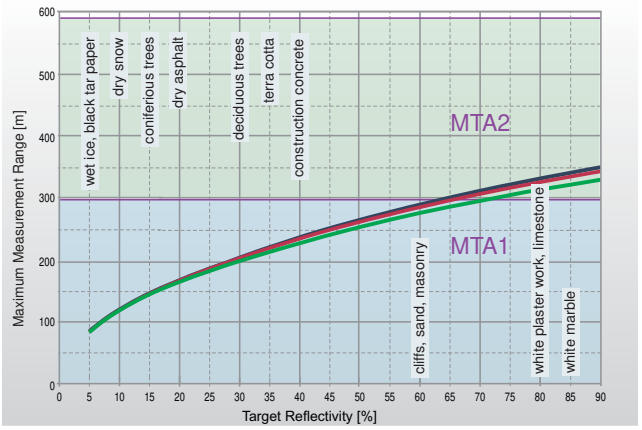
PRR = 300 kHz



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

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

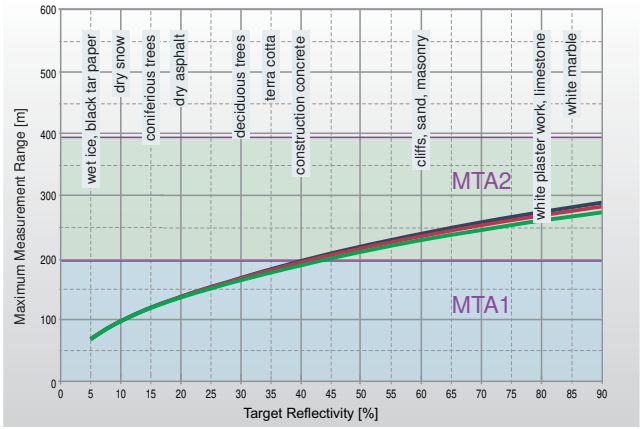
PRR = 500 kHz



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

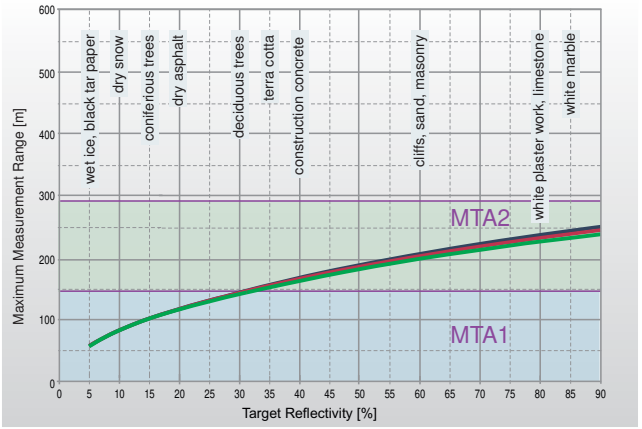
PRR = 750 kHz full power



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

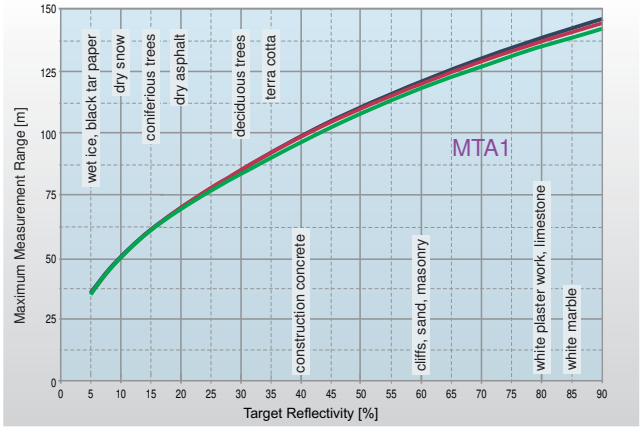
PRR = 1000 kHz full power



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

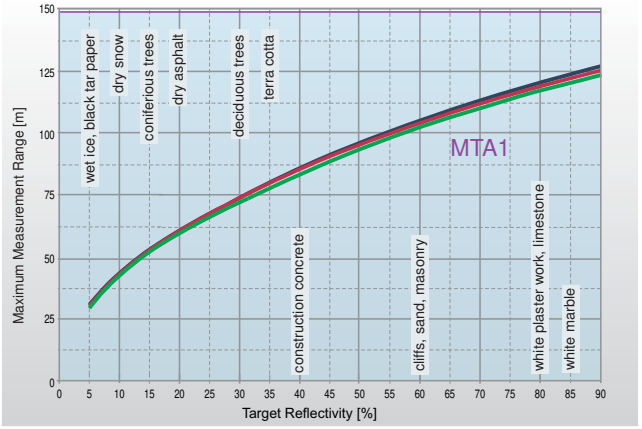
PRR = 750 kHz reduced power



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

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

PRR = 1000 kHz reduced power



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

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

Cooling Fan Device

***RIEGL* VUX-1HA with Protective Cap**

***RIEGL* VUX-1HA with external IMU-Sensor** (*RIEGL* VUX-SYS)

Additional Equipment for *RIEGL* VUX-1HA

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-1HA. The cooling fan device can be mounted either on the top side or on the bottom side of the *RIEGL* VUX-1HA 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).

