

Waveform Processing Airborne Laser Scanner for Ultra Wide Area Mapping and High Productivity.

NEW

RIEGL VQ[®]-780i

- *online waveform processing as well as smart and full waveform recording*
- *excellent multiple target detection capability*
- *excellent suppression of atmospheric clutter*
- *Multiple-Time-Around (MTA) processing of up to 25 pulses simultaneously in the air*
- *high laser pulse repetition rate up to 1 MHz*
- *up to 666,000 measurements/sec on the ground*
- *parallel scan lines and uniform point distribution*
- *high-speed optical data link to RIEGL data recorder*
- *interface for GNSS time synchronization*
- *seamless integration and compatibility with other RIEGL ALS systems and software packages*

The new **RIEGL VQ-780i** is a high performance, rugged, lightweight, and compact airborne mapping sensor. This versatile system is designed for high efficient data acquisition at low, mid, and high altitudes, covering a variety of different airborne laser scanning applications from high density to ultra wide area mapping.

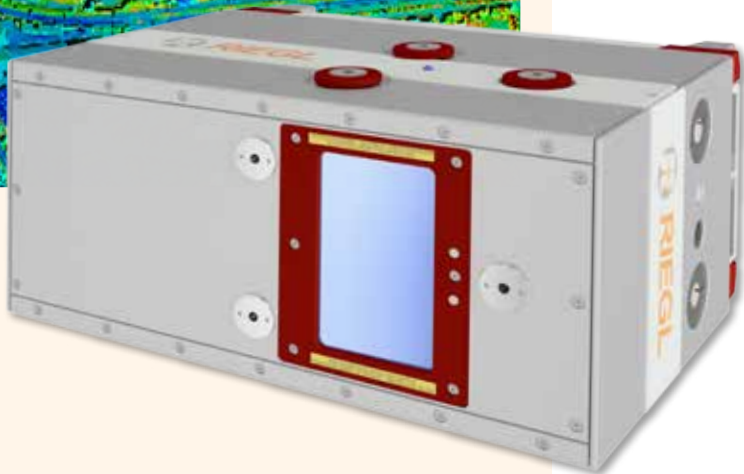
High speed rotating mirror design ensures reliability, and uniform point distribution across its entire wide field of view and at all flying altitudes. Based on **RIEGL's** proven Waveform-LiDAR technology, the system provides clutter-free point clouds with high accuracy, excellent vertical target resolution, calibrated reflectance readings, and pulse shape deviation for unsurpassed information content on each single measurement.

The system is complimented with **RIEGL's** advanced acquisition and data processing software suite that utilizes parallel computing (GPU) for fast data processing.

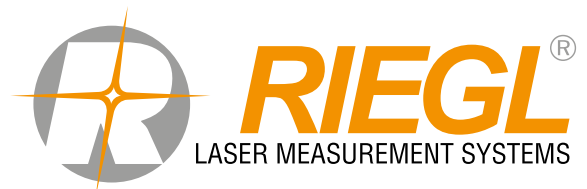
The **RIEGL VQ-780i** is designed to work with the latest Inertial Navigation (IMU) Systems, flight management systems, and camera options.

Applications:

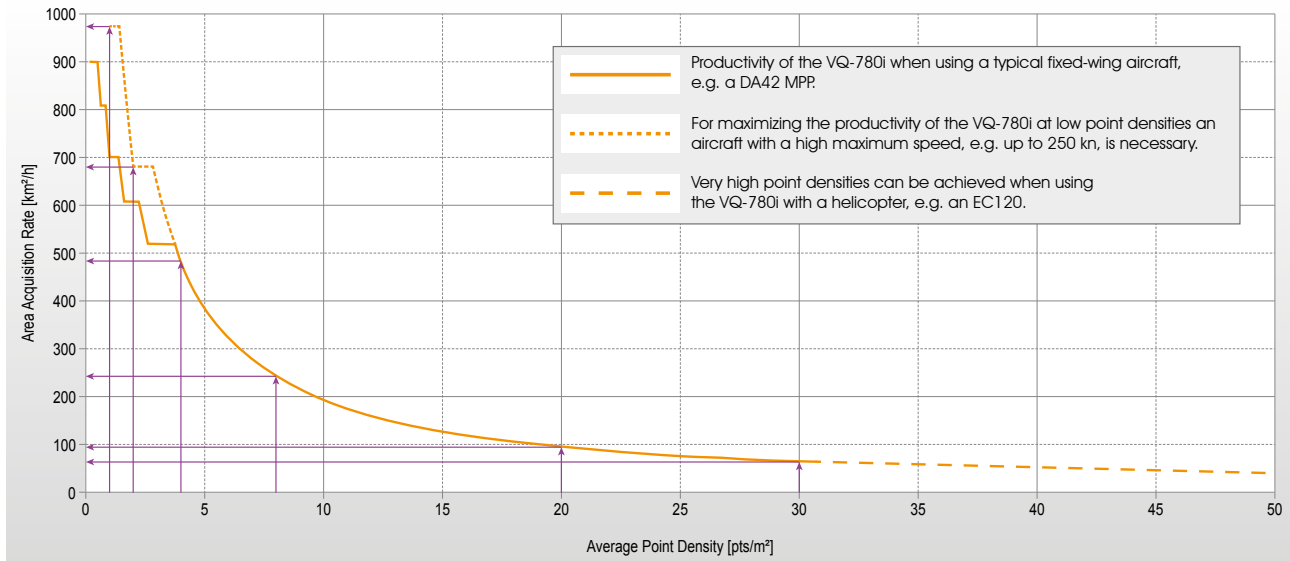
- *Ultra Wide Area / High Altitude Mapping*
- *High Point Density Mapping*
- *Mapping of Complex Urban Environments*
- *Glacier & Snowfield Mapping*
- *City Modeling*
- *Mapping of Lakesides & River Banks*
- *Agriculture & Forestry*
- *Corridor Mapping*



