

RIEGL VMX[®]-2HA



High-Speed 10 GigE Link
for acquisition of
3.6 million measurements/sec
and image data with up to
240 MP resolution

The **RIEGL VMX-2HA** is a High Speed, High Performance Dual Scanner Mobile Mapping System which provides dense, accurate, and feature-rich data at highway speeds.

With 3.6 million measurements and 500 scan lines per second, this turn-key solution is ideally suited for survey-grade mobile mapping applications.

This powerful technology comprises two **RIEGL VUX-1HA²²** High Accuracy LiDAR Sensors and a high performance IMU/GNSS unit, housed in an aerodynamically-shaped protective cover.

A camera interface for up to 9 optional cameras enables complementation of the LiDAR data with precisely geo-referenced images.



High Speed, High Performance Dual Scanner Mobile Mapping System

Typical Applications

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

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RIEGL VMX-2HA Key Features

Proven System

The *RIEGL VMX-2HA* is the consistent further development of the compact *RIEGL VMX* Mobile Mapping System.

The well proven alignment and placement of the two *VUX-1HA²²* (High Accuracy) scanners enables a simultaneous forward/backward looking to reduce scan shadows. A compact dual scanner platform carries both, LiDAR sensors and a high-grade IMU/GNSS subsystem, and provides an accurate and long-term stable system calibration.



VMX-2HA Scan Pattern

1.8 MHz program		pattern @ 3 m distance		pattern @ 10 m distance		pattern @ 50 m distance	
platform speed	line spacing of a single scanner (mm)	point spacing within a scan-line of a single scanner (mm)	VMX-2HA point density (pts/m ²)	point spacing within a scan-line of a single scanner (mm)	VMX-2HA point density (pts/m ²)	point spacing within a scan-line of a single scanner (mm)	VMX-2HA point density (pts/m ²)
platform speed 50 km/h	56	2.6	13750	8.7	4100	44.0	820
platform speed 80 km/h	89	2.6	8590	8.7	2570	44.0	510
platform speed 120 km/h	133	2.6	5700	8.7	1700	44.0	340

Camera System and Features

The VMX-2HA impresses with an extremely enhanced camera performance and a number of new features. Camera interface and SYNC of up to 9 external devices are included in the basic system configuration. Multiple high-resolution *RIEGL* cameras allow for unique capture angles and a high degree of details in the images.

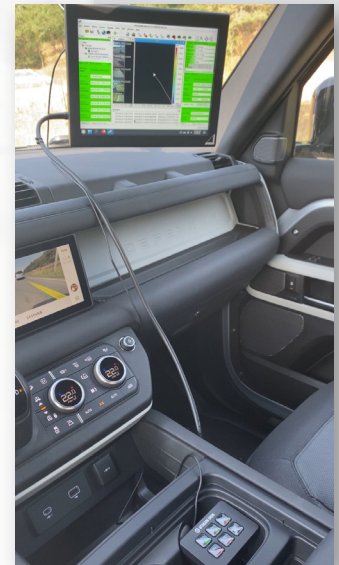
The VMX-2CU (equipped with a high performance 7th generation Intel Core i7 processor) precisely controls management of power, data acquisition, and operation of the laser scanners, IMU/GNSS sensors and the optional cameras.

A 10 GigE network and a set of SSD storage media with a total of 7.6 TB (15.3 TB optional) disk space enable big data handling for uninterrupted data recording of comprehensive missions.

