

Ammonit ZephIR LiDAR Systems for Accurate Wind Measurement

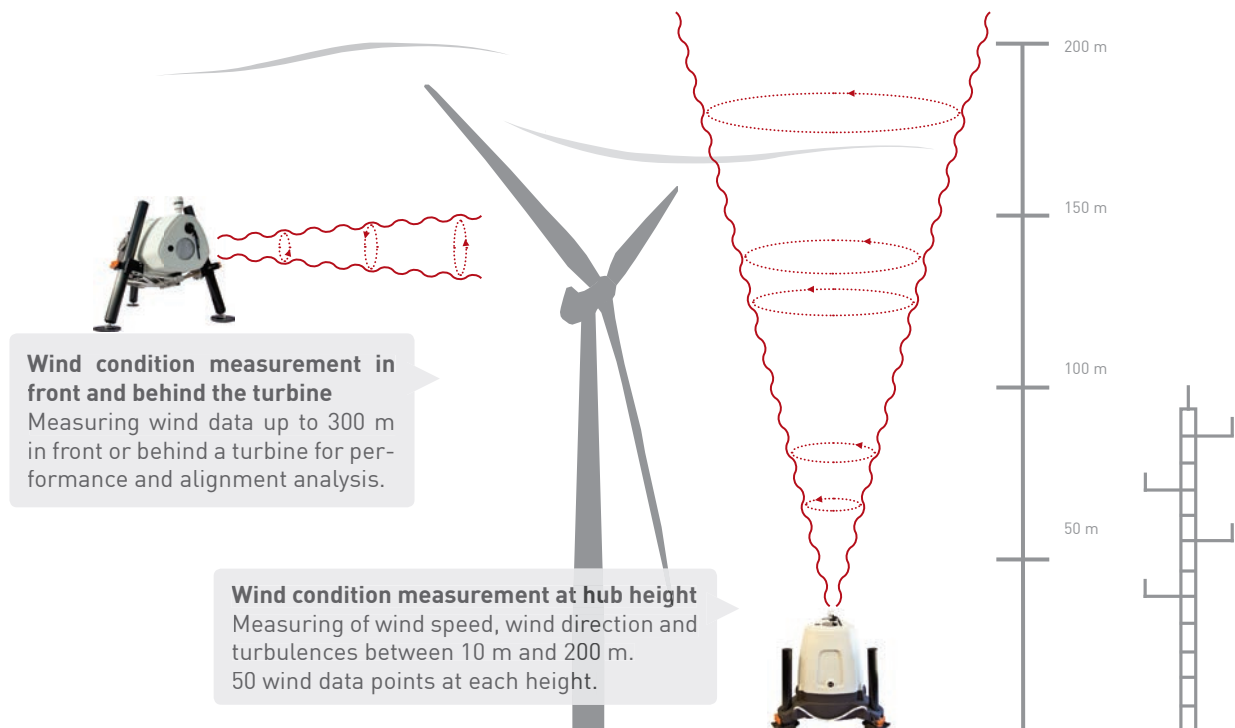


Remote sensing with Ammonit LiDAR instruments

LiDAR systems are increasingly being used in the wind industry for site assessment, power curve measurement as well as wind farm monitoring. As Trusted Service Provider, Ammonit offers the leading ZephIR Lidar systems: ZephIR 300 for ground-based installations and ZephIR DM for turbine-mounted applications. **According to the clear and auditable staging process by DNV GL, ZephIR 300 wind LiDAR is accepted for use in finance-grade wind speed and energy assessments with either no or limited on-site met mast comparisons under benign conditions (in simple terrain).**

ZephIR 300 measures wind conditions **from just 10 meters up to a height of 200 meters**. By installing ZephIR 300, you can benefit at every stage of your wind energy project - from pre-planning, through development and on to operation. ZephIR DM is a dual mode variation of ZephIR 300. Mounted on top of a wind turbine, **ZephIR DM** measures **wind conditions in front or behind the turbine** from just 10 meters to a distance of up to 300 meters. Install ZephIR DM to analyse performance and alignment of wind turbines.

Ammonit LiDAR systems for reliable wind condition measurement at all stages of wind energy projects.



