RIEGL VQ-380i

- *high ranging based on echo digitization and online waveform processing*
- *high laser repetition rate - fast data acquisition*
- *multiple target capability*
- *interface for smooth integration of GPS*
- *perfectly linear scan lines*
- *compact, rugged, and lightweight design*
- *integrated LAN-TCP/IP interface*

The V-Line® 2D Laser Scanner *RIEGL* VQ-380i provides high speed data acquisition using a narrow infra-red laser beam and a fast line scanning mechanism.

High-accuracy laser ranging is based on *RIEGL*´s unique echo digitization and online waveform processing, which allows achieving superior measurement capability even under adverse atmospheric conditions and the evaluation of multiple target echoes.

The scanning mechanism is based on a fast rotating multi-facet polygonal mirror, which provides fully linear, unidirectional and parallel scan lines.

The *RIEGL* VQ-380i is a very compact and lightweight device, mountable in any orientation and also under limited space conditions on small fixed-wing aircrafts, helicopters and land based vehicles. The instrument needs only one power supply and provides line scan data via the integrated LAN-TCP/IP interface. The binary data stream can easily be decoded by user-designed software making use of the available software libary RiVLib.

Typical applications include

- ***Terrain Mapping***
- ***Corridor Mapping***

visit our website
www.riegl.com

RIEGL®
LASER MEASUREMENT SYSTEMS

Laser Product Classification	Class 1 Laser Product according to IEC60825-1:2007 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.

CLASS 1 LASER PRODUCT

Range Measurement Performance

Measuring Principle	time of flight measurement, echo signal digitization, online waveform processing, multiple-time-around-processing

Laser Pulse Repetition Rate PRR [1]	*70 kHz*	*100 kHz*	*200 kHZ*	*300 kHz*	*400 kHz*	*550 kHz*
Effective Measurement Rate (meas./sec.) [1,2]	29 000	42 000	83 000	125 000	167 000	230 000
Max. Measuring Range [3,4]						
natural targets $\rho \geq 20$ %	850 m	700 m	500 m	450 m	350 m	300 m
natural targets $\rho \geq 60$ %	1400 m	1200 m	850 m	700 m	650 m	550 m
Max. Operating Flight Altitude AGL [1,2]	475 m (1550 ft)	400 m (1300 ft)	275 m (900 ft)	250 m (820 ft)	200 m (650 ft)	175 m (570 ft)
Max. Number of Targets per Pulse	practically unlimited (details on request)					

1) Rounded values.
2) Reflectivity $\rho \geq 20\%$, 100° FOV, additional roll angle $\pm 5°$.
3) The following conditions are assumed: target larger than the footprint of the laser beam, perpendicular angle of incidence, visibility 23 km, average ambient brightness.
4) Ambiguity to be resolved by post-processing with RiMTA software.

Minimum Range	10 m
Accuracy [5,7]	25 mm
Precision [6,7]	25 mm
Laser Pulse Repetition Rate [1,8]	up to 550 kHz
Max. Effective Measurement Rate [1]	up to 230 000 meas./sec. (@ 550 kHz PRR & 100° FOV)
Echo Signal Intensity	for each echo signal, high-resolution 16 bit intensity information is provided
Laser Wavelength	near infrared
Laser Beam Divergence [9]	0.35 mrad
Laser Beam Footprint (Gaussian Beam Definition)	36 mm @ 100 m, 88 mm @ 250 m, 175 mm @ 500 m

5) Accuracy is the degree of conformity of a measured quantity to its actual (true) value.
6) Precision, also called reproducibility or repeatability, is the degree to which further measurements show the same result.
7) One sigma @ 150 m range under *RIEGL* test conditions.
8) User selectable.
9) Measured at the $1/e^2$ points. 0.35 mrad corresponds to an increase of 35 mm of beam diameter per 100 m distance.

