Waveform Processing Airborne Laser Scanning System with Increased Range Capacity

RIEGL VQ®-580 II-S

- *increased measurement range of up to 2.450 m*
- *high accuracy ranging based on RIEGL Waveform-LiDAR technology*
- *high laser pulse repetition rate up to 2 MHz*
- *measurement rate up to 1,250,000 measurements/sec*
- *perfectly linear and parallel scan lines*
- *wide field of view of 75°*
- *excellently suited to measure to snow & ice*
- *interfaces for up to 5 optional cameras*
- *mechanical and electrical interface for IMU/GNSS integration*
- *removeable storage card and integrated solid state drive (SSD) for data storage*
- *compact and lightweight design*
- *compatible with stabilized platforms and even small hatches*
- *seamless integration and compatibility with other RIEGL ALS systems and software packages*

To meet the increasing requirements of compact laser scanners for medium- and wide-area mapping as well as for corridor mapping, *RIEGL* offers the VQ-580 II-S, which provides an increased maximum measurement range of up to 2.450 m. It is perfectly suited for integration with gyro-stabilized mounts as well as into the VQX-1 Wing Pod, *RIEGL's* fully integrated laser scanning system for user-friendly installation on Cessna single piston engine aircraft to facilitate various airborne mapping applications.

Based on *RIEGL*'s proven Waveform-LiDAR technology, the VQ-580 II-S provides highly accurate and precise point clouds, excellent vertical target resolution, calibrated reflectance readings, and pulse shape deviation for unsurpassed information content on each single measurement. With a measurement rate of up to 1,250,000 meas./sec and an extremely wide field of view of 75 degrees, the versatile instrument perfectly meets the challenges in various special airborne surveying applications – from corridor mapping to forestry – from a wide range of manned aircraft such as helicopters, small fixed wing aircraft and ultralight aircraft.

Due to the laser wavelength used, the system enables measurements to wet and frozen surfaces and delivers first class results in snowfield mapping and glacier monitoring.

The *RIEGL* VQ-580 II-S provides mechanical and electrical interfaces for the integration with an appropriate IMU/GNSS unit and is ready for controlling up to 5 optional cameras. Convenient access to the acquired scan data is ensured by data storage on an easy to remove CFast® storage card and an integrated solid state drive, but also by streaming scan data via a LAN TCP/IP interface.

Typical applications include

- *Medium to Wide Area Mapping*
- *Corridor Mapping*
- *City Modeling*
- *Glacier and Snowfield Monitoring*
- *Agriculture & Forestry*

