Complete Sensor System for Kinematic Laser Scanning

RIEGL VUX®-SYS

- *complete, compact & lightweight kinematic LiDAR system*
- *fully integrated RIEGL VUX-1 Series LiDAR sensor*
- *various mounting options for highly flexible installation*
- *prepared for remote control via low-bandwidth data link*
- *fully integrated system versions with application-oriented IMU/GNSS unit*
- *compact control unit with various interfacing options*
- *operates up to 4 digital cameras*

The *RIEGL* VUX-SYS is a completely integrated laser scanning system of low weight and compact size for flexible use in kinematic applications (e.g. UAS/UAV/RPAS, helicopter, gyrocopter and ultra-light aircraft installations).

The system comprises a *RIEGL* VUX-1 Series LiDAR Sensor, an IMU/GNSS system and - if applicable - a dedicated control unit. The excellent measurement performance of the VUX-1 in combination with the precise inertial measurement unit and the associated GPS/GLONASS receiver results in survey-grade measurement accuracy over its full range of applications.

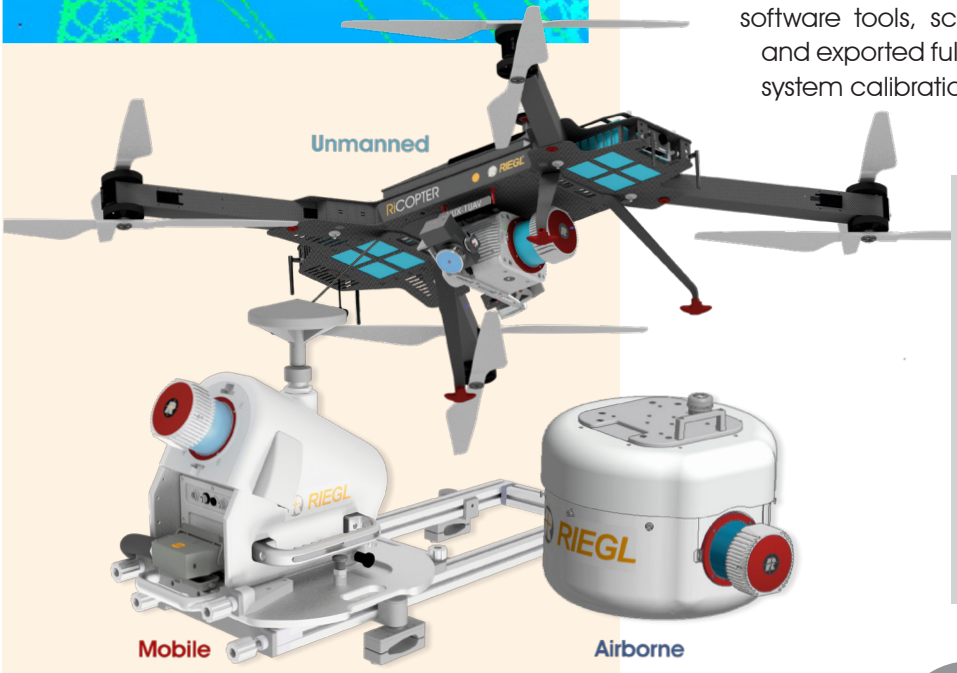
The VUX-SYS is specifically designed to be easily installed or exchanged by the user, alternatively either in the *RIEGL* VP-1 HeliCopterPod, the RiCOPTER unmanned aerial system, or in any kinematic measuring system, whatsoever.

The VUX-SYS provides interfaces for controlling up to four digital cameras. When installed in the VP-1 HeliCopterPod or the RiCOPTER UAV the VUX-SYS is complemented by up to two cameras.

The small size, low weight, and small number of interconnecting cables required account for a very short set-up time of the system.

The VUX-SYS is delivered with the necessary software tools for processing scan data as well as IMU/GNSS data.

Based on the software bundle RiPROCESS and its associated software tools, scan data is geo-referenced, calibrated and exported fully automatically. *RIEGL* offers an optional system calibration service.



