

Measurement equipment for the wind industry



Welcome to Ammonit

Visit our website for the most current information on our products, our latest news and where you can find us at international trade fairs:

www.ammonit.com

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Ammonit & Partner

AMMONIT has been offering high quality measurement equipment for wind site assessment, wind farm monitoring and climate research since 1989. Our reliable data loggers, first class sensors, data communication systems and various related components are applied by wind consultants, wind farm operators and research institutes in over 100 countries. With 20 years of experience in the international wind industry, we offer bespoke measurement systems as well as standard ready-to-use measurement systems, suitable for extreme weather conditions and remote areas.

In addition to our wind measurement systems, Ammonit now also provides solar measurement systems, to meet an increasing demand from our partners and customers.

With our international partner network, we provide full service packages for successful measurement campaigns, from offer, through to construction, operation and maintenance of the mast and measuring system.

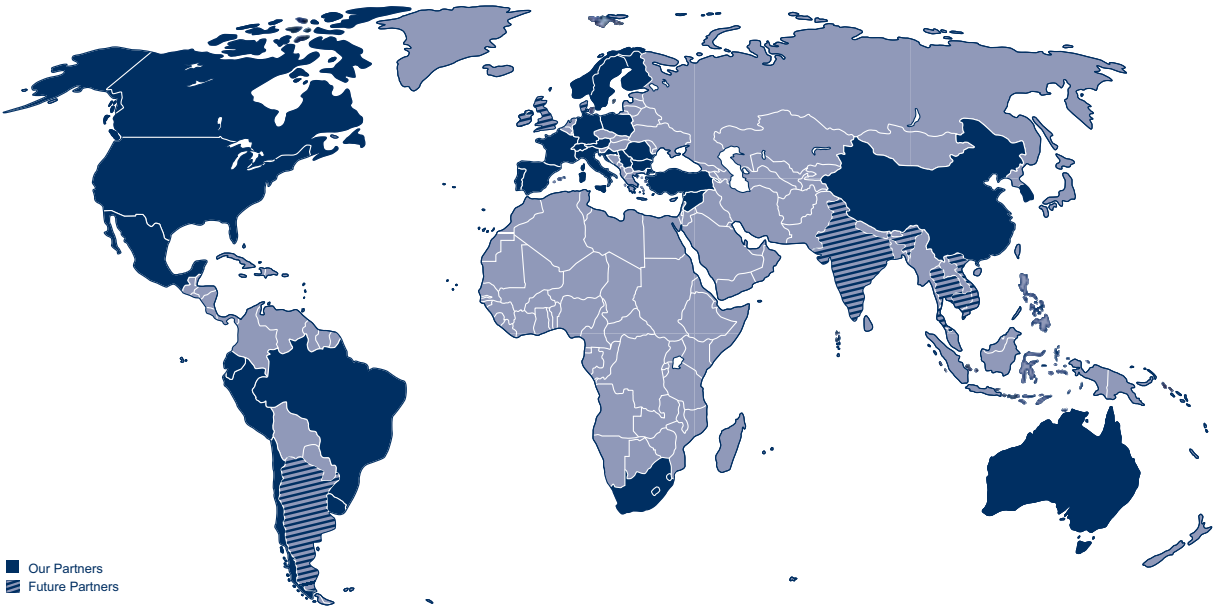
The Ammonit catalogue provides a general overview of what we have on offer, but as we continuously expand our product range it might not always be entirely up-to-date. Our website will always have the most current information on our products, events and trade fair activities. The Wind Info section of our website provides some very useful and detailed background information on what is important when measuring wind. There you can download all of our product data sheets, technical information, a solar brochure and wind info brochure.

Our multi-lingual sales, support and marketing team is looking forward to hearing from you and will be happy to assist you with any further information.

Thanks very much for your attention

Your Ammonit Team

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Benefit from our international partner network

Together with our partners we market our products in over 100 countries.

Our met-mast manufacturer and/or wind consultant partners can offer quick and professional service on location and provide regional know-how. Together we provide full service packages for successful measurement campaigns, from offer through to construction and servicing of custom or standard measurement systems.

You will find our partners' details in the Contact section of our website

www.ammonit.com/en/contact/partner-network



© GTZ: wind site assessment in Northern Chile by GTZ (financed through International Climate Initiative BMU)

Why measure wind?

Wind measurement in the wind industry?

Wind measurement is essential to assess whether a potential wind farm site will be economically viable. Once a wind farm is in operation wind measurement is required to monitor the turbines, ensuring they operate properly and generate the best possible energy yield.

It is important to employ the most accurate measuring technology and to achieve the highest standard of wind measurement. A small discrepancy of 3 % in the evaluation of wind speed data can multiply drastically during assessment calculations and could result in a loss of 7 digits in economic figures. To evaluate whether a wind farm will be profitable, investors and banks require wind site assessments to be based on the most accurate measurement data, compiled with high quality measurement equipment. Compared to the costs for the construction of a wind farm, the costs for a high quality measuring system are trivial.

Performing a successful wind measurement campaign

Prior to setting up a wind farm, wind is measured and assessed by professional wind consultants. A measuring campaign usually lasts for at least 12 months, during which wind measurement data is gathered at regular intervals without interruption. The measurement data is processed and evaluated and then compared to long-term meteorological data (e.g. data from adjacent weather stations) to assess whether the site will be suitable for the erection of a wind farm.