visit our website
www.riegl.com



The RIEGL VQ-780i Airborne Laser Scanner offers highest productivity.



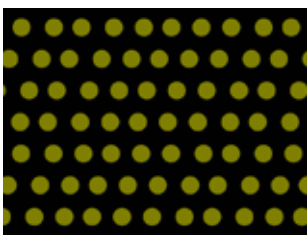
Examples ¹⁾

Average Point Density	1 pts/m ²	2 pts/m ²	4 pts/m ²	8 pts/m ²	20 pts/m ²	30 pts/m ²
Flight Altitude AGL	7500 ft 2280 m	6600 ft 2000 m	5700 ft 1740 m	3200 ft 970 m	1600 ft 490 m	1150 ft 350 m
Ground Speed	246 kn	196 kn	161 kn	145 kn	115 kn	106 kn
Swath Width	2600 m	2300 m	2000 m	1120 m	560 m	410 m
Productivity	960 km ² /h	672 km ² /h	480 km ² /h	240 km ² /h	96 km ² /h	64 km ² /h
Measurement Rate ²⁾	333 000 meas./sec	466 000 meas./sec	666 000 meas./sec	666 000 meas./sec	666 000 meas./sec	666 000 meas./sec

¹⁾ calculated for 20% target reflectivity and 20% stripe overlap

²⁾ The target detection rate is equal to the measurement rate for terrains offering only one target per laser pulse but may be much higher for vegetated areas.

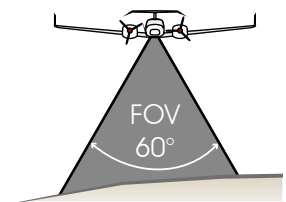
RIEGL VQ[®]-780i Dense Scan Pattern and Wide Effective Swath Width



RIEGL VQ-780i point distribution

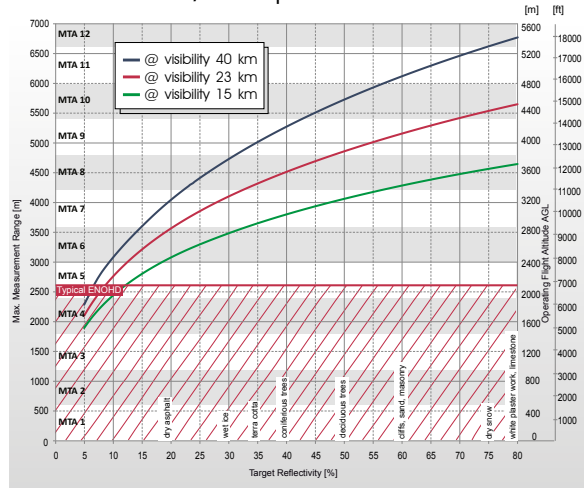
The RIEGL VQ-780i scanning mechanism – based on a continuously rotating polygon mirror wheel – delivers straight parallel scan lines resulting in a regular point pattern on the ground. With equal spatial sampling frequency along and across track, object extents are well defined and even small objects may be detected. The instrument is perfectly suited for applications where a superior point pattern on target surfaces is required.

The wide field of view and the multiple-time-around measurement capability of the RIEGL VQ-780i make the instrument perfectly suited for wide area mapping applications. The instrument has been designed for utmost efficiency in collecting data by enabling scanning operations from high altitudes at high laser pulse repetition rates simultaneously, reducing the necessary flight time to a minimum.

