



# Airborne Bathymetric Laser Scanner

## Measuring seabed topography

**Multiwavelength LiDAR for highly precise 3D maps**

*Coastline and water depth provide information about the erosion of coastal landscapes. The Airborne Bathymetric Laser Scanner ABS measures shallow waters from the air and provides data for detailed 3D maps.*

Airborne measurements are particularly efficient for monitoring the depth and level of bodies of water or the course of coastlines. The Airborne Bathymetric Laser Scanner ABS from Fraunhofer IPM was specially developed for surveying shallow waters. Thanks to multi-wavelength pulsed time-of-flight measurement, the ultra-lightweight LiDAR scanner captures the topography of the water body bed very precisely.

### Ultra-lightweight, compact design

Digital terrain models of water bodies are important for safety in shipping, coastal and flood protection or for documenting the habitat of people, animals, and plants. The Airborne Bathymetric Laser Scanner ABS captures the water surface and depth, but also the peripheral area of water bodies including the adjacent terrain from the air, generating 3D data efficiently and quickly. The lightweight scanner with its compact design can be mounted on commercially available Unmanned Aerial Vehicles (UAV). Based on pulsed time-of-flight ranging, it simultaneously captures the environment with two laser beams of different wavelengths. Using two lasers, the undesirable effect of light refraction, which makes the water depth appear optically less deep than it actually is, can be corrected.

This makes topographic seabed measurements significantly more accurate than measurements with just one laser beam. The recorded data is available as a complete full waveform as well as a point cloud in LAS format.

### Measuring water surface and floor

The laser pulses are emitted at different wavelengths simultaneously via a nonlinear optical process and internal beam expansion ensures safe operation. A scanning unit deflects the beams over the water surface at a full angle of 30°. The infrared light (IR) of 1064 nm wavelength does not penetrate the water and thus provides an undistorted signal of the water surface. By contrast, the green light (VIS) of 532 nm wavelength propagates to the bottom but is attenuated due to water turbidity. The backscattered

### Advantages at a glance

- High-precision multiwavelength laser scanning
- Ultra-lightweight system (starting at 2.5 kg)
- Deployable on sub 25 kg take-off-mass UAV / multicopters
- Customization according to application



*The ABS mounted on a UAV: The 3.3 kg scanner can be mounted on different drone platforms. A GNSS positioning solution is integrated for position determination.*

light from the IR and VIS lasers is separated by a beam splitter and directed to a suitable detector using a collecting lens. To maximize light yield especially for the attenuated green light, extremely light-sensitive photomultiplier tubes (PMTs) in combination with conventional avalanche photodiodes (APDs) are used.

## Two systems for short and long range measurements

The ABS-SR is optimized for short range measurements at about 15 m distance, using a collimated beam with a diameter of 5 cm. Long range measurements can be carried out by the ABS-LR, which is specially designed for measurement distances from 50 to 100 m. The ABS-LR uses a divergent beam with adjustable diameter.

## Rapid signal conversion

In underwater surveying, the measurement signal consists of complex contributions from water surface, turbidity and water bottom

rather than individually separable pulses. Instead of simple pulse detection, it is essential to record and interpret the entire waveform, which requires very fast data processing. The ABS' central FPGA/CPU unit processes up to 50 GB of raw data per second, performing intelligent data reduction. It controls and communicates with other system components and provides all the necessary interfaces. A GNSS/IMU positioning solution can be integrated into the ABS or connected externally.

## Integration on UAVs

The shoebox-sized system with a minimum total weight of 2.5 kg plus battery and GNSS/IMU can be carried by UAV with a take-off-weight under 25 kg. Fraunhofer IPM supports customers in the customization and integration of the scanner on different platforms.

## Technical specifications

Laser	1064 nm and 532 nm wavelength, class 2M (SR version), class 3B (LR) according to EN 60825-1:2014
Laser pulse repetition	35 kHz (SR); 100 kHz (LR)
Measurement range	1–2 Secchi (depending on conditions)
Scanning unit	Tilted rotating mirror
Scan unit	Nearly elliptical, 30° beam deflection
Dimensions	320 mm × 175 mm × 145 mm (L × W × H)
Weight	min. 2.5 kg plus GNSS/IMU
Interfaces	Ethernet control interface, PTP or PPS + NMEA time synchronization, power supply (6 s LiPo battery), WiFi option

*All specifications and features are subject to modification without notice.*

## Contact

Prof. Dr. Alexander Reiterer  
Head of Department  
Object and Shape Detection  
Phone +49 761 8857-183  
alexander.reiterer@ipm.fraunhofer.de

Dr. Jana Heuer  
Business Development  
Phone +49 761 8857-413  
jana.heuer@ipm.fraunhofer.de

Fraunhofer Institute for Physical Measurement Techniques IPM  
Georges-Köhler-Allee 301  
D-79110 Freiburg  
www.ipm.fraunhofer.de/en

