RIEGL
VMX®-2HA

MLS

420m | 2 MHz | optional

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 2 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-1HA High Accuracy LiDAR sensors and a high performance INS/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 • Rapid Capture of Construction Sites and Bulk Material • City Modeling • 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 alignment and placement of the two VUX-1HA (High Accuracy) scanners keeps within the proven VMX tradition with 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 MHz program		pattern @ 3m distance		pattern @ 10m distance		pattern @ 50m 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/m2)	point spacing within a scan-line of a single scanner (mm)	VMX-2HA point density (pts/m2)	point spacing within a scan-line of a single scanner (mm)	VMX-2HA point density (pts/m2)
platform speed 50km/h	56	4.7	7640	15.7	2300	78.5	458
platform speed 80km/h	89	4.7	4774	15.7	1432	78.5	286
platform speed 120km/h	133	4.7	3184	15.7	954	78.5	190

New 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 interface between the VMX-MH (Measuring Head) with scanners and cameras and the VMX-CU (Control Unit) was completely re-designed.

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

A 10 GigE network and a set of SSD storage media with a total of 6 TB 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 requirments. 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 for transportation infrastructure, facades, overhead structures, power lines, bridges, tunnels etc.
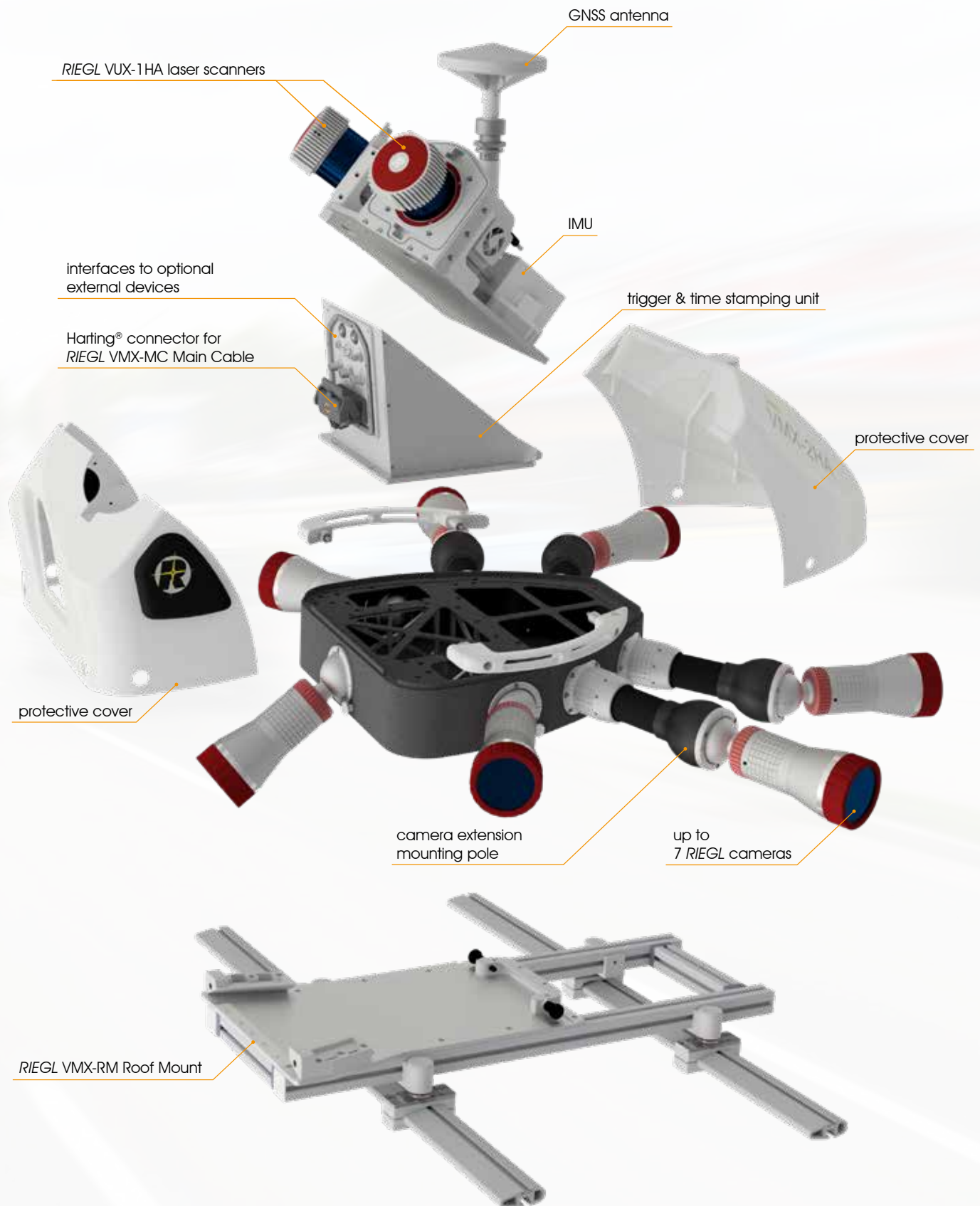
Seamless **RIEGL** Workflow