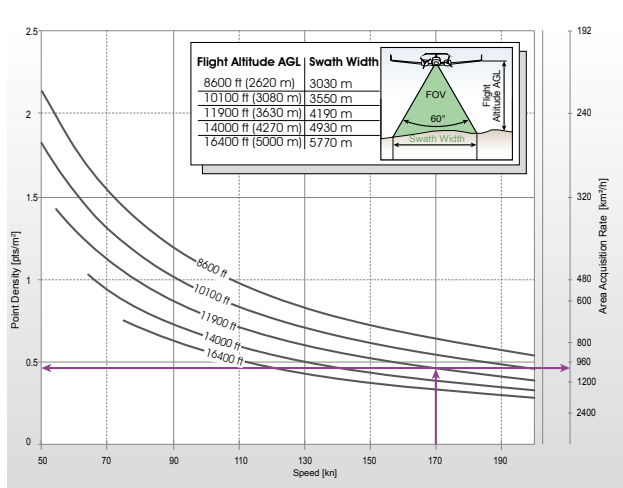


broad effective swath width

PRR = 250 kHz, laser power level 100%

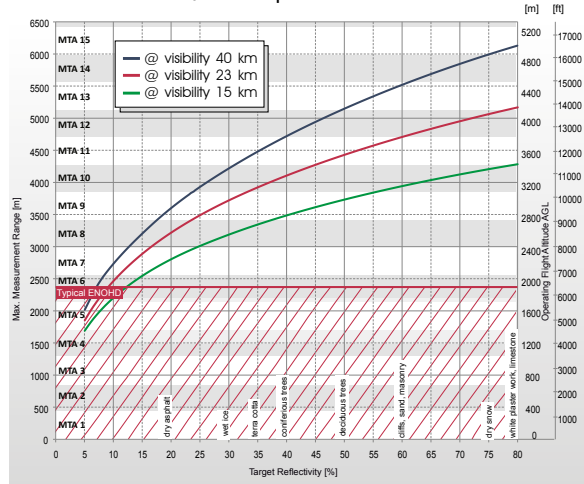


Example: VQ-780i at 250,000 pulses/sec, laser power level 100%
Altitude = 11,900 ft AGL, Speed = 170 kn

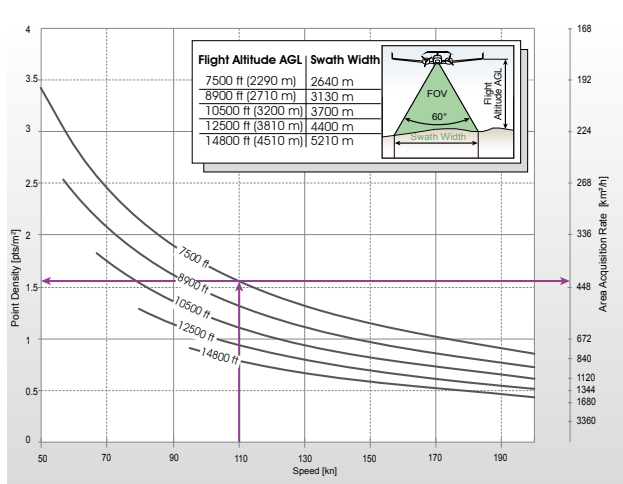


Results: Point Density ~ 0.46 pts/m²
Area Acquisition Rate ~ 1040 km²/h

PRR = 350 kHz, laser power level 100%

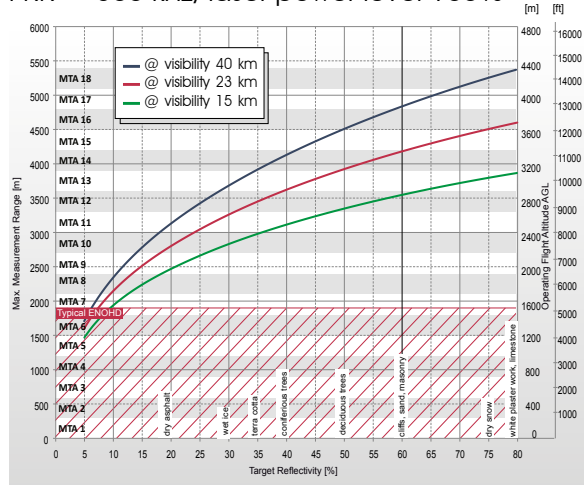


Example: VQ-780i at 350,000 pulses/sec, laser power level 100%
Altitude = 7,500 ft AGL, Speed = 110 kn

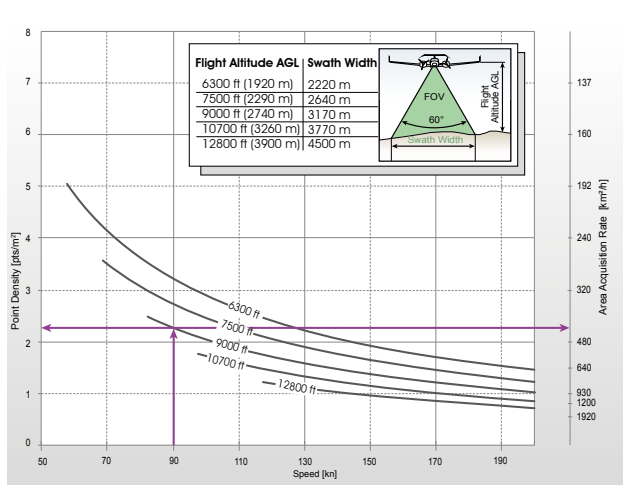


Results: Point Density ~ 1.56 pts/m²
Area Acquisition Rate ~ 431 km²/h

PRR = 500 kHz, laser power level 100%



Example: VQ-780i at 500,000 pulses/sec, laser power level 100%
Altitude = 9,000 ft AGL, Speed = 90 kn