visit our website
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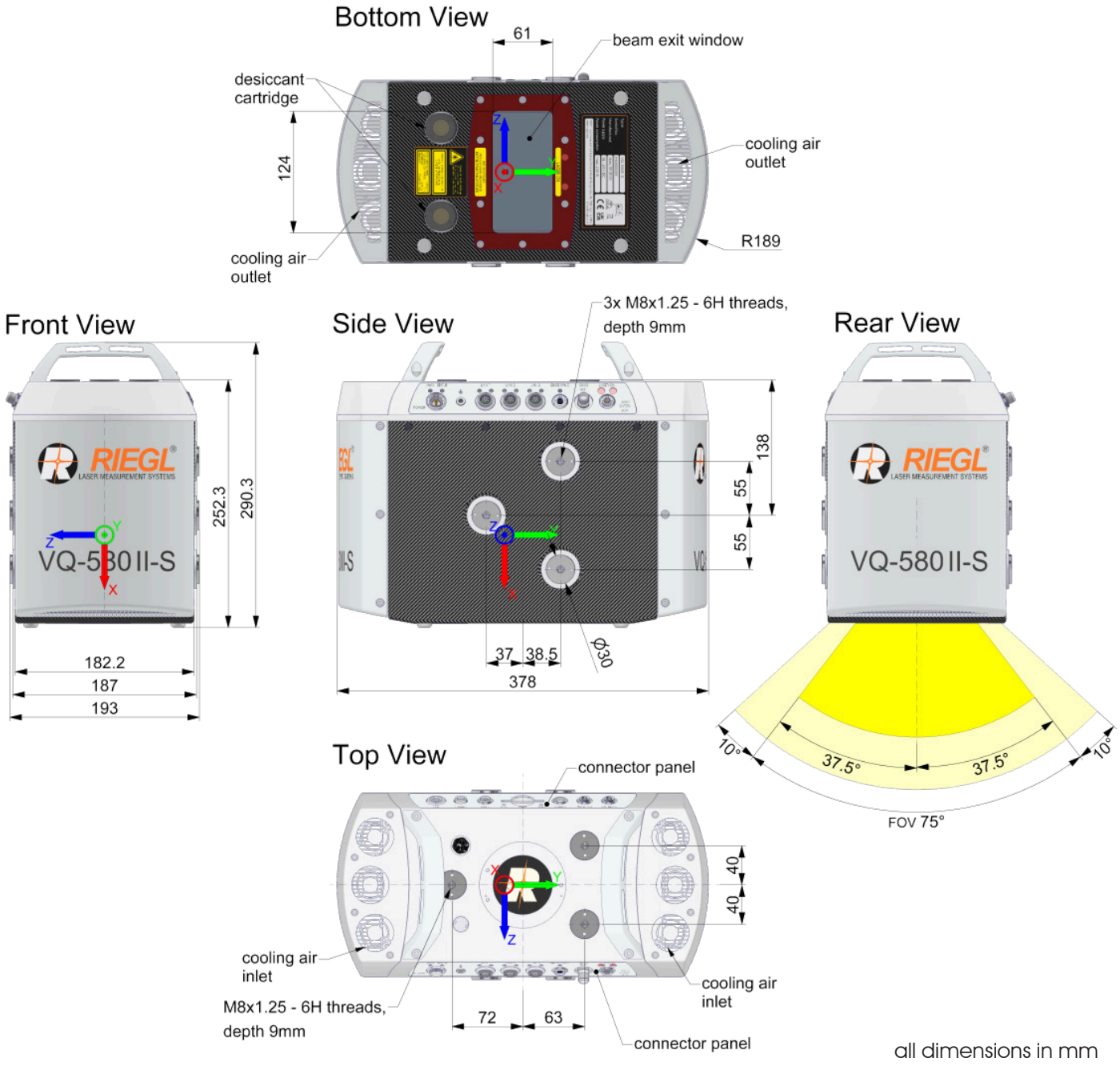
RIEGL®
LASER MEASUREMENT SYSTEMS