Typical applications include

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

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www.riegl.com

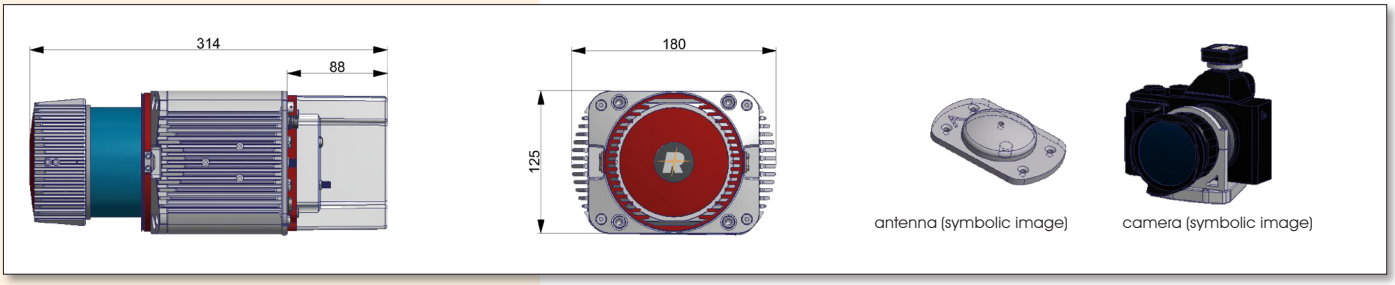
RIEGL®
LASER MEASUREMENT SYSTEMS

RIEGL VUX®-SYS - Integration Options

RIEGL VUX-1 with APX-20 UAV

interface for 4 optional cameras available

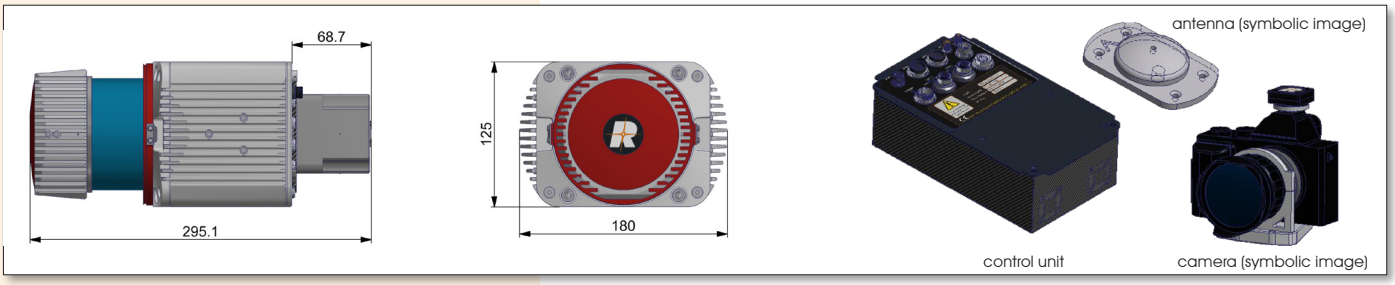
Main Dimensions	
VUX-1 with IMU	314 x 180 x 125 mm
VUX-1 with IMU and Cooling Fan Device	314 x 209 x 128 mm
Weight	
VUX-1 with IMU	approx. 4.2 kg
Cooling Fan Device	approx. 0.25 kg
Camera(s)	depending on selected camera type



RIEGL VUX-1 with AP20

with separate control unit accommodating the GNSS board stack as well as the camera trigger electronics for up to 4 optional cameras

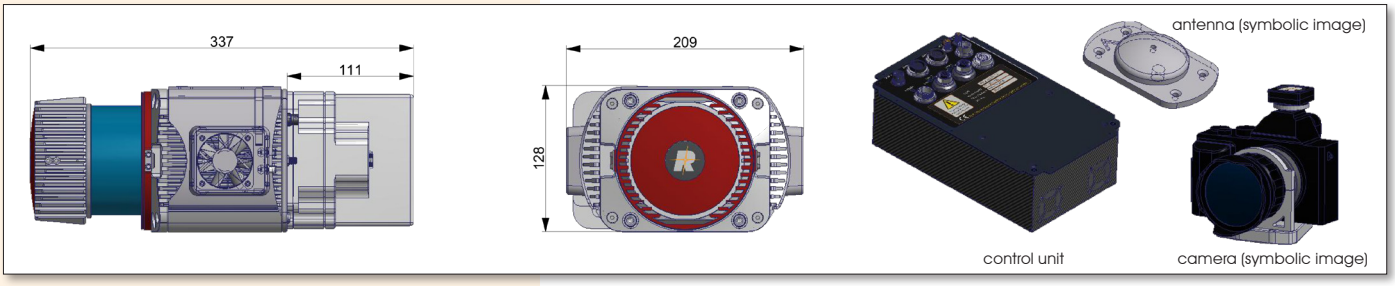
Main Dimensions	
VUX-1 with IMU	295 x 180 x 125 mm
VUX-1 with IMU and Cooling Fan Device	295 x 209 x 128 mm
Control Unit	210 x 124 x 79 mm
Weight	
VUX-1 with IMU	approx. 4.2 kg
Cooling Fan Device	approx. 0.25 kg
Control Unit	approx. 0.9 kg
Camera(s)	depending on selected camera type



