

Long Range, High Speed 3D Terrestrial Laser Scanner with Online Waveform Processing

# RIEGL VZ-2000<sup>®</sup>

- **very long range**  
*up to more than 2,000 m*
- **very high effective measurement rate**  
*up to 400,000 meas./sec*
- **eye safe operation in Laser Class 1**
- **wide field of view, 100° x 360°**
- **fully customizable scan parameters**  
*(field of view, laser pulse repetition rate PRR, measurement rate)*
- **ideal for use within the RIEGL VMZ Hybrid Mobile Laser Mapping System**
- **high accuracy, high precision ranging**  
*based on echo digitization and online waveform processing*
- **multiple target capability - unlimited number of targets**
- **high-precision mount for optional digital camera**
- **on-board inclination sensors**
- **integrated L1 GPS receiver with antenna**
- **interface for external GNSS receiver**
- **integrated compass and laser plummet**
- **various interfaces (LAN, WLAN, USB 2.0)**
- **internal data storage**



The V-Line<sup>®</sup> 3D Laser Scanner *RIEGL VZ-2000* is characterized by an extremely high effective measurement rate offering high accuracy data acquisition up to 400,000 measurements/sec and up to 240 scan lines/sec. The scanner further offers exceptional long range measurement performance of more than 2000 m to natural surfaces while still maintaining completely eye safe operation (Laser Class 1).

*RIEGL's* unique V-Line technology, based on echo digitization, online waveform processing, and multiple-time-around processing is the key to enabling such high speed, long range, high accuracy measurements even in poor visibility and demanding multi target situations caused by dust, haze, rain, snow, etc.

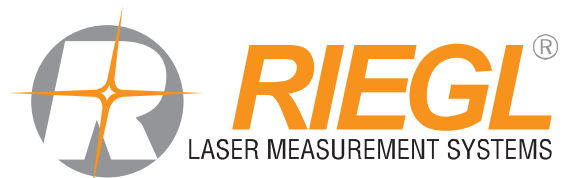
## Modes of Operation:

- stand-alone operation with integrated graphical user interface via 3.5" TFT color display
- remote control with any standard tablet PC or mobile device via WiFi and Web-Browser
- 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

- *Stand-alone Static and (within RIEGL VMZ) Mobile Laser Scanning*
- *Open-Pit Mining*
- *Measurement of Bulk Material*
- *Civil Engineering*
- *City Modeling*
- *Mapping of Construction Sites and Construction-Site Monitoring*
- *Surveillance*
- *Archaeology*

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



# VZ<sup>®</sup>-2000 Key Features and Components

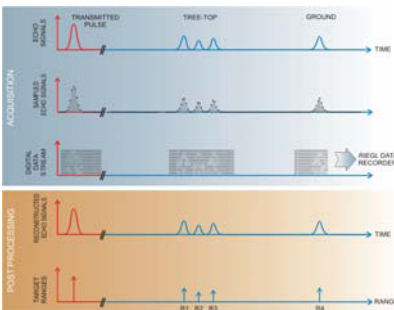
## High Speed Performance

The High-Speed 3D Laser Scanner *RIEGL* VZ-2000 provides state-of-the-art laser technology offering Laser PRR up to 950 kHz. *RIEGL*'s unique MTA processing software enables exploiting the full scanner's capability resulting in an effective measurement rate up to 400,000 measurements per second. Additionally the scanner offers an excellent maximum range of more than 2000 m, 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 recreation of any virtual point of view. For mobile scanning application within a *RIEGL* VMZ System, the additional functionality for triggering and exact GPS synchronization is supported.



## Waveform Data Output Option

The digitized echo signals, also known as waveform data, acquired by the *RIEGL* VZ-2000 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-2000 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. 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.

For mobile laser scanning applications within a *RIEGL* VMZ-System the *RIEGL* software packages RiACQUIRE, RiPROCESS, RiPRECISION, and RiWORLD, provide a seamless workflow for data acquisition and processing.