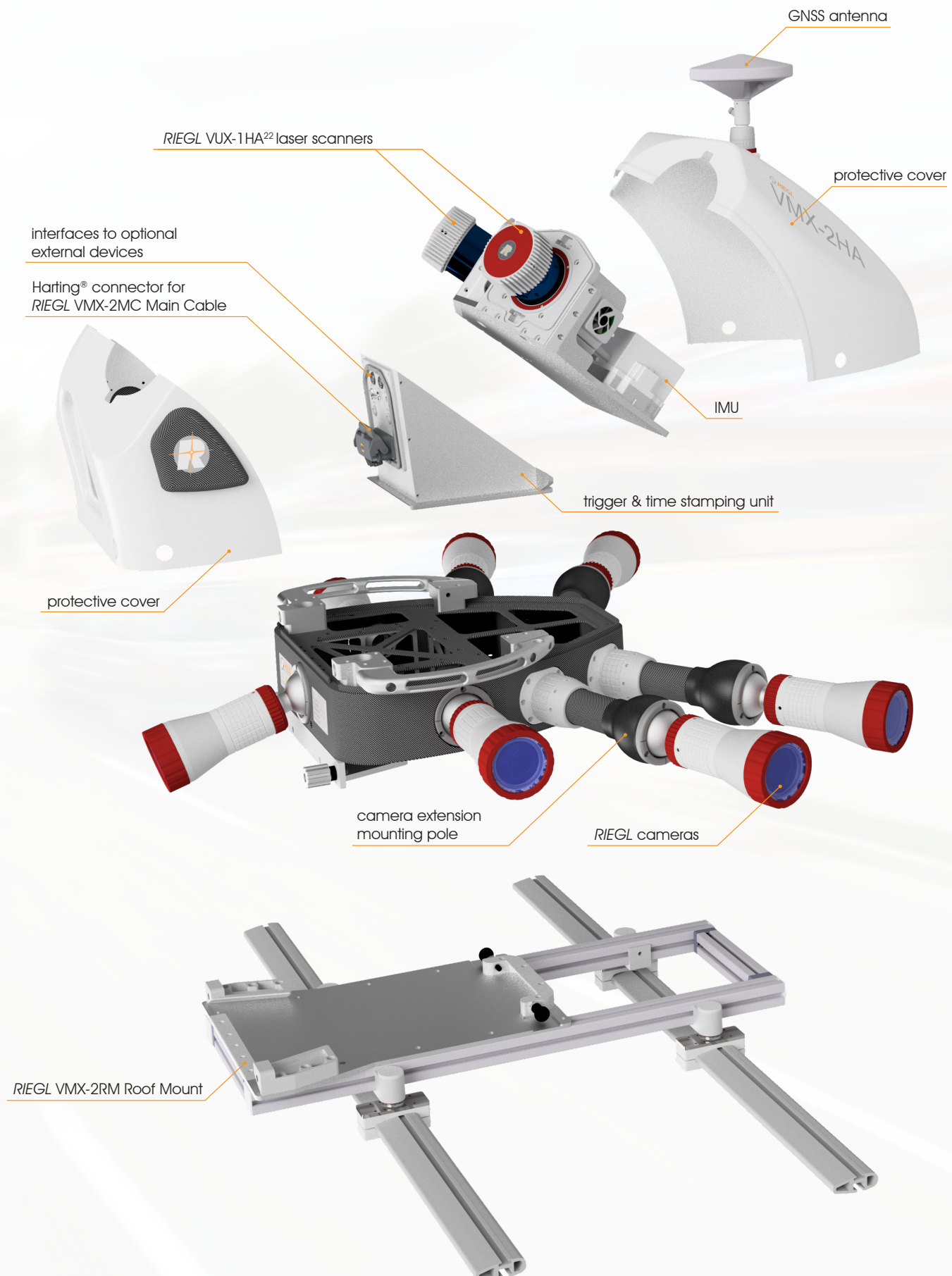
The modular design of the system provides unique flexibility to meet a diversity of project requirements. Ready to be mounted on road and off-road vehicles, as well as on trains and boats, it provides the user with the technology and tools to ensure full data capturing of transportation infrastructure, pavement surface, facades, overhead structures, power lines, bridges, tunnels, etc.