Results: Point Density ~ 2.3 pts/m²
Area Acquisition Rate ~ 423 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
- effective FOV 58°
- average ambient brightness
- roll angle ±5°

Typical ENOHD

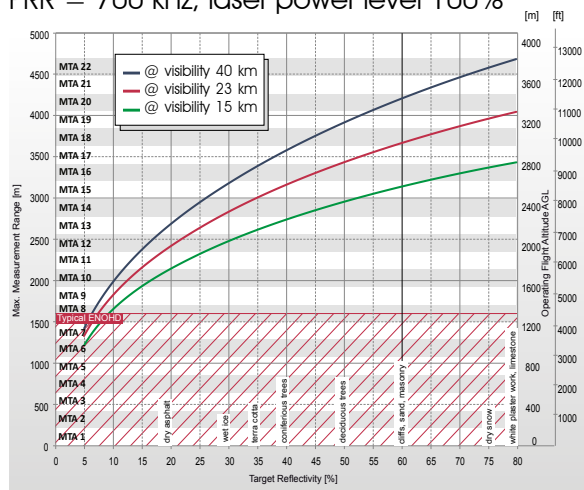
- Calculated under assumption of an angular step width of 0.012° and an aircraft speed higher than 10kn.

Assumptions for calculation of the Area Acquisition Rate

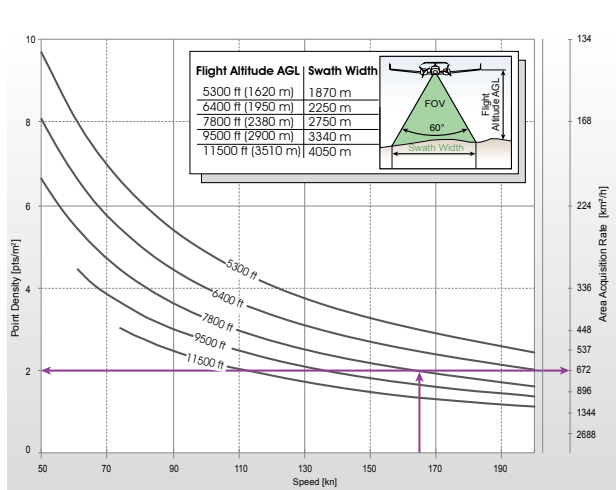
- 20% overlap of neighboring flight strips. This overlap covers a roll angle of ±5° or a reduction of flight altitude AGL of 20%.

Measurement Range & Point Density RIEGL VQ[®]-780i

PRR = 700 kHz, laser power level 100%

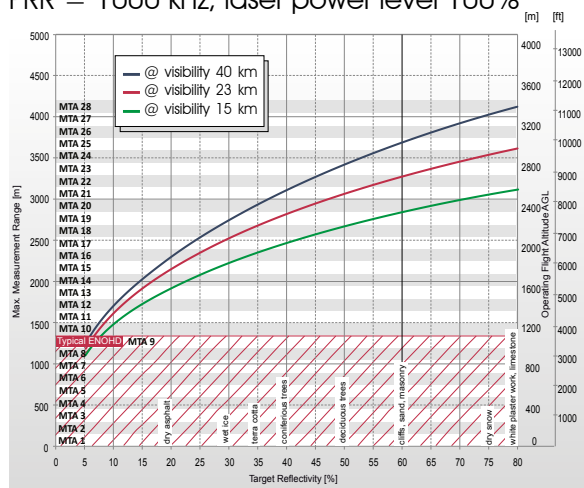


Example: VQ-780i at 700,000 pulses/sec, laser power level 100%
Altitude = 7,800 ft AGL, Speed = 165 kn

