

RIEGL VUX-SYS[®]

- **complete miniaturized & lightweight kinematic LiDAR system**
- **fully integrated RIEGL VUX-1 Series LiDAR sensor**
- **integrated inertial measurement unit and GPS/GLONASS receiver**
- **compact control unit with various interfacing options**
- **various mounting options for highly flexible installation**
- **prepared for remote control via low-bandwidth data link**
- **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 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** helicopter pod, 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 helicopter pod 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.

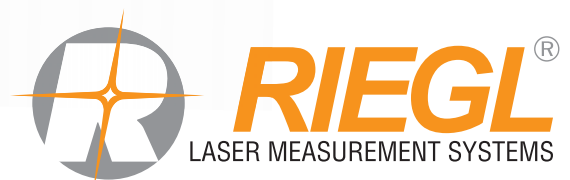
Based on the software bundle **RIPROCESS** and its associated software tools, scan data is geo-referenced, calibrated and exported fully automatically. **RIEGL** offers an optional system calibration service.

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**



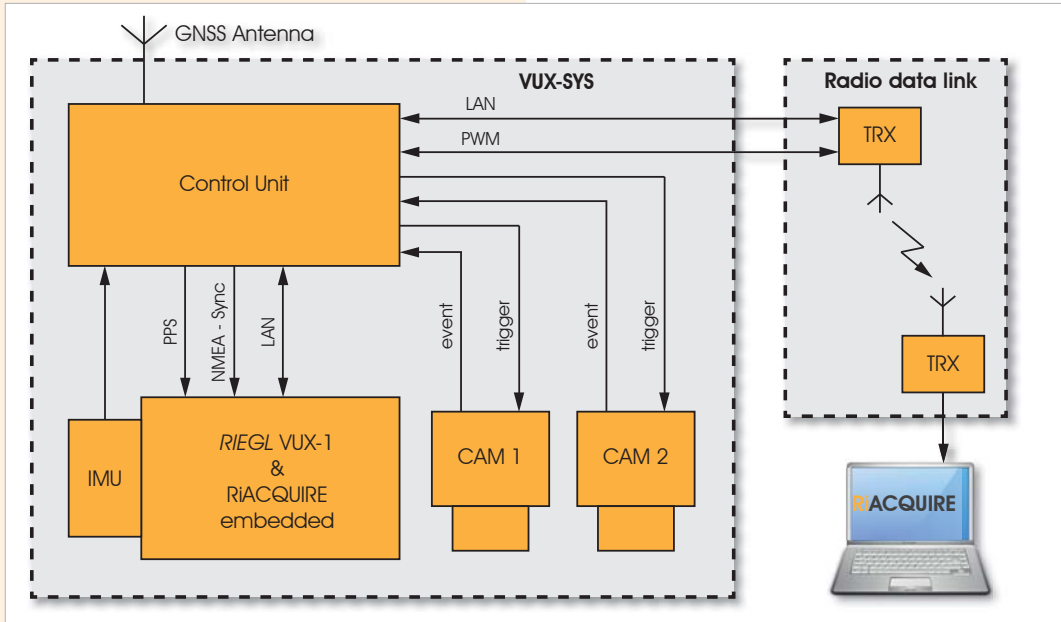
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RIEGL VUX®-SYS - Block Diagram Remote Control Setup

Accounting for the integration in unmanned remotely piloted systems, like the RiCOPTER, a dedicated TTL interface for receiving and emitting **Pulse-Width Modulated (PWM)** signals enables full control as well as system status feedback. Based on a predefined set of commands and associated pulse widths the system can be controlled easily via a standard remote-control radio channel of low bandwidth.

It is possible to adjust the data rate of scan data for streaming monitoring data even in real-time via suitable radio channels of sufficient bandwidth.