Once a wind farm is in operation, wind measurements are required for monitoring turbine performance and for collecting data to evaluate profitability (e.g. with SCADA systems).

High quality measurement equipment, selected according to the specific site conditions, and its correct installation by professional wind consultants and mast installation teams, is crucial to ensure the most accurate measurement data that is required for wind site assessment.

Several international standards for wind measurements are in place. The regulation IEC 61400-12-1:2005 (E) is the most significant, describing the optimal installation of masts, traverses and sensors.

Conforming to these standards, along with taking advice from professional wind consultants and manufacturers of measuring systems, will help to ensure that your wind farm investment pays off.

Download the Ammonit Wind Info brochure

You can download our brochure "Measuring wind – know-how for successful wind measurements" on our website. It offers plenty of useful information on what is important when assessing potential wind farm sites or when monitoring wind farms in operation.

To learn more, visit our website:

www.ammonit.com/en/wind-info/wind-measurement

Product Overview

What makes a good wind measurement system?

The better the quality of the components of a measurement system, the more accurate the results of a wind site assessment and wind farm monitoring. Accurate wind measurements help to ensure that a wind farm will be profitable. Inaccurate wind measurements can result in significant economic losses.

The choice of an appropriate, state-of-the-art measurement system and the correct installation of the equipment are crucial. To perform well in the remote regions and extreme weather conditions typical of wind farm sites, a good measurement system must be robust, reliable and self-contained.

The measurement data must be accessible and transferred consistently and reliably to the wind consultant's PC. The measurement equipment should be selected according to site specific climatic and geographical requirements.

Ammonit products

Ammonit designed the first wind computer in 1989 in Berlin, in close co-operation with research institutes, such as the Fraunhofer IWES (ISET in Kassel) and a network of other wind energy pioneers (e.g. DEWI, Windguard and Cube). The data logger remains our core product.

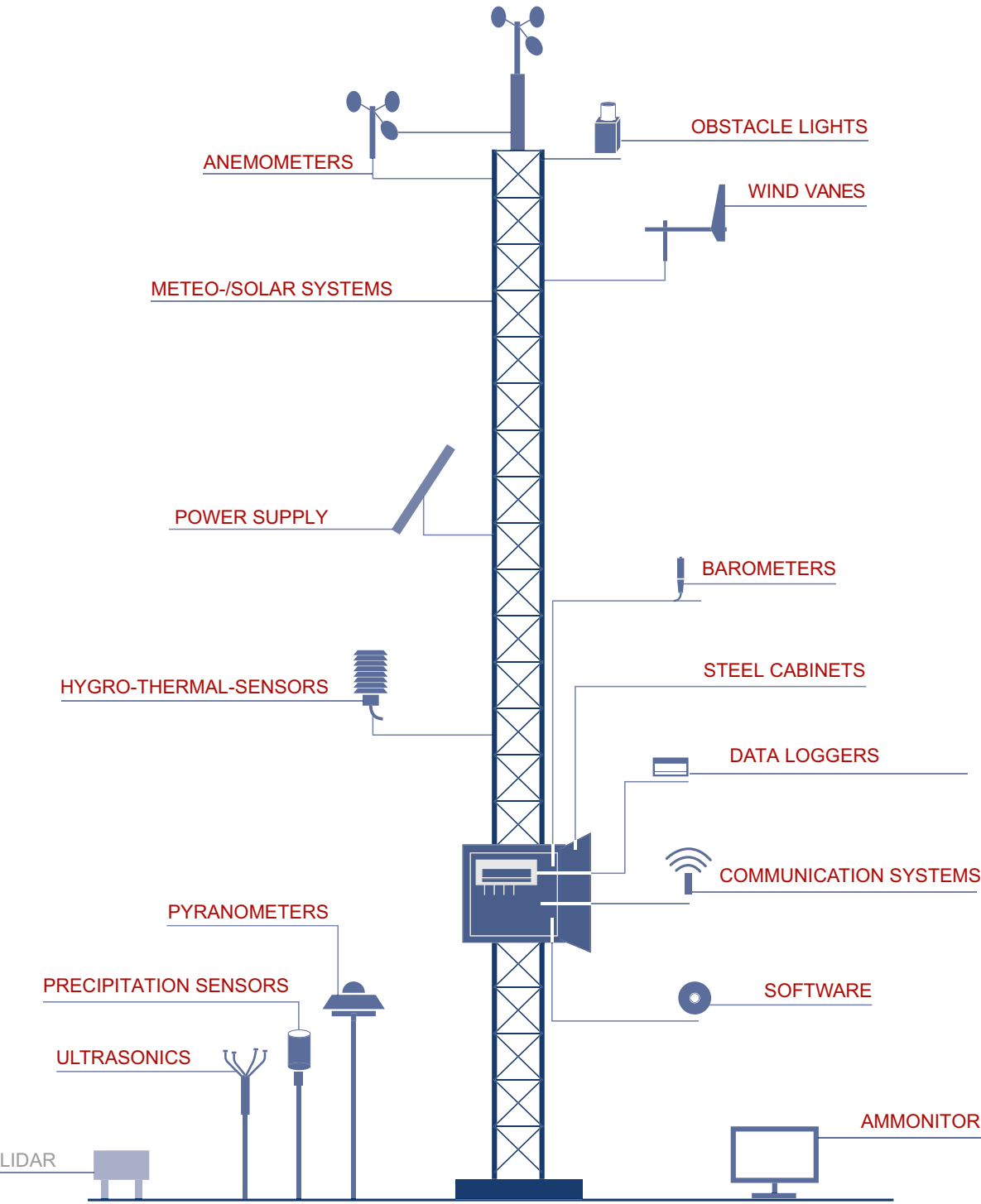
Ammonit development engineers have constantly improved the data logger, in close co-operation with Ammonit production and sales teams and responding directly to the requirements of our customers as well as to the latest research developments.