Dimensional Drawings *RIEGL* VQ®-580 II-S

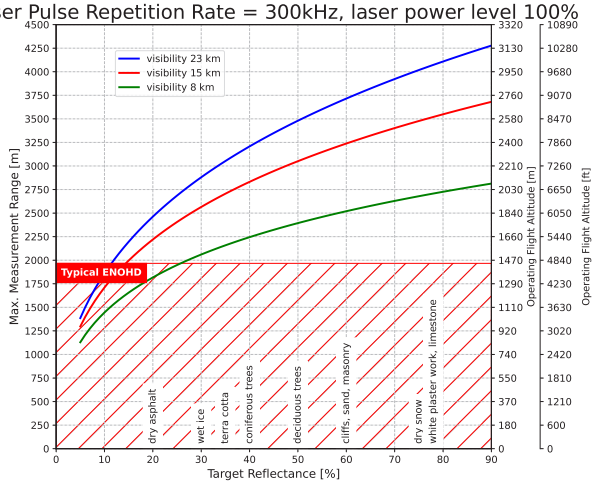


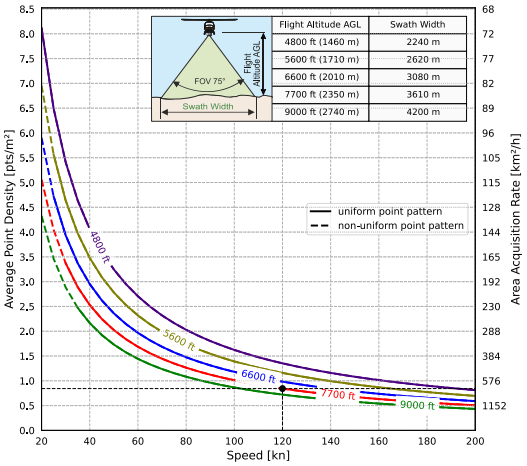
all dimensions in mm

RIEGL VQ®-580 II-S Installation Example

RIEGL VQ-580 II-S installed on GSM-5000 stabilized platform

Laser Pulse Repetition Rate = 300kHz, laser power level 100%

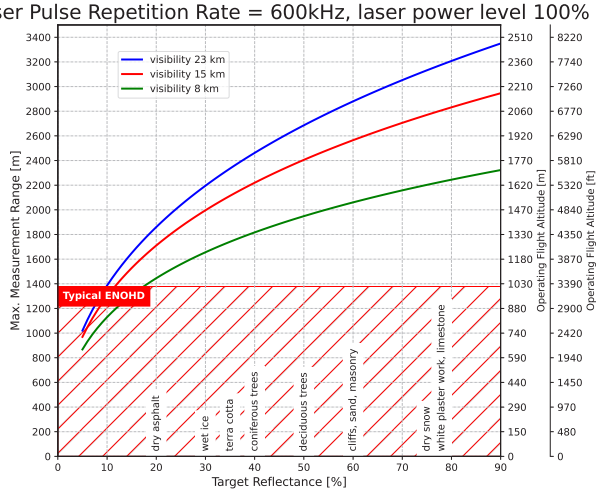


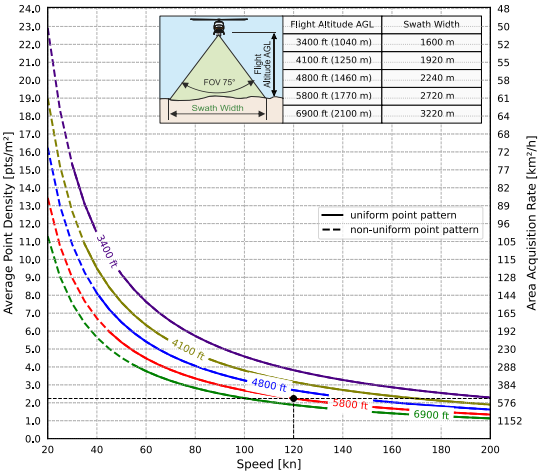


Example: VQ-580 II-S at 300,000 pulses/sec, laser power level 100%
altitude 7,700 ft AGL, speed 120 kn