Ammonit ZephIR LiDAR Wind Measurement System

LiDAR technology – Principle of operation

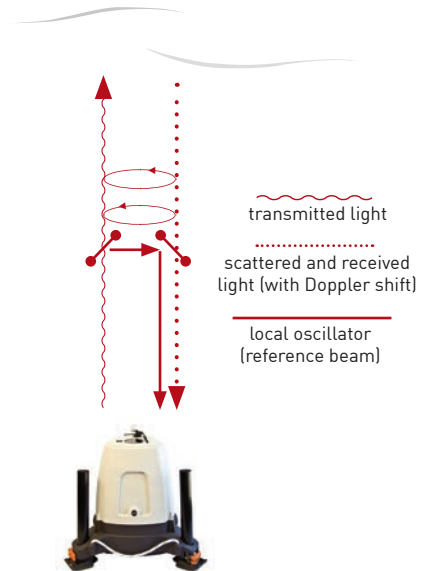
LiDAR (Light Detection And Ranging) technology measures wind conditions with the help of a **laser beam**, which is reflected by aerosols moved by the wind flow. The system evaluates the frequency shift caused by the **Doppler effect** between sent and received signals. By measuring in at least three different directions, wind speed and wind direction can be calculated.

ZephIR's Unique Continuous Wave Technology

The Continuous Wave principle of operation offers constant **high sensitivity at all heights**. The emitted laser beam is physically focused using optics and the laser power does not change with height. Thus the sensitivity does not degrade and ensures **high data availability at all heights and in all conditions** - even in areas with clean air containing low concentration of natural aerosols.

The laser is rotated through a full 360°-scan at each height. Each scan takes **50 measurements**, providing valuable wind data, from which horizontal and vertical wind speeds as well as wind direction can be calculated.

High data availability at all heights for your measurement campaigns.



Benefit from ZephIR LiDAR Technology

Continuous Wave Technology

Constant high sensitivity at all heights ensures high data availability at all heights and in all conditions. Rapid 50 Hz data rate for data acquisition in complex terrains with fast moving wind flow. High sensitivity for best performance even in extremely clear air.

Finance-Grade Wind Data

DNV GL considers ZephIR 300 to be at Stage 3* under "benign" conditions - accepted for use in bankable wind speed and energy assessments with either no or limited on-site met mast comparisons.

ZephIR Care™ for ZephIR 300

Benefit from 3 years warranty, support and 3-year service intervals for unbroken measurement campaigns.



Industry Approved Validation

IEC equivalent power performance measurements, extensive onshore / offshore campaigns and tall met mast verifications.

Waltz - User Interface

Monitoring of real-time wind data as well as time series of wind shear. User-defined configurations and data exports.

Collection of up to 50 wind data points at each height

Provides 50 data points per second across a full 360-degree scan to measure rapidly changing wind flow environments such as complex terrain and turbulences.

* According to DNV GL Stage 3 specifics: A device is considered proven for use in the assessment of wind farm sites. The data may be used quantitatively within formal wind speed and energy assessments with only limited or no site-specific validations against conventional anemometry.

Ammonit ZephIR LiDAR Wind Measurement System

ZephIR 300 for ground-based installation

At every stage of your wind energy project - from pre-planning through to re-powering, ZephIR 300 records accurate and reliable wind condition data **from 10 meters up to a height of 200 meters**. Every system is uniquely subjected to an industry-approved validation process, ensuring **repeatable finance-grade wind data**.

DNV GL considers ZephIR 300 to be at Stage 3* under “benign” conditions - accepted for bankable wind speed and energy assessments with either no or limited on-site met mast comparisons.

ZephIR 300 is designed user-friendly for fast and **easy deployment**. Within 5 minutes, you can set up ZephIR 300 at your selected site and start collecting data. ZephIR 300 comes with a complete set of **support packages** for remote power supply, communication and validation. Designed to make wind measurement as simple as possible.