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

GNSS antenna

RIEGL VUX-1HA laser scanners

IMU

interfaces to optional external devices

trigger & time stamping unit

Harting® connector for *RIEGL* VMX-MC Main Cable

protective cover

protective cover

camera extension mounting pole

up to 7 *RIEGL* cameras

RIEGL VMX-RM Roof Mount

RIEGL VMX-2HA Camera Options

Camera System

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 5MP, 9MP and 12MP *RIEGL* cameras**
- **spherical camera FLIR Ladybug 5+**
- **DSLR camera such as Nikon D810 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 new integration of the spherical Ladybug 5+ camera improves time stamping and enables fully integrated operation within the *RIEGL* system operating software.

Multiple 5MP, 9MP or 12MP *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 camera for detailed capturing of the road surface to improve pavement analysis and crack indexing.

As high-resolution cameras such as the 12 MP *RIEGL* camera triggered with 8 fps require up to 1GigE bandwidth the data transfer to the VMX-2HA Control Unit is realized by an 10GigE interface.

colored point cloud: image data captured by FLIR Ladybug 5+

Camera Options [1]	max. numbers of cameras	max. frames[2] per second	resolution [px (H) x px (V)]	lens focal length [mm]	Field of View (FOV)
5 MP CMOS	9	20	2464 x 2056	5	80.7° x 70.7°
9 MP CMOS	9	10	4112 x 2176	8	83.1° x 50.3°
12 MP CMOS	9	8	4112 x 3008	8	83.1° x 65.9°
FLIR Ladybug®5+	1 unit / 6 lens	19	6 x [2048x2448]	4.4	90% of full sphere
Nikon® D810	9	1	7360 x 4912	14 / 20	104° x 81° / 83° x 61°

1) The combination of different cameras is possible.
2) Maximum frame rate of a single camera operated in 8-bit mode. The use of multiple cameras may reduce maximum frame rates.

▶ Specifications *RIEGL* Cameras

RIEGL offers special high-sensitive 5MP, 9MP and 12MP cameras with leading edge CMOS technology for high resolution images, high frame rates, and minimized lens distortion.
The camera's CMOS global shutter sensor is responsible for a higher dynamic range, less smearing effects caused by sunlight, greater details in shadows and highlights, low temporal dark noise for more signal gain up to 40dB.

The system provides 6 side-facing and one backward facing camera mounting options.

Up to 6 Side-Facing Cameras

These cameras are optimized for capturing traffic signs, overhead structures, building structures, and facades.

Camera Key Features:
- cantilever-mounted cameras reducing the occurence of car shadows
- forward/backward facing positions enabling different view angles on objects
- ball-joint camera heads with ± 50deg v×h rotation for flexible adjustment of the camera positions


Backward Facing Camera

The rear port is optimized to carry a close to nadir downward looking camera offering

- detailed capturing of the road surface
- reliable data for pavement analysis and crack indexing
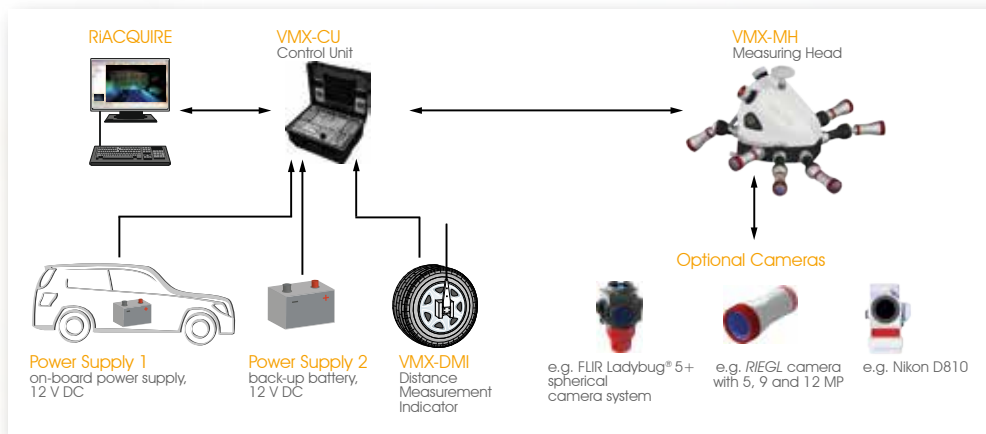- little distortion of projected image on road surface