We have continuously expanded our product range as we co-operate with other manufacturers (in particular Thies Clima). In addition to our reliable data loggers, we offer a variety of precise sensors, data transfer systems and power supply systems and various other components for wind site assessment, wind farm monitoring, solar site assessment, solar farm monitoring, climate research and agricultural and traffic meteorology.

Please contact our bi-lingual sales, marketing and support team to learn more about our products. We are looking forward to your queries.

Your Ammonit Team

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Measurement Systems

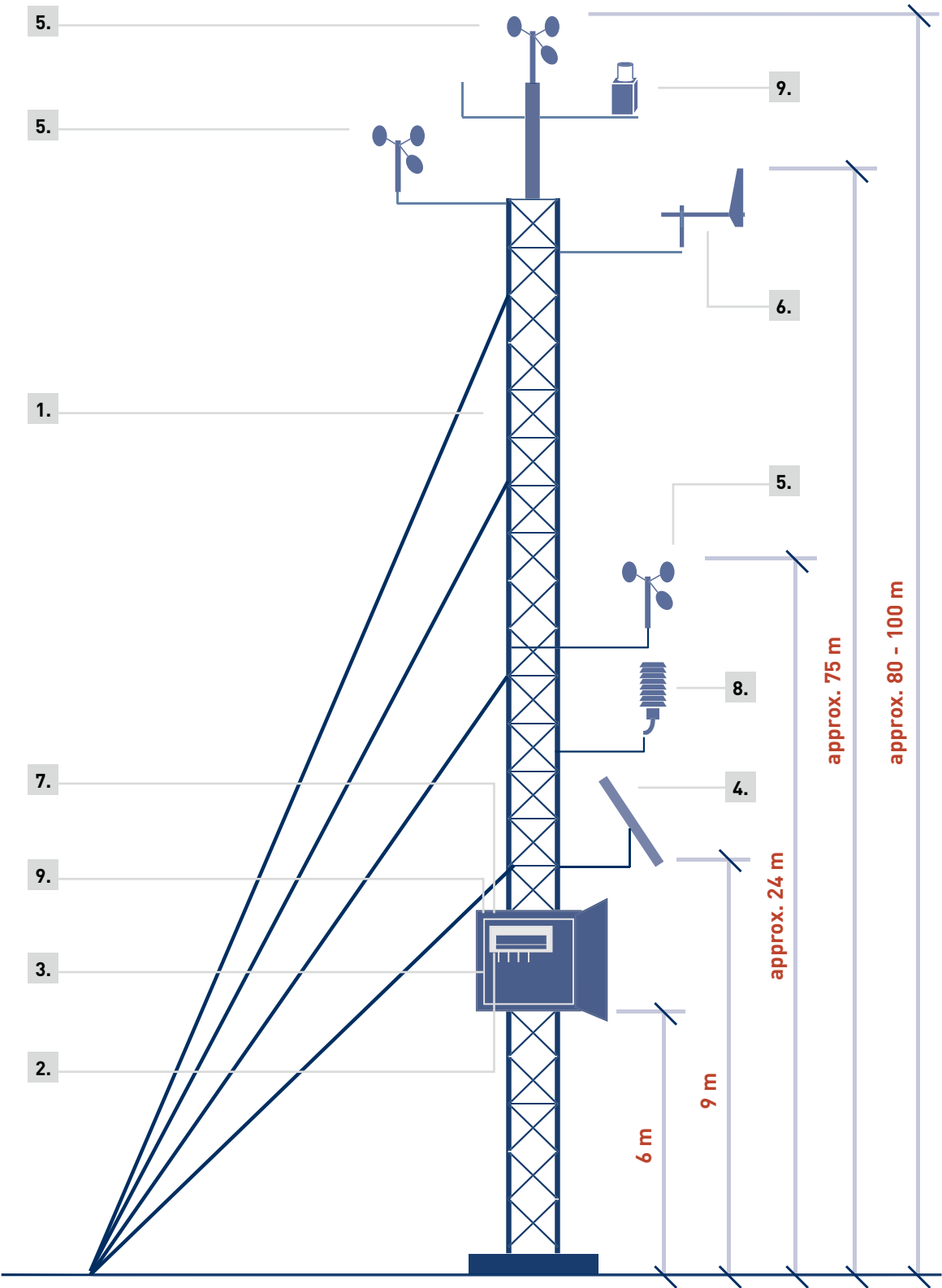
Basic Rules

- Take advice from professional wind consultants to select a suitable site and height for the met-mast
- Use high quality measurement equipment, selected according to regional and climatic requirements
- Choose the best possible components for your measurement system, e.g. reliable data loggers and first class sensors
- Employ mast specialists to ensure correct installation of the met-mast
- Maintain and service the mast and measurement equipment regularly