Install ZephIR 300 to get valuable wind data for **various applications**, e.g.:

- Complement to Met Mast
- Wind Shear Verification
- Turbulence Analysis
- Wind Resource Assessment, Site Classification and Micro-Siting
- Wind Model Verification
- Energy Yield Analysis
- Power Performance Testing and Performance Optimisation

ZephIR 300 comes with the standard support package **ZephIR Care™: 3 years warranty and support as well as 3-year service interval**. So you can operate your ZephIR 300 in the field for unbroken 3-year measurement campaigns. It is particularly suitable in applications, where sensors must remain in place for long-term campaigns such as during Annual Energy Predictions.

Effective wind measurement with reliable wind data at every stage of your project with ZephIR 300.



ZephIR DM for turbine-mounted applications

ZephIR DM provides you with dual-mode functionality, allowing deployments either ground-based or turbine-mounted applications. Installed inside the spinner or on top of the nacelle, ZephIR DM measures **wind conditions in front and behind the turbine from 10 meters out to 300 meters**. ZephIR DM provides valuable wind data for effective **turbine performance management** including **absolute and relative power curve measurements**.

ZephIR DM is the only LiDAR system providing a **circular scan in the plane of the rotor** at a rate of 1 scan per second and 50 readings per scan. By measuring 50 points at each range, you can, e.g.:

- Determine horizontal wind speed and **yaw misalignment**
- Determine **wind veer** (change in wind direction with height)
- Determine **wind shear** (change in wind speed with height)
- Provide **hub height and rotor equivalent wind speeds**

Advanced turbine control with unique wind condition measurements by ZephIR DM.



Technical Details: ZephIR 300 and ZephIR DM

Specifications

Characteristics	ZephIR 300	ZephIR DM
Order-No.	S96110 (DC supply) S96120 (AC supply)	S96210 (DC supply) S96220 (AC supply)
Measurement range	10 ... 200 m	10 ... 300m
Accuracy horizontal wind speed	< 0.5% **	
Accuracy wind direction	< 0.5° **	
Number of measurement heights	up to 10 heights (configurable)	
Wind speed range	0 ... 70 m/s	
Mean value period	10 minute averages & 1 second data	
Scanning cone angle	30° (other angles available)	30° or 15° (other angles available)
Sampling rate	50 Hz	
Operating temperature range	-40 ... 50 °C	-25 ... 50 °C
Operating humidity range	0 ... 100% RH	
Visible laser alignment accuracy	(only for ZephIR DM)	1°
Measurement accuracy compensation	(only for ZephIR DM)	0.1 m/s
Inclination and roll measurement compensation accuracy	not applicable	0.1°
User Interface	WALTZ for configuration and real-time wind data	
Data transfer	LAN; Modbus, WiFi, Global SIM; Iridium Satellite Communication	
Data format	CSV	
Data storage	3MB/day @ 1 sec-data; 90kB/day @ 10 min average data (on board storage for 36 months)	
Laser classification	Class 1 / IEC 60825-1	
IP class	IP 67	
Dimension [mm] / Weight	1010 (height) x 1120 (diameter) / approx. 55 kg	Mounted on a tripod for nacelle operation: 1450 (height) x 1174 (width) x 1215 (length) / approx. 74 kg DM unit itself: 534 (height) x 569 (width) x 846 (length) / approx. 44 kg
Manufacturer	ZephIR Lidar	

**as measured against a calibrated moving target

NOTE:

In order to protect the ZephIR LiDAR device from being damaged, use only original equipment from ZephIR Lidar.

Technical Details: ZephIR 300 and ZephIR DM

Electrical specifications

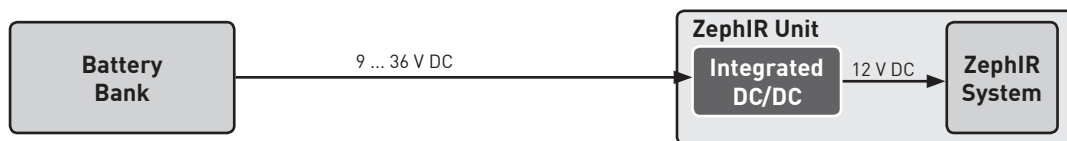
The ZephIR LiDAR is rated at 12 V DC!