Camera Key Features:
- up to 20 fps per camera @ 5MP
- 1.1 m distance @ 80 km/h
- small pixel footprint of 1.4 mm @ 2 m
- very short exposure time (0.1ms) to avoid motion blur 1.6 pixel blur @ 80 km/h
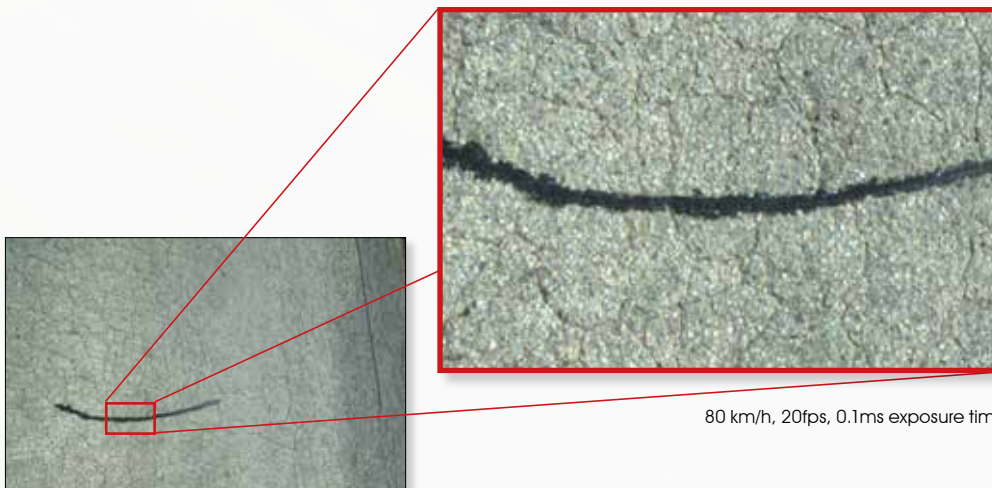
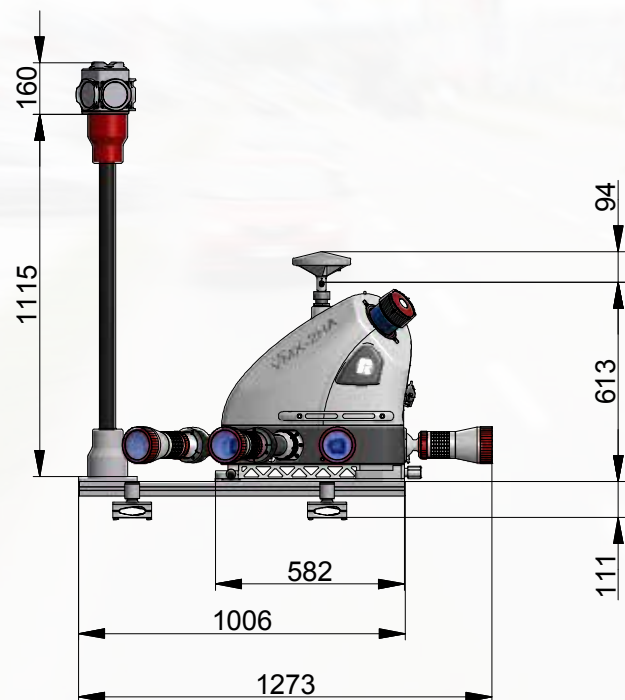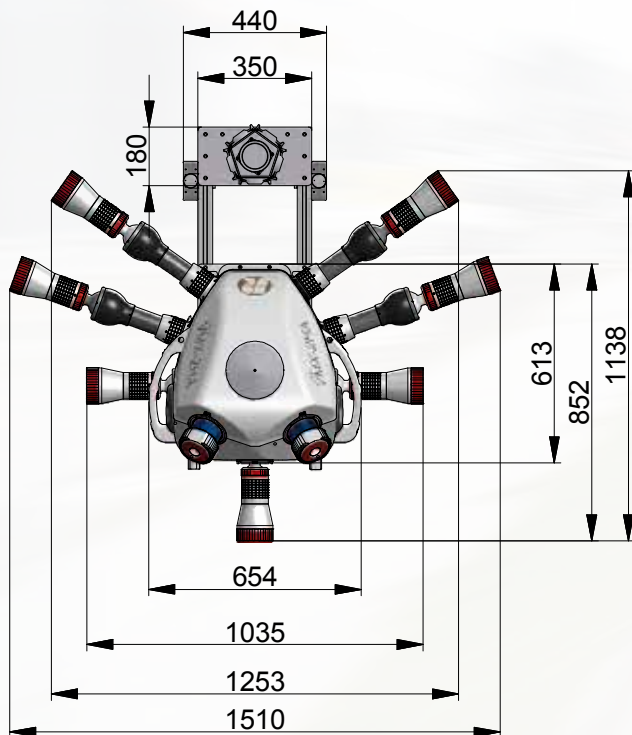

