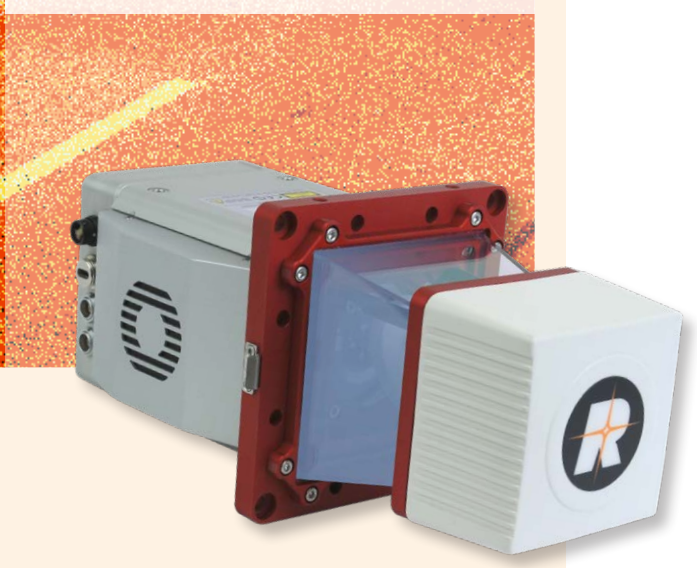
LiDAR Sensor for KINEMATIC Laser Scanning

RIEGL miniVUX®-HA

- *survey grade performance for mobile laser scanning*
  - *5 mm accuracy*
  - *4 mm precision*
- *measurement rate up to 300,000 measurements/sec*
- *scan speed up to 150 scans/sec*
- *minimum range 1 m*
- *compact & lightweight (1.85 kg / 4.1 lbs)*
- *up to 360° field-of-view*
- *robust aluminum housing*
- *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*
- *user-friendly, application- and installation-oriented solutions for integration*



With the *RIEGL* miniVUX-HA a miniVUX-Series LiDAR sensor especially suited for applications in mobile laser scanning is provided.
The extremely lightweight and compact sensor comes in a robust aluminum housing and offers itself as the core part of small, user-friendly, and economically priced kinematic laser scanning systems.

RIEGL's state-of-the-art Waveform-LiDAR technologies provide pure digital LiDAR signal processing, multiple targets per laser shot enabling the penetration of dense foilage, calibrated amplitudes and reflectance estimates and thus highly accurate, extremely informative measurement data. Scan data can be stored on the easy-to-remove SD card and/or streamed via LAN-TCP/IP interface.

The *RIEGL* miniVUX-HA provides up to 300,000 meas./sec, 150 lines/sec scan speed, 360° field of view, 5 mm accuracy and 4 mm precision – these features allow the kinematic acquisition of laser scan data in a wide range of applications.

The sensor is offered as the core part of the *RIEGL* VMY Mobile Mapping Systems, which are fully integrated with IMU/GNSS and optional cameras.

Typical applications include

- *Transportation Infrastructure Mapping*
- *City Modeling*
- *As-Built Surveying*
- *GIS Mapping and Asset Management*
- *HD Mapping for Autonomous Vehicles*
- *Rapid Capture of Construction Sites and Bulk Material*
- *Open-Pit Mine Surveying*

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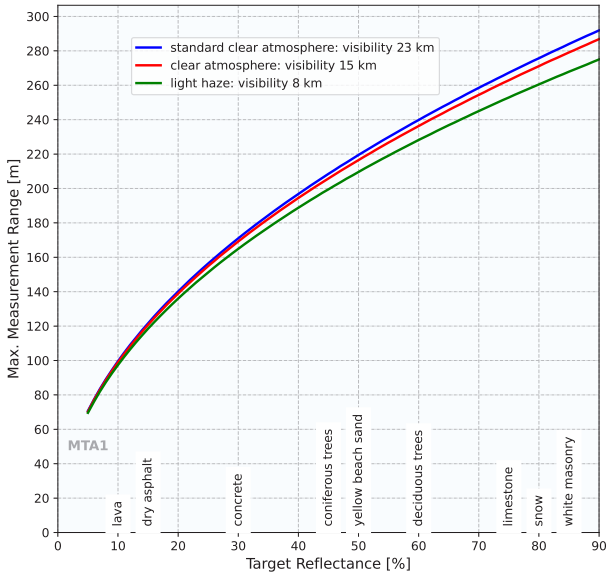
RIEGL®
LASER MEASUREMENT SYSTEMS