Seamless RIEGL Workflow

A handy touch-screen and the *RIEGL* data acquisition software facilitate the operator's task in the field by providing real-time visualization of acquired scan data and imagery. The *RIEGL* software packages also offer comprehensive features in data processing. This covers enhanced scan data adjustment to merge overlapping mobile scan data. Furthermore it enables the scan data to be fitted to specific control objects which results in a consistent point cloud of enhanced precision and increased geo-referenced accuracy. Finally, the precise geo-referenced scan data and high resolution (panorama) images can be exported to well-known file formats or interfaced directly with third-party software.



RIEGL VMX-2HA Components and Setup



RIEGL VMX-2HA Camera Options

The VMX-2HA Mobile Mapping System provides interface and SYNC for up to 9 external devices and allows flexible combination of different camera configurations.

- high-sensitivity 5 MP, 12 MP and 24 MP **RIEGL** cameras
- various spherical cameras up to 72 MP
- DSLR camera such as Nikon D850 or Sony Alpha

The modular setup of the system allows to change or upgrade the camera configuration any time. The provided camera ports enable unique flexibility to select an optimal position and orientation of the cameras to meet the specific project requirements. Each single camera can be mounted and dismounted smoothly with accurate reproducibility of camera position and orientation. The integration of the various spherical cameras improves time stamping and enables fully integrated operation within the *RIEGL* system operating software. Multiple 5MP, 12MP or 24MP *RIEGL* cameras can be used to enable full capture of the surrounding.

The rear port is optimized to carry a close to NADIR downward looking *RIEGL* pavement camera system for detailed capturing of the road surface to improve pavement analysis and crack indexing.



colored point cloud

RIEGL Camera Options	max. number of cameras	max. frames per second ¹⁾	resolution [px (H) x px (V)]	pixel size [μm]	lens focal length [mm]	Field of View (FOV) ²⁾
5 MP RAW ³⁾	9	20	2464 x 2056	3.45	5	80.7° x 70.7°
12 MP RAW ³⁾	9	8	4112 x 3008	3.45	8 / 16	83.1° x 65.9° / 47.8° x 35.9°
12 MP JPEG ³⁾	9	17 ⁴⁾	4112 x 3008	3.45	8	83° x 66°
24 MP RAW ³⁾	9	4.5	5328 x 4608	2.74	8.5	81.3° x 73.1°
24 MP JPEG ³⁾	9	9 ⁴⁾	5328 x 4608	2.74	8.5	81.3° x 73.1°

¹⁾ Maximum frame rate of a single camera operated with 8-bit color depth. The use of multiple cameras may reduce the maximum frame rates.

²⁾ Nominal values (actual values may be slightly different due to manufacturing tolerances)

³⁾ A user defined „region of interest“ can be defined during data acquisition, resulting in a reduction of the FOV and the resolution.

This may help to reduce image file sizes on the one hand and to further increase frame rates on the other hand.

⁴⁾ @ 90% image compression.

Specifications RIEGL Cameras

RIEGL offers high-sensitive ball-joint directional cameras (5 MP, 12 MP, and 24 MP) with leading edge CMOS technology for high resolution images, high frame rates, and minimized lens distortion.

The camera's CMOS global shutter sensor provides a high dynamic range, hardly any smearing effects caused by sunlight, great details in shadows and highlights, and low temporal dark noise for more signal gain up to 40 dB.

The system provides 6 side-facing camera ports and a backward-facing port that can either be equipped with a single camera or a dual camera option for pavement imagery.

Gapless 360 Degree Horizontal Field of View

The high-sensitive directional cameras are optimized for capturing traffic signs, overhead structures, building structures, and facades.

Camera Key Features

- cantilever-mounted cameras reducing the occurrence of car shadows
- forward/backward facing positions enabling different view angles on objects
- ball-joint directional camera heads with ± 50 deg $v \times h$ rotation for flexible adjustment of the camera positions

Pavement Camera Mount (optional)

The Pavement Camera Mount enables operation of two cameras at the rear port of the VMX-2HA. This increases the field of view and allows more road surface to be covered, so that a lane width can be reliably covered in any case.

