

## 3D Very Long Range Terrestrial Laser Scanner with Online Waveform Processing

# RIEGL VZ-4000<sup>®</sup>

- very long range up to 4,000 m
- eye safe operation at Laser Class 1
- wide field of view, 60° x 360°
- high speed data acquisition up to 222,000 meas. / second
- high accuracy, high precision ranging based on echo digitization and online waveform processing
- multiple target capability - unlimited number of targets
- optional waveform data output
- built-in calibrated digital camera
- on-board inclination sensors
- integrated L1 GPS receiver with antenna
- integrated compass
- built-in SSD drive storage
- compact and rugged design
- advanced camera options

This 3D VZ-Line Laser Scanner offers superior and unrivaled long range measurement performance up to 4,000 m reflectorlessly while still maintaining completely eye safe operation (Laser Class 1).

RIEGL's unique V-Line technology is based on echo digitization and online waveform processing and is the key to enabling such extreme long range measurements. The VZ-4000 operates even in poor visibility and demanding multi target situations caused by dust, haze, rain, snow, etc. which are frequently found in difficult environments such as mine sites.

### Modes of Operation:

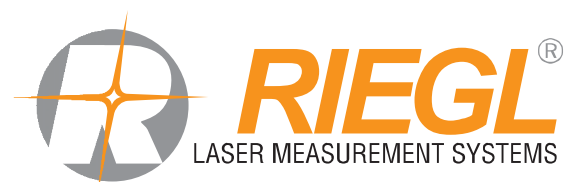
- stand-alone operation with integrated graphical user interface via 7" touchscreen
- remote control VNC Viewer with any standard tablet PC or mobile device via WiFi
- remote operation with RiSCAN PRO on a notebook via LAN or WiFi connection
- customized operation by third party tools / applications based on RIEGL's well documented interfaces and scanner libraries (e.g., RiVLib).

### Typical applications include

- Topography & Mining
- Long Range Monitoring
- Civil Engineering
- Archaeology



visit our website  
[www.riegl.com](http://www.riegl.com)



# VZ<sup>®</sup>-4000 Key Features and Components



## Extremely Long Range Performance

The High-Speed, High-Resolution 3D Laser Scanner *RIEGL VZ-4000* offers an extremely long range of more than 4,000 m and a wide field of view of 60° vertical and 360° horizontal. It uses an invisible laser beam for eye safe operation in Laser Class 1.

The high accuracy and reliability of range measurement performance is based on *RIEGL*'s unique V-Line technology of echo digitization and online waveform processing. Extreme long range measurements can be achieved even with poor visibility and demanding multi target situations caused by dust, haze, rain, snow, etc.

## Built-in Camera

A built-in calibrated 5-Megapixel camera capturing images deflected by the laser mirror enables coverage of the entire field of view with an appropriate number of high resolution images automatically stitched together to create a high resolution panorama image. This panorama image, in combination with precise 3D measurements produced by the *VZ-4000*, enables the creation of photorealistic virtual models for geological and geotechnical investigations, avalanche research, geomorphology, and geological features.

## Waveform Data Output Option

The digitized echo signals, also known as waveform data, acquired by the *RIEGL VZ-4000* 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 investigations and research on multi target situations based on the digital waveform data samples of the target echoes.

## Compatible Software Packages

The *RIEGL VZ-4000* 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*. The optional software plugin *RiMTA TLS* provides automatic assignment of the scan data to the correct MTA zone in multiple time around situations.

## 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  $\pm 10^\circ$ , accuracy typ.  $\pm 0.008^\circ$ )

### GNSS Traversing

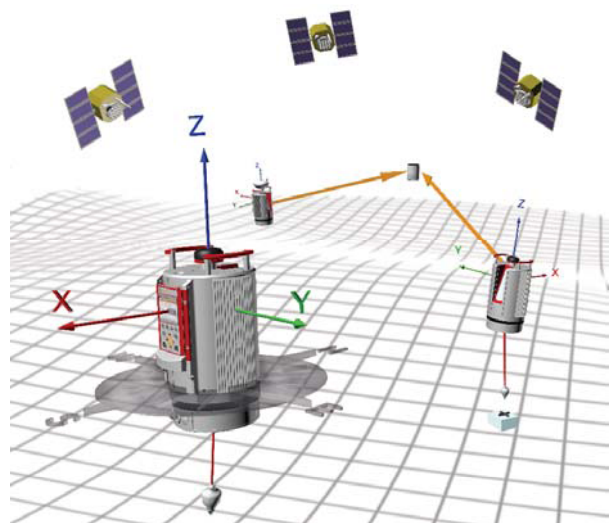
- GNSS position (RTK or autonomous)
- on-board inclination sensors
- automatic acquisition of well known remote target (reflector)