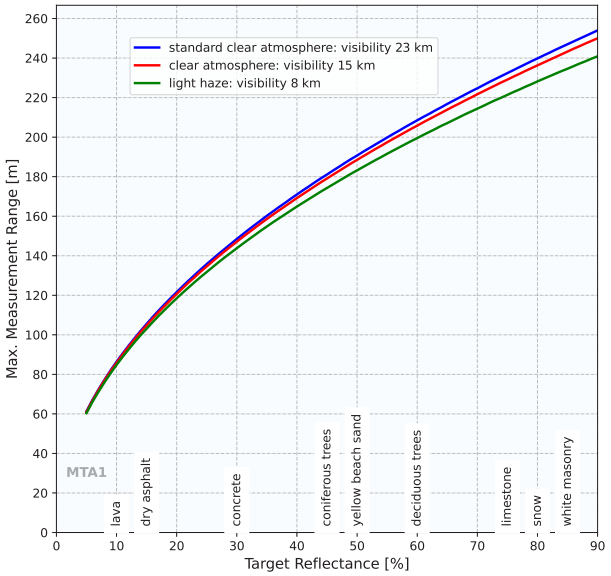
Maximum Measurement Range vs. Target Reflectance *RIEGL* miniVUX®-HA

Laser PRR = 100 kHz / 300 kHz 120° FOV



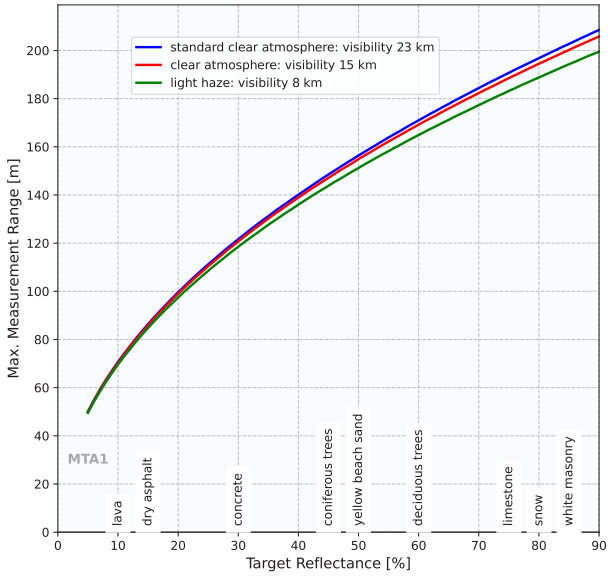
MTA 1: no ambiguity / one transmitted pulse „in the air"

Laser PRR = 200 kHz



MTA 1: no ambiguity / one transmitted pulse „in the air"

Laser PRR = 300 kHz



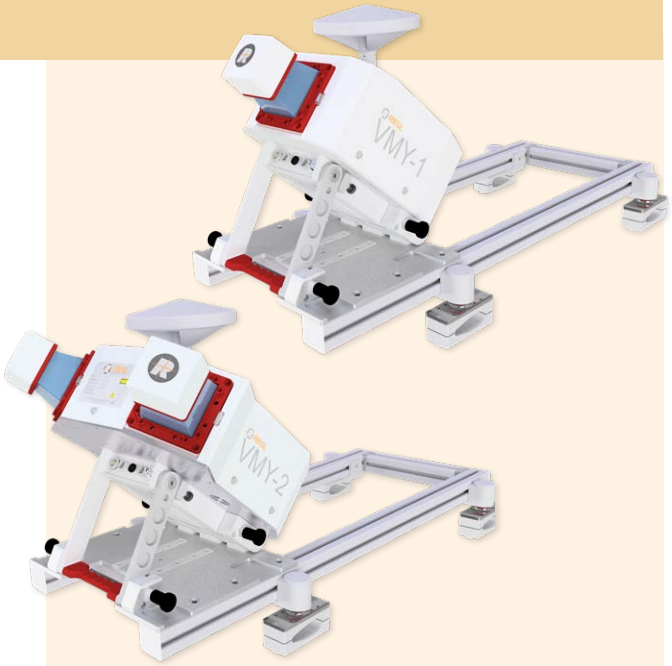
MTA 1: no ambiguity / one transmitted pulse „in the air"

RIEGL miniVUX®-HA - Integration Examples

The *RIEGL* miniVUX-HA LiDAR sensor is the core part of *RIEGL*'s compact and economically priced VMY Mobile Mapping Systems. The VMY-1 (based on a single miniVUX-HA sensor) and the VMY-2 (with two miniVUX-HA sensors integrated) are well suited for a variety of mobile mapping applications.