The Pavement Camera Mount is optimized to carry two close to NADIR downward looking cameras offering

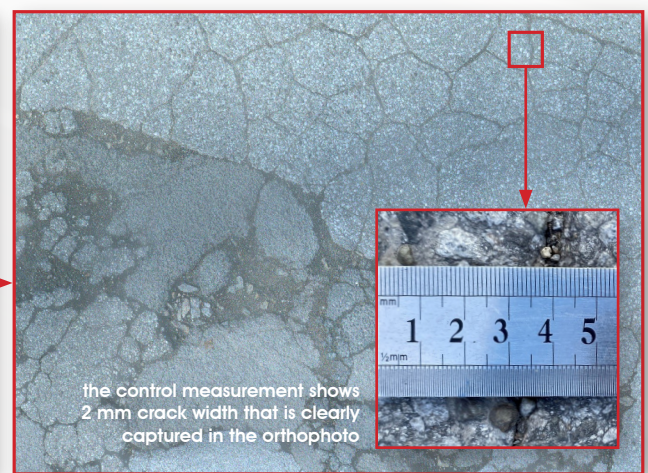
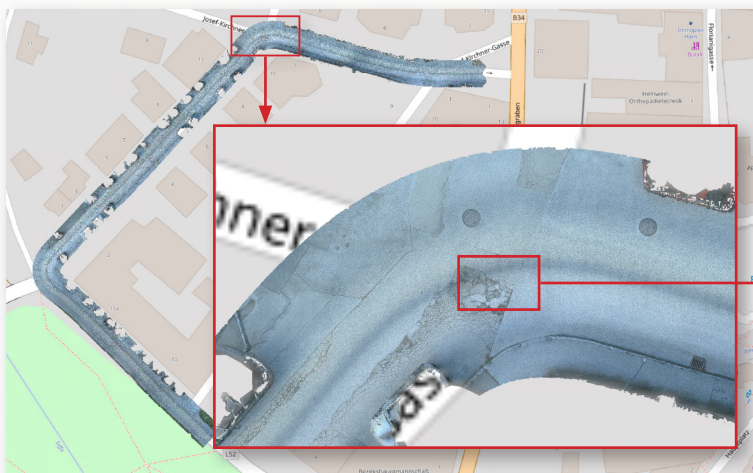
- detailed capturing of the road surface
- reliable data for pavement analysis and crack indexing
- little distortion of projected image on road surface
- generation of true-orthophotos with up to millimeter resolution



VMX-2HA equipped with 7 ball-joint directional RIEGL cameras



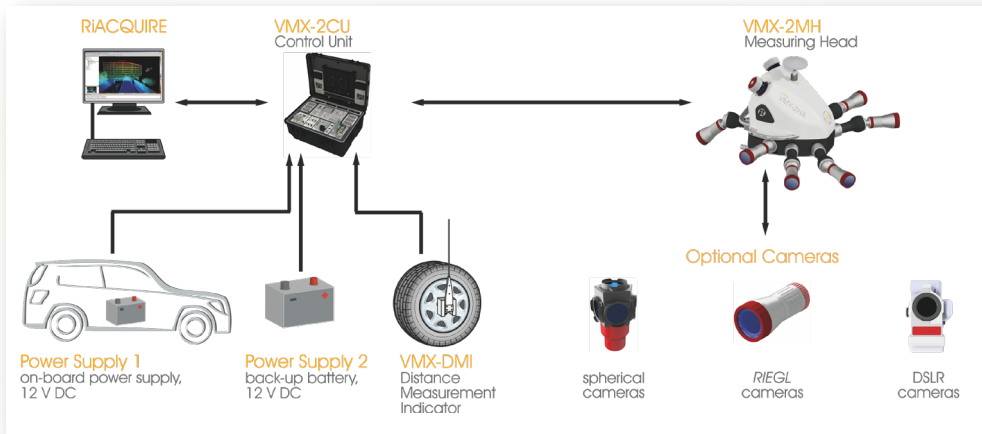
VMX-2HA equipped with 6 horizontally aligned ball-joint directional RIEGL cameras and two ball-joint mounted pavement cameras with close to NADIR orientation