Results: point density ~ 0.8 pts/m²
area acquisition rate ~ 683 km²/h

Laser Pulse Repetition Rate = 600kHz, laser power level 100%

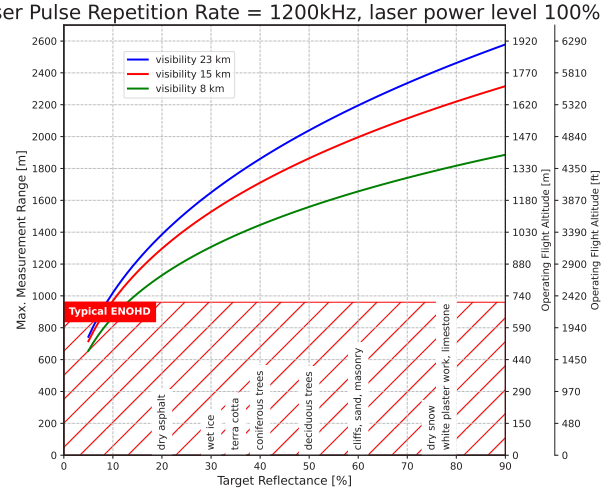


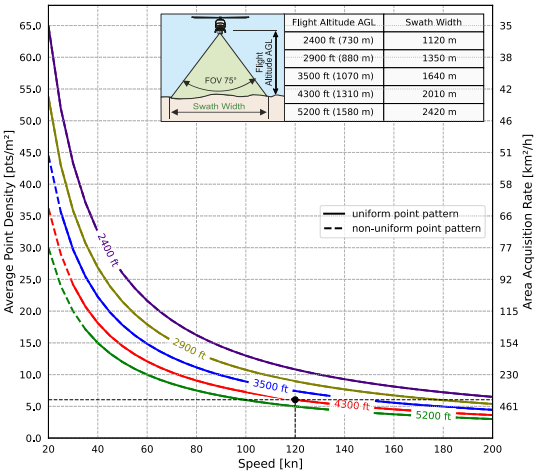


Example: VQ-580 II-S at 600,000 pulses/sec, laser power level 100%
altitude 5,800 ft AGL, speed 120 kn

Results: point density ~ 2.2 pts/m²
area acquisition rate ~ 515 km²/h

Laser Pulse Repetition Rate = 1200kHz, laser power level 100%



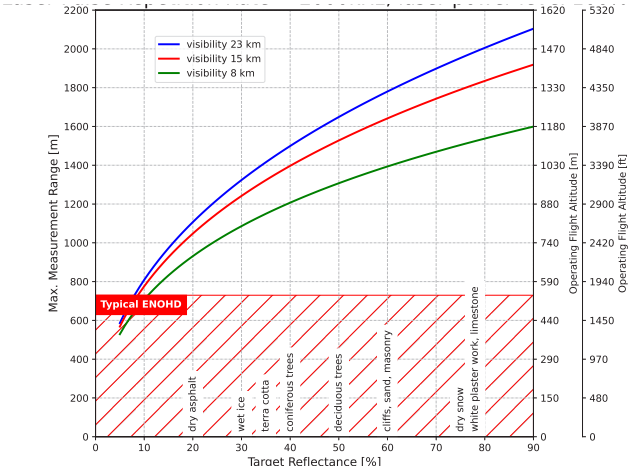


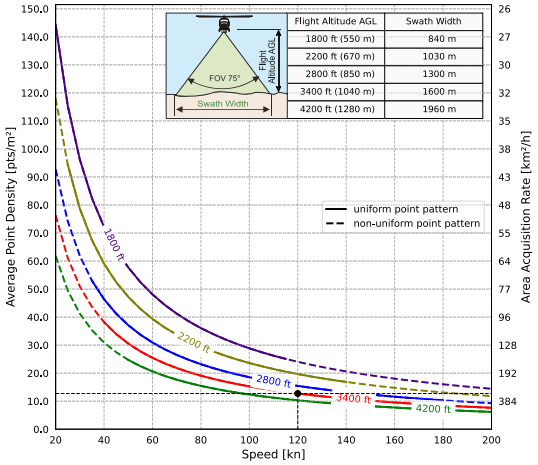
Example: VQ-580 II-S at 1,200,000 pulses/sec, laser power level 100%
altitude 4,300 ft AGL, speed 120 kn

Results: point density ~ 6.4 pts/m²
area acquisition rate ~ 381 km²/h

The following conditions are assumed for the Operating Flight Altitude AGL

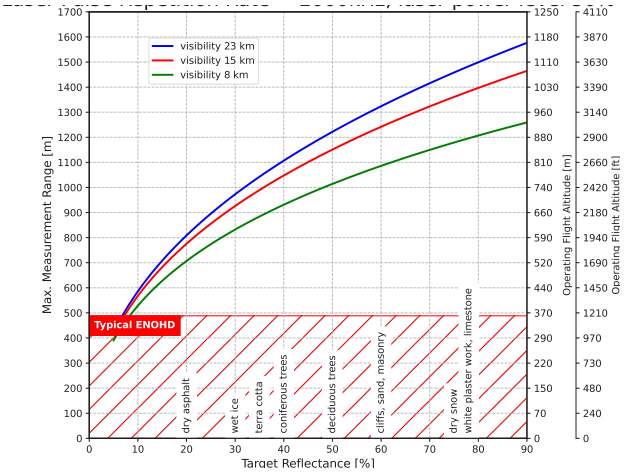
- ambiguity resolved by multiple-time-around (MTA) processing
- roll angle up to ±5°
- target size ≥ laser footprint
- average ambient brightness
- operating flight altitude given at a FOV of ±37.5°