Typical wind measurement system

Data Logger Meteo-32:

1. 1 Telescope or lattice met-mast (standard height: 80 - 100 m)
2. 1 Data logger Meteo-32 X, (P 2520.3)
3. Logger accessories:
 - Standard steel cabinet with screw terminal, (P 9453)
 - Data transfer system - GSM/GPRS, (P 8150M.63)
 - Solar supply 12 V without solar module (P 8270 M)
4. Solar module 20 W (P 8202)
5. At least 3 first class anemometers with cables
Thies FC Advanced Anemometers, (P 6101 H)
Anemometer calibration, (P 6199)
6. 2 Wind vanes with cables,
Thies FC (P 6200 H) or Thies Compact (P 6245 H)
7. 1 Barometric pressure sensor AB60 (P 6330M.2)
8. 1 Hygro-Thermal Sensor with cable (P 6312/010)
1 Weather radiation shield for air temperature (P 6300)
9. Additional components, where required:
precipitation sensor, pyranometer, obstacle lights, obstacle lights, surge protection



Data Logger Meteo-40



Ammonit data loggers offer a wide range of possibilities and are the core of every wind measurement station. Our reliable high quality data loggers have ensured the most accurate and reliable measurement data for wind site assessments, wind farm monitoring and climate research since 1989. The new data logger generation Meteo-40 can also be utilised for solar assessment and monitoring, and traffic and agricultural meteorology.

The low maintenance Ammonit data loggers are designed as self-contained measurement systems suitable for all climates and very remote regions. Meteo-40 has been designed in direct response to the requirements of our customers and incorporates the latest technology.

It has been tested both in independent laboratories and in the toughest real-world conditions. From early 2011 the Meteo-40 will be available in two configurations: Meteo-40 M (medium) and Meteo-40 L (large).

Data Logger Meteo-40: Overview

The Ammonit data logger is stored safely into a CE certified steel cabinet to protect it against weather and condensation damage, theft and vandalism. Several optional components can be included in the cabinet, such as a GSM / GPRS communication module, a barometric pressure sensor, a battery and surge protection.

Data communication and exchange between your PC and the logger can be carried out via a HTTPS/FTP, SCP connection, email, satellite and direct interface.

A wide range of accessories is available to customise each measurement system to meet specific regional and climatic requirements. The low power consumption of Meteo-40 and our first class sensors allows for self-contained measurement systems in remote, undeveloped areas. A solar module of 50W will reliably run an entire measurement system.

Meteo-40 offers significant benefits: 2 GB of memory, the recording of complete 1 sec. original measurement data (approx. 1 year for a typical measurement application) and additional storage of aggregation data (min. 3 years). It offers many channels (Meteo-40M: ~22 channels or Meteo-40L: ~35 channels), a precise resolution (~16 bit, ~8 Hz) and symmetric, differential analog channels, as well as various input ranges to choose from ($\pm 0.1V$, $\pm 1V$, $\pm 10V$).

Meteo-40 offers 3 USB slots for PC connections; modem: GSM/GPRS/CDMA (in addition to RS-485 / RS-232); adapter: WiFi, Ethernet or memory stick. UMTS and Bluetooth connections will be provided at a later stage.

Ammonit provides free software to simplify your communication and data management procedures. Our online platform, AmmonitOR, can be used to access, manage, monitor and visualise your measurement data comfortably, around-the-clock, from wherever it suits you.



Our website offers comprehensive and detailed information on our data loggers. There you can download data sheets, software and all other relevant technical information.

Data Logger Meteo-40: Features

Application / Outdoors

1.

Data logger applications: wind site assessment, wind farm monitoring, climate research, solar assessment and solar monitoring, traffic and agricultural meteorology.
2.

Meteo-40 is available in two configurations: Meteo-40 M (medium) & Meteo-40 L (large).
3.

Suitable for all climates and the remotest regions.
4.

Self-contained, low maintenance & high performance.
5.

Designed for the toughest real-world conditions and tested in independent laboratories.
6.

Low power consumption, runs on 50W solar panels.

Measurement Technology

7.

2 GB memory: recording of complete 1 sec. original measurement data (approx. 1 year - typical number of sensors).
8.

Additional storage of aggregate data (min. ~3 years).
9.

Many channels (max. ~22 or max. ~35), differential measurement.
10.

High resolution (~16bit, ~8Hz): symmetric, differential analog channels with various input ranges to choose from ($\pm 0.1V$, $\pm 1V$, $\pm 10V$).
11.

High sensitivity analog input, e.g. temperature sensor PT 100.
12.

Digital channel for smart sensors such as the Thies TMR vane, no mechanical wear, higher precision.
13.

Counter channel with AC input support allows for a combination of high quality Thies sensors with cheaper sensors, e.g. NRG sensor w/o adapter.

Communication

14.

Data communication and data exchange via HTTPS, FTP, SCP connection and email.
15.

Modem: GSM, CDMA, GPRS, (RS-485 / RS-232); 3 USB slots for PC-connections; Adapter: WiFi, Ethernet or memory stick.
16.

UMTS & Bluetooth to be offered at a later stage.
17.

Compatibility with all SCADA systems.
18.

Easy connection to computer via USB cable or remote via the internet.

Flexibility / Convenience

19.

Integrated Linux system for maximum flexibility and adaptability.
20.

