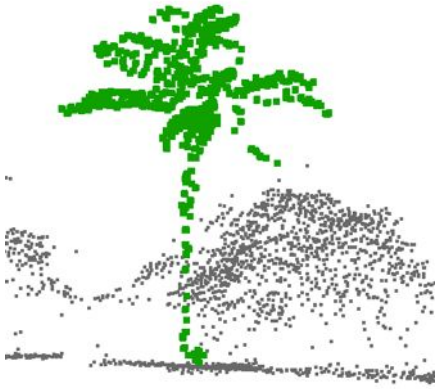
L-MAP Airborne Laser Mapping Solutions



Preliminary Product Information

Rev. 2019-09-08

GeoLas Systems

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EL-MAP Airborne LiDARs are a new series of compact, high-performance laserscanners designed for cost-effective airborne laser mapping with fixed-wing and helicopter aircraft. They provide highly accurate measurements in a compact and lightweight package that can easily be installed even on small survey aircraft. ***EL-MAP*** systems make advanced airborne lidar technology affordable also for smaller photogrammetry and survey firms and organizations. They are the ideal choice for replacing outdated or updating older systems with state-of-the-art performance.

EL-MAP lidars feature

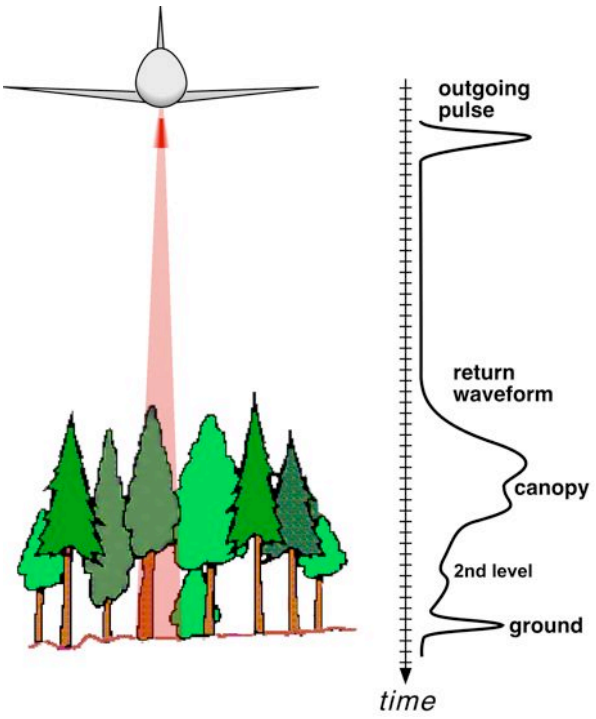
- an industry-leading large scan angle of up to 80° (±40°) for efficient wide-area mapping
- high ranging capability (***EL-MAP30*** up to 3750m, ***EL-MAP15*** up to 2350m) for mapping of mountainous terrain
- high effective measurement rates of up to 800.000 shots-on-the-ground per second for high-density mapping
- waveform digitization with a market-leading 14 bits-per-sample radiometric resolution for high-accuracy ranging and surface modeling
- captures *every* return of each shot, providing detailed information about vertical structure, surface reflectance (intensity), and surface slope/ roughness (pulse width) information
- integrated removable data storage with standard high-capacity SSDs for unlimited data acquisition during flight and rapid post-flight data transfer
- compact size and lowest power consumption (max. 125W) of their class, facilitating installation on small aircraft
- single-handed operation in pilot-only environments and autonomous operation in unmanned airborne vehicles

Waveform Digitization Benefits

EL-MAP systems provide state-of-the-art echo waveform digitization and recording for *every* laser shot. Echo waveforms carry a wealth of information about the vertical surface structure, and only digitizing waveform technology is able to make this information available for processing.

Not only the heights of the first or last reflecting surface as with conventional (discrete return) lidars but also detailed insights into the vertical structure of the surface cover become available, for instance the vertical density distribution of tree crowns, the vegetation density at different height levels, or the roughness and slope of the surface on a per-return level. Even returns from very close surfaces like low vegetation and ground can be distinguished, providing additional cues for automated point classification.