To further increase efficiency, the optional integration of up to four cameras allows simultaneous acquisition of imagery to complement the captured LiDAR data.

The innovative design of both systems enables folding and thus a convenient transport and space-saving storage.



Please find more detailed information on the according datasheets:

***RIEGL* VMY-1**
Single Scanner Mobile Mapping System

***RIEGL* VMY-2**
Dual Scanner Mobile Mapping System

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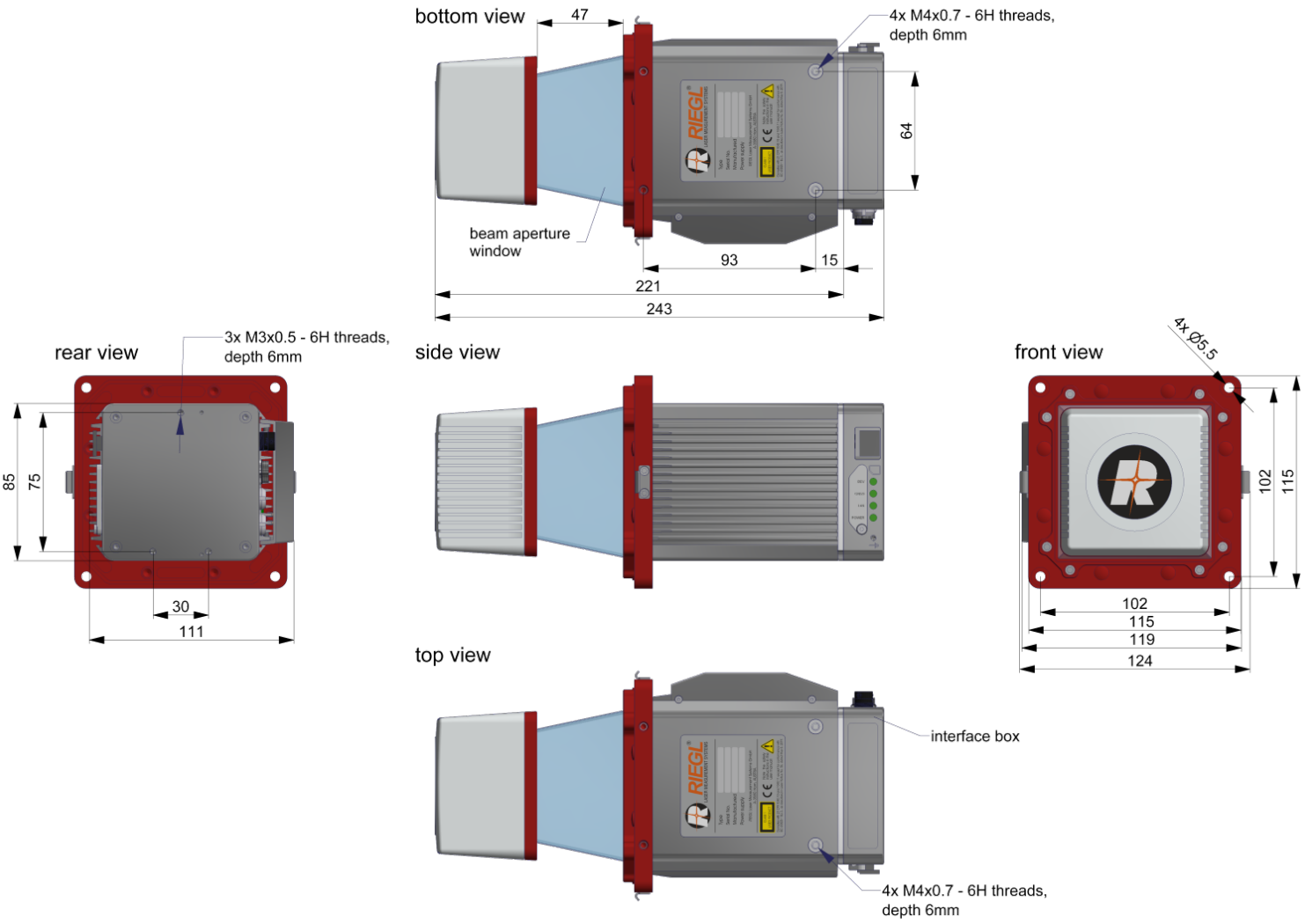
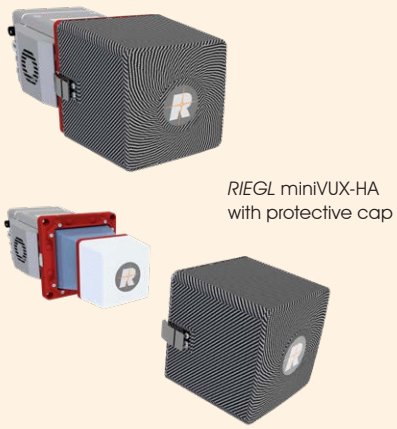