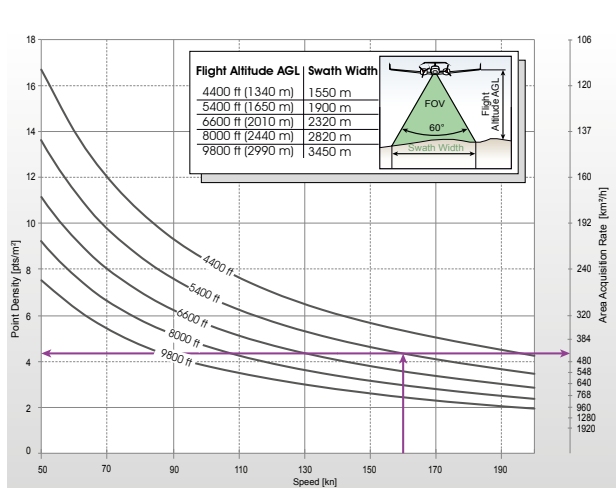


Results: Point Density ~ 2 pts/m²
Area Acquisition Rate ~ 672 km²/h

PRR = 1000 kHz, laser power level 100%

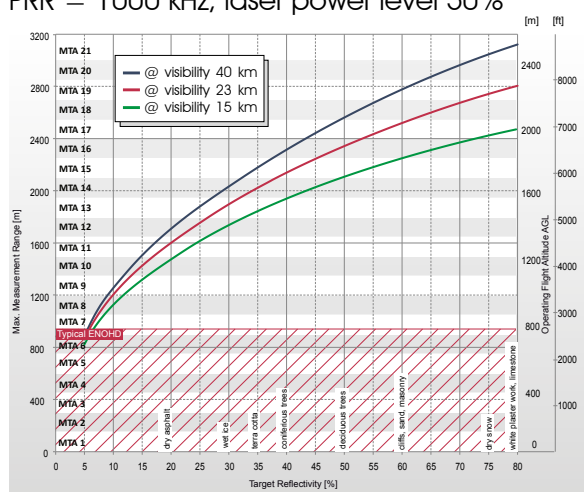


Example: VQ-780i at 1,000,000 pulses/sec, laser power level 100%
Altitude = 5,400 ft AGL, Speed = 160 kn

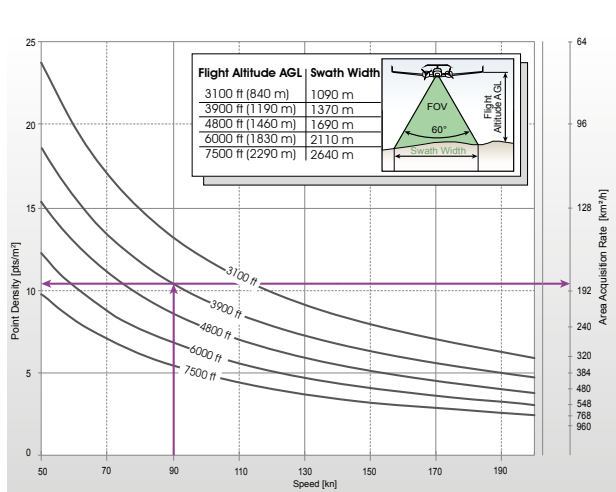


Results: Point Density ~ 4.26 pts/m²
Area Acquisition Rate ~ 451 km²/h

PRR = 1000 kHz, laser power level 50%



Example: VQ-780i at 1,000,000 pulses/sec, laser power level 50%
Altitude = 3,900 ft AGL, Speed = 90 kn



Results: Point Density ~ 10.5 pts/m²
Area Acquisition Rate ~ 183 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
- effective FOV 58°
- average ambient brightness
- roll angle ±5°

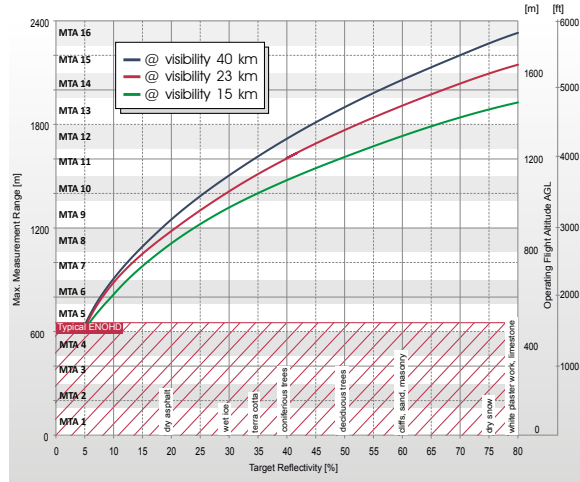
Typical ENOHD

- Calculated under assumption of an angular step width of 0.012° and an aircraft speed higher than 10kn.

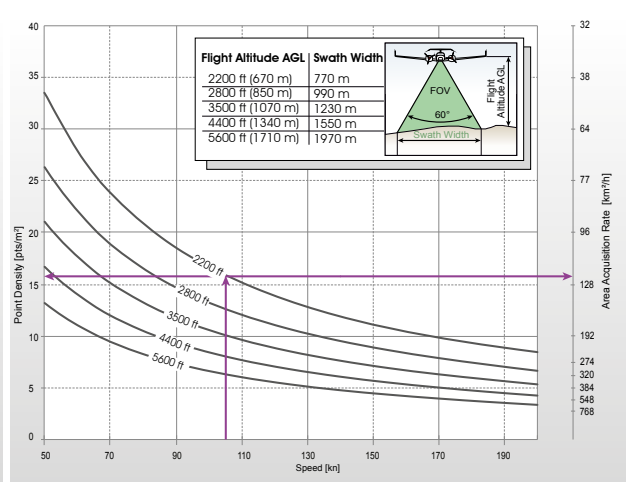
Assumptions for calculation of the Area Acquisition Rate

- 20% overlap of neighboring flight strips. This overlap covers a roll angle of ±5° or a reduction of flight altitude AGL of 20%.

