3D Terrestrial Laser Scanner with Online Waveform Processing

RIEGL VZ®-1000

- *very long range, more than 1,400 m*
- *high speed data acquisition*
- *wide field-of-view, configurable*
- *high-accuracy, high-precision ranging based on echo digitization and online waveform processing*
- *multiple target capability*
- *superior measurement capability in adverse atmospheric conditions*
- *high-precision mount for an optional digital camera*
- *integrated inclination sensors and laser plummet*
- *integrated GPS receiver with antenna*

The *RIEGL* VZ-1000 V-Line® 3D Terrestrial Laser Scanner provides high speed, non-contact data acquisition using a narrow infrared laser beam and a fast scanning mechanism. High-accuracy laser ranging is based upon *RIEGL*'s unique echo digitization and online waveform processing, which enables superior measurement performance even during adverse environmental conditions and provides multiple return capability.

The *RIEGL* VZ-1000 is a very compact and lightweight surveying instrument, mountable in any orientation and able to perform in limited space conditions.

Modes of Operation

- stand-alone data acquisition without the need of a computer
- basic configuration and control via the built-in user interface
- remote operation via RiSCAN PRO on a notebook, connected either via LAN interface or integrated WLAN
- well-documented command interface for smooth integration into mobile laser scanning systems
- interfacing to post processing software

User Interfaces

- integrated Human-Machine Interface (HMI) for stand-alone operation without a computer
- high-resolution 3,5" TFT color display, 320 x 240 pixel, scratch resistant glass with anti-reflection coating and multi-lingual menu
- water and dirt resistant key pad with large buttons for instrument control
- speaker for audible status and operation communications

- ***Topography & Mining***
- ***As-Built Surveying***
- ***Architecture & Facade Measurement***
- ***Archaeology & Cultural Heritage Documentation***
- ***City Modelling***
- ***Civil Engineering***
- ***Forestry***
- ***Research***

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RIEGL®
LASER MEASUREMENT SYSTEMS

Terrestrial Laser Scanning

VZ-1000 Key Features and Components

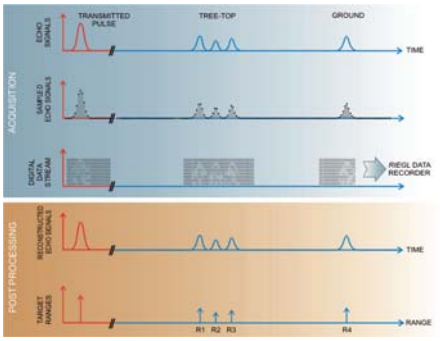
High-Resolution and Accurate 3D Measurements

The 3D Laser Scanner *RIEGL* VZ-1000 provides a measurement range of more than 1,400 m, 5 mm repeatability and an efficient measurement rate up to 122,000 measurements/sec. The fully portable, rugged and robust instrument offers a wide field of view of 100° vertical and 360° horizontal, and uses an invisible laser beam for eye safe operation in Laser Class 1.

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 2.0 interface are provided via the scanner directly.

The combination of scanner, software, and camera results in photorealistic 3D data, exact identification of details, position and distance measurements, as well as a depiction of any virtual point of view.



Waveform Data Output Option

The digitized echo signals, also known as waveform data, acquired by the *RIEGL* VZ-1000 are the basis for waveform analysis.

This data is provided by the optionally available waveform data output and accessible via the associated *RIEGL* software library RiWAVELib for investigations and research on multi target situations based on the digital waveform data samples of the target echoes.

Compatible Software Package

The *RIEGL* VZ-1000 is compatible with the *RIEGL* software package RiSCAN PRO for terrestrial laser scanning, *RIEGL*'s interface library RiVLib, as well as the workflow-optimizing software packages, e.g. RiMINING.

Combined with the one-touch workflow of the scanner, *RIEGL*'s ultimate 3D scene capture solution, RiSOLVE, enables fully automatic registration and colorization of scan data.