New structural concept makes Meteo-40 very flexible. (An application programming interface (API) to customise the data logger is planned for later Meteo-40 firmware releases.)
21.

Web based access without the need for additional software.
22.

User-friendly web interface and large LC display.
23.

Multi-lingual configuration; Meteo-40 settings can be adjusted to a language of your choice, currently English, Spanish, German, French. (Additional languages options will be added at a later stage.)
24.

Multi-lingual online help.
25.

Accessible, modern product design.
26.

Custom software provided by Ammonit, on request.

Meteo-40 is available in early 2011.

Data Logger Meteo-40: Channels

Overview Channels	Meteo-40 M (P 4020)	Meteo-40 L (P 4030)	Applications
Switches	4	8	Sensor supply, relais (for heating)
Connectivity	{2} USB host, {1} USB device		PC; Modem; Memory Stick; Ethernet; WiFi
	{1} RS-485, Master		Smart Sensors (e.g. Ultrasonics)
	{1} RS-485, Slave		SCADA, Wind Farm Monitoring Software
	{1} RS-232		Modem
Display & Keys	{20 x 4} LC display with backlight, five keys		
Counter	8	12	Anemometers Precipitation
Digital/Status	4	8	Serial Wind Vane (e.g. TMR Vane)
Analog Voltage	8 16-bit $\pm 0.1V$, $\pm 1V$, $\pm 10V$	12 16-bit $\pm 0.1V$, $\pm 1V$, $\pm 10V$	Potentiometric Wind Vane Meteo Sensors Barometers Hygro- Thermal Sensors Pyranometers
Analog Current	1 16-bit $\pm 20\text{ mAmp}$	2 16-bit $\pm 20\text{mAmp}$	PT 100 Temperature

Our website offers comprehensive and detailed information on our data loggers. There you can download data sheets, software and all other relevant technical information.

Data Loggers Meteo-40 + Series 32

Installation and maintenance



All Ammonit loggers are enclosed in IP65 protective housings that bear the CE-mark of the European Commission. The data logger should be installed in a lockable and well-earthed metal cabinet. This not only provides protection against weather and lightning, but also protects against theft and vandalism. Ammonit has developed solid steel cabinets for its data loggers, which can house additional components for a comfortable installation of the equipment on site.

All Ammonit measurement equipment is designed for permanent automatic operation in exposed positions. If the system is provided with a remote monitoring facility and a small solar system as power supply, the only required maintenance is an occasional check of the sensors.

It is crucial that all sensor cables are safely attached to the mast. Damaged cables could result in harmful moisture entering the cabinet or into the logger itself.

Services software and online platform AmmonitOR



Ammonit develops three different types of software programs to simplify your data access and management.

Firmware for the data loggers

This essential software is delivered with every data logger. Our firmware is regularly updated and can be downloaded from our website (Support and Software section).

Communication software programs

We provide additional software programs to facilitate communication between measuring stations and your PC/laptop. All software programs are available for free on our website (Support and Software section).

Online platform AmmonitOR

Our online platform, AmmonitOR – Ammonit Online Report, allows you to access, manage, monitor and visualise your wind measurement data online, around-the-clock. To register email us at **ammonitor@ammonit.com**

To learn more about AmmonitOR, see the Software section of this catalogue, page 42-45, and/or visit our website **www.ammonit.com/en/ammonit-customer-login**

Data Logger Series 32

The very successful and reliable Ammonit data logger Series 32 has been applied in over 100 countries, in all climates and very remote regions, for wind site assessments, wind farm monitoring and climate research. The Series 32 will remain available until early 2012 when it will be replaced by our new data logger Meteo-40. We will continue to provide unlimited support and maintenance for all Series 32 data loggers.

Series 32 Data Logger Series 32: Features

- Detailed statistics & measurement data set.
- Minimal power consumption, a 10 to 20 W solar panel will usually be sufficient.
- Suitable for all climates, even extreme weather conditions.
- Automated alarm messages by SMS in case of system failure, e.g. power supply cut.
- Data output: RS-232, RS-485, 38400 bps.
- Memory 4 MB non volatile memory (EEPROM), storage space for 1 year measurement.

Channels



Overview of Channels		WICOM-32	METE0-32	METE0-32X
Anemometers (*1)	16-bit Counters	3	4 (*1)	6 (*1)
Wind Vanes (*2 + *3 + *4)	12-bit ADC	2	2 (*4)	2 (*2 + *3 + *4)
Thermometer (*3)	12-bit ADC		1	1 (*3)
Hygrometer (*3)	12-bit ADC		1	1 (*3)
Barometer (*3)	12-bit ADC		1	1 (*3)
Pyranometer (*4)	12-bit ADC		1 (*4)	1 (*3 + *4)
Precipitation (*1)	16-bit Counters		(*1)	(*1)
12-bit ADC (*3)	12-bit ADC		1	4 (*3)
Status (0 or 1)				2
Total number of channels		5 channels	10 channels	18 channels