PRR = 1000 kHz, laser power level 25%

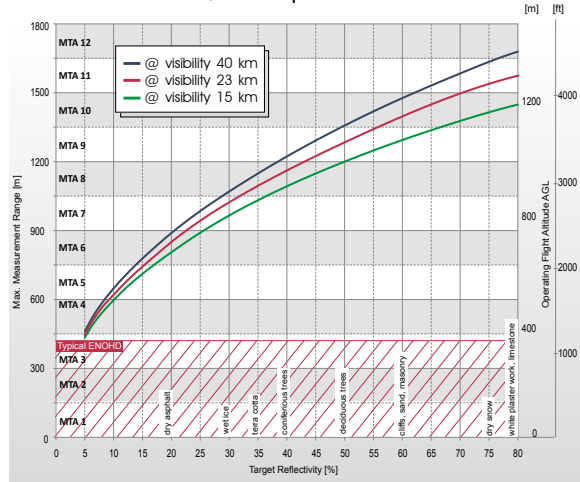


Example: VQ-780i at 1,000,000 pulses/sec, laser power level 25%
Altitude = 2,200 ft AGL, Speed = 105 kn

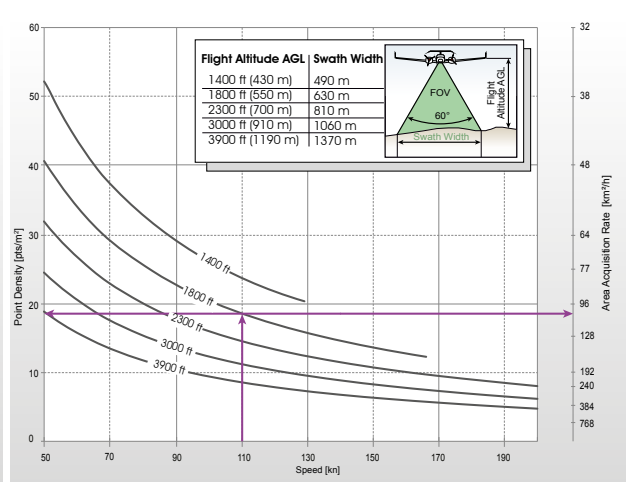


Results: Point Density ~ 15.9 pts/m²
Area Acquisition Rate ~ 121 km²/h

PRR = 1000 kHz, laser power level 12%

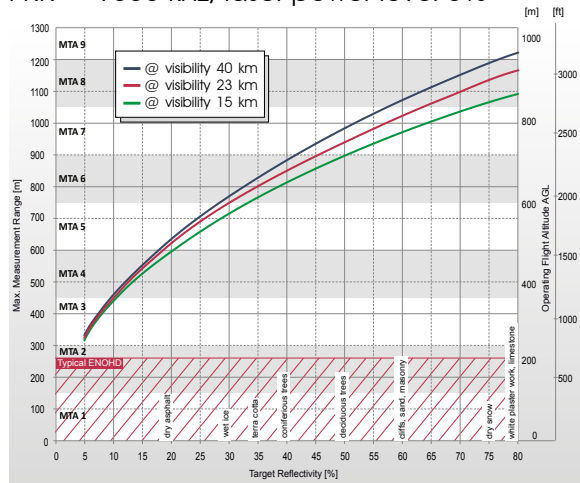


Example: VQ-780i at 1,000,000 pulses/sec, laser power level 12%
Altitude = 1,800 ft AGL, Speed = 110 kn

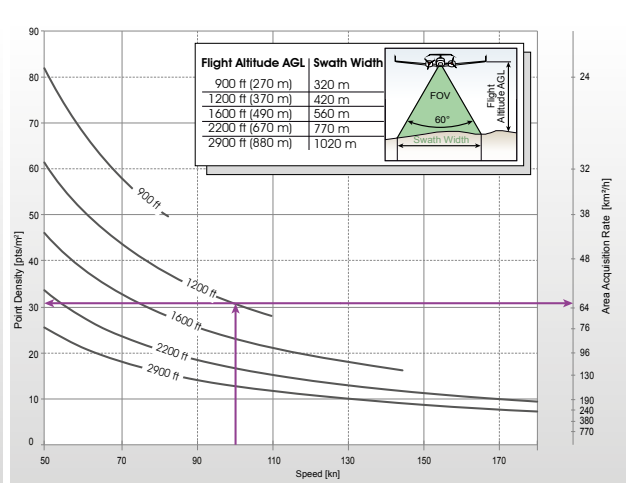


Results: Point Density ~ 18.9 pts/m²
Area Acquisition Rate ~ 103 km²/h

PRR = 1000 kHz, laser power level 6%



Example: VQ-780i at 1,000,000 pulses/sec, laser power level 6%
Altitude = 1,200 ft AGL, Speed = 100 kn



Results: Point Density ~ 30.7 pts/m²
Area Acquisition Rate ~ 62.5 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
- effective FOV 58°
- average ambient brightness
- roll angle ±5°