Scanner Performance

Scanning Mechanism	rotating polygon mirror
Field of View (selectable)	100° (+60° / -40°)
Scan Speed (selectable)	10 - 120 scans/sec
Angular Step Width $\Delta\ \vartheta$ (selectable) between consecutive laser shots	$0.004° \leq \Delta\vartheta \leq 0.41°$
Angle Measurement Resolution	0.001°
Internal Sync Timer	for real-time synchronized time stamping of scan data
Scan Sync (optional)	scanner rotation synchronization

Data Interfaces

Configuration	LAN 10/100/1000 Mbit/sec
Scan Data Output	LAN 10/100/1000 Mbit/sec, USB 2.0
GPS-System	Serial RS232 interface for data string with GPS-time information, TTL input for 1PPS synchronization pulse

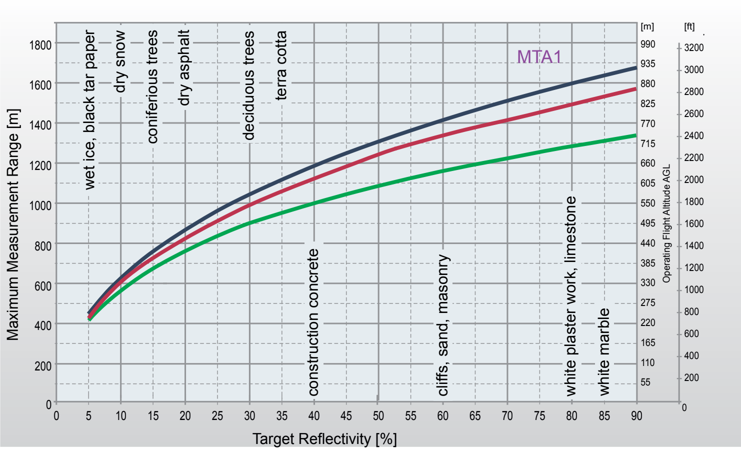
Mechanical Interfaces

Mounting of the Laser Scanner	3 x M6 thread inserts in the rear and the front plate removable mounting plate with 6 x M6 thread inserts
Mounting of IMU sensor	3 x M6 thread inserts in the rear plate (rigidly coupled with the internal mechanical structure)

General Technical Data

Power Supply Input Voltage	18 - 32 V DC
Current Consumption	typ. 72 W
Main Dimensions / Weight	294.5 x 198 x 185 mm (L x W x H), approx. 7.10 kg
Humidity	max. 80 % non condensing @ +31°C
Protection Class	IP64, dust and splash-proof
Max. Flight Altitude (operating)	16 500 ft (5 000 m) above MSL
Max. Flight Altitude (not operating)	18 000 ft (5 500 m) above MSL
Temperature Range	-10°C up to +40°C (operation) / -20°C up to +50°C (storage)

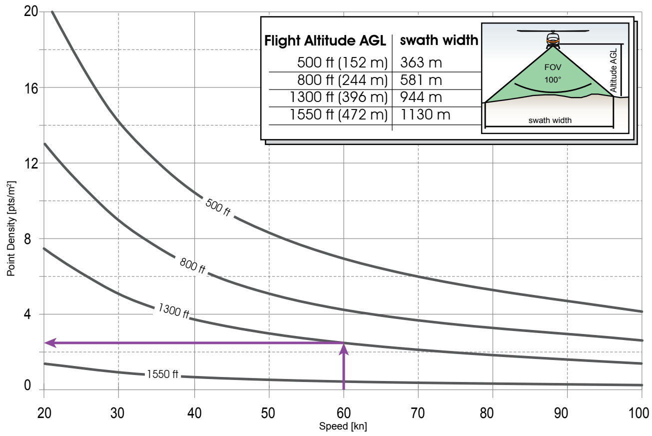
PRR = 70 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"