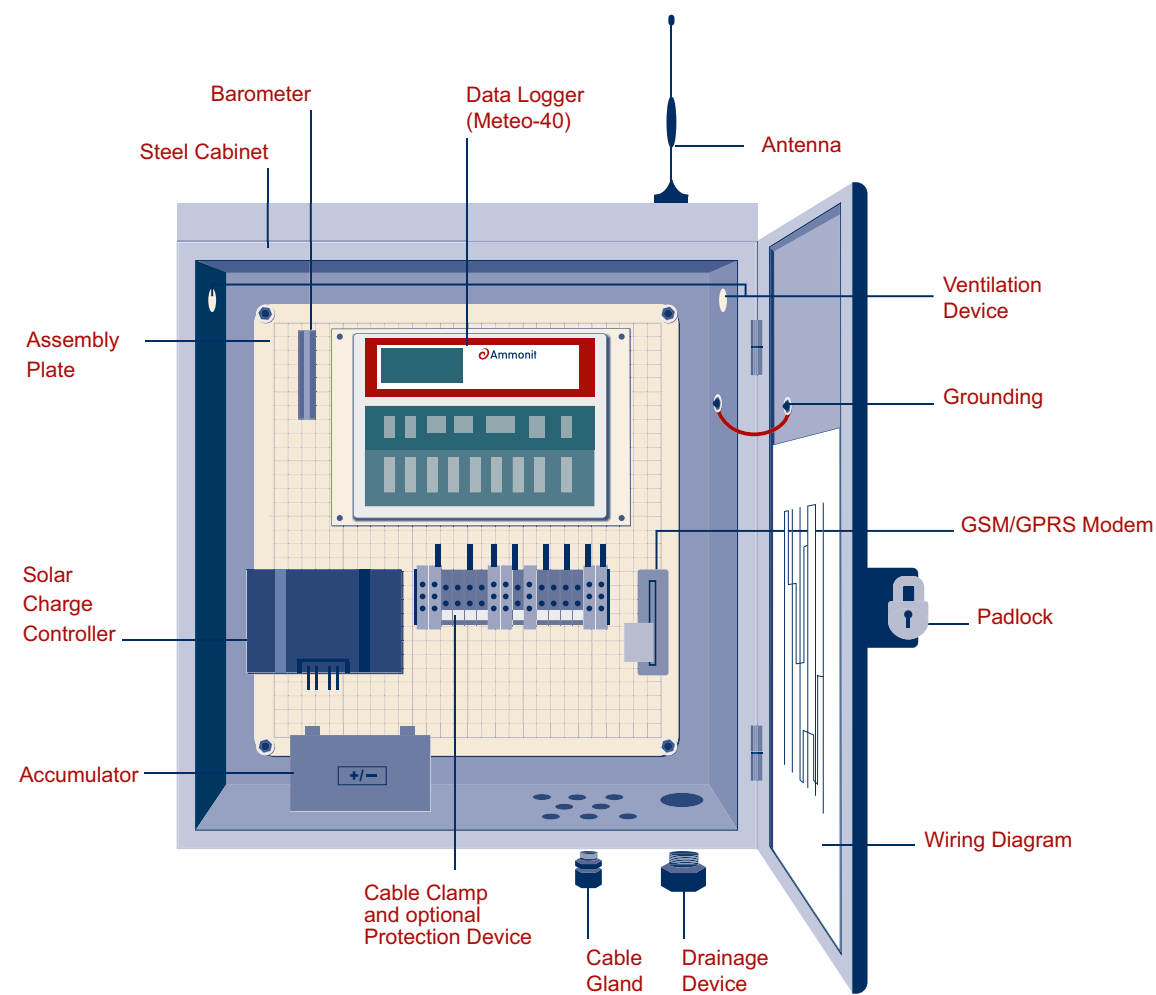
* 1) A precipitation sensor can be connected instead of a 4th anemometer (Meteo-32) and 6th anemometer (Meteo-32X).
* 2) Up to 7 wind vanes can be connected, refer to (*3) & (*4).
* 3) 4 additional analog sensors can be connected: wind vanes, thermometer, hygrometer, barometer ultrasonic, pyranometer, propeller anemometer.
* 4) A 3rd wind vane could be connected, instead od a pyranometer.

Our website offers comprehensive and detailed information on our data loggers. There you can download data sheets, software and all other relevant technical information.

Logger Accessories

Logger accessories overview

Ammonit offers robust, weatherproof steel data logger cabinets in various sizes. The cabinet will protect your data logger against weather and condensation damage, theft and vandalism. Our CE certified steel cabinets are easy to install and maintain. Optional components, such as a GSM/GPRS communication module, barometric pressure sensor, battery and surge protection, can also be accommodated within the cabinet. The size of cabinet depends on the size of battery and the number of selected components; we currently offer two sizes. Cabinets are typically mounted at a height of approximately 6m and padlocked for protection from vandalism and theft.



Data communication systems

The data communication and exchange between your PC and the logger can be carried out via HTTPS, FTP, SCP connection, email, satellite or direct interface. Meteo-40 offers 3 USB slots for PC connections, modem: GSM, GPRS, CDMA (in addition to RS-485 / RS-232), adapter: WiFi, Ethernet or memory stick. UMTS and Bluetooth connections will be offered at a later stage.

Measurement data can be accessed at time periods of your choice, e.g. daily, several times a week, or monthly. Ammonit has developed several software programs that simplify communication with your data, such as automatic data mailing and archiving procedures. These programs are available on our website for your free download.



Our website offers comprehensive and detailed information on our logger accessories. There you can download data sheets, software and all other relevant technical information.