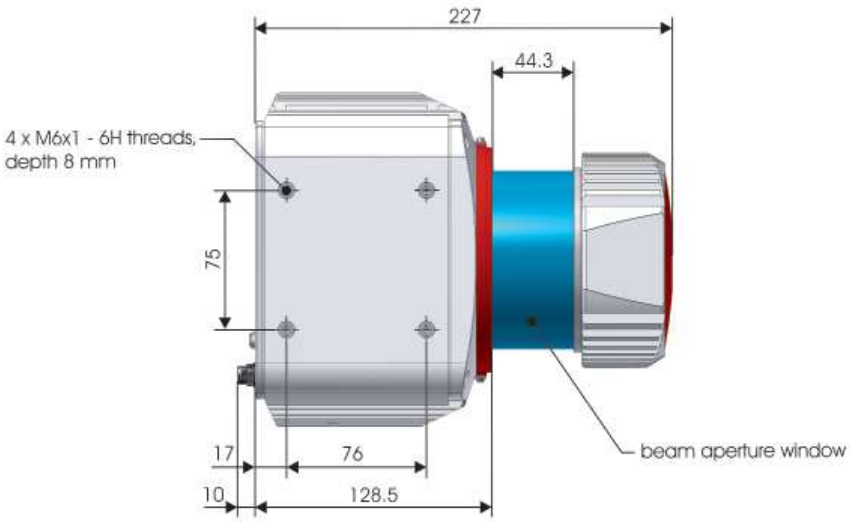
Protective Cap

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

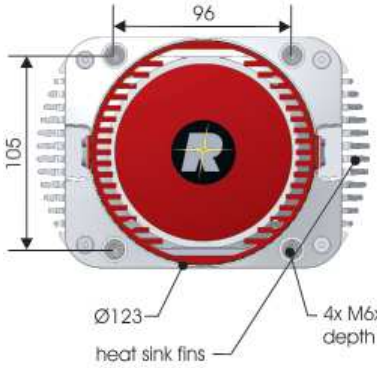
Options for *RIEGL* VUX-1HA Integration

RIEGL is developing user-friendly, application- and installation-specific solutions for integration of the VUX-1HA LiDAR sensor into whatsoever type of moving platform.

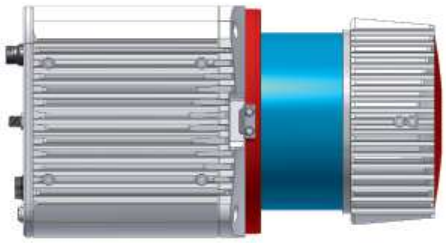
bottom view



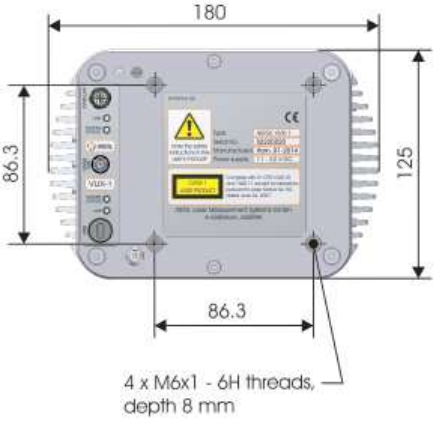
front view



side view



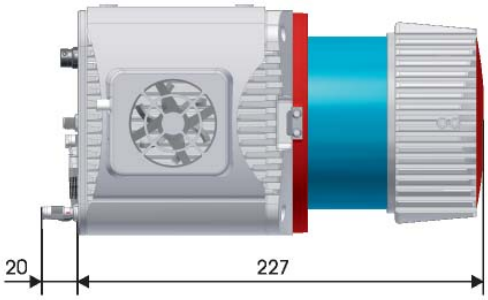
rear view



Dimensional Drawings *RIEGL* VUX®-1HA with Cooling Fan Device

front view

side view



rear view

all dimensions in mm

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