

Compact & lightweight bathymetric depth finder for surveying tasks

**NEW**

# RIEGL BDF-1

- **Laser rangefinder for bathymetric applications**
- **Surveying system with integrated IMU, GNSS, and data storage unit**
- **Optimized for UAV-borne operation**
- **Ideally suited for generating profiles of inland waterbodies**
- **Optionally equipped with up to two external cameras**
- **Active pitch compensation**
- **Essential performance improvements in adverse conditions by predetection averaging**
- **Highly accurate, reliable and informative bathymetric data resulting from RIEGL's proprietary hydrographic waveform processing**

World Premiere at  
**INTERGEO 2016**

The **RIEGL BDF-1** is a laser range finder specifically designed for bathymetric surveying tasks. The compact and lightweight device is ideally suited for generating profiles of inland waterbodies when operated from a UAV. The topo-bathymetric depth finder comprises of tilt compensator, an IMU/GNSS unit with antenna, a control unit, and can be equipped with up to two external digital cameras.

The BDF-1 laser depth finder sends out laser pulses at a rate of 4 kHz. The echo signal for each laser pulse is digitized and recorded for the entire range gate of 50 m. This means that predetection averaging of the waveforms can be performed in post processing, increasing the depth performance. The averaging rate can be chosen after the flight on basis of measurement conditions. Subsequently the waveforms are processed by **RIEGL's** new and patented hydrographic full waveform processing algorithm based on exponential decomposition. Finally data sets with high accuracy, high range resolution, and hydrography-specific attributes are provided which support point classification.

The BDF-1 is designed to be operated from low altitudes at moderate flying speeds, as in surveying missions carried out by UAV or RPAS. With a measurement rate of 4 kHz the distance of the measurements on the ground is in the range between 1 cm and 10 cm, depending on the flying speed and averaging rate.

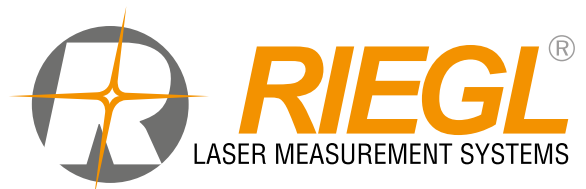
An innovative optical design allows the device to be classified as Class 2M Laser Product which can be considered safe for the unaided eye.

#### Typical applications include

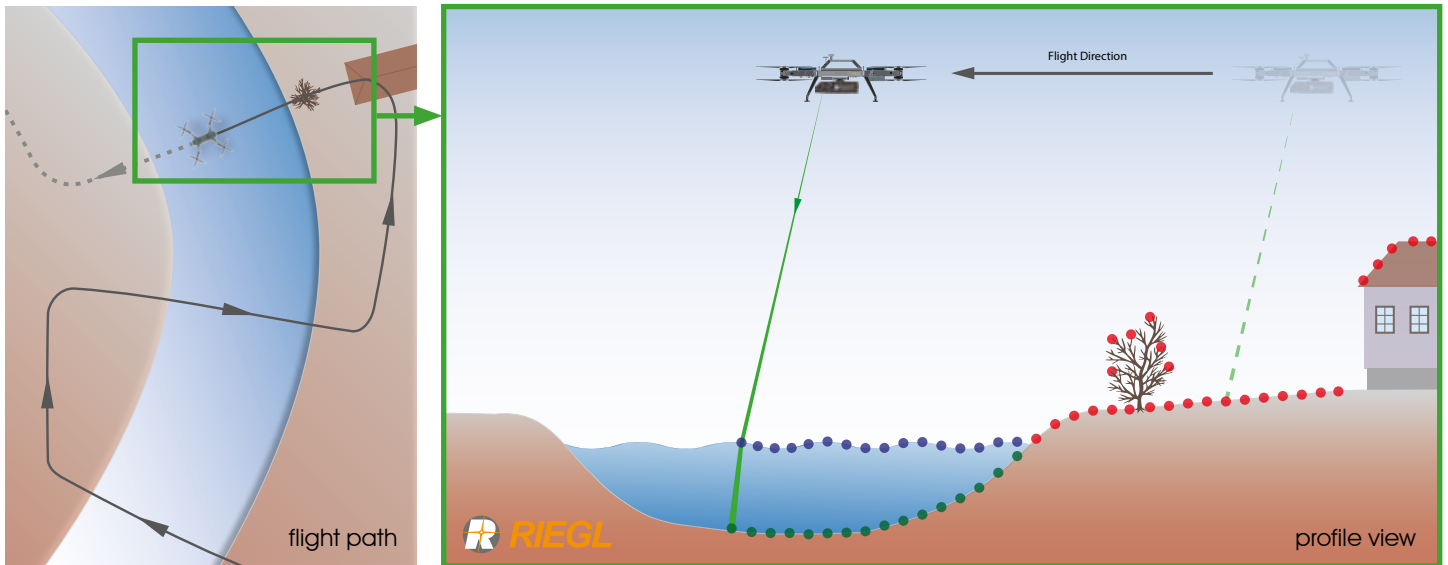
- **Generation of River Profiles**
- **Repeated Survey of Water Reservoirs**
- **Canal Surveying**
- **Landscaping**
- **Surveys for Planning and Hydraulic Engineering Work**



