

Technical Data RIEGL VZ[®]-400i

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 ¹⁾

Measuring Principle / Mode of Operation

time of flight measurement, echo signal digitization, online waveform processing, multiple-time-around processing, full waveform export capability (optional) / single pulse ranging

Laser Pulse Repetition Rate PRR (peak) ^{2) 3)}	100 kHz	300 kHz	600 kHz	1200 kHz
Effective Measurement Rate (meas./sec) ²⁾	42,000	125,000	250,000	500,000
Max. Measurement Range ⁴⁾				
natural targets $\rho \geq 90\%$	800 m	480 m	350 m	250 m
natural targets $\rho \geq 20\%$	400 m	230 m	160 m	120 m
Minimum Range	1.5 m	1.2 m	0.5 m ⁵⁾	0.5 m ⁵⁾
Max. Number of Targets per Pulse ⁶⁾	15	15	8	4

Accuracy ^{7) 9)} 5 mm
 Precision ^{8) 9)} 3 mm
 Laser Wavelength near infrared
 Laser Beam Divergence 0.35 mrad ¹⁰⁾

1) With online waveform processing.
 2) Rounded values.
 3) In order to minimize multiple-time-around issues it is crucial to carefully select the laser pulse repetition rate according to the application in question.
 4) 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.
 5) Minimum range specified for vertical zenith angles from 30 deg to 120 deg, resp. 90° vertical field of view.
 6) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achievable range is reduced.
 7) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
 8) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
 9) One sigma @ 100 m range under RIEGL test conditions.
 10) Measured at the 1/e² points. 0.35 mrad corresponds to an increase of 35 mm of beam diameter per 100 m distance.

Scanner Performance

Scan Angle Range
 Scanning Mechanism
 Scan Speed
 Angular Step Width ¹¹⁾ $\Delta \theta$ (vertical), $\Delta \phi$ (horizontal)

Vertical (Line) Scan
 total 100° (+60° / -40°)
 rotating multi-facet mirror
 3 lines/sec to 240 lines/sec
 $0.0007^\circ \leq \Delta \theta \leq 0.6^\circ$
 between consecutive laser shots
 better 0.0007° (2.5 arcsec)

Horizontal (Frame) Scan
 max. 360°
 rotating head
 0°/sec to 150°/sec ¹²⁾
 $0.0015^\circ \leq \Delta \phi \leq 0.62^\circ$
 between consecutive scan lines
 better 0.0005° (1.8 arcsec)

Angle Measurement Resolution

Orientation Sensors

GNSS Receiver
 Laser Plummet
 Internal Sync Timer
 Scan Sync (optional)
 Waveform Data Output (optional)
 Cloud Storage
 Automatic On-board Registration

integrated 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer (compass), barometer
 integrated L1, concurrent reception of GPS, GLONASS, Beidou
 integrated
 integrated, for real-time synchronized time stamping of scan data
 scanner rotation synchronization for operating several scanners
 providing digitized echo signal information for specific target echoes
 Amazon S3, FTP-Server, Microsoft Azure
 automatic scan data registration as background process

11) Selectable.

12) Frame scan can be disabled, providing 2D scanner operation.

General Technical Data

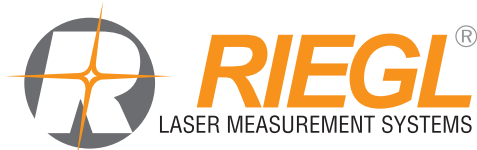
Power Supply Input Voltage / Consumption
 External Power Supply

11 - 34 V DC / typ. 65 W (max. 83 W)
 up to two independent external power sources can be connected for uninterrupted operation, in addition to the RIEGL add-on NiMH battery
 206 mm x 346 mm (width x height)
 approx. 9.7 kg (with antennas)
 max. 80 % non condensing @ +31°C
 IP64, dust- and splash-proof

Main Dimensions
 Weight
 Humidity
 Protection Class
 Temperature Range
 Storage
 Operation
 Low Temperature Operation ¹³⁾

-10°C up to +50°C
 0°C up to +40°C: standard operation
 -20°C: continuous scanning operation if instrument is powered on while internal temperature is at or above 0°C and still air
 -40°C: scanning operation for about 20 minutes if instrument is powered on while internal temperature is at or above 15°C and still air

13) Insulating the scanner with appropriate material will enable operation at even lower temperatures.



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Ultra High Performance 3D Laser Scanner

RIEGL VZ[®]-400i

- high laser pulse repetition rate of up to 1.2 MHz
- high speed data acquisition with up to 500,000 measurements/sec
- eye safe operation at Laser Class 1
- wide field of view 100°x360°
- range up to 800 m, accuracy 5 mm
- high accuracy, high precision ranging based on echo digitization, online waveform processing, and multiple-time-around processing
- innovative processing architecture for data acquisition and simultaneous geo-referencing in real-time
- automatic on-board registration
- NEW simultaneous image and scan data acquisition
- user-developed apps via python software
- cloud connectivity via Wi-Fi and 3G/4G LTE
- fully compatible with the RIEGL VMZ Hybrid Mobile Laser Mapping System
- multiple target capability
- optional waveform data output
- orientation sensor for pose estimation
- integrated GNSS receiver

The RIEGL VZ-400i is a cutting-edge 3D Laser Scanning System which combines a future-oriented, innovative new processing architecture and internet connectivity with RIEGL's latest waveform processing LiDAR technology.

This real-time data flow is enabled through dual processing platforms: a dedicated processing system for simultaneous acquisition of scan data and image data, waveform processing and system operations, and a second processing platform which enables automatic on-board registration, geo-referencing, and analysis to be executed in parallel. The VZ-400i provides an integrated 3G/4G LTE modem, Wi-Fi, and Ethernet communications hardware.