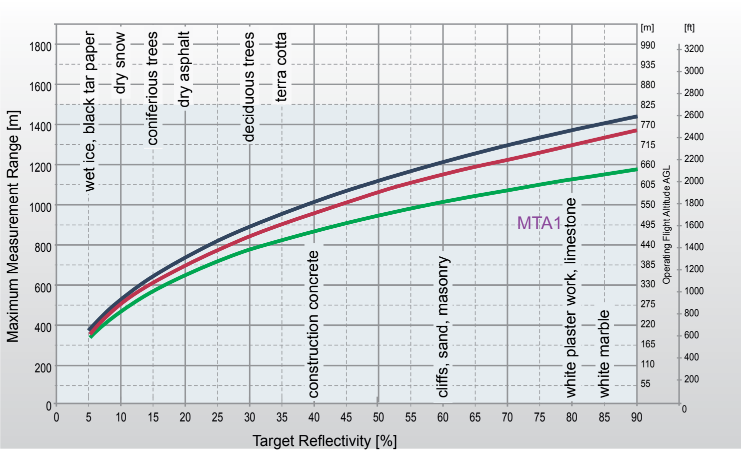
- @ visibility 23 km
- @ visibility 15 km
- @ visibility 8 km

PRR = 70 kHz



Example: VQ-380i at 70,000 pulses/second
Altitude = 1300 ft AGL, Speed = 60 kn
Resulting Point Density ~ 2,5 pt/m²

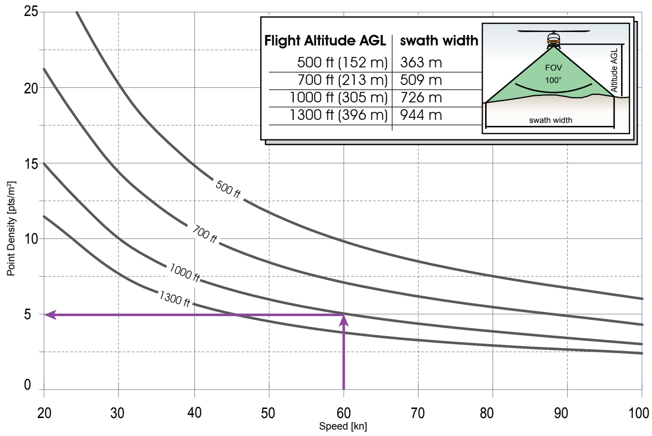
PRR = 100 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"

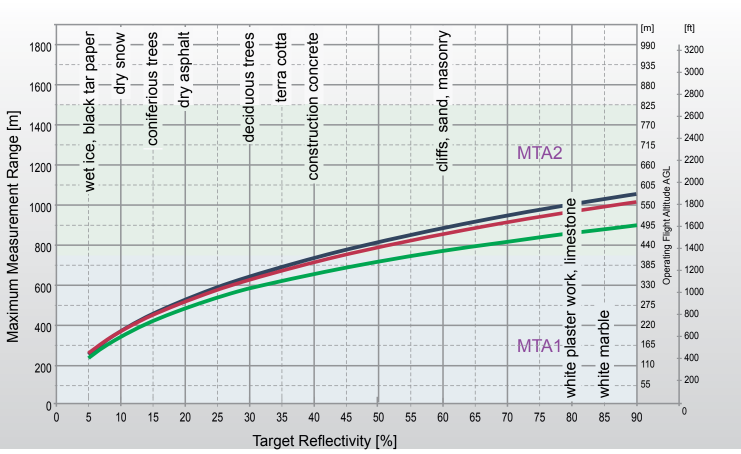
- @ visibility 23 km
- @ visibility 15 km
- @ visibility 8 km

PRR = 100 kHz



Example: VQ-380i at 100,000 pulses/second
Altitude = 1000 ft AGL, Speed = 60 kn
Resulting Point Density ~ 5 pt/m²