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## RIEGL BDF-1 Measuring Principle



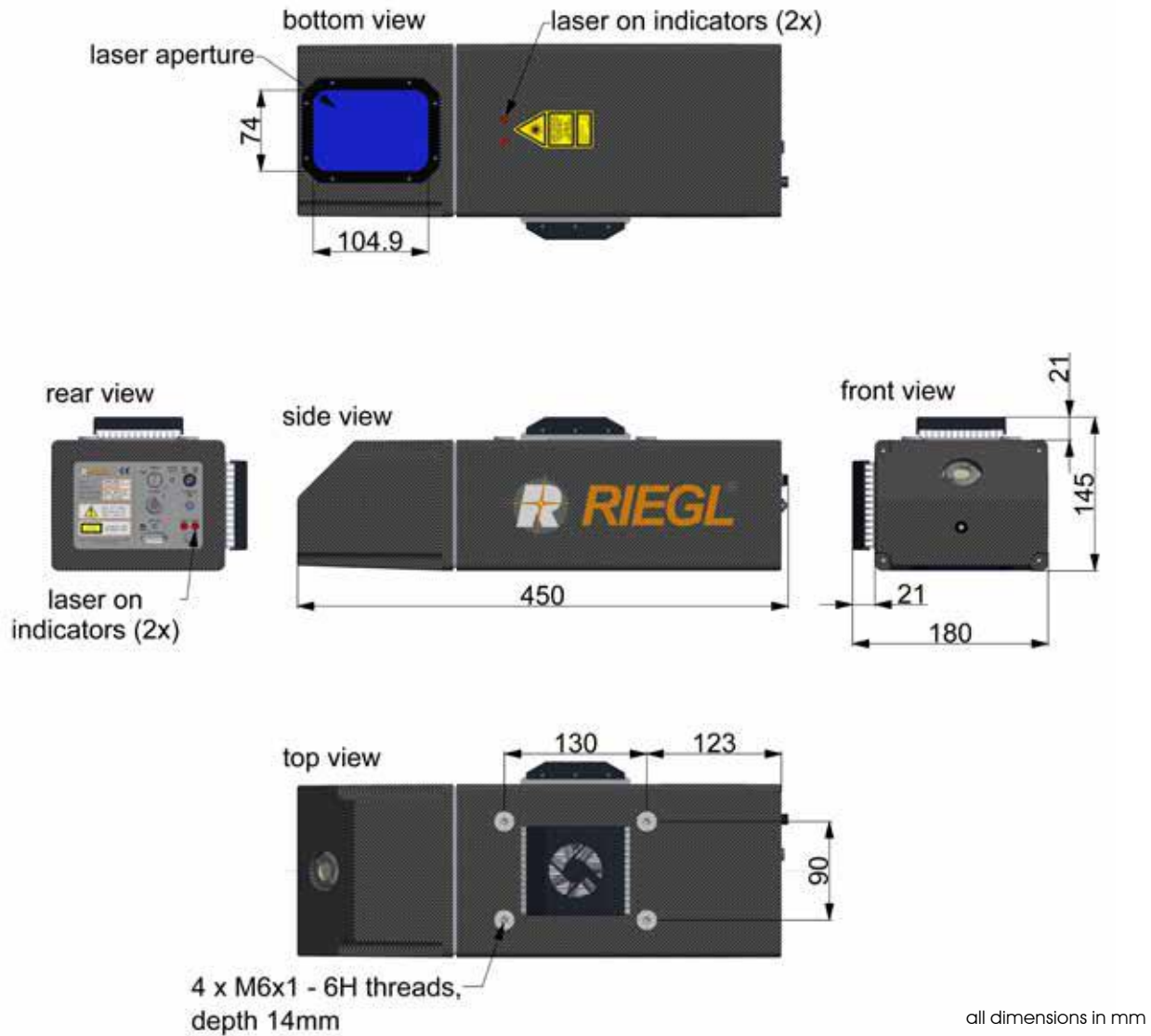
The figures above illustrate the measurement principle of the BDF-1 when operated from a UAV: The UAV performs a meander-like flight path over an inland water body (river, channel, or lake) while the BDF-1 is measuring downward with its defined and stabilized look-ahead angle. Profiles of the water surface (blue circles), ground (green circles) as well as the surrounding landscape (red circles) are generated this way. The multi-target capability of the rangefinder is not only employed for separating the water surface from the ground but also for vegetation penetration.