all dimensions in mm

RIEGL miniVUX®-HA - Additional Equipment and Integration



RIEGL miniVUX-HA
with protective cap

Additional Equipment for *RIEGL* miniVUX-HA

Protective Cap

To shield the glass prism of the *RIEGL* miniVUX-HA from mechanical damage and soiling, a protective cap is provided to cover the upper part of the instrument during transport and storage. It is secured by two spring-loaded latch fasteners and has to be removed before scan data acquisition is started.

Options for *RIEGL* miniVUX-HA Integration

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

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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.

Range Measurement Performance

Measuring Principle: time of flight measurement, echo signal digitization, online waveform processing

Laser Pulse Repetition Rate PRR [1]	100 kHz	200 kHz	300 kHz	300 kHz / 120° FOV [4]
Max. Measuring Range [2]				
natural targets ρ ≥ 20 %	140 m	120 m	100 m	140 m
natural targets ρ ≥ 60 %	240 m	210 m	170 m	240 m
natural targets ρ ≥ 80 %	270 m	240 m	200 m	270 m
Max. Number of Targets per Pulse [3]	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) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achieveable range is reduced.
4) Measurement program for UAV applications with maximum range performance @ 300 kHz with limited scanner FOV of 120°.

Minimum Range	1 m
Accuracy [4] [6]	5 mm
Precision [5] [6] [7]	4 mm
Laser Pulse Repetition Rate [1]	100 kHz / 200 kHz / 300 kHz (selectable)
Max. Effective Measurement Rate [1]	up to 300 000 meas./sec. (@ 300 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 [8]	1.6 x 0.5 mrad
Laser Beam Footprint	12 mm x 15 mm @ exit, 160 mm x 50 mm @ 100 m

4) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
5) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
6) One sigma @ 16 m range under *RIEGL* test conditions.
7) Degraded precision on targets with very low reflectivity below 1.5 m range.
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)	up to 360° @ 100/200/300 kHz
Scan Speed (selectable)	10 - 150 scans/sec [9] @ 100 kHz 20 - 150 scans/sec [9] @ 200 kHz 30 - 150 scans/sec [9] @ 300 kHz
Angular Step Width Δ φ (selectable) between consecutive laser shots	0.036° ≤ Δ φ ≤ 0.54°
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 [10]	Serial RS-232 interface for data string with GNSS-time information, TTL input for 1PPS synchronization pulse.
General IO & Control [11]	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. 24 W @ 150 scans/sec
Main Dimensions (L x W x H) / Weight with Cooling Fan	243 x 115 x 115 mm / approx. 1.85 kg
Humidity	max. 80 % non condensing @ 31°C
Protection Class	IP64, dust-tight and splash-proof
Temperature Range [12]	-10 °C up to +40 °C (operation) / -20 °C up to +50 °C (storage)

12) Continuous operation at ambient temperature of ≥ 30 °C (≥ 86 °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.

RIEGL® LASER MEASUREMENT SYSTEMS

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

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