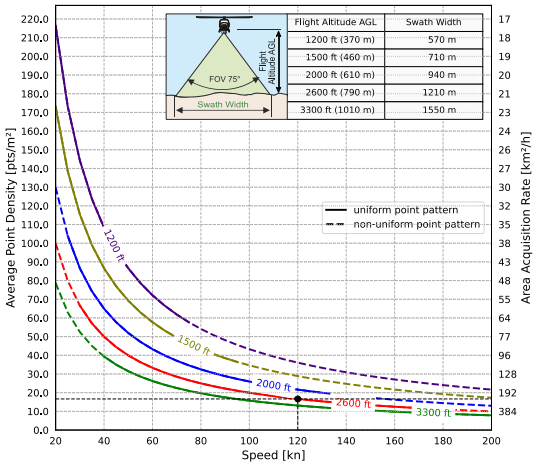




Example: VQ-580 II-S at 2,000,000 pulses/sec, laser power level 100%
altitude 3,400 ft AGL, speed 120 kn

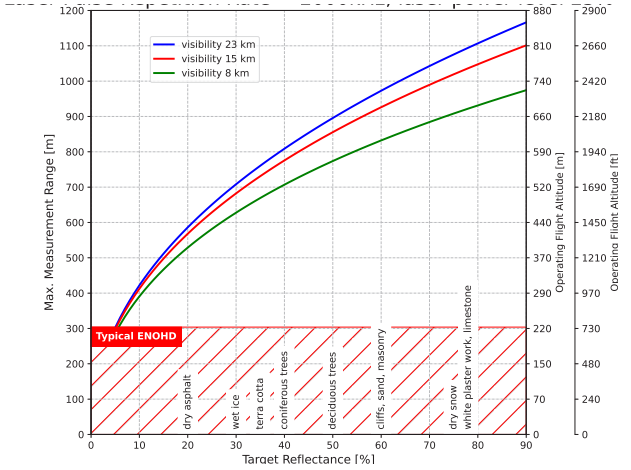
Results: point density ~ 12.73 pts/m²
area acquisition rate ~ 302 km²/h

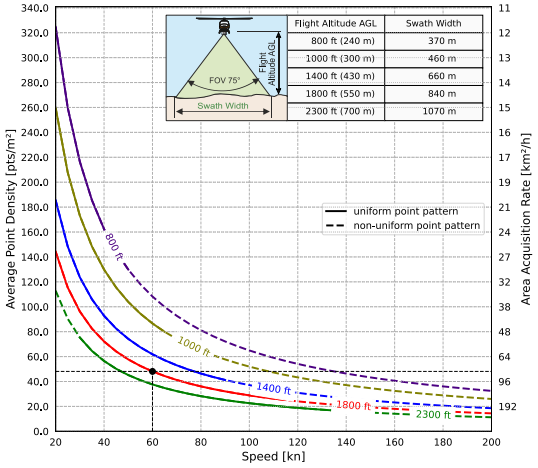




Example: VQ-580 II-S at 2,000,000 pulses/sec, laser power level 50%
altitude 2,600 ft AGL, speed 120 kn