Logger Accessories

Power supply

Ammonit measuring systems are fully self-contained. A connection to the local power network is not required. The entire measuring system with a Meteo-40 data logger can be reliably powered with a 50 W solar panel. In some cases, larger panel sizes may be required, such as with the application of a large number of sensors when a satellite communication system is applied, or in cold climates requiring sensor heating. You can download an Ammonit excel schedule to calculate solar panel size requirements from our website

www.ammonit.com/en/products/data-logger-accessories/power-supply



Surge protection

Ammonit offers lightning and surge protection devices for DC and AC low-voltage supplies of components and measuring systems, ensuring the protection of data and signal lines and power cables. The surge protection cable clamp is installed within the steel cabinet instead of a regular unprotected cable clamp. We offer several types of surge protection devices, differing in number of pins and voltage levels. Although the installation of surge protection devices is not mandatory, we highly recommend it, as unprotected lightning can lead to a total breakdown of the entire measuring system. Surge protection is strongly advised at freestanding measuring stations or when aircraft obstacle lights are applied.



Our website offers comprehensive and detailed information on our logger accessories. There you can download data sheets, software and all other relevant technical information.



© Ammonit / Windhunter (Ammonit partner Poland): logger, steel cabinet and logger accessories



© Ammonit / SME-Wind (Ammonit partner Bulgaria): mast and sensors prior to setting up the mast

Why high quality sensors?

High quality first class sensors selected according to the specific local and climatic requirements of the site will generate the most accurate wind measurement data and help to make the right investment decisions for your wind farm project.

The choice of sensor type depends on the specific requirements of the measurement system and the local climatic and topographic conditions. Sensors measure wind speed (velocity), wind direction, barometric pressure, hygro-thermal conditions, precipitation and global radiation.

To obtain the accurate measurements that are essential for producing reliable wind site assessments, wind sensors must perform as precisely as possible. We strongly recommend the application of individually calibrated and classified sensors.

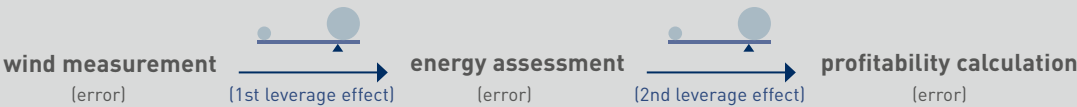
A small discrepancy of just 3% in the evaluation of wind speed data can multiply drastically in wind site assessment calculations, resulting in an economic loss of 7 figures. Our sensors are calibrated and classified according to international standards, including MEASNET.

It is also essential that appropriate, high quality cables connect the sensors with the data logger. Corrupted measurement data can occur when connection cables are too long or when the cable resistant is compensated in the supply. Cables must be carefully installed within the lattice tower to avoid damage.



Impact measurement error on profitability

The effects of a measurement error double up during the wind assessment procedures, due to a leverage effect. They double up even further when calculating the profitability.



= resulting in an uncertainty of wind farm profitability

Make the right investment decision for your wind farm project

Choose high quality measurement equipment to ensure the most accurate measurement results.

Please refer to our table on page 57 for detailed information on impact of sensor accuracy

Our website offers comprehensive and detailed information on our sensors. There you can download data sheets, software and all other relevant technical information.

Anemometers

Anemometers measure the horizontal wind speed (velocity). This parameter is crucial for any wind site assessment. Cup anemometers are the standard type of anemometer. They are robust and resistant to the turbulence and skew winds caused by masts and traverses. Each anemometer should be individually calibrated and equipped with a certified calibration report, according to international standards (e.g. MEASNET). The number of anemometers applied at one mast can vary from a minimum of 3 sensors up to 12 sensors (using Ammonit data loggers). Most anemometers can be equipped with electronically regulated heating.

THIES FIRST CLASS ADVANCED ANEMOMETER

The Thies First Class Advanced anemometer is outstanding in its performance, as it is the only sensor on the market complying with all requirements, according to IEC 61400-12-1 [2005-12], Class S0.5.

Manufacturer: Thies

Order-No: P 6101H

Classified according to

IEC 61400-12-1 (2005-12), Class A, B & S 0.5, MEASNET, CLASSCUP, ISO 17713-1

- Highly accurate anemometer (class: S 0.5 / A 0.9 / B 3.0)
- Outstanding performance & excellent price to value ratio
- Optimum linearity: $r > 0.999\ 99$ (4...20 m/s)
- Suitable for high turbulence intensity
- Measuring range: 0.3....75 m/s
- Temperature range: -50 °C to +80 °C
- Low start up value & high survival speed
- Minimum overspeeding & small distance constant (3 m)
- Very robust and weatherproof (seawater-proof)
- Heatable
- Resolution 0.05 m wind run

This sensor is the best sensor on the market, according to the ACCUWIND study.

Download the ACCUWIND study on our website www.ammonit.com/en/products/sensors/anemometres/testreport

Thies First Class Advanced



The application of flaps at the cup stem improves performance ratings.