RIEGL VUX-1 with AP60

with separate control unit accommodating the GNSS board stack as well as the camera trigger electronics for up to 4 optional cameras

Main Dimensions	
VUX-1 with IMU	337 x 180 x 125 mm
VUX-1 with IMU and Cooling Fan Device	337 x 209 x 128 mm
Control Unit	210 x 124 x 79 mm
Weight	
VUX-1 with IMU	approx. 6.8 kg
Cooling Fan Device	approx. 0.25 kg
Control Unit	approx. 0.9 kg
Camera(s)	depending on selected camera type

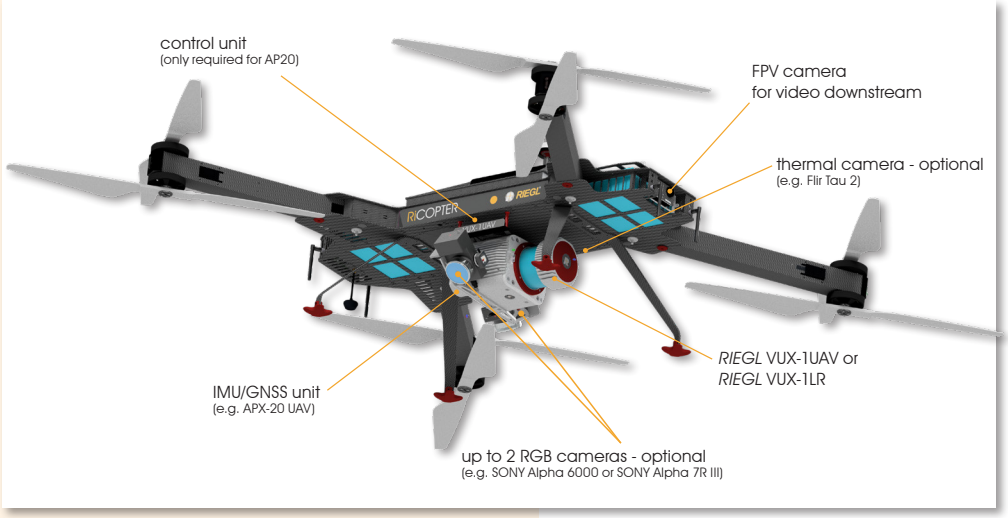


all dimensions in mm

RIEGL VUX®-SYS System Installation

RIEGL VUX®-SYS installed in RiCOPTER (Unmanned)

The VUX-SYS fits the dedicated mounting bay of the RiCOPTER directly without any adaptations. The system is supplemented by two digital cameras, covering a field of view of approximately 160 degrees, where as the VUX-SYS covers a FOV of 230°. The low weight of the VUX-SYS enables the RiCOPTER to operate up to half an hour at a gross weight of 25 kg.

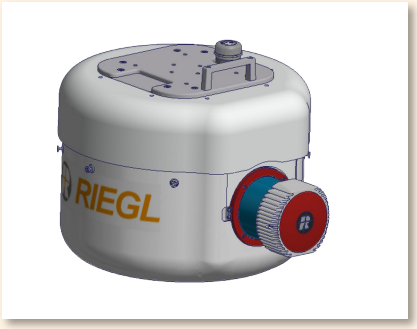


RIEGL VUX-SYS for RiCOPTER System Components:

- *RIEGL* VUX-1UAV LiDAR sensor or *RIEGL* VUX-1LR LiDAR sensor
- IMU/GNSS unit (Applanix AP20 or APX-20 UAV)
- GNSS antenna
- control unit [1)]
- camera(s) optional (2x e.g. SONY Alpha 6000 or SONY Alpha 7R III)
- connecting cables

RIEGL VUX®-SYS installed in VP-1 (Airborne)

The VUX-SYS fits the small and lightweight *RIEGL* VP-1 HeliCopterPod, to be mounted on standard hard points and typical camera mounts of manned helicopters. Quick release adapter brackets and a minimum of external cabling (i.e. power supply, LAN, GPS antenna) allow quick system installation and removal.



RIEGL VUX-SYS for VP-1 System Components:

- *RIEGL* VUX-1UAV LiDAR sensor or *RIEGL* VUX-1LR LiDAR sensor
- IMU/GNSS unit (Applanix AP20, APX-20 UAV or AP60)
- GNSS antenna
- control unit [1)]
- digital camera(s) (1x Nikon D810, or 1x Phase One iXU, or 1x Phase One iXM-50 /-100, or up to 4x Sony Alpha 6000, or up to 3 x Sony A7R III)
- connecting cables

RIEGL VUX®-SYS installed in VMQ (Mobile)

Fully integrated into the measuring head of the system, the VUX-SYS is the core part of the *RIEGL* VMQ Single Scanner Mobile Mapping System. Together with the universal VMQ roof mount the system can be easily mounted on a great variety of vehicles. One single external VMQ main cable minimizes the efforts of the set-up time. The swivel plate allows the operator to achieve different point cloud patterns according to the project requirements.