the control measurement shows 2 mm crack width that is clearly captured in the orthophoto

application example of pavement data acquisition with subsequent generation of true-orthophotos (RiPROCESS)

RIEGL VMX-2HA System Block Diagram

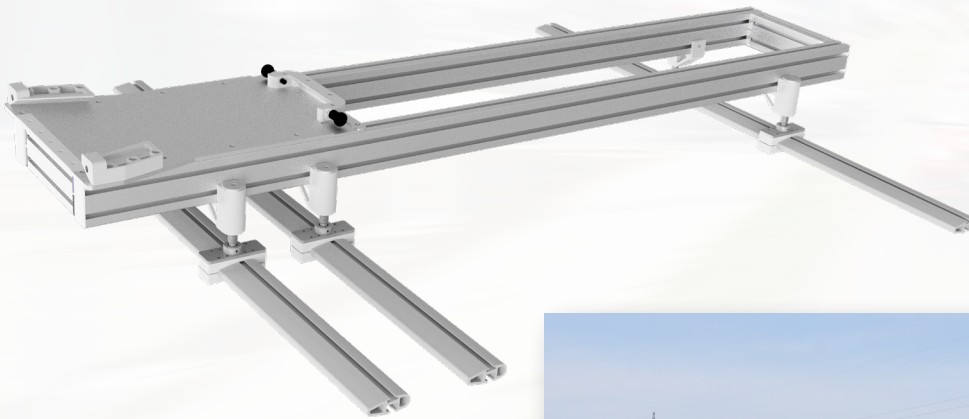


RIEGL VMX-2HA System Components:

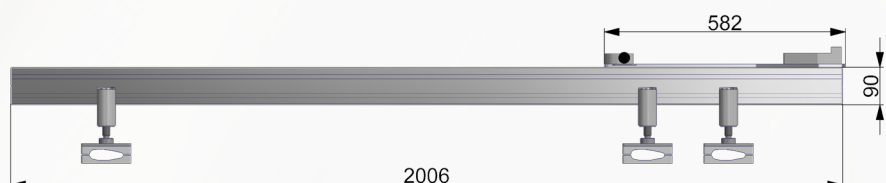
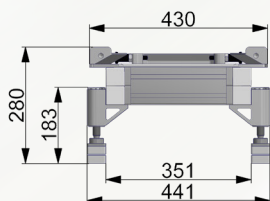
- RIEGL VMX-2MH Measuring Head
- RIEGL VMX-2CU Control Unit
- VMX-DMI Distance Measurement Indicator
- up to 9 cameras (optional)
- sustainable power supply with back-up battery
- single VMX-2MC Main Cable with Harting® connectors

RIEGL VMX-2RM Reinforced Roof Mount (optional)

This roof mount is a reinforced version of the standard VMX-2RM Roof Mount and has 6 height-adjustable brackets that allow to adjust to the aerodynamically shaped roof lines of the car.