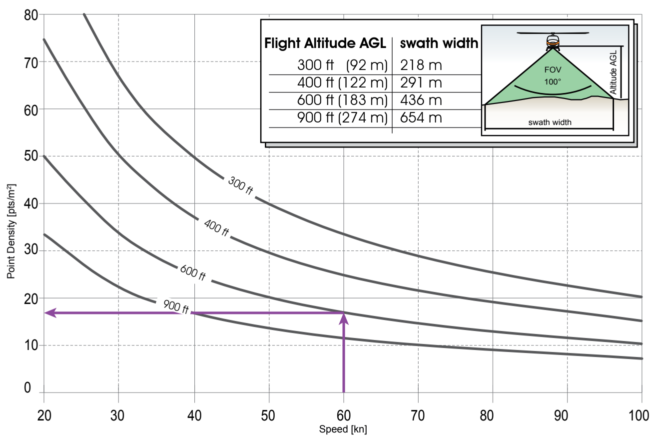
PRR = 200 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"
MTA2: 2 transmitted pulses „in the air"

- @ visibility 23 km
- @ visibility 15 km
- @ visibility 8 km

PRR = 200 kHz

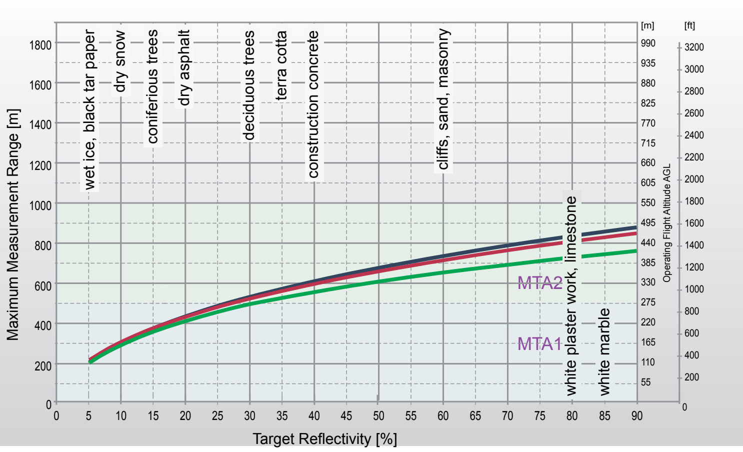


Example: VQ-380i at 200,000 pulses/second
Altitude = 600 ft AGL, Speed = 60 kn
Resulting Point Density ~ 17 pt/m²

The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- target size ≥ laser footprint
- scan angle 100°
- average ambient brightness
- roll angle +/-5°

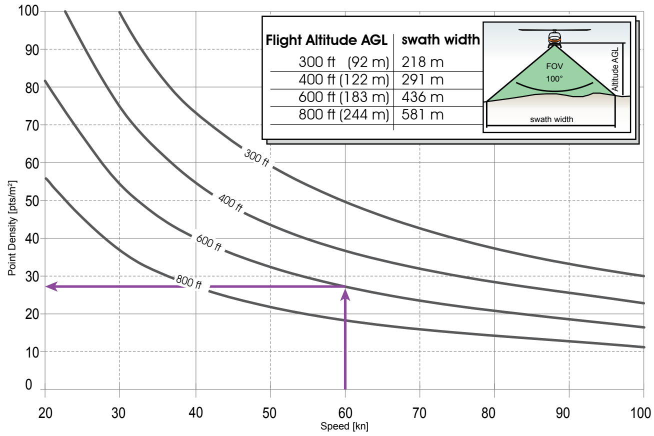
PRR = 300 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"
MTA2: 2 transmitted pulses „in the air"