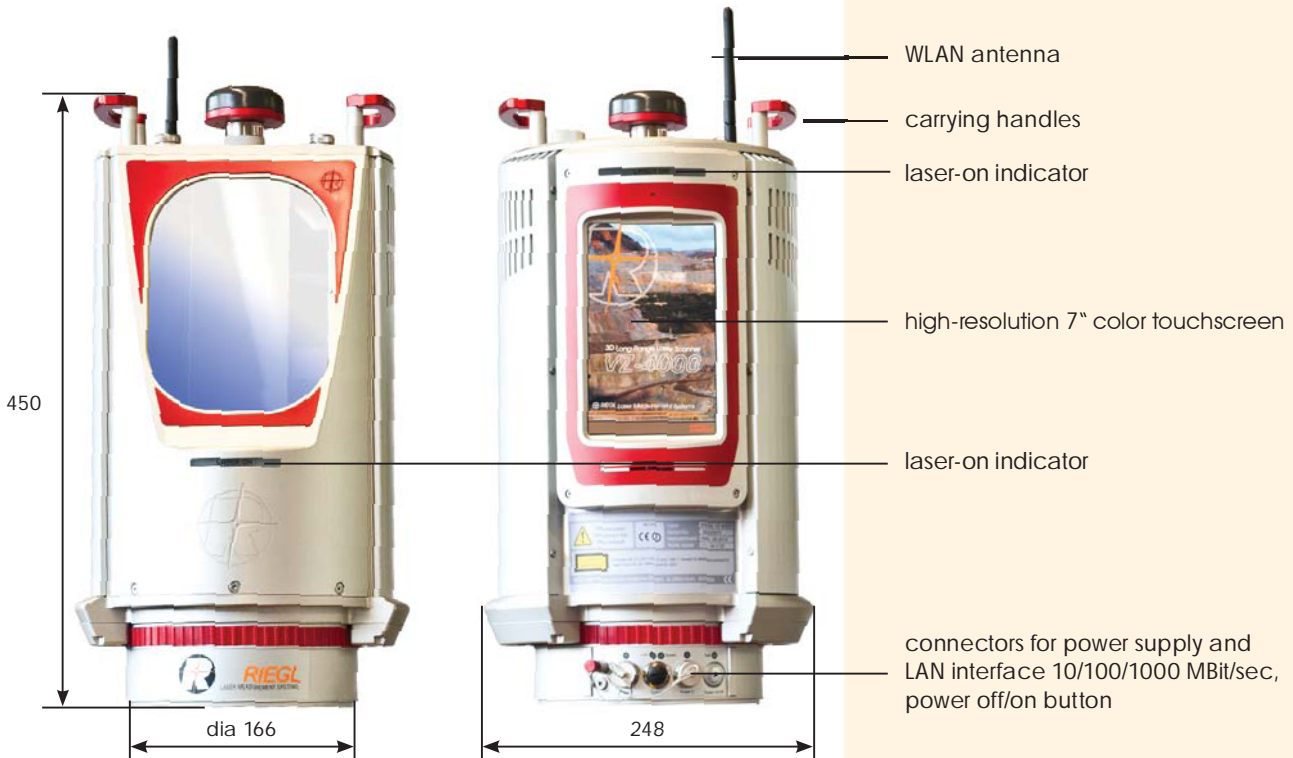
### Free Stationing

- 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)

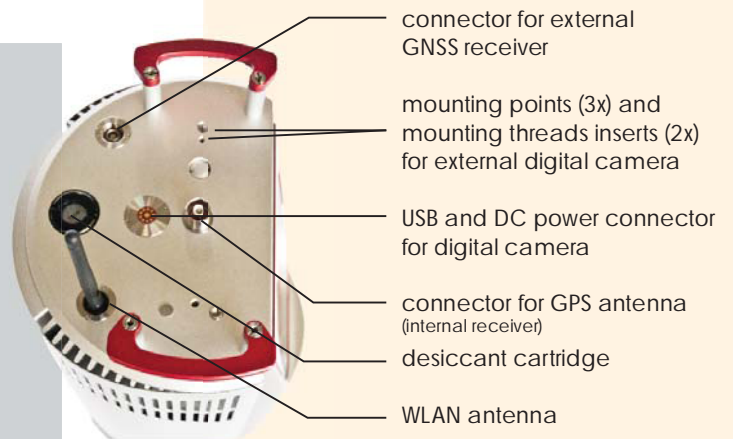




All dimensions in mm.

