

## WindCube Scan Lidar Explore Edition



### Features

- 24/7 real-time measurements
- Fully configurable for monitoring, cross-sectioning, wind profiling, and more
- A wind reconstruction tool proven by international third parties is also available
- Dedicated reprocessing and display software

The WindCube® Scan series provides accurate wind and atmospheric measurements reliably and affordably even in extreme environments.

The WindCube Scan series of wind and aerosol lidars perform 24/7 real-time measurements and high-level data processing. They are versatile tools for recovering accurate real-time wind and aerosol backscatter measurements in any scanning geometry up to more than 10 km. They are among the most flexible and accurate wind measurement technologies available, complementing met masts and accurate vertical profiling lidars in wind energy applications, for example.

### Versatility and robustness

WindCube Scan units feature rugged, industrial design and can be placed in extreme environments. Each system is fully configurable for several uses including monitoring, atmospheric cross-sectioning, wind profiling, and more.

State of the art structure detection algorithm offers the capability to detect, locate, and classify clouds and aerosol layers in the troposphere, as well as to monitor the height of the atmospheric boundary layer (ABL). They can be deployed either as standalone units for wind hazards detection, or in combination with other weather sensors as part of comprehensive systems like windshear alert systems at airports.

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# WindCube Scan Lidar Explore Edition datasheet

## GENERAL SPECIFICATIONS

Dimensions (L × W × H)	
System	830 x 1050 x 1355 mm
Shipping case closed	948 x 1204 x 1507 mm (shipping case closed)
Shipping case opened	948 x 2736 x 1905 mm (shipping case opened)

  

Weight	
System only	220 kg
Shipping case only	116 kg
Total with accessories	355 kg

Outdoor Operating condition	
Temperature <sup>1)</sup>	-40°C to + 55°C
Max. wind resistance <sup>2)</sup>	≥ 60 m/s
Installation altitude	Up to 3048 m
IP rating	IP65

- 1) Ambient shadow temperature  
2) Tested in wind tunnel. Lidar working nominally up to 55m/s. Beyond, the Lidar has been tested in "survival mode", i.e. switched off and scanner pointing toward ground.

Laser	
LASER source	Solid state pulsed at @1.54 μm
LIDAR eye safety	Class 1M according to IEC 60825-1:2014

Electrical	
Power supply	100-240Vac, 18-9A RMS, 50-60Hertz With mains supply voltage fluctuations up to ±10% of the nominal voltage
Power consumption	1100W maximum average power (including the use of coolers and heaters), brief peaks up to 1600W

## REGULATORY COMPLIANCE

Property	Description/Value
Compliance marks	CE, UKCA, FCC Part 15, ICES-003

## HARDWARE OPTIONS

External PTH sensor	Temperature Measurement range: -50°C to +60°C Pressure Measurement range: 500hPa to 1100 hPa Humidity Measurement range: 0% to 100%
4G-cellular router <sup>1)</sup>	Cellular Router allows to plug in a sim and connect to a 4G network.

- 1) The required M2M sim card is not provided with the system. The user must acquire it themselves.  
Countries covered: American Samoa, Australia, Canada, EU (excluding Luxemburg), Guam, Iceland, Japan, Liechtenstein, Malta, Mexico, New Zealand, North Marina Island, Peru, Puerto Rico, Singapore, Switzerland, United Kingdom, US, U.S. Virgin Islands

## SCANNING CAPABILITIES

### Scanning scenarios

Scanning modes <sup>1)</sup>	<b>Fixed:</b> A fixed Line Of Sight scenario at user defined Elevation and Azimuth. <b>DBS:</b> A vertical wind profile measurement scenario, consisting of 5 fixed Line Of Sights. (4 x inclined Line Of Sights at a selected elevation towards the North, South, East and West. Plus 1 vertical pointing Line of Sight) <b>VAD:</b> A vertical wind profile measurement scenario, consisting of multiple Line Of Sight measurements of the radial wind speed along a selected sector. <b>PPI:</b> A constant elevation angle scan <b>Volume Scan:</b> A stack of similar PPI scans at multiple elevations <b>RHI:</b> A constant azimuth angle scan <b>Segment Scan:</b> An inclined flat plane scan, with user selectable plane inclination angle
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Scanning Type	<ul style="list-style-type: none"><li>Endless full hemispherical scanning</li><li>Continuous scanning (scanner can measure while rotating)</li></ul>
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- 1) The WindCube Scan 100P is limited to Fixed, DBS and VAD scans

### Scanner Performances

Scanner pointing accuracy <sup>1)</sup>	<0.1°
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1) The WindCube scan pointing accuracy specification is 0.1°. This value has to be understood as the accuracy after alignment on distant hard target(s), on a limited area, ±22.5° in elevation or azimuth, around a reference hard target and without considering possible backlash i.e. using always the same scanning direction.