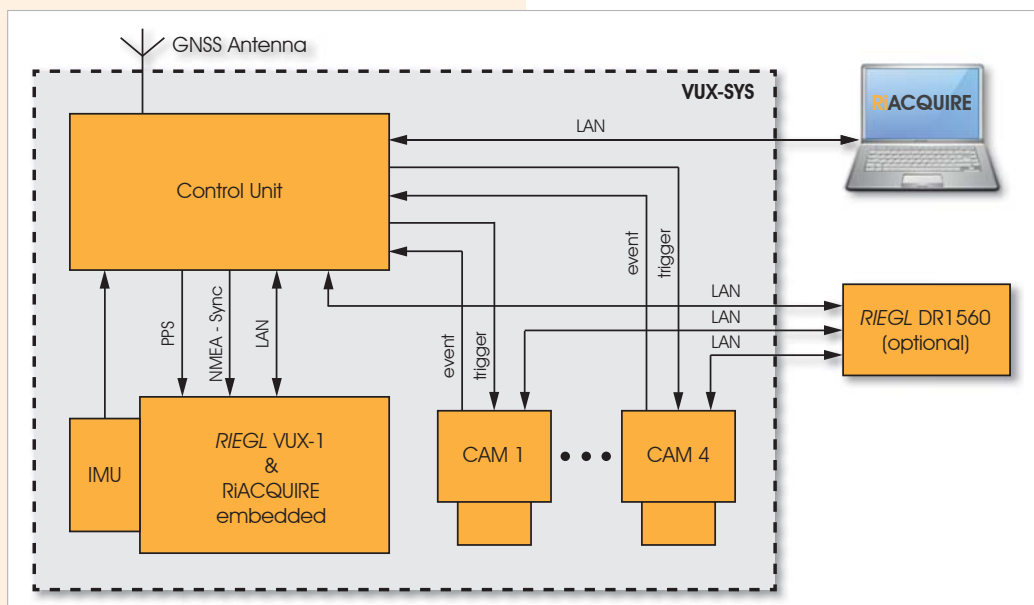


RIEGL VUX®-SYS - Block Diagram Conventional Control Setup

The VUX-SYS contains a LAN interface for direct control from an operator's working station running RiACQUIRE when operated manually in an aircraft or vehicle. RiACQUIRE is fully compatible with the VUX-SYS and enables full control over the laser scanner, the IMU/GNSS system, and optionally up to 4 digital cameras.

Scan data and image data can be directly stored on the particular sensor's internal storage, or can be directly stored on an optional data recorder DR1560 or on a laptop.

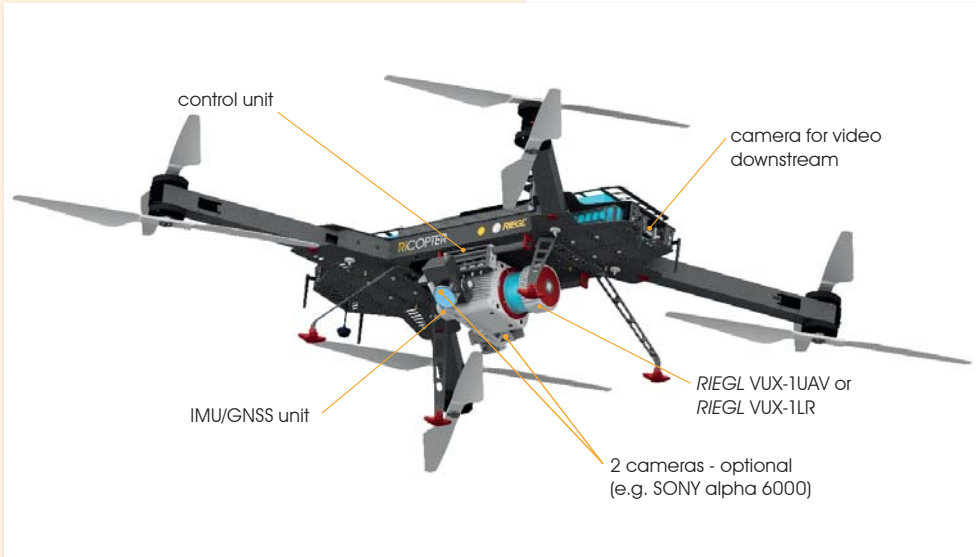
The control unit contains trigger and event marker interfaces for each camera. Precise time stamps of the camera's release-events are stored in the raw scan data stream enabling combination of point cloud data and imagery in subsequent data processing.



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, whereas 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 or RIEGL VUX-1LR LiDAR sensor
- IMU/GNSS unit (Applanix AP20)
- GNSS antenna
- control unit
- camera(s) optional (2x e.g. SONY alpha 6000)
- connecting cables

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

The VUX-SYS fits the small and lightweight RIEGL VP-1 pod, 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 or RIEGL VUX-1LR LiDAR sensor
- IMU/GNSS unit (Applanix AP20 or AP60)
- GNSS antenna
- control unit
- digital camera(s) (1x Nikon D810, or 1x Phase One iXU, or 2x Sony Alpha 6000)
- connecting cables

RIEGL VUX®-SYS installed in VMQ (Mobile)