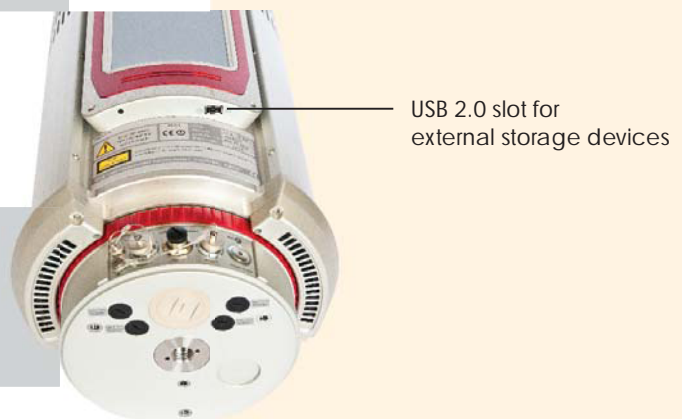
## Communication and Interfaces

- LAN port 10/100/1000 MBit/sec within base
- integrated WLAN interface with high-gain antenna
- USB 2.0 for connecting an external digital camera
- connector for GPS antenna
- two external power supply ports
- connector for external GPS synchronization pulse (1PPS)
- connector for external GNSS receiver



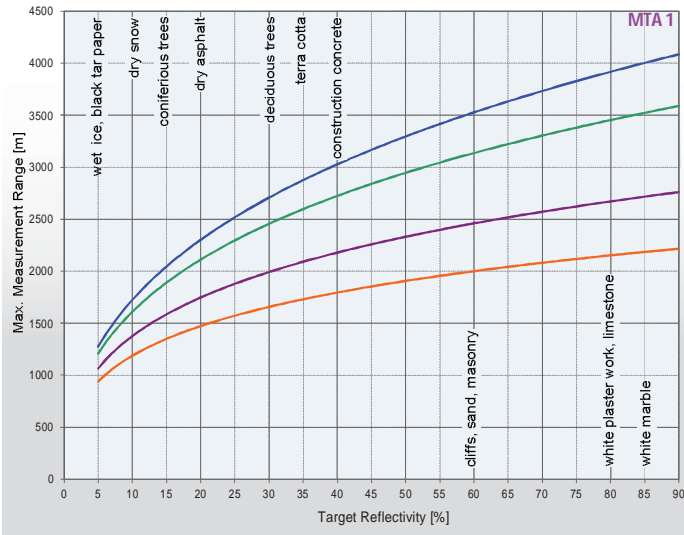
## Scan Data Storage

- **internal 80 GBytes SSD (Solid State Disc)** (2 GBytes reserved for the operating system)
- **external storage devices** (USB flash drives or external hard drives) **via USB 2.0 interface**

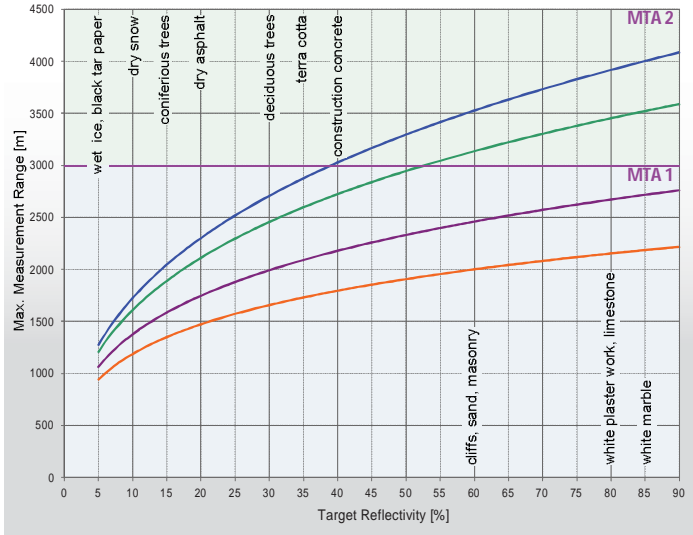


Blue	standard clear atmosphere: visibility 23 km
Green	clear atmosphere: visibility 15 km
Purple	light haze: visibility 8 km
Orange	medium haze: visibility 5 km