RIEGL VUX-SYS for VMQ System Components:

- *RIEGL* VUX-1HA LiDAR sensor (preferred) or *RIEGL* VUX-1UAV LiDAR sensor (possible)
- IMU/GNSS unit (Applanix AP20 or AP60)
- GNSS antenna
- control unit [1)]
- up to 4 digital camera(s) (e.g., FLIR Ladybug® 5+, Nikon D810, 5 MPix industrial camera)
- connecting cables

1) for use with AP20 and AP60

RIEGL VUX®-SYS Technical Data

Scanner Performance (for details refer to the corresponding *RIEGL* data sheets)

RIEGL VUX-1 Series Sensor	**VUX-1LR**	**VUX-1UAV**	**VUX-1HA** [1]
Maximum Range	1,350 m [2]	920 m [2]	420 m [3]
Minimum Range	5 m	3 m	1.2 m
Accuracy / Precision	15 mm / 10 mm	10 mm / 5 mm	5 mm / 3 mm
Laser Pulse Repetition Rate	up to 820 kHz	up to 550 kHz	up to 1000 kHz
Max. Effective Measurement Rate	up to 750,000 meas./sec.	up to 500,000 meas./sec.	up to 1,000,000 meas./sec.
Field of View (selectable) [4]	up to 330°	up to 330°	up to 360°
Max. Scan Speed	200 scans/sec	200 scans/sec	250 scans/sec

1) Not recommended to be seen as a first choice for ALS and UAV applications because of its lower range capability.

2) Maximum range is specified for natural targets ρ ≥ 60%.
3) Maximum range is specified for natural targets ρ ≥ 80%.
4) Note limitations when integrated in kinemtatic systems.

Data Interfaces

Configuration	LAN 10/100/1000 Mbit/sec or TTL PWM
Scan Data Output	LAN 10/100/1000 Mbit/sec or USB 2.0
Internal Data Storage	Solid State Disc SSD, 1TByte
Memory Card Slot[5]	for CFAST® [6] memory card 120 GByte (can be upgraded to 256 GByte)
GNSS Interface	Serial RS-232 interface for data string with GNSS-time information, TTL input for 1PPS synchronization pulse
Camera	4x trigger and event marker

5) applies to IMU APX-20 UAV only

6) CFast is a registered trademark of CompactFlash Association

IMU & GNSS

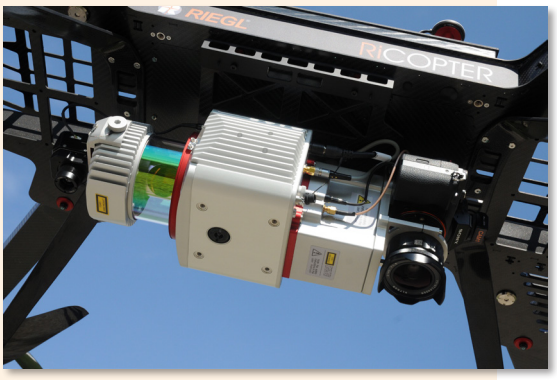
	Applanix APX-20 UAV [7]	Applanix AP20 [7]	Applanix AP60 [7]
IMU Accuracy			
Roll, Pitch [8]	0.015°	0.015°	0.002° [9]
Heading [8]	0.035°	0.035° [10]	0.005° [11]
IMU Sampling Rate	200 Hz	200 Hz	200 Hz
Position Accuracy (typ.)			
horizontal	< 0.05 m	< 0.05 m	< 0.05 m
veritcal	< 0.1 m	< 0.1 m	< 0.1 m

7) See technical details at the according Applanix datasheet
8) values are given for airborne applications
9) roll, pitch for mobile applications: 0.005°
10) heading for mobile applications: 0.05°
11) heading for mobile applications: 0.015°

General Technical Data

Power Supply Input Voltage	11 - 34 V DC
Power Consumption	typ. 95 W
Humidity	max. 80 % non condensing @ 31°C
Temperature Range	-10°C up to +40°C (operation) / -20°C up to +50°C (storage)

RIEGL VUX®-SYS UAV Platform Integration



VUY-SYS set-up (example)

RiCOPTER with VUX-SYS components:

- *RIEGL* VUX-1UAV
- APX-20 UAV
- Sony Alpha 7R III or Sony A7R IV
- Flir Tau 2 thermal camera
- other 3rd party cameras integrated[1)]

1) Multispectral camera, hyperspectral camera – more information on request.

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