### Scanner parameters

Scanner rotation speed	Up to 50°/s
Azimuth angle	0° ... 360° (with 0.01° increment)
Elevation angle	-20° ... 200° (with 0.01° increment)
Mirrors and window diameter (clear aperture)	120mm

## METROLOGICAL PERFORMANCES

### Lidar performance

Radial wind speed range <sup>1)</sup>	-41 ... 41 m/s
Reconstructed wind speed range (DBS scan)	0 ... 60 m/s for 60° elevation angle 0 ... 115 m/s for 75° elevation angle
Radial wind speed accuracy <sup>2)</sup>	< 0.1 m/s

- 1) Close to extremal values, wind speed can be less accurate, according to the resolution used  
2) Accuracy must be understood as absolute mean error of the radial wind speed, after filtering by the status and in regular Lidar measurement situation: diffuse particles, no hard target in the direct line of sight, no ambiguities

## MEASUREMENT PARAMETERS

### Lidar parameters

Accumulation time	100 ms <sup>1)</sup> to 10 s
Distance between two range gates (display range resolution)	Down to 1m (with range gate overlapping)

<sup>1)</sup> In some configurations (in particular combination of a large number of range gates and large number of lines of sight inside a scan), the CPU and memory loads on the Lidar computer could impair measurement for accumulation times under 500 ms. This will not put the system at risk but could generate missing lines of sight measurement. When accumulation time below 500 ms is required, a trial shall be performed beforehand

### Lidar parameters for each mode

Range gate length (range resolution)	Max number of gates	First range of measurement (min)	Max acquisition range <sup>1)</sup>
25m	319	50m	6.4 km
25m TP <sup>2)</sup>	319	50m	9.8 km
50m	319	100m	7.9 km
50m TP	319	100m	14.8 km
75m	159	150m	9.6 km
75m TP	159	150m	14.6 km
100m	159	200m	11.6 km
150m	159	300m	15.3 km
200m	79	400m	18.9 km

<sup>1)</sup> The maximum acquisition range is defined in ISO 28902-2:2017 as the maximum distance to which the lidar signal is recorded and processed. It depends on the mode used.

<sup>2)</sup> TP = Tropospheric profiler: An optimized mode to measure the vertical profile of the atmosphere

### Configurations

Mode available	100P	100S	200S	400S
FIXED / VAD / DBS scans	✓	✓	✓	✓
PPI / RHI / Volume / Segment scans		✓	✓	✓
25m		✓	✓	✓
25m TP	✓	✓	✓	✓
50m		✓	✓	✓
50m TP	✓	✓	✓	✓
75m		✓	✓	✓
75m TP	✓	✓	✓	✓
100m		✓	✓	✓
150m			✓	✓
200m				✓

### Range

Property	WINDCUBE 100P	WINDCUBE 100S	WINDCUBE 200S	WINDCUBE 400S
Typical maximum operational range <sup>1)</sup>	6 km	6km	8 km	10 km
Maximum acquisition range <sup>2)</sup>	14.6 km	14.8 km	15.3 km	18.9 km

<sup>1)</sup> The maximum operational range is defined in ISO 28902-2:2017 as the distance to which a confident wind speed can be derived from the lidar signal. It depends on various parameters such as the accumulation time, range gate length, visibility, type of aerosols, and variations of refractive index in the atmosphere. It must be understood within the planetary boundary layer, without any cloud along the line of sight and without precipitation. The typical maximum operational range are given for a standard atmosphere (Visibility of 10 km, Lidar Ratio of 30) and a standard configuration (largest range gate length available in each configuration, 1s accumulation time). Vaisala has developed a unique LIDAR simulator to estimate the maximum operational range of in a specific deployment location and a specific Lidar configuration. A custom simulation can be provided upon request.