Characteristics	ZephIR 300	ZephIR DM
Order-No.	S96110 (DC supply) S96120 (AC supply)	S96210 (DC supply) S96220 (AC supply)
	According to the manufacturer, ZephIR DM requires approximately 10% more power at similar conditions than the ZephIR 300.	
DC supply		
DC input voltage	Input operating range: 9 ... 36 V DC via integrated DC/DC power supply.	
Typical DC power consumption	Standard climate (-15 ... +22 °C): 69 W (80 W, if DC/DC is used) Hot climate (+23 ... +50 °C): 94 W (108 W, if DC/DC is used) Cold climate (-16 ... -40 °C): 119 W (137 W, if DC/DC is used)	
AC supply		
AC input voltage	Input operating range: 90 ... 264 V AC via integrated AC/DC power supply. Frequency: 50 ... 60 Hz	
Typical AC power consumption	Standard climate (-15 ... +22 °C): 83 W (via integrated AC/DC) Hot climate (+23 ... +50 °C): 108 W (via integrated AC/DC) Cold climate (-16 ... -40 °C): 137 W (via integrated AC/DC)	
General		
Standby power	1 W	
Startup	102 W Note: Load test initiated during start-up only for testing external power source (up to 30 sec).	
Input ripple (noise)	< 200 mV rms	
Absolute max. power rating	240 W	
Max DC Current	20A @12 V DC	

Power connection configurations

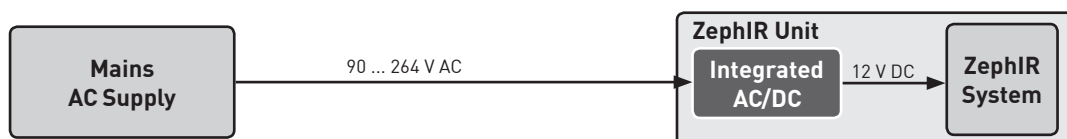
The integrated DC/DC supply is rated between 9 ... 36 V DC. Supplies outside this range run the risk of damaging the unit and will invalidate the warranty.

The integral DC/DC power supply produces 12 V DC to power the ZephIR LiDAR. There is no need to use an external DC/DC converter.



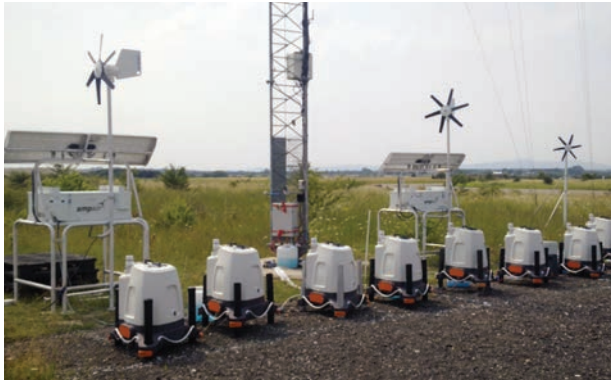
The supply is rated between 90 ... 264 V AC at 50 ... 60 Hz. Supplies outside of this range run the risk of damaging the unit and will invalidate the warranty.

The integral AC/DC power supply produces 12 V DC to power the ZephIR LiDAR.



ZephIR Verification and Deployment

ZephIR LiDAR performance verification



All ZephIR systems are offered with a Performance Verification certificate demonstrating that the performance is equivalent to or greater than a Class 1 cup anemometer specification. All comparisons are undertaken at the UK's LiDAR and SoDAR Test Site comprising a 90m tall met mast constructed to conform fully with the recommendations for mast anemometry in IEC 61400-12-1 approved for use by GL Garrad Hassan.

Deployment of the ZephIR 300



During the measurement campaign the ZephIR 300 should be installed in a trailer to protect the LiDAR device from being damaged or stolen. Ammonit offers a trailer solution (Order No. M58600) including stand-alone power supply for the LiDAR device. The supply system combines a powerful fuel cell and three solar modules. Refer to the Ammonit data sheet for further details.

ZephIR 300 at different sites for wind resource assessment



Thanks to ZephIR Lidar (www.zephirlidar.com) for providing the photos for this brochure.

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