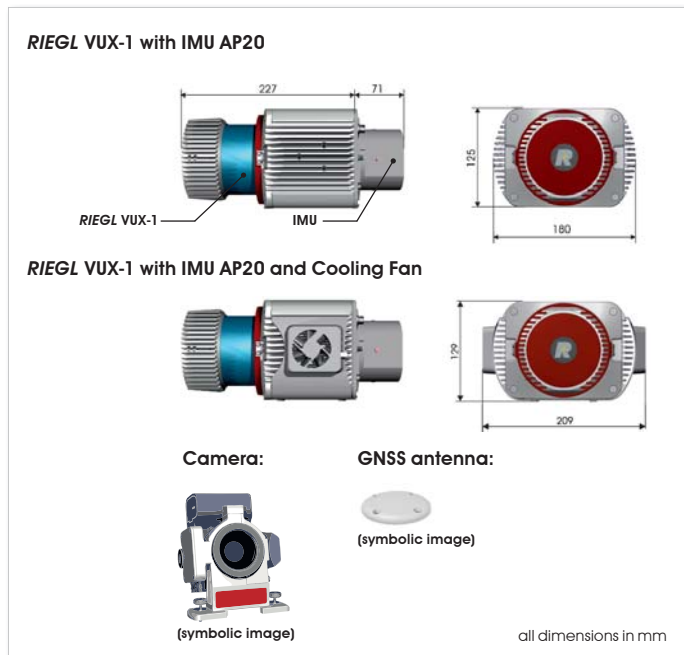
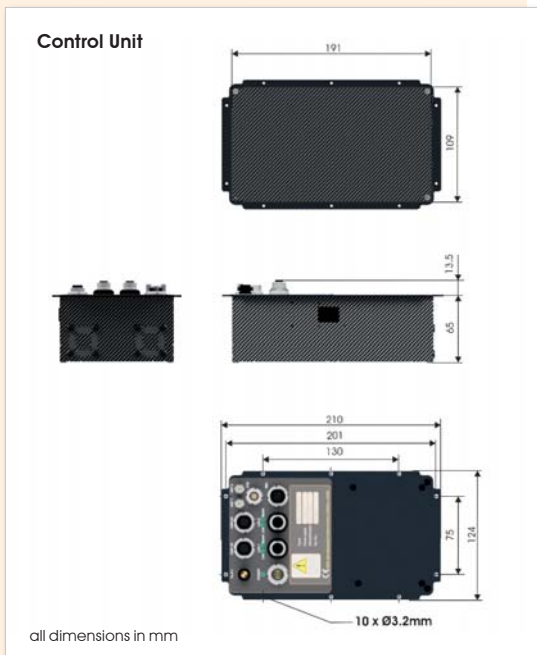
Fully integrated into the measuring head of the system, the VUX-SYS is the core part of the RIEGL VMQ Single Scanner Mobile Mapping System. Together with the universal VMQ roof mount the system can be easily mounted on a great variety of vehicles. One single external VMQ main cable minimizes the efforts 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 sensor (possible)
- IMU/GNSS unit (Applanix AP20 or AP60)
- GNSS antenna
- control unit
- up to 4 digital camera(s) (e.g., FLIR Ladybug® 5, Nikon D810, 5 MPix industrial camera)
- connecting cables

RIEGL VUX®-SYS Mechanical Drawings



Technical Data RIEGL VUX®-SYS

Scanner Performance (for details refer to the corresponding info sheets and data sheets)

RIEGL VUX-1 Series Sensor

Maximum Range
 Minimum Range
 Accuracy / Precision
 Laser Pulse Repetition Rate
 Max. Effective Measurement Rate
 Field of View (selectable) ⁴⁾
 Max. Scan Speed

VUX-1LR	VUX-1UAV	VUX-1HA ¹⁾
1,350 m ²⁾	920 m ²⁾	420 m ³⁾
5 m	3 m	1.2 m
15 mm / 10 mm	10 mm / 5 mm	5 mm / 3 mm
up to 750 kHz	up to 550 kHz	up to 1017 kHz
up to 750,000 meas./sec.	up to 500,000 meas./sec.	up to 1,000,000 meas./sec.
up to 330°	up to 330°	up to 360°
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 $\rho \geq 60\%$.
 3) Maximum range is specified for natural targets $\rho \geq 80\%$.
 4) Note limitations when integrated in kinematic systems.

Data Interfaces

Configuration
 Scan Data Output
 GNSS Interface

Camera

IMU & GNSS

IMU Accuracy
 Roll, Pitch
 Heading
 IMU Sampling Rate
 Position Accuracy (typ.)

LAN 10/100/1000 Mbit/sec or TTL PWM
 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
 4x trigger and event marker

Applanix AP20 ⁵⁾

Applanix AP60 ⁵⁾

0.015°
 0.035°
 200 Hz
 < 0.05 m horizontal, < 0.1 m vertical

0.002°
 0.005°
 200 Hz
 < 0.05 m horizontal, < 0.1 m vertical

5) See technical details at the according Applanix datasheet

General Technical Data

Power Supply Input Voltage / Consumption

11 - 34 V DC / typ. 95 W

Main Dimensions

VUX-1 with IMU, without Cooling Fan Device
 VUX-1 with IMU and Cooling Fan Device
 Control Unit

298 x 180 x 125 mm
 298 x 209 x 129 mm
 210 x 124 x 78.5 mm

Weight

VUX-1 without / with Cooling Fan Device
 Control Unit
 IMU/GNSS (Applanix AP20)
 Camera(s)

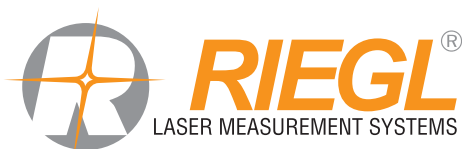
approx. 3.5 kg / approx. 3.75 kg
 approx. 0.9 kg
 approx. 0.7 kg
 depending on selected camera type

Humidity

max. 80 % non condensing @ 31°C

Temperature Range

-10°C up to +40°C (operation) / -20°C up to +50°C (storage)



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