<sup>2)</sup> The maximum acquisition range is defined in ISO 28902-2:2017 as the maximum distance to which the lidar signal is recorded and processed. It depends on the mode used

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## OUTPUT DATA

### System behavior data

Environmental data (CSV format)	30-minute average, minimum, maximum, and number of samples for: <ul style="list-style-type: none"> <li>Latitude, Longitude (°) and altitude (m)</li> <li>Pitch, Roll (°)</li> <li>Disk occupation (%)</li> <li>Internal temperature (°C) and Humidity (%)</li> <li>External temperature (°C) and Humidity (%) optionally</li> </ul>
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Status (CSV format)	OK/WARNING/CRITICAL for: <ul style="list-style-type: none"> <li>Overall view (Lidar status)</li> <li>Precise view (components status)</li> <li>Measurement thresholds (Temperature, disk space...)</li> </ul>
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Activity (CSV format)	Time stamp Actions (LOG IN/OUT, START/STOP Acquiring, START/STOP Operating) User information
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### Wind data exports

Radial wind	Radial wind speed (m/s) Radial wind speed dispersion (m/s) Carrier to noise ratio (dB) Confidence index
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Vertical profile wind (in DBS mode)	Horizontal wind speed (m/s) Wind direction (m/s) Vertical wind speed (m/s) Carrier to noise ratio (dB) Confidence index
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Spectra (activate upon request)	Spectral density
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Data format	Stored in an embedded SQL database. Export in auto documented NetCDF files. The NetCDF file format is built on NetCDF-4 (which is in turn built on HDF5) and its architecture is based on CfRadial2 and Cf convention Send to Output data
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### Particles data exports (optional)

Structure	Residual planetary boundary layer Mixing planetary boundary layer Aerosols Clouds
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Radial backscatter coefficient	Attenuated relative beta ( $m^{-1}.sr^{-1}$ ) Attenuated absolute beta ( $m^{-1}.sr^{-1}$ )
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## SOFTWARE CAPABILITIES

### WindForge : Real time control and monitoring software

Main functionalities	Instrument control and configuration Management of a library of scans Programming in a loop or a scheduler Real-time data acquisition and measurement display System diagnostics and alarms
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### WAPP: Wind and Aerosol Post-Processing software

Features	Display and Export: animated data visualization
Volume Wind [option]	Post processing tool designed to reconstruct and visualize horizontal wind speed and direction in a configurable 3D volume

## SOFTWARE AND NETWORK

### WindForge : Real time control and monitoring software

Minimum configuration to run the WINDFORGE client interface	Processor: Core i3 or better RAM: 4 GB Hard disk: 500 GB 1366 × 768 screen resolution Operating system: Windows 10
Storage capacity	Database storage autonomy depends on scenario. 1 TB SSD (with additional 1 TB backup SSD) Typically 1 year (without saving raw signal averaged spectra, and with 1-second accumulation time).
Data bandwidth requirement	Ethernet / LAN Radial Wind Speed file, 70 gates, 1s accumulation = 25 MB/h Size proportional to the number of gates and the accumulation time.
Synchronization	UTC clock via NTP server (recommended) and GPS

### WAPP: Wind and Aerosol Post-Processing software

Minimum configuration to run the WAPP software	Processor: Core i5 / Core i7 and 3.4GHz or better RAM: 8GB Storage: <ul style="list-style-type: none"> <li>Capacity: 1TB (depending on campaign duration)</li> <li>Interface: SATA III 6.0 Gbps</li> <li>Single track seek time: <ul style="list-style-type: none"> <li>Read : 0.6 ms</li> <li>Write : 0.8 ms</li> </ul> </li> </ul> 1366x768 screen resolution OS: Windows 10 or Windows server 2019 (64 bit)
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## APPLICATION PROGRAMMING INTERFACE (API)

### API

API types	REST Web API Streaming API
Functionalities	Lidar configuration and programming Status/Activities/Logs monitoring Data download (JSON stream or NetCDF files)
Possible uses	Change the programming automatically according to wind direction Program several WindCubes simultaneously Integrate WindCube data easily in a third-party software Create a custom-made file format using JSON data stream

**VAISALA**

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