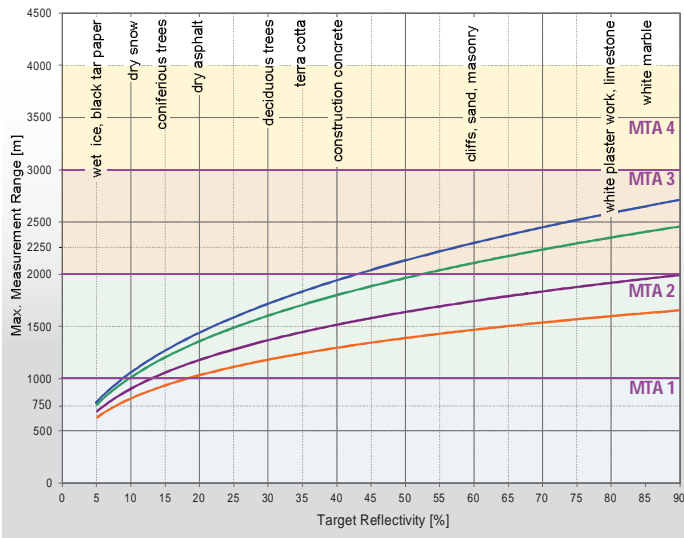
### 30 kHz PRR



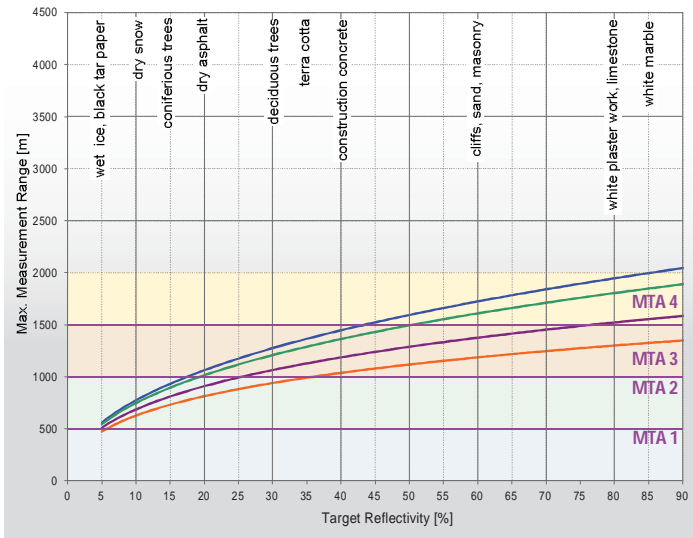
### 50 kHz PRR



### 150 kHz PRR



### 300 kHz PRR



**The following conditions are assumed:**

- flat target larger than footprint of the laser beam
- perpendicular angle of incidence
- average brightness
- ambiguity resolved by post processing with RIMTA TLS

**MTA zones:**

- MTA 1: no ambiguity / 1 pulse „in the air“*
- MTA 2: 2 pulses „in the air“*
- MTA 3: 3 pulses „in the air“*
- MTA 4: 4 pulses „in the air“*

## User-Friendly and Efficient Operation and Acquisition Workflow

Operation is easy with the integrated graphical user interface via 7" touchscreen, or by remote control of the scanner via VNC Viewer with any tablet PC or mobile device via WiFi connection.

Highly efficient scan data acquisition and global registration is supported by on-board inclination sensors, integrated L1 GPS receiver, an interface

for a high-end external GNSS receiver on top of the scanner, a digital compass and built-in SSD data storage media. With a visual project overview of acquired scan data, it is possible to ensure complete data coverage or check the progress of a project as it is acquired. The system provides a number of useful features that help to make the user experience better overall. One of these features is the ability to schedule scans to be acquired fully automatically on a regularly defined time interval which is useful for

capturing 4D (3D time-lapse) datasets without direct user supervision of the system.



## Power Supply

- intelligent power supply management, up to three independent external power sources can be connected simultaneously for uninterrupted operation
- reliable under- and over voltage protection
- wide external voltage supply range 11-32 V DC
- power consumption typ. 75 W (max. 90W)
- LED indicators for power status

## Camera Capabilities

### Advanced Camera Support Capability

The VZ-Line of scanners has been updated with advanced camera support capability. Utilizing a specialized interface and a universal mount system, *RIEGL* is able to provide support for a wide variety of industrial cameras in standalone operation. This development enables the VZ-4000 to **directly control, operate and acquire images from RGB, Thermal, Industrial and a number of other camera systems and types** without complex cabling, connections or the need of an external laptop. With simplified mount integrations, it is now possible to acquire advanced images from state-of-the-art camera technologies simply using *RIEGL* Terrestrial Laser Scanners.



# Technical Data *RIEGL* VZ<sup>®</sup>-4000

## Laser Product Classification

Class 1 Laser Product according to IEC60825-1:2007  
The following clause applies for instruments delivered into the United States:  
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant  
to Laser Notice No. 50, dated June 24, 2007.