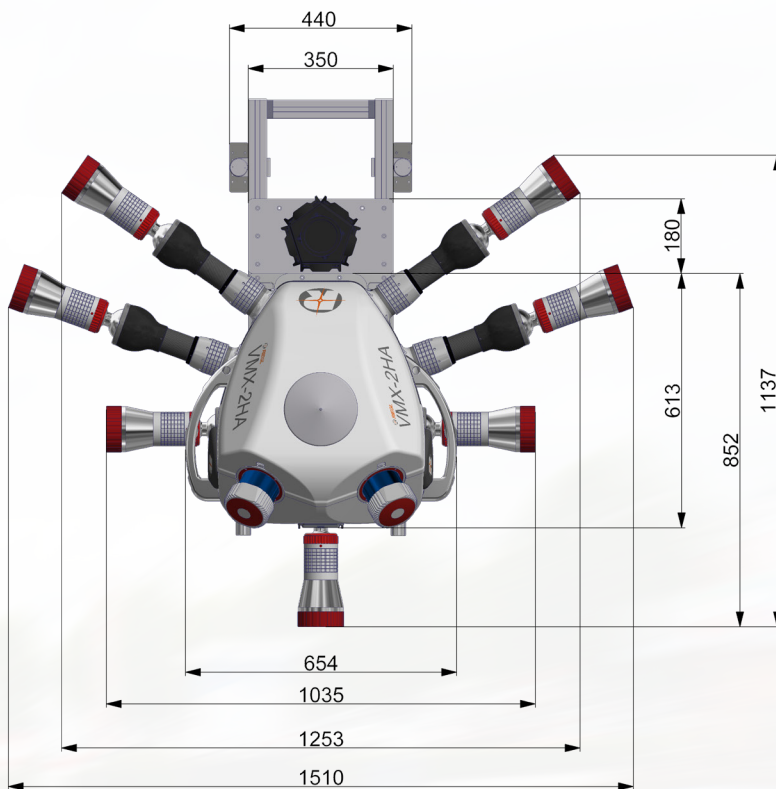


RIEGL VMX-2HA system mounted by means of the VMX-2RM Reinforced Roof Mount

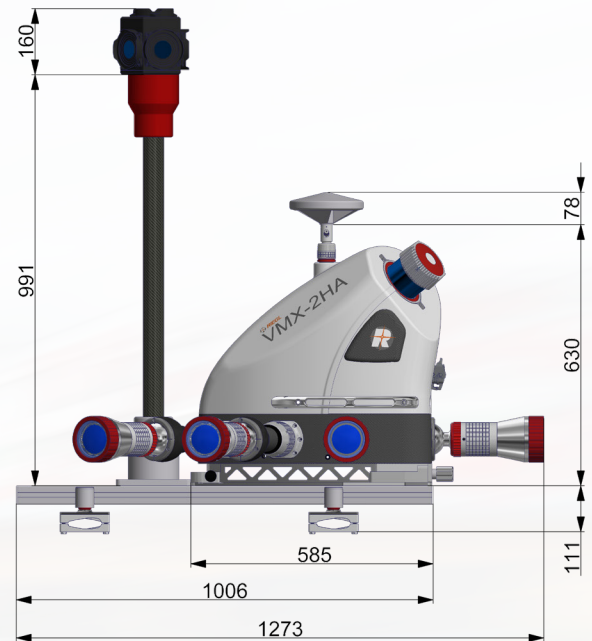


all dimensions in mm

RIEGL VMX-2HA Dimensions



all dimensions in mm



RIEGL VMX-2HA Technical Data



475m max.
measurement range



3.6MHz pulse repetition
rate (peak)



online waveform
processing



optional
digital camera



multiple
target capability



eye safe operation
at Laser Class 1

VMX-2HA Scanner Performance

Laser Class	Laser Class 1 (Class 1 Laser Product according to IEC 60825-1:2014)					
Effective Measurement Rate ^{1) 2)}	2x 300 kHz	2x 500 kHz	2x 1000 kHz	2x 1250 kHz	2x 1500 kHz	2x 1800 kHz
Max. Range, Target Reflectivity $\rho \geq 80\%$ ^{3) 4)}	475 m	370 m	235 m	235 m	235 m	235 m
Max. Range, Target Reflectivity $\rho \geq 10\%$ ^{3) 4)}	170 m	130 m	85 m	85 m	85 m	85 m
Max. Number of Targets per Pulse ⁵⁾	15	15	9	7	5	4
Minimum Range	1 m @ PRR $\geq$ 1 MHz, 1.2 m @ PRR < 1 MHz					
Accuracy ^{6) 7)} / Precision ^{7) 8)}	5 mm / 3 mm					
Field of View	360° "full circle"					
Scan Speed (selectable)	2x up to 250 scans/sec					

1) Rounded values, selectable by measurement program.