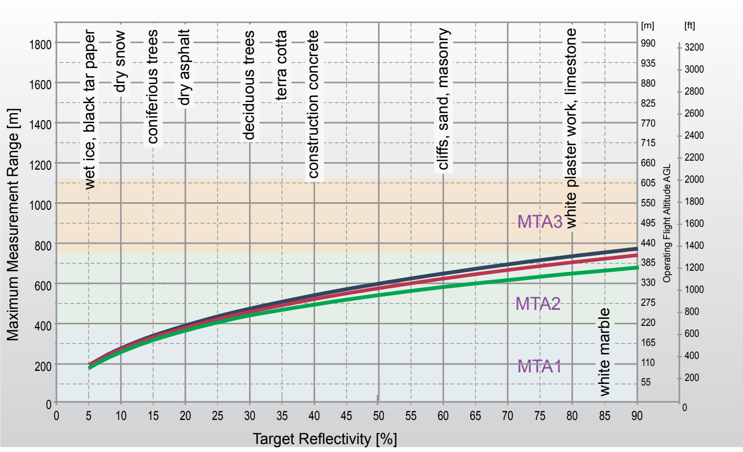
@ visibility 23 km
@ visibility 15 km
@ visibility 8 km

PRR = 300 kHz



Example: VQ-380i at 300,000 pulses/second
Altitude = 600 ft AGL, Speed = 60 kn
Resulting Point Density ~ 26 pt/m²

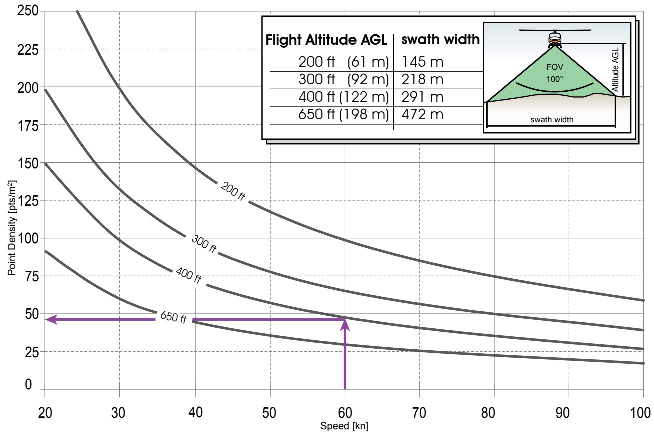
PRR = 400 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"
MTA2: 2 transmitted pulses „in the air"
MTA3: 3 transmitted pulses „in the air"

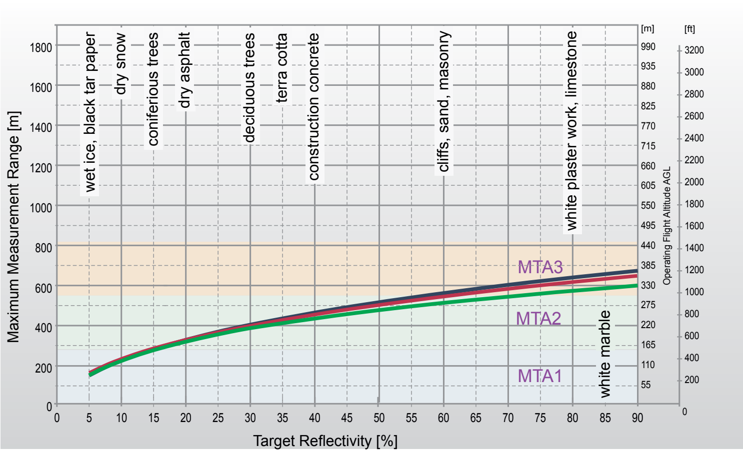
@ visibility 23 km
@ visibility 15 km
@ visibility 8 km

PRR = 400 kHz



Example: VQ-380i at 400,000 pulses/second
Altitude = 400 ft AGL, Speed = 60 kn
Resulting Point Density ~ 45 pt/m²