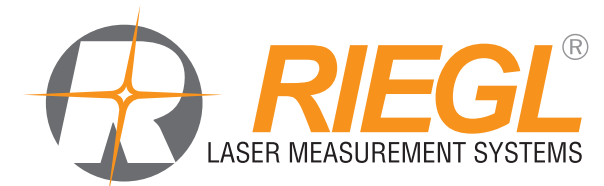
With its integrated orientation sensor (MEMS IMU, compass, and barometer), the VZ-400i's up to 1200 kHz pulse repetition rate can be fully utilized in many environments and orientations. The system provides a high range of flexibility by supporting numerous external peripherals and accessories via its integrated USB ports and stable mounting points.

Typical applications include

- As-Built Surveying
- Architecture & Facade Measurement
- Archeology & Cultural Heritage Documentation
- Building Infrastructure Management (BIM)
- Forensics & Crash Scene Investigation
- City Modeling
- Tunnel Surveying
- Civil Engineering
- Forestry
- Research
- Monitoring



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 www.riegl.com



Camera Option

A high-precision mount enables the **integration of an optional DSLR camera**. The camera can be easily integrated into the mount by means of two screws. Precise position and orientation of the camera is enabled by three supporting points. Power supply and a USB interface are provided via the scanner directly. The combination of scanner, software, and camera results in photorealistic 3D data, exact identification of details, positions, and distance measurements, as well as a re-creation of any virtual point of view. A new feature enables the acquisition of images simultaneously during scanning and thus, reduces the time for handling a scan position drastically.

External GNSS Receiver with Bluetooth Connection

To support precise global scan data registration, the RIEGL VZ-400i offers an interface for a high-end external third party GNSS receiver that is to be mounted on top of the instrument. For smooth operation in the field, GNSS data is transferred to the scanner via Bluetooth transmission or cable.

Lightweight Carbon Tripod

RIEGL offers a lightweight carbon tripod to support a quick and smooth workflow in data acquisition.

Power Supply via Rechargeable Batteries

The RIEGL VZ-400i can be connected to the following optionally available rechargeable batteries:

- >> **NEW** RIEGL Add-On Rechargeable Li-Ion Battery RBLI 2900 (3 X 99 Wh)
- >> RIEGL Add-On Rechargeable NiMH Battery RBNE 2210 (205 Wh)
- >> NiMH Battery (235 Wh)

Use of other battery types to be discussed with RIEGL support.

Waveform Data Output Option

The digitized echo signals, also known as full waveform data, acquired by the RIEGL VZ-400i are the basis for waveform analysis. This data is provided via the optionally available waveform data output and accessible with the associated RIEGL software library RIWAVELib for advanced research and analysis of digital waveform data samples acquired in multiple-target situations.

RIEGL Software Packages

- >> **RiSCAN PRO** standard processing software for efficient data acquisition and registration in terrestrial laser scanning
- >> **RiSOLVE** for automatic registration, colorization, and 2D-map generation
- >> **RiMINING** optimized workflow for open-pit mining

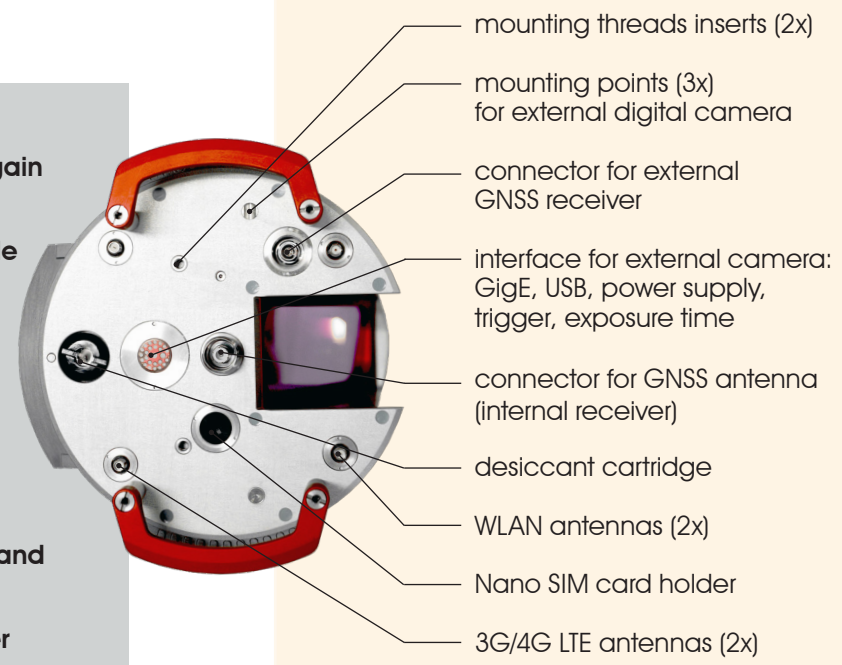


All dimensions in mm.

Communication and Interfaces

- LAN port 10/100/1000 MBit/sec
- integrated WLAN interface with high-gain MIMO antennas
- integrated multi-mode cellular module available for different regions¹⁾ with MIMO 3G/4G LTE antennas
- GigE and USB for connecting an external digital camera
- connector for GNSS antenna
- two external power supply ports
- connector for external GNSS receiver and synchronization (1PPS)
- Bluetooth connection to GNSS receiver

¹⁾ available for North America, Europe/APAC, Japan, or South America/APAC



Scan Data Storage

- internal 1 TB SSD (Solid State Disc) 900 GB useable
- external storage devices (SDXC cards up to 512 GBytes or USB flash drives)