2) Setting of intermediate PRR values possible.

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) Ambiguity to be resolved by post-processing with RIUNITE software.

5) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.

6) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.

7) One sigma @ 30 m range under RIEGL test conditions.

8) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.

IMU/GNSS Performance

Position Accuracy (absolute)	AP+60
Horizontal	typ. 0.02 m
Vertical	typ. 0.03 m
Roll & Pitch Accuracy ¹⁾	0.0025°
Heading Accuracy ¹⁾	0.015°

1) Absolute Accuracy Specifications (RMS). Typical performance. Actual results are dependent upon satellite configuration, atmospheric conditions and other environmental effects. Post processed using base station data. No GNSS outages, with DMI option.



General Technical Data

VMX-2CU Power Supply Input Voltage	11 - 15 V DC powered by on-board source (e.g. alternator) 11 - 15 V DC backup power
VMX-2MH Input Voltage	24 V DC (powered via VMX-2CU)
Typ. Power Consumption system operation without cameras additional power consumption per camera	typ. 250 W / max. 1020 W typ. 6 W / max. 34 W
Protection Class VMX-2MH with camera system	IP64
Temperature Range VMX-2MH with camera system Temperature Range VMX-2CUz	-20°C up to +40°C (operation) / -20°C up to +50°C (storage) 0°C up to +40°C (operation) / -20°C up to +50°C (storage)
Interface VMX-2CU to VMX-2MH	single main cable for power & data interface with robust Harting® connectors
Humidity	max. 80% non condensing @ +31°C
Weight (approx.) VMX-2MH Measuring Head (without cameras) VMX-2RM Roof Mount (including Thule wing bars with Thule mountings) VMX-2RM Reinforced Roof Mount (including Thule wing bars with Thule mountings) VMX-2MC Main Cable (5m length) VMX-2CU Control Unit RIEGL cameras 24 MP JPEG camera / 24 MP camera 12 MP JPEG camera / 12 MP camera 5 MP camera camera extension mounting pole Mounting Kit for various spherical cameras (including cabling, excluding camera)	39 kg 17.3 kg 34 kg 5 kg 25 kg 1.42 kg / 1.5 kg 1.36 kg / 1.65 1.25 kg 1.2 kg 5.8 kg

Data Interfaces

VMX-2MH Measuring Head
9x multi-purpose ports supporting complementary camera systems and additional devices, each with - trigger pulse - precise time stamping of exposure pulse - NMEA data - PPS - LAN 1GigE - power 24V DC, max. 34 W
VMX-2CU Control Unit
1x DMI input (for distance measuring indicator; odometer) 1x NAV RS-232 (COM port for IMU/GNSS for RTK, SBAS) 1x AUX +12V DC 1x touch screen incl. USB (for system operation) 1x HDMI (additional video output) 1x Display Port (additional video output) 2x LAN (1x 1000 Mbit/sec, 1x 10000 Mbit/sec) 4x USB 3.0 2x USB 3.0 specific configuration for a spherical camera 4x removable double SSD drive carrier with a total of 7.6 TB (optional up to 15.3 TB) swappable disc space wireless communication via Bluetooth, WLAN and LTE
VMX-2MC Main Cable (single cable connection between VMX-2MH and VMX-2CU) with 10 GigE Link

Further Information

RIEGL VUX-1HA²²
Data SheetRIACQUIRE
Data SheetRIPROCESS
Data SheetRIUNITE
Data SheetRIPRECISION MLS
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