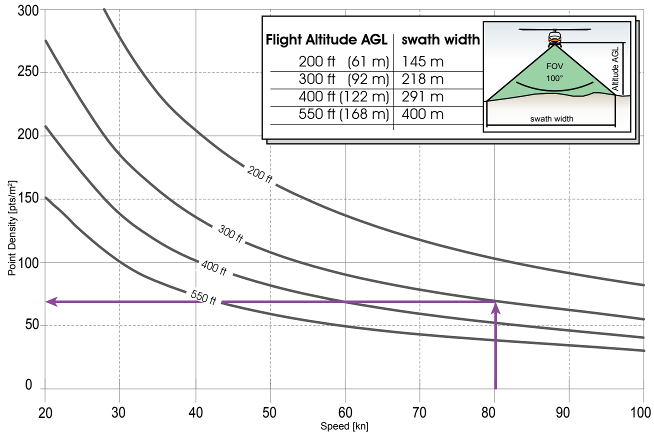
PRR = 550 kHz



MTA1: no ambiguity / 1 transmitted pulse „in the air"
MTA2: 2 transmitted pulses „in the air"
MTA3: 3 transmitted pulses „in the air"

@ visibility 23 km
@ visibility 15 km
@ visibility 8 km

PRR = 550 kHz

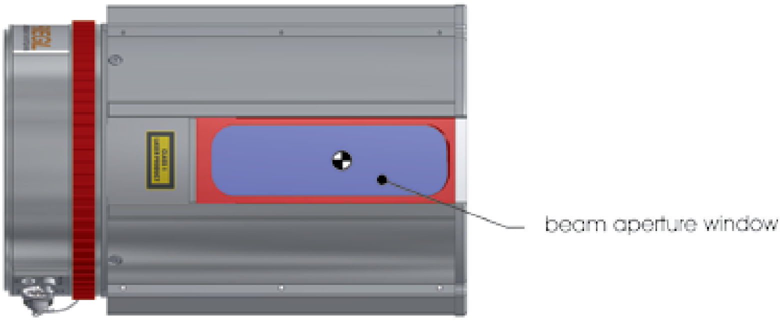


Example: VQ-380i at 550,000 pulses/second
Altitude = 300 ft AGL, Speed = 80 kn
Resulting Point Density ~ 65 pt/m²

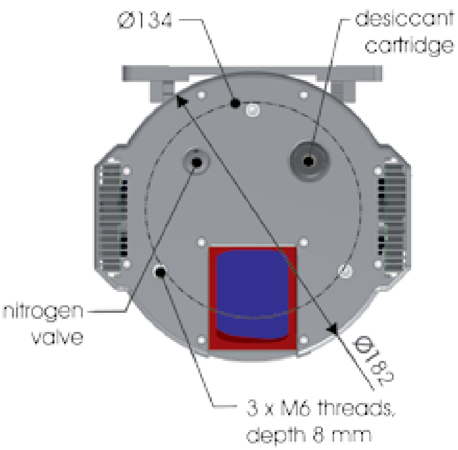
The following conditions are assumed for the Operating Flight Altitude AGL

- ambiguity resolved by multiple-time-around (MTA) processing & flight planning
- target size ≥ laser footprint
- scan angle 100°
- average ambient brightness
- roll angle +/-5°