## 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

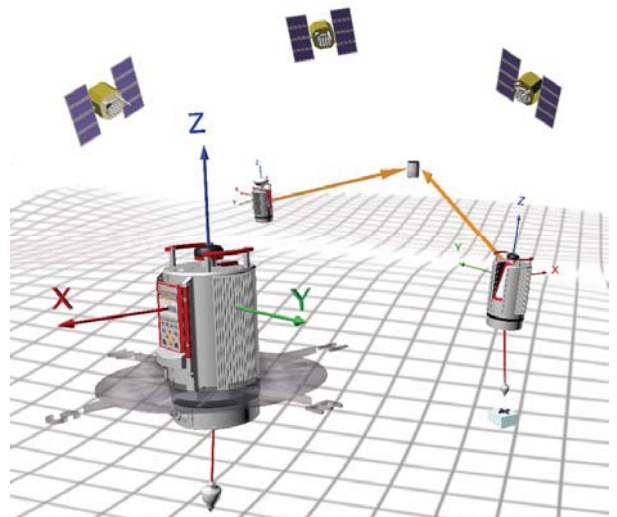
- GNSS position (RTK or autonomous)
- on-board inclination sensors
- automatic acquisition of well known remote target (reflector)

### 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)

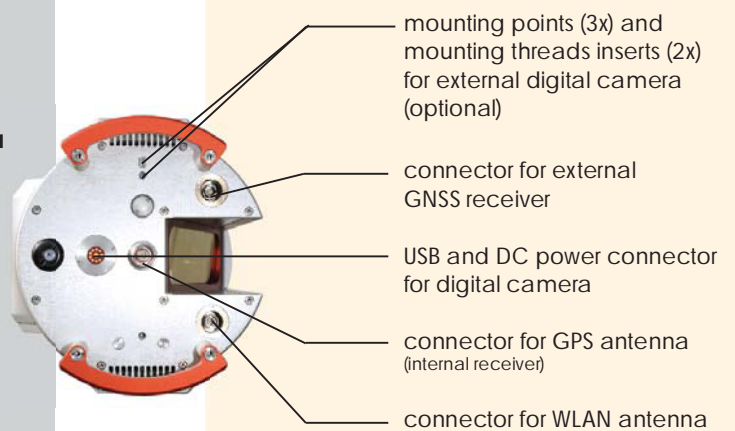




All dimensions in mm.

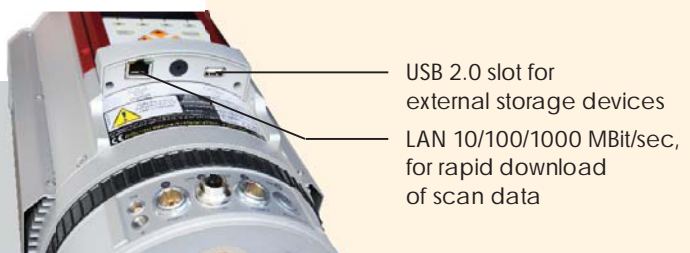
### Communication and Interfaces

- LAN port 10/100/1000 MBit/sec within 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