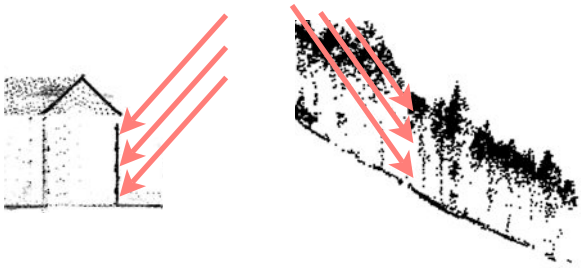
Waveform processing improves ranging accuracy in difficult surface conditions and more reliably eliminate slope and intensity dependent range walk than is possible with conventional approaches. Also, for each height level at which the laser pulse was reflected information about the surface reflectance in the near infrared is available allowing for example to discern a paved road surface from an unpaved path below the forest canopy.



Wide-angle Field-Of-View Benefits

EL-MAP systems are able to collect returns in an exceptionally wide field-of-view. This makes highly efficient wide-area mapping possible (up to 600 km^2 per hour at maximum flying height, 110kts flying speed and 30% strip-to-strip overlap). But even when data acquisition is not possible at the maximum flying height due to cloud cover, the ***EL-MAP***'s large FOV offers maximum flexibility by providing the widest possible swath when flying below the cloud base. Wider swath means fewer flightlines and more efficient surveying also under such conditions.

Additionally, measurements at lower angles of incidence towards the swath edges (oblique views) can provide important information not available from systems with small scan angles.

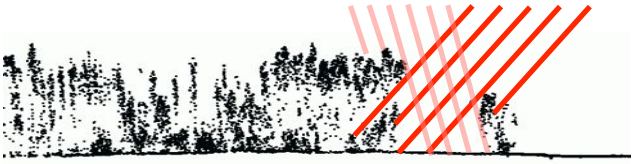


Vertical surfaces like building facades, tower structures, and tree stems will be detected, benefiting building modeling in urban mapping applications, powerline modeling, and tree classification in forestry applications.

Similarly, lower angles of incidence allow ground measurements below overhanging structures like bridges and roofs, improving ground modeling in these situations.

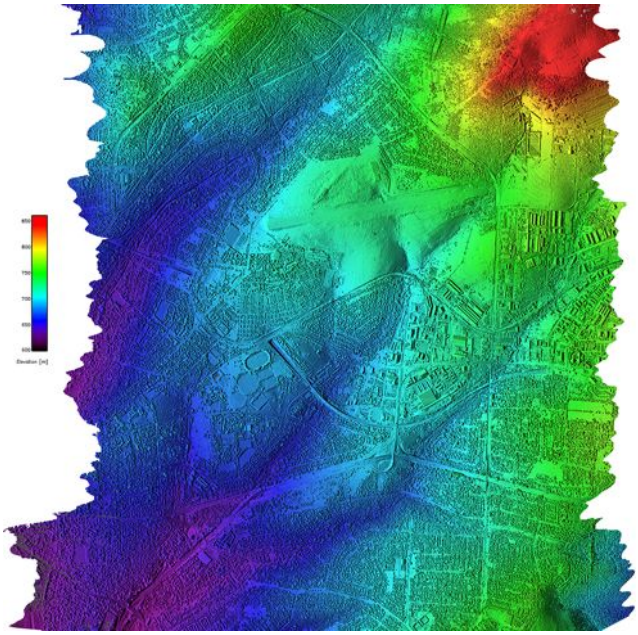
EL-MAP's large FOV matches that of wide-angle digital photogrammetric cameras so that planning of combined lidar + camera flights is simplified and can be optimized for digital imagery requirements.

Finally, due to the larger swath width projects may be flown with a larger strip overlap without penalty to flight effort compared to systems with smaller FOV. For instance, with a flightline spacing that a 60° FOV lidar requires to achieve a 30% strip overlap, the ***EL-MAPs*** provides more than 50% strip overlap. Every surface segment is thus viewed from at least two different directions.



Multi-aspect coverage minimizes shadow gaps, increases the penetration probability of vegetation for ground detection, and improves modeling of complex canopy shapes for automated tree species classification and other forestry applications.