Supported Registration Methods

Direct Geo-Referencing

- integrated GPS receiver (L1) connected
- external high-end RTK GNSS receiver connected
- integrated compass, accuracy typ. 1°
  (one sigma value, available for vertical scanner setup position)
- on-board inclination sensors (tilt range ±10°, accuracy typ. ±0.008°)

GNSS Traversing

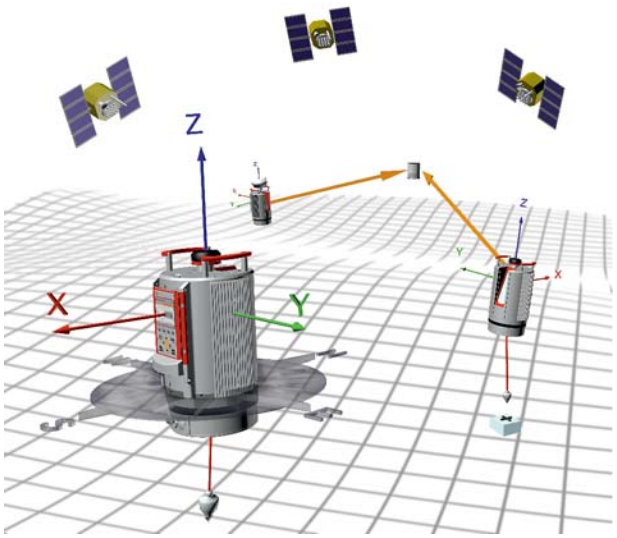
- GNSS position (RTK or autonomous)
- on-board inclination sensors
- automatic acquisition of well known remote target (reflector)

Free Stationing

- fast fine scanning of reflectors for precise determination of scanner position using control points

Backsighting

- setup on well known point
- on board inclination sensors
- precise fine scanning of well known remote target (reflector)



Operating Elements and Connectors

WLAN antenna

Carrying handles

High-resolution color TFT display

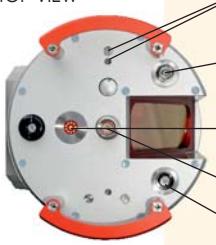
Key pad for instrument control

Connectors for power supply and LAN interface 10/100 MBit/sec, power off/on button

Communication and Interfaces

- *LAN port 10/100/1000 MBit/sec within rotating head*
- *LAN port 10/100 MBit/sec within base*
- *integrated WLAN interface with rod antenna*
- *USB 2.0 for external storage devices (USB flash drives, external HDD)*
- *USB 2.0 for connecting the optional digital camera*
- *connector for GPS antenna*
- *two ports for external power supply*
- *connector for external GPS synchronization pulse (1PPS)*
- *connector for external GNSS receiver*
- *connector for optional add-on battery*

TOP VIEW



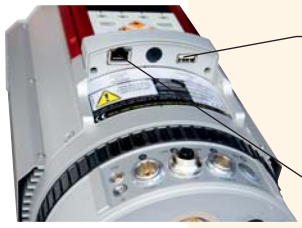
Mounting points (3x) and mounting thread inserts (2x) for digital camera

Connector for external GNSS receiver

USB and DC power connector for optional digital camera

Connector for GPS antenna (internal receiver)