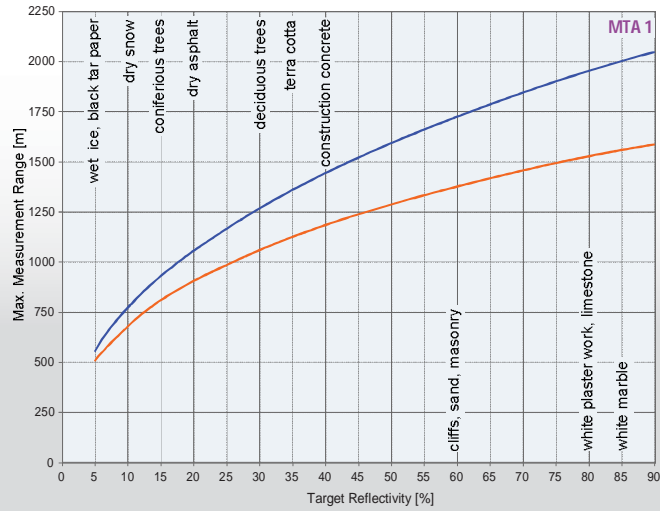
### Scan Data Storage

- internal 64 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

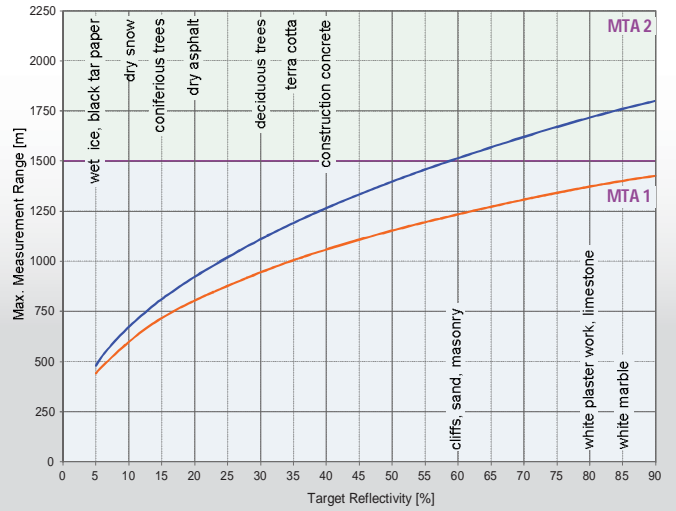


# RIEGL VZ®-2000 Max. Measurement Range vs. Target Reflectivity

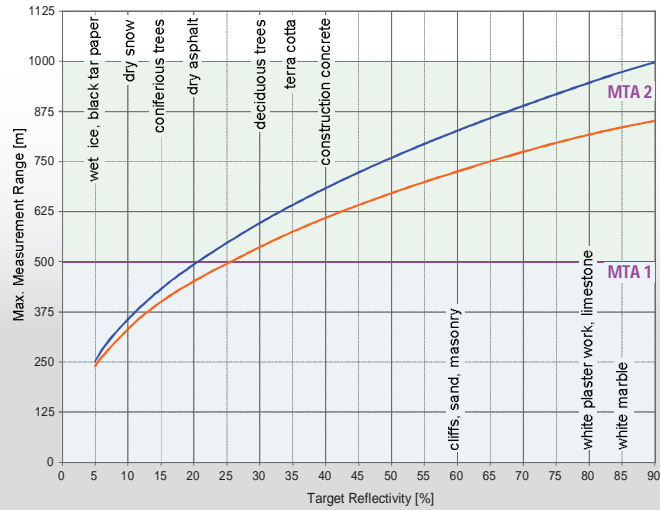
## 50 kHz PRR



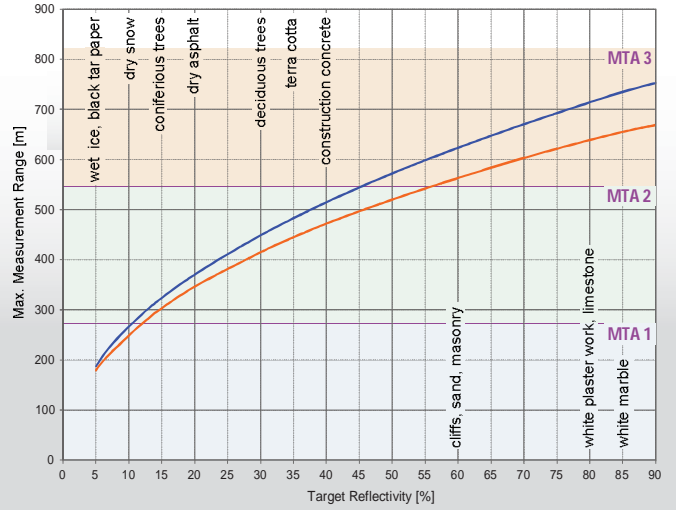
## 100 kHz PRR



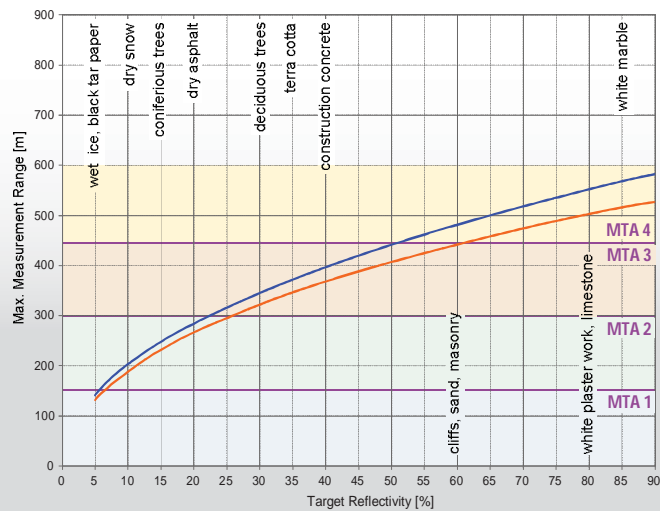
## 300 kHz PRR



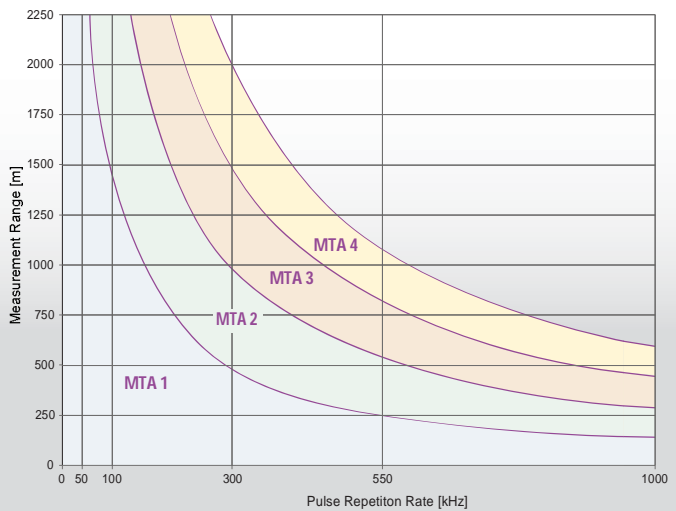
## 550 kHz PRR



## 1 MHz PRR



## MTA zones vs. 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“

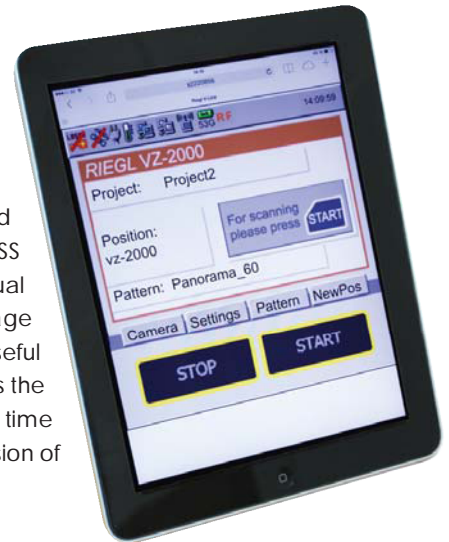
- standard clear atmosphere: visibility 23 km
- light haze: visibility 8 km



## User-Friendly and Efficient Operation and Acquisition Workflow

Operation is easy with the integrated graphical user interface via 3.5" TFT color display, or by remote control of the scanner via WIFI connection and Web Browser 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 internal data storage. 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 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. 85 W (max. 110 W)
- LED indicators for power status
- optional add-on rechargeable battery pack (high power, high capacity NiMH cells)