## RIEGL BDF-1 Scan Data



Riverine zone surveying is a typical application of the RIEGL BDF-1:

The image above shows a colorized 3D point cloud acquired with a VUX-1 UAV combined with profiles acquired by the BDF-1. Both devices were mounted on the RiCOPTER. The combined dataset provides comprehensive information about the topography of the river and its surroundings. The locations of the detailed river profiles are selected according to hydrographic viewpoints. They can be used to assess water transportation, roughness, and clarity.

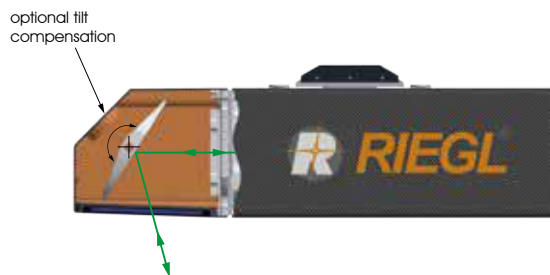


Configurations *RIEGL* BDF-1

**vertical setup**  
for static measurements



**horizontal setup**  
with beam folding mirror including tilt compensation for UAV-borne surveying





Laser Product Classification

Class 2M Laser Product according to IEC 60825-1:2014



Range Measurement Performance

Measuring Principle

time of flight measurement, echo signal digitization, online waveform processing, concurrent full waveform output for all measurements

Minimum Range  
Maximum Range  
Accuracy <sup>1) 3)</sup>  
Precision <sup>2) 3)</sup>  
Laser Pulse Repetition Rate  
Achievable Secchi Depth vs. Measurement Rate<sup>4)</sup>

1 m  
50 m  
10 mm  
5 mm  
4 kHz  
1.0 @ 4,000 meas./sec (single pulse)  
1.2 @ 400 meas./sec (10 pulses averaged)  
1.5 @ 40 meas./sec. (100 pulses averaged)  
for each echo signal, high-resolution 16 bit intensity information is provided  
532 nm (green)  
approx. 70 mm @ 1 m  
approx. 20 mm @ 20 m

Echo Signal Intensity  
Laser Wavelength  
Laser Beam Footprint

- 1) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
- 2) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
- 3) One sigma @ 15 m range under *RIEGL* test conditions.
- 4) Flight altitude 15 m above water surface.

Optional Tilt Compensator Performance<sup>5)</sup>

Single Axis Tilt Compensation Mechanism  
Compensation Range  
Angle Measurement Resolution  
Internal Sync Timer

swinging mirror  
up to 24°  
0.0055°  
for real-time synchronized time stamping of scan data

- 5) Tilt compensation is only available with Embedded GNSS-Inertial System

Data Interfaces

Configuration  
Scan Data Output  
GNSS Interface

LAN 10/100/1000 Mbit/sec  
LAN 10/100/1000 Mbit/sec  
Serial RS232 interface for data string with GNSS-time information,  
TTL input for 1PPS synchronization pulse  
SDXC (SD 3.0) Slot (up to 2TB)  
TTL input/output for up to two digital cameras  
SMA connector

External Memory Interface  
External Camera  
External GNSS Antenna

General Technical Data

Power Supply Input Voltage / Consumption  
Main Dimensions (L x W x H)  
Weight  
Humidity  
Protection Class  
Max. Flight Altitude (operating / not operating)  
Temperature Range

11 - 34 V DC / typ. 50 W  
143 x 180 x 450 mm  
approx. 5.3 kg  
max. 80 % non condensing @ 31°C  
IP64, dust and splash-proof  
16 500 ft (5 000 m) above MSL / 18 000 ft (5 500 m) above MSL  
0°C up to +40°C (operation) / -20°C up to +50°C (storage)

Optional Components (integrated)

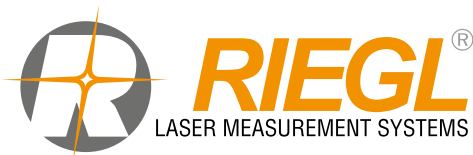
Embedded GNSS-Inertial System

Applanix APX-15 UAV high performance multi-channel, multi-band GNSS receiver, solid-state MEMS IMU

Optional Components (external)

Digital Camera

RGB digital camera, 24.3 MPixel, APS-C, 24 mm focal length, FOV 83°



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