Connector for WLAN antenna



USB 2.0 slot for external memory devices

LAN 10/100/1000 MBit/sec, for rapid download of scan data

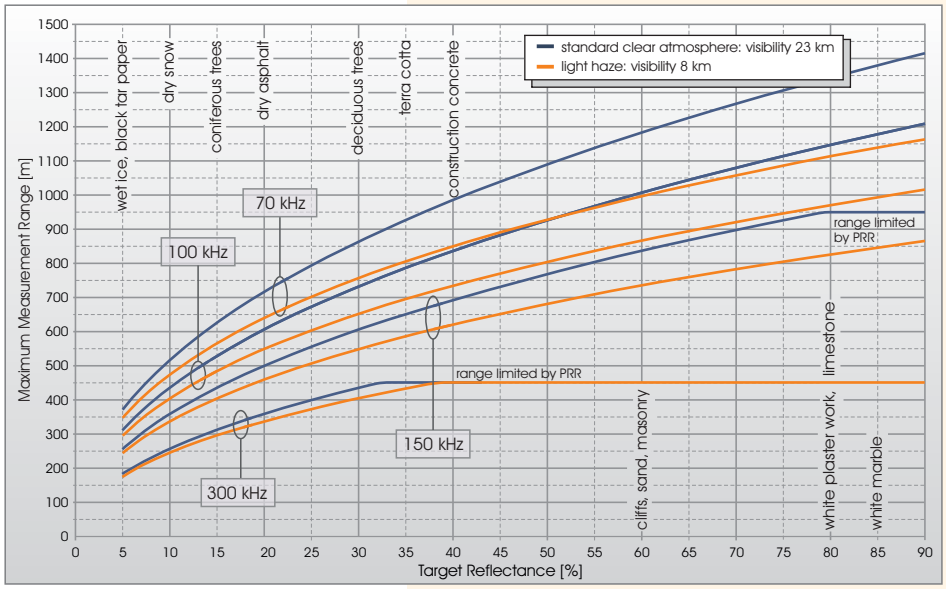
Scan Data Storage

- *internal 32 GBytes flash memory (2 GBytes reserved for the operating system)*
- *external storage devices (USB flash drives or external hard drives) via USB 2.0 interface*

Max. Measurement Range

The following conditions are assumed:

Flat target larger than footprint of laser beam, perpendicular angle of incidence, average brightness



Technical Data 3D Scanner Hardware *RIEGL* VZ®-1000

Laser Product Classification	Class 1 Laser Product according to IEC 60825-1:2014

CLASS 1
LASER PRODUCT

Range Performance[1]

Laser Pulse Repetition Rate PRR (peak) [2]	70 kHz	100 kHz	150 kHz	300 kHz
Effective Measurement Rate (meas./sec) [2]	29,000	42,000	62,000	122,000
Max. Measurement Range [3] for natural targets $\rho \geq 90\%$ for natural targets $\rho \geq 20\%$	 1,400 m 700 m	 1,200 m 600 m	 950 m[4] 500 m	 450 m[4] 350 m
Max. Number of Targets per Pulse	practically unlimited [5]			
Accuracy [6] [8]	8 mm			
Precision [7] [8]	5 mm			

Minimum Range	2.5 m
Laser Wavelength	near infrared
Beam Divergence [9]	0.3 mrad

1) with online waveform processing
2) rounded values, selectable by measurement program
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 an overcast sky.
4) limited by PRR
5) If the laser beam hits, in part, more than one target, the laser's pulse power is split accordingly. Thus, the achievable range is reduced. Details on request.
6) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
7) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
8) One sigma @ 100 m range under *RIEGL* test conditions.
9) Measured at the $1/e^2$ points. 0.3 mrad corresponds to an increase of 30 mm of beam diameter per 100 m distance.

Scan Performance

	Vertical (Line) Scan	Horizontal (Frame) Scan
Scan Angle Range	total 100° (+60° / -40°)	max. 360°
Scanning Mechanism	rotating multi-facet mirror	rotating head
Scan Speed	3 lines/sec to 120 lines/sec	0°/sec to 60°/sec [10]
Angular Stepwidth $\Delta\vartheta$ (vertical), $\Delta\varphi$ (horizontal)	$0.0024° \leq \Delta\vartheta \leq 0.288°$ [11] between consecutive laser shots	$0.0024° \leq \Delta\varphi \leq 0.5°$ [11] between consecutive scan lines
Angle Measurement Resolution	better 0.0005° (1.8 arcsec)	better 0.0005° (1.8 arcsec)

Inclination Sensors	integrated, for vertical scanner setup position, details see page 2
GPS receiver	integrated, L1 antenna
Compass	integrated, for vertical scanner setup position, details see page 2
Internal Sync Timer	integrated, real-time synchronized time stamping of scan data
Scan Sync (optional)	scanner rotation synchronization

10) frame scan can be disabled, providing 2D operation
11) selectable, minimum stepwidth increasing to 0.004° @ 70 kHz PRR

General Technical Data

Power Supply Input Voltage	11 - 32 V DC
Power Consumption	Scanning, typ. 75 W (max. 90 W)
External Power Supply	up to three independent external power sources can be connected for uninterrupted operation
Main Dimensions	Ø 200 mm x 308 mm (diameter x length)
Weight	approx. 9.8 kg
Humidity	max. 80 % non condensing @ +31°C
Protection Class	IP 64 (dust and splash-proof)
Temperature Range	
Storage	-10°C to +50°C
Operation	0°C to +40°: standard operation
Low Temperature Operation [12]	-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

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

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LASER MEASUREMENT SYSTEMS

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