Results: point density ~ 16.7 pts/m²
area acquisition rate ~ 231 km²/h





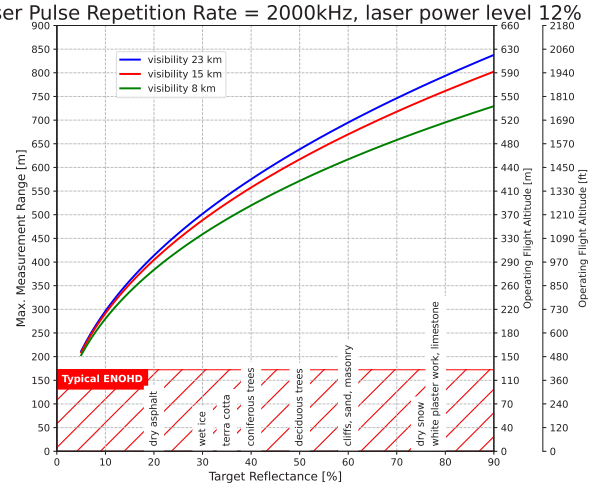
Example: VQ-580 II-S at 2,000,000 pulses/sec, laser power level 25%
altitude 1,800 ft AGL, speed 60 kn

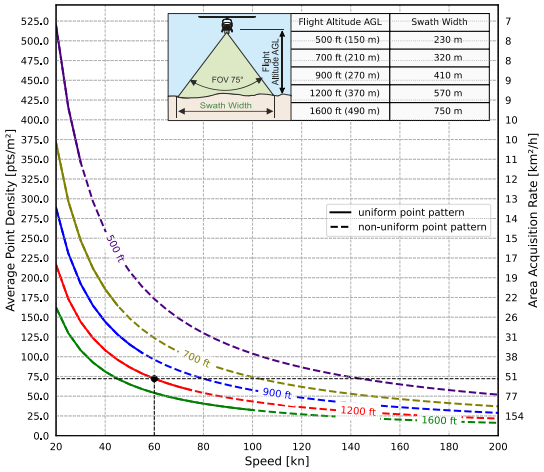
Results: point density ~ 48.1 pts/m²
area acquisition rate ~ 80 km²/h

The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing
- target size ≥ laser footprint
- average ambient brightness
- roll angle up to ±5°
- operating flight altitude given at a FOV of ±37.5°

Laser Pulse Repetition Rate = 2000kHz, laser power level 12%





Example: VQ-580 II-S at 2,000,000 pulses/sec, laser power level 12%
altitude 1,200 ft AGL, speed 60 kn

Results: point density ~ 72.2 pts/m²
area acquisition rate ~ 53 km²/h

The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing
- roll angle up to ±5°
- target size ≥ laser footprint
- average ambient brightness
- operating flight altitude given at a FOV of ±37.5°

Laser Product Classification	Class 3B Laser Product according to IEC 60825-1:2014

The following clause applies for instruments delivered into the United States: Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56, dated May 8, 2019.

The instrument must be used only in combination with the appropriate laser safety box.

Range Measurement Performance

Measuring Principle: echo signal digitization, online waveform processing, time-of-flight measurement, multiple target capability

Laser Pulse Repetition Rate PRR [1]	300 kHz	600 kHz	1200 kHz	2000 kHz	2000 kHz	2000 kHz	2000 kHz
Laser Power Level	100%	100%	100%	100%	50%	25%	12%
Max. Measuring Range [2] [3]							
natural targets ρ ≥ 20 %	2460 m	1860 m	1390 m	1100 m	810 m	590 m	410 m
natural targets ρ ≥ 60 %	3720 m	2880 m	2200 m	1780 m	1320 m	970 m	700 m
Max. Operating Flight Altitude [2] [4] Above Ground Level (AGL)							
natural targets ρ ≥ 20 %	1820 m 5950 ft	1370 m 4500 ft	1020 m 3350 ft	820 m 2700 ft	600 m 1950 ft	430 m 1400 ft	300 m 1000 ft
natural targets ρ ≥ 60 %	2740 m 9000 ft	2120 m 6950 ft	1620 m 5300 ft	1310 m 4300 ft	980 m 3200 ft	720 m 2350 ft	510 m 1700 ft
NOHD [5] [7]	201 m	139 m	95 m	70 m	44 m	27 m	14 m
ENOHD [6] [7]	1450 m	1016 m	708 m	538 m	360 m	224 m	127 m
Max. Number of Targets per Pulse [8]	15	15	9	5	5	5	5