Elevation

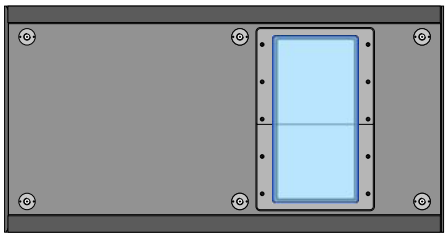


Surface Reflectance

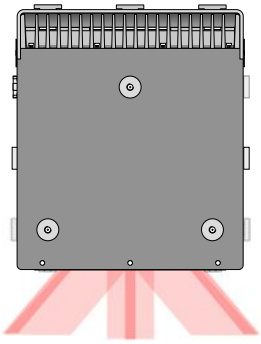
4200m wide single-pass swath acquired from 2800m AGL flying height, avg. point spacing: 1.6m

EL-MAP	
Dimensions	405 x 216 x 243mm (LxWxH)
Weight	21 kg
IMU/Camera mounting facilities	3 threads M6 each on top, front, and sides
Power requirements	18 - 32 VDC, 110 W (avg.)
Operating conditions	0°C - 40°C
External connectors (rear panel)	RJ45 1GBit Ethernet for control / data download HDMI Monitor output USB3.0 Data download USB2.0 Touchscreen control or keyboard Lemo Serial GPS Timetag and 1PPS inputs Lemo Remote control box SATA Removable SSD (in SSD slot) Amphenol Power supply input
Included items	Remote control box with safety key switch Removable SSD (2 TB capacity) + SATA docking station Set of cables and spare fuses Detachable carrying handles Transportation case *Geocode-L* point cloud geocoding software license
Options	Integrated tactical grade MEMS IMU (for backup) 10" high-brightness touchscreen monitor + keyboard Sensor navigation system (GNSS/IMU)