80 km/h, 20fps, 0.1ms exposure time

RIEGL VMX-2HA System Block Diagram

RIEGL VMX-2HA System Components:

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

RIEGL VMX-2HA Dimensions and Weight

all dimensions in mm

Weight and Dimensions	Weight (approx.)
VMX-MH Measuring Head (without cameras)	39 kg
VMX-RM Roof Mount	12.5 kg
VMX-RM Mounting Kit (Thule wing bars with Thule mountings)	4.8 kg
VMX-MC Main Cable (5m length)	5 kg
VMX-CU Control Unit	25 kg
RIEGL cameras	
12 MP camera	1.65 kg
9 MP camera	1.65 kg
5 MP camera	1.25 kg
camera extension mounting pole	1.2 kg
FLIR Ladybug 5+ Kamera (with cabling and mounting)	9 kg

RIEGL VMX-2HA Technical Data

420m max. measurement range	**2 MHz** 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]	600 kHz	1 MHz	1.5 MHz	2 MHz
Max. Range, Target Reflectivity ρ ≥ 80% [2] [3]	420 m	330 m	270 m	235 m
Max. Range, Target Reflectivity ρ ≥ 10% [2] [3]	150 m	120 m	100 m	85 m
Max. Number of Targets per Pulse	practically unlimited (details on request)			
Minimum Range	1.2 m			
Accuracy [4] [6] **/ Precision** [5] [6]	5 mm / 3 mm			
Field of View	360° "full circle"			
Scan Speed (selectable)	up to 500 scans/sec			

1) Rounded values, selectable by measurement program.
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) Ambiguity to be resolved by post-processing with RiMTA software.
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 @ 30 m range under RIEGL test conditions.

IMU/GNSS Performance [7]

Position Accuracy (absolute)	typ. 20 - 50 mm
Roll & Pitch Accuracy	0.005°
Heading Accuracy	0.015°

7) One sigma values, no GNSS outage, with DMI option, post-processed using base station data.

General Technical Data

VMX-CU Power Supply Input Voltage	11 - 15 V DC powered by on-board source (e.g. alternator) 11 - 15 V DC backup power
VMX-MH Input Voltage	24 V DC (powered via VMX-CU)
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-MH with camera system	IP64
Temperature Range VMX-MH with camera system **Temperature Range VMX-CU**	-10°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-CU to VMX-MH	single main cable for power & data interface with robust Harting® connectors
Humidity	max. 80% non condensing @ +31°C

Data Interfaces

VMX-MH Measuring Head

9 x 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-CU Control Unit
1 x DMI input (for distance measuring indicator; odometer) 1 x NAV RS232 (COM port for IMU/GNSS for RTK, SBAS) 1 x AUX +12V DC 1 x touch screen incl. USB (for system operation) 1 x HDMI (additional video output) 1 x Display Port (additional video output) 2 x LAN, 1000 Mbit/sec (e.g. connect additional computer) 4 x USB 3.0 2 x USB 3.0 specific configuration for FLIR Ladybug® 5+ 4 x removable double SSD drive carrier with a of total 6TB swappable disc space wireless communication via Bluetooth, WLAN and LTE
VMX-MC Main Cable (single cable connection between VMX-MH and VMX-CU) with 10 GigE Link

Further Information

RiACQUIRE
Data Sheet

RiPROCESS
Data Sheet

RiWORLD
Data Sheet

RiPRECISION MLS
Brochure

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