## Range Measurement Performance <sup>1)</sup> Measuring Principle

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

## Mode of operation

Laser Pulse Repetition Rate PRR (peak) <sup>2)</sup>	30 kHz	50 kHz	150 kHz	300 kHz
Effective Measurement Rate (meas./sec) <sup>2)</sup>	23,000	37,000	113,000	222,000
Max. Measurement Range <sup>3)</sup>				
natural targets $\rho \geq 90\%$	4,000 m	4,000 m <sup>4)</sup>	2,700 m <sup>4)</sup>	2,000 m <sup>4)</sup>
natural targets $\rho \geq 20\%$	2,300 m	2,300 m <sup>4)</sup>	1,450 m <sup>4)</sup>	1,000 m <sup>4)</sup>
Max. Number of Targets per Pulse	practically unlimited <sup>5)</sup>			

## Accuracy <sup>6) 8)</sup>

15 mm

## Precision <sup>7) 9)</sup>

10 mm

## Minimum Range

5 m

## Laser Wavelength

near infrared

## Laser Beam Divergence

0.15 mrad

## Laser Beam Footprint (Gaussian Beam Definition)

18 mm @ exit, 75 mm @ 500 m, 150 mm @ 1000 m, 300 mm @ 2000 m

- 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 overcast sky.

- 4) Ambiguity to be resolved by post-processing with RIMTA TLS
- 5) 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 @ 150 m range under *RIEGL* test conditions.
- 9) Measured at the 1/e<sup>2</sup> points. 0.15 mrad corresponds to an increase of 15 mm of beam diameter per 100 m of range.

## Scanner Performance Scanning Mechanism

*Vertical (Line) Scan*  
lightweight mirror  
rotating / oscillating

*Horizontal (Frame) Scan*  
rotating head

## Field of View (selectable)

total 60° (+30° / -30°)

max. 360°

## Scan Speed (selectable)

100°/sec to 14 400°/sec (= 20 rotations/sec), full FOV

0°/sec to 60°/sec <sup>10)</sup>

## Angular Step Width $\Delta \vartheta$ (vertical), $\Delta \varphi$ (horizontal)

0.002° ≤  $\Delta \vartheta$  ≤ 0.280° <sup>11)</sup>

0.002° ≤  $\Delta \varphi$  ≤ 3° <sup>11)</sup>

better 0.0005° (1.8 arcsec)  
between consecutive laser shots

better 0.0005° (1.8 arcsec)  
between consecutive scan lines

## Angle Measurement Resolution

## Inclination Sensors

integrated, for vertical scanner setup position, details see page 2

## GPS Receiver

integrated, L1, with antenna

## Compass

integrated, for vertical scanner setup position, details see page 2

## Laser Plummet

integrated

## Internal Sync Timer

integrated, for real-time synchronized time stamping of scan data

## Scan Sync (optional)

scanner rotation synchronization

## Waveform Data Output (optional)

providing digitized echo signal information for specific target echoes

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

11) Selectable.

## General Technical Data

### Power Supply Input Voltage / Power Consumption External Power Supply

11 - 32 V DC / typ. 75 W (max. 90 W)  
up to 3 independent external power sources can be connected  
simultaneously for uninterrupted operation

### Main Dimensions / Weight

248 x 226 x 450 mm (length x width x height), approx. 14.5 kg

### Humidity / Protection Class

max. 80 % non condensing @ +31°C / IP64, dust- and splash-proof

### Temperature Range

-10°C up to +50°C / 0°C up to +40°C (standard operation)

### Storage / Operation

-20°C: continuous scanning operation if instrument is powered on  
while internal temperature is at or above 0°C and still air

### Low Temperature Operation <sup>12)</sup>

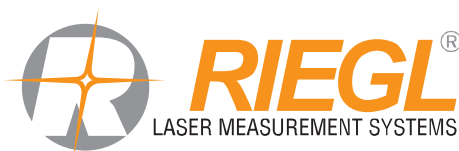
## Integrated Digital Camera

field of view 7.2°x5.5° (v x h)  
resolution 2560 x 1920 pixels (5 Mpixel)

## Display

7" WVGA (800 x 480) color  
capacitive touchscreen, full operation control for stand alone usage

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



Edificio Antalia  
Albasanz, 16  
28037 MADRID  
Tel: 91 567 97 00  
Fax: 91 570 26 61

[www.alvainingenieros.com](http://www.alvainingenieros.com)



Torre Mapfre-Vila Olímpica  
Marina, 16 - Planta 11-C-2  
08005 BARCELONA  
Tel: 93 459 42 50  
Fax: 93 459 42 62

[alava@alava-inges](mailto:alava@alava-inges)

[www.riegl.com](http://www.riegl.com)