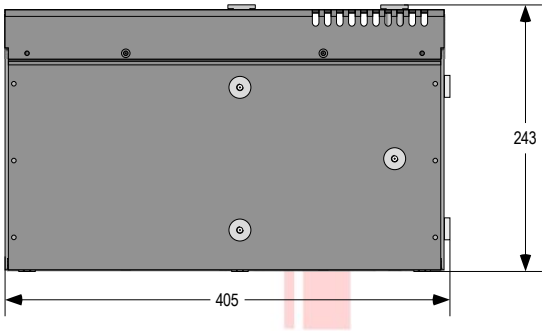
Bottom view



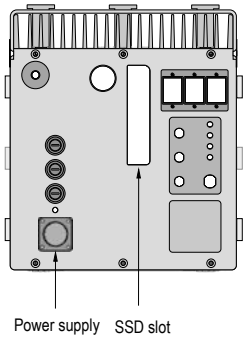
Front view



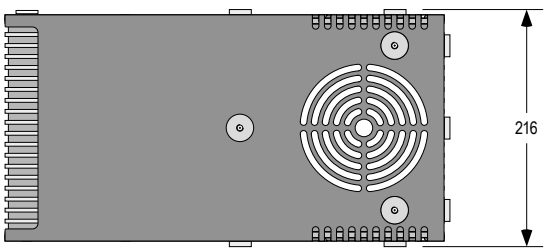
Right side view



Rear view



Top view



EL-MAP Airborne LiDAR
Preliminary Specifications

Parameter	*EL-MAP30*	*EL-MAP15*	Conditions/Remarks
Measurement range	3750 m	2350 m	single target, flat surface, 20% diffuse reflectance, 60° incidence angle, ≥30km visibility, 125kHz PRF, 100% output power, 60° FOV
Range uncertainty	≤ 0.03 m (RMS)		flat surface, 20% reflectance, 90° incidence angle, 1200 m AGL
Laser pulse repetition frequency	100 kHz - 900 kHz		adjustable (program-controlled, increasing pulse repetition frequency reduces maximum range)
Effective measurement rate	80 - 810 k meas/s		80° scan angle
Beam divergence	≤ 0.65 mrad	≤ 0.35 mrad	
Average laser output power	max. 7.5 W	max. 2.5 W	adjustable (10% - 100%, program-controlled)
Laser wavelength	1030 nm	1064 nm	
Laser eye-safety class	Class 4		
NOHD	125 m	51 m	100 % laser power, 100kHz PRF, 30Hz scan speed, ≥42kts flying speed
ENOHD	999 m	408 m	
Ranging method	pulse time-of-flight, waveform digitization		range, intensity, and pulse spreading (pulse width) are derived from stored waveform data in post-processing
Waveform sampling interval	1.25 nsec		
Radiometric resolution	14 bit per sample		
Number of returns per pulse	virtually unlimited		
Return separation	0.5 m		return pulse width identifies multiple targets with less separation
Data storage capacity	1TB (optional up to 5TB) 2TB		SSD, internal SSD, removable in flight
Beam deflection	rotating pyramidial polygon mirror, 4 facets		Linear scan pattern, equidistant point spacing in the direction of flight
Scanning range (FOV)	±5° - ±40°		adjustable (program-controlled, reducing the scanning range clips measurements reduces effective measurement rate) reduced sensitivity/max. range for scan angles ≥ ±35°
Scan rate	20 - 220 scans/s		adjustable (program-controlled)
Angular accuracy	0.0025°		
Max. operational AGL	3250 m	1930 m	flat surface, 20% reflectance, ≥30km visibility, 125kHz PRF, 100% output power, 60° scan angle
Swath width	4700 m	2790 m	flat surface, 86% of max. AGL, ±40° scan angle
Laser point size on ground	1.80 m	0.58 m	86% of max. AGL, 90° incidence angle (nadir on flat surface)

Preliminary specifications, subject to change without notice, Rev. 2019/09

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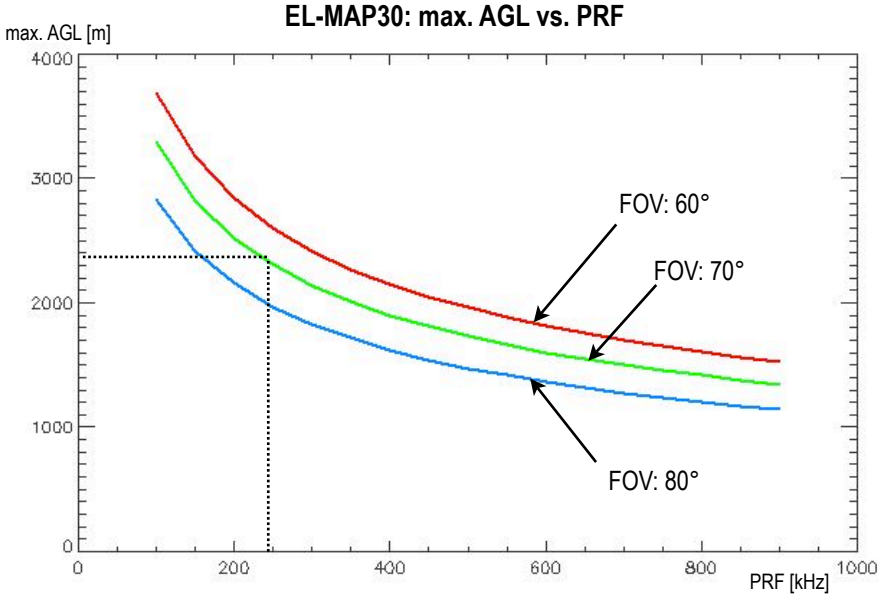
Performance Envelope	Point density	AGL	PRF	FOV	Scan speed	Flight speed
EL-MAP30	0.4 pts/m^2	**3250m**	125kHz	60°	36Hz	110kts
	1 pt/m^2	**2350m**	240kHz	70°	57Hz	110kts
	4 pts/m^2	**1550m**	630kHz	70°	114Hz	110kts
	10 pts/m^2	**900m**	900kHz	70°	180Hz	110kts
	16 pts/m^2	**600m**	900kHz	60°	215Hz	105kts
EL-MAP15	0.4 pts/m^2	**1930m**	100kHz	70°	41Hz	110kts
	1 pt/m^2	**1570m**	160kHz	70°	57Hz	110kts
	4 pts/m^2	**1030m**	420kHz	70°	114Hz	110kts
	10 pts/m^2	**780m**	800kHz	70°	180Hz	110kts
	16 pts/m^2	**600m**	900kHz	60°	215Hz	105kts

EL-MAP30: max. AGL vs. PRF



EL-MAP15: max. AGL vs. PRF