1) Rounded average PRR
2) Typical values for average conditions and average ambient brightness. In bright sunlight, the max. range is shorter than under an overcast sky.
3) The 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. Range ambiguities have to be resolved by multiple-time-around processing.
4) Typical values for max. effective FOV 75°, additional roll angle ±5°
5) Nominal Ocular Hazard Distance, based upon MPE according to IEC 60825-1:2014, for single line condition.
6) Extended Nominal Ocular Hazard Distance, based upon MPE according to IEC 60825-1:2014, for single line condition.
7) NOHD and ENOHD have been calculated for a typical angular step width with non-overlapping laser footprints and an aircraft speed higher than 10kn. NOHD and ENOHD increase when using overlapping laser footprints which may be intended e.g. for power line mapping.
8) If more than one target is hit, the total laser transmitter power is split and, accordingly, the achieveable range is reduced.

Minimum Range	20 m
Accuracy [9] [11]	20 mm
Precision [10] [11]	20 mm
Laser Pulse Repetition Rate [12]	up to 2000 kHz
Max. Effective Measurement Rate	up to 1,250,000 meas./sec (@ 2000 kHz PRR & 75° scan angle)
Echo Signal Intensity	provided for each echo signal
Laser Wavelength	near infrared
Laser Beam Divergence	typ. 0.28 mrad @ 1/e² [13], typ. 0.20 mrad @ 1/e [14]

9) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
10) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
11) One sigma @ 150 m range under *RIEGL* test conditions.
12) User selectable.
13) Measured at 1/e² points, 0.28 mrad corresponds to an increase of 28 mm of beam diameter per 100 m distance.
14) Measured at 1/e points, 0.20 mrad corresponds to an increase of 20 mm of beam diameter per 100 m distance.

Scanner Performance

Scanning Mechanism	rotating polygon mirror
Scan Pattern	parallel scan lines
Scan angle range	± 37.5° = 75°
Total Scan Rate	30 [15] – 400 lines/sec
Angular Step Width Δ ϑ	0.008° ≤ Δ ϑ ≤ 0.12° [16] [17]
Angle Measurement Resolution	0.001°

15) The minimum scan rate depends on the selected laser PRR.
16) The angular step width depends on the selected laser PRR.
17) The maximum angular step width is limited by the maximum scan rate.

Data Interfaces

Configuration	LAN 10/100/1000 MBit/sec
Scan Data Output	LAN 10/100/1000 MBit/sec
Synchronization	Serial RS-232 interface, TTL input for 1 pps synchronization pulse, accepts different data formats for GNSS-time information
Camera Interface	1 connector for power, RS-232, pps, trigger, exposure 2 connectors for power, 2x trigger, 2x exposure

Data Storage

Permanently Installed Data Storage	SSD, 2 TByte
Removable Data Storage	Cardholder for CFAST® [1] storage cards (up to 1 TByte)

1) CFast is a registered trademark of CompactFlash Association.

General Technical Data

Power Supply Input Voltage	18 - 34 V DC
Power Consumption	typ. 140 W, max. 270 W [2]
Main Dimensions (L x W x H)	378 mm x 193 mm x 252 mm (without mounted carrying handles)
Weight	
without integrated IMU/GNSS	10.5 kg
with integrated IMU/GNSS	11.0 kg
Humidity	non condensing
Protection Class	IP54, dust-protected and splash-proof
Max. Flight Altitude	
operating & not operating	18500 ft (5600 m) above MSL (Mean Sea Level)
Temperature Range	-5 °C up to +40 °C (operation) / -10 °C up to +50 °C (storage)

Integrated IMU & GNSS (optional) [3]

IMU Accuracy	
Roll, Pitch	0.015°
Heading	0.035°
IMU Sampling Rate	200 Hz
Position Accuracy (typ.)	
horizontal	≤ 0.05 m
vertical	≤ 0.1 m

2) Max. scan rate, all heaters in operation.
3) Accuracy specifications for post-processed data.

RIEGL®
LASER MEASUREMENT SYSTEMS

RIEGL Laser Measurement Systems GmbH, *Headquarters*
RIEGL USA Inc., *Headquarters North America*

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