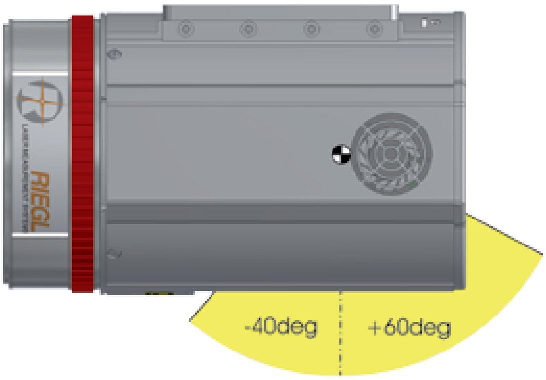
bottom view



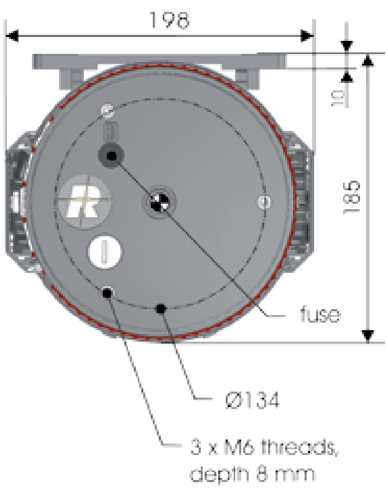
front view



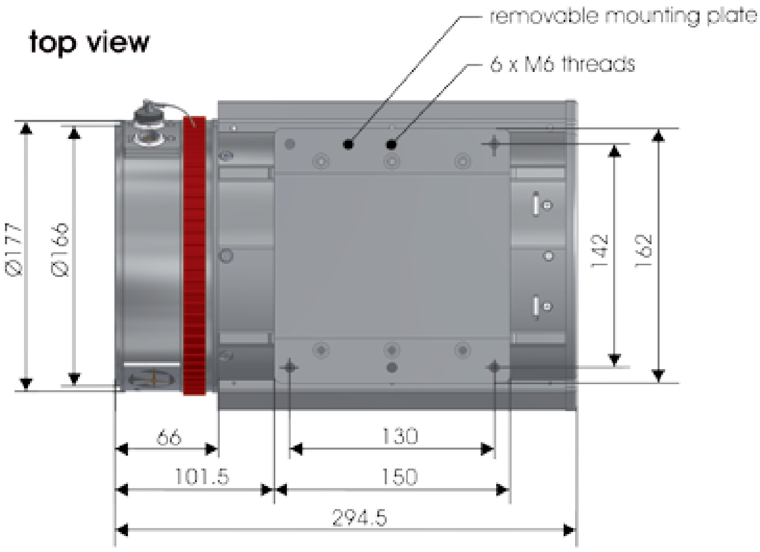
side view



rear view



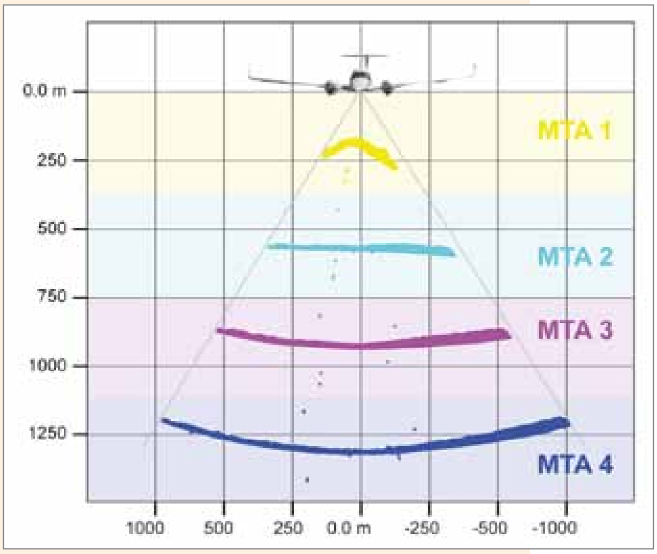
top view



all dimensions in mm

origin of scanner´s local coordinate system

Multiple-time-around Data Acquisition and Processing



Example for a profile of scan data processed in MTA zones 1 to 4

In time-of-flight laser ranging a maximum unambiguous measurement range exists, which is defined by the laser pulse repetition rate and the speed of light. In case the echo signal of an emitted laser pulse arrives later than the emission of the subsequently emitted laser pulse, the range result becomes ambiguous - an effect known as **„Multiple-Time-around“ (MTA)**.

The *RIEGL* VQ-380i allows ranging beyond the maximum unambiguous measurement range using a sophisticated modulation scheme applied to the train of emitted laser pulses. The dedicated post-processing software RiMTA provides algorithms for multiple-time-around processing, which automatically assign definite range results to the correct MTA zones without any further user interaction required.

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