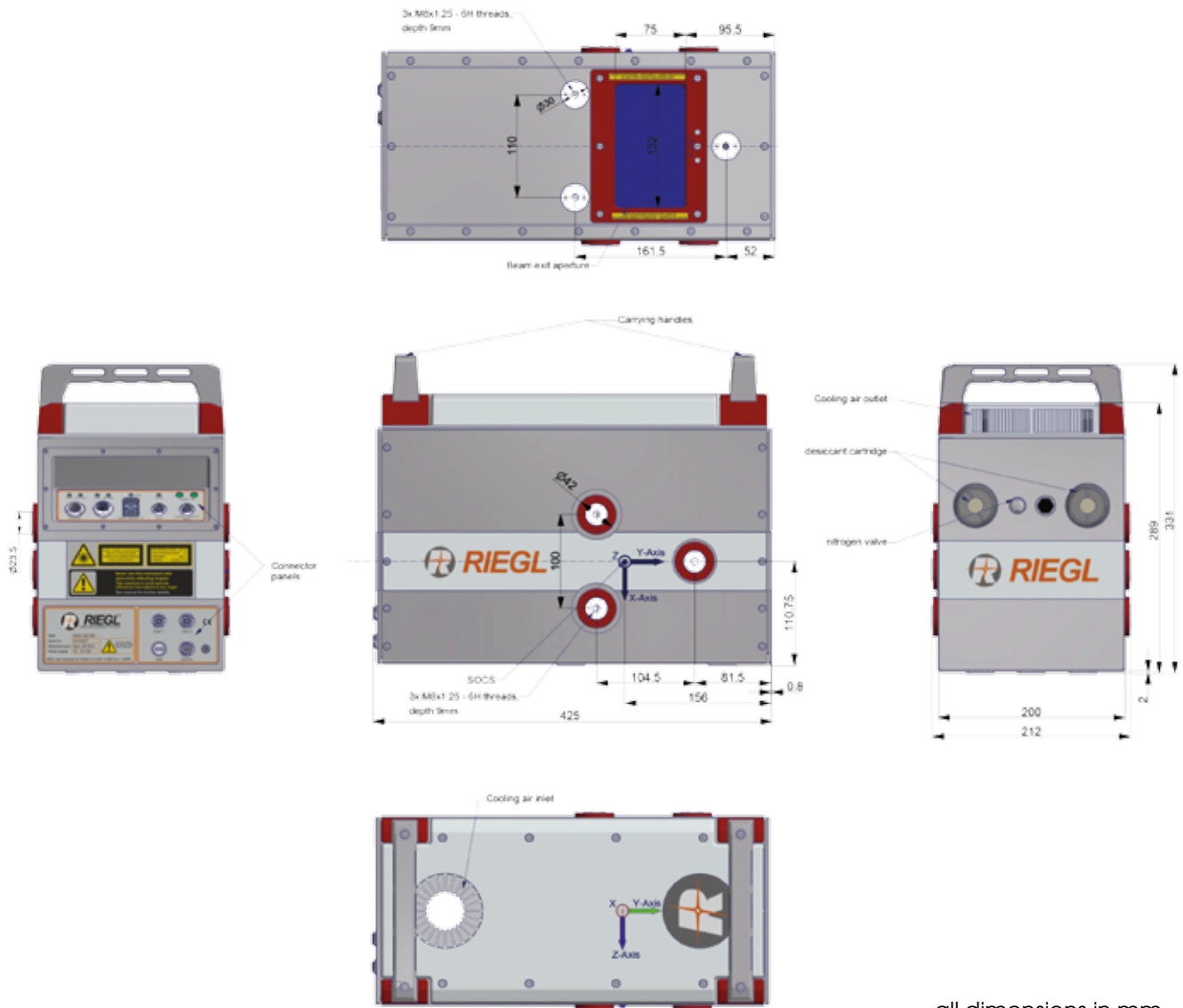
Assumptions for calculation of the Area Acquisition Rate

- 20% overlap of neighboring flight strips. This overlap covers a roll angle of ±5° or a reduction of flight altitude AGL of 20%.

Typical ENOHD

- Calculated under assumption of an angular step width of 0.012° and an aircraft speed higher than 10kn.

RIEGL VQ®-780i Main Dimensions



all dimensions in mm

Laser Product Classification

Class 4 Laser Product according to IEC60825-1:2014
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.