## Mobile Scanning with the RIEGL VMZ Hybrid Mobile Mapping System

### RIEGL VMZ Hybrid Mobile Mapping System

The RIEGL VZ-2000 3D Terrestrial Laser Scanner provides an extremely high measurement rate and a fast scanning mechanism. Thus, it is excellently suited for integration with the RIEGL VMZ System for combined static and kinematic data acquisition resulting in lower mobilization costs with a high return on investment. A fully integrated IMU/GNSS unit supports the scanner for kinematic data acquisition.

Fast transition from tripod to mobile mount without the necessity of bore-sight calibration is realized by use of an adapter plate mounted to the scanner. Mobile mounts for vertical or horizontal position offer flexible setup and easy mounting on the frame based roof mount which is compatible with standard roof bars.

By applying different scanning modes data acquisition can be arranged according to the requirements of each application.



# Technical Data *RIEGL VZ*<sup>®</sup>-2000

## 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, up to 300 kHz PRR)  
single pulse ranging

## Mode of operation

Laser Pulse Repetition Rate PRR (peak) <sup>2)</sup>	50 kHz	100 kHz	300 kHz	550 kHz	1 MHz
Effective Measurement Rate (meas./sec) <sup>2)</sup>	21,000	42,000	122,000	230,000	396,000
Max. Measurement Range <sup>3)</sup>					
natural targets $\rho \geq 90\%$	2,050 m	1,800 m <sup>4)</sup>	1,000 m <sup>4)</sup>	750 m <sup>4)</sup>	580 m <sup>4)</sup>
natural targets $\rho \geq 20\%$	1,050 m	930 m <sup>4)</sup>	500 m <sup>4)</sup>	370 m <sup>4)</sup>	280 m <sup>4)</sup>
Max. Number of Targets per Pulse	practically unlimited <sup>5)</sup>				

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

8 mm

## Precision <sup>7) 8)</sup>

5 mm

## Minimum Range

2.5 m

## Laser Wavelength

near infrared

## Laser Beam Divergence

0.3 mrad <sup>9)</sup>

- 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. 0.3 mrad corresponds to an increase of 30 mm of beam diameter per 100 m of range.

## Scanner Performance

### Scanning Mechanism

### Vertical (Line) Scan

### Horizontal (Frame) Scan

rotating multi-facet mirror

rotating multi-facet mirror

rotating head

Field of View (selectable)

total 100° (+60° / -40°)

max. 360°

Scan Speed (selectable)

3 lines/sec to 240 lines/sec

0°/sec to 150°/sec <sup>10)</sup>

Angular Step Width  $\Delta \theta$  (vertical),  $\Delta \phi$  (horizontal)

$0.0015^\circ \leq \Delta \theta \leq 1.15^\circ$  <sup>11)</sup>

$0.0024^\circ \leq \Delta \phi \leq 0.62^\circ$  <sup>11)</sup>

between consecutive laser shots

between consecutive scan lines

### Angle Measurement Resolution

better 0.0015° (5.4 arcsec)

better 0.0005° (1.8 arcsec)

### 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 <sup>12)</sup>

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

- 11) Selectable, minimum stepwidth increasing to 0.014° @ 50 kHz PRR
- 12) up to a max. PRR of 300 kHz

## General Technical Data

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

11 - 32 V DC / typ. 85 W (max. 110 W)  
up to 3 independent external power sources can be connected  
simultaneously for uninterrupted operation

### Main Dimensions / Weight

196 x 203 x 308 mm, approx. 9.9 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)

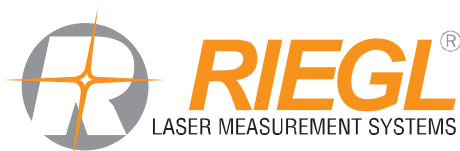
### Storage / Operation

-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>13)</sup>

-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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