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

Range Measurement Performance

as a function of laser power setting, PRR, and target reflectivity

Laser Power Level	100%				
Laser Pulse Repetition Rate (PRR) ¹⁾	250 kHz	350 kHz	500 kHz	700 kHz	1000 kHz
Max. Measuring Range ^{2) 3)} natural targets $\rho \geq 20\%$ natural targets $\rho \geq 60\%$	4000 m	3600 m	3100 m	2700 m	2300 m
	6100 m	5500 m	4800 m	4300 m	3700 m
Max. Operating Flight Altitude Above Ground Level (AGL) ^{2) 4)}	5000 m	4500 m	3900 m	3500 m	3000 m
	16400 ft	14800 ft	12800 ft	11500 ft	9800 ft
NOHD ^{5) 7)}	395 m	350 m	290 m	250 m	200 m
ENOHD ^{6) 7)}	2610 m	2270 m	1900 m	1600 m	1340 m

Laser Power Level	50%	25%	12%	6%
Laser Pulse Repetition Rate (PRR) ¹⁾	1000 kHz	1000 kHz	1000 kHz	1000 kHz
Max. Measuring Range ^{2) 3)} natural targets $\rho \geq 20\%$ natural targets $\rho \geq 60\%$	1700 m	1200 m	900 m	600 m
	2800 m	2100 m	1500 m	1100 m
Max. Operating Flight Altitude Above Ground Level (AGL) ^{2) 4)}	2300 m	1700 m	1200 m	900 m
	7500 ft	5600 ft	3900 ft	2900 ft
NOHD ^{5) 7)}	140 m	95 m	60 m	40 m
ENOHD ^{6) 7)}	940 m	650 m	420 m	260 m

1) rounded average PRR

2) Typical values for average conditions and average ambient brightness; in bright sunlight the operational range may be considerably shorter and the operational flight altitude may be considerably lower 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 40 km. Range ambiguities have to be resolved by multiple-time-around processing.

4) Typical values for reflectivity $\rho \geq 60\%$, max. effective FOV 58°, additional roll angle $\pm 5^\circ$

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 of 0.012° (which means non-overlapping laser footprints), and an aircraft speed higher than 10 kn. NOHD and ENOHD increase when using overlapping laser footprints which may be intended e.g. for power line mapping.

Minimum Range ⁸⁾

Accuracy ^{9) 10)}

Precision ^{10) 11)}

Laser Pulse Repetition Rate

Effective Measurement Rate

Echo Signal Intensity

Laser Wavelength

Laser Beam Divergence

Number of Targets per Pulse

100 m

20 mm

20 mm

up to 1 MHz

up to 666 kHz @ 60° scan angle

provided for each echo signal

near infrared

≤ 0.18 mrad @ $1/e^{12}$, ≤ 0.25 mrad @ $1/e^{213}$

with online waveform processing: practically unlimited ^{14) 15)}

monitoring data output: first pulse

Scanner Performance

Scanning Mechanism

Scan Pattern

Scan Angle Range

Total Scan Rate

Angular Step Width $\Delta\theta$

Angle Measurement Resolution

rotating polygon mirror

parallel scan lines

$\pm 30^\circ = 60^\circ$

20 ¹⁶⁾ - 300 lines/sec

$\Delta\theta \geq 0.006^\circ$ ^{17) 18)}

0.001°

8) Limitation for range measurement capability, does not consider laser safety issues! The minimum range for valid reflectivity values is 250 m.

9) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.

10) Standard deviation one sigma @ 250 m range under RIEGL test conditions.

11) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.

12) Measured at the $1/e$ points. 0.18 mrad correspond to an increase of 18 cm of beam diameter per 1000 m distance.

13) Measured at the $1/e^2$ points. 0.25 mrad correspond to an increase of 25 cm of beam diameter per 1000 m distance.

14) Depending on laser pulse repetition rate, up to a max. of 15 targets per laser pulse.

15) If the laser beam hits, in part, more than one target, the laser's pulse power is split accordingly. Thus, the achievable range is reduced.

16) The minimum scan rate depends on the selected laser PRR.

17) The minimum angular step width depends on the selected laser PRR.

18) The maximum angular step width is limited by the maximum scan rate.

Technical Data to be continued at page 10

Technical Data *RIEGL VQ®-780i (continued)*

Data Interfaces

Configuration
Monitoring Data Output
Digitized Data Output
Synchronization

TCP/IP Ethernet (10/100/1000 MBit/s)
TCP/IP Ethernet (10/100/1000 MBit/s)
High-speed serial data link to *RIEGL* Data Recorder DR1560(i)
Serial RS232 interface, TTL input for 1 pps synchronization pulse,
accepts different data formats for GNSS-time information
2 x power, RS232, 1 pps, trigger, exposure

Camera interface

General Technical Data

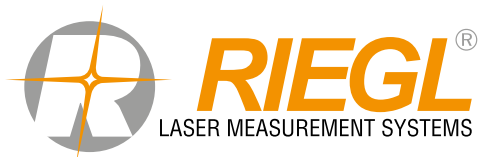
Power Supply / Current Consumption
Main Dimensions (length x width x height)
Weight

18 - 32 V DC / typ. 140 W
425 mm x 212 mm x 331 mm
approx. 20 kg

Protection Class
Max. Flight Altitude operating / not operating
Temperature Range operation / storage

IP54
18500 ft (5600 m) above MSL¹⁾ / 18500 ft (5600 m) above MSL
-5°C up to +40°C / -10°C up to +50°C

1) Mean Sea Level



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