Comparison of performance of anemometers

CUP ANEMOMETER	CLASS A`	CLASS B`	Class B information as stated according to CLASSCUP & ACCUWIND Study (Table 4-4 horizontal wsp definition Risø-R-1563-EN)
NRG MAX 40	2.4	7.7	
Risø P2546	1.9	8.0	
Vaisala WAA 151	1.7	11.1	
Vector L100	1.8	4.5	
Thies First Class	1.5	2.9	IEC 61400-12-1(2005-12) according to Deutsche Windguard
Thies First Class Advanced	0.9	3.0	

* Class A: simple landscape
Class B: complex landscape



VECTOR ANEMOMETER L100 FIRST CLASS

Manufacturer: Vector Instruments UK

Order-No: P 6171.03

Classified according to IEC Standards
opto-electronic wind speed sensor

- Class: 1 / A 1.8 / B 4.5
- Measuring range: 0.2 to 75 m/s
- Temperature range: -30 °C to +70 °C
- Resolution: 0.05 m/s
- Weight: approx. 0.5 kg
- Low energy consumption
- Robust and weatherproof (seawater proof)
- Non heatable



RISØ ANEMOMETER P2546

Manufacturer: Risø (Windsensor)

Order-No: P 6181

Classified according to CLASSCUP, very reliable anemometer

- Signal reading: permanent magnet with switch, two pulses per revolution
- Class: 1 / A 1.9 / B 8.0
- Measuring range: 0....70 m/s
- Temperature range: -15 °C to +60 °C
- Starting speed: < 0.4 m/s
- Non heatable



VAISALA ANEMOMETER WAA 252

Manufacturer: Vaisala

Order-No: P 6150H

Non-freezing all weather sensor, heatable cups!
opto-electronic transducer. Recommended for applications in cold (arctic)
climatic conditions

- Class: 1 / A 1.7 / B 11.1
- Measuring range: 0.4....75 m/s
- Temperature range: -55 °C to +55 °C
- Starting speed: < 0.5 m/s
- Heatable (cups included)



THIES ANEMOMETER COMPACT

Manufacturer: Thies

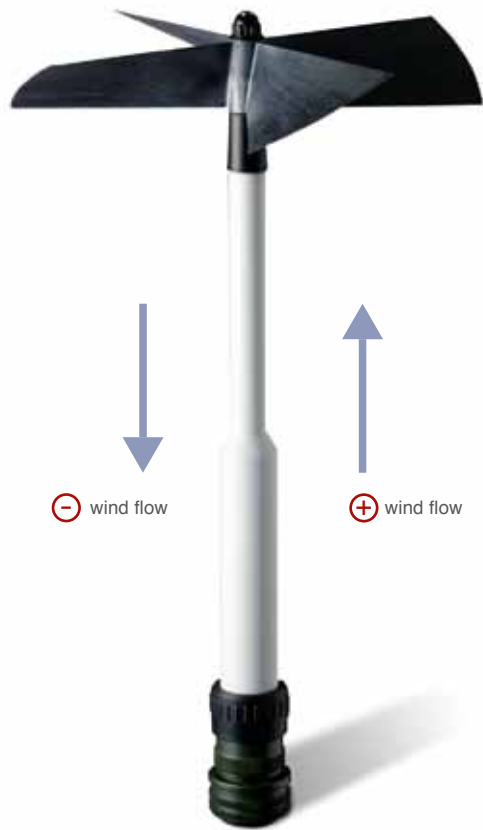
Order-No: P 6140H

Opto-electronic wind sensor
with low power frequency output signal

- Measuring range: 0.5.... 50 m/s
- Resolution: < 0.1 m/s
- Temperature range: -30 °C to +70 °C
- Heatable
- Not suitable for wind site assessment according to IEC 61400-12-1

Propeller Anemometers

Propeller anemometers measure the air flow from any vertical and horizontal wind direction. They are usually applied in wind farm monitoring by showing how the turbines react to airflow. A propeller-anemometer utilises a fast-response helicoid propeller and high-quality tach-generator transducer to produce a DC voltage that is linearly proportional to air velocity. Airflow from any direction may be measured, but the propeller responds only to the component of the airflow that is parallel to its axis of rotation. Off-axis response closely approximates a cosine curve with appropriate polarity; with perpendicular air flow, the propeller does not rotate. The output signal of propeller anemometers is suitable for a wide range of signal translators and data logging devices.



YOUNG PROPELLER ANEMOMETER

Manufacturer: Young

MODEL 27106T

Order-No: P 6161

Measuring of horizontal and vertical wind speed. Not classified

- Measuring range: axial flow 0...40 m/s (90 mph)
- Measuring range: all angles 0...35 m/s (80 mph)
- Temperature range: -50 °C to +50 °C
- Distance constant: 2.1 m
- Output signal: 1800 rpm (±500 mV) = 9.0 m/s (20.1mph)

Our website offers comprehensive and detailed information on our anemometers. There you can download data sheets, software and all other relevant technical information.

Wind Vanes

Wind vanes determine wind direction. Evaluation of the wind direction enables the best possible positioning of wind turbines. Ammonit wind vanes offer an excellent, fine resolution of 1°, while having very low energy consumption. It is essential that a wind vane covers an entire 360° degree radius, without a north gap. Cheaper wind vanes often have lower quality internal electro-mechanic fittings, which limit their life span, and a considerable north gap. Most wind vanes can be equipped with electronically regulated heating. Analog or potentiometric wind vanes are available.

	THIES WIND VANE FIRST CLASS Manufacturer: Thies Order-No: P 6200H Highly recommendable robust high quality potentiometric wind vane ▪ Measuring range: 0 to 360°, no north gap ▪ 0.....2 k Ohm ▪ Accuracy: ± 2° ▪ Resolution: 1° ▪ Damping coefficient: > 0.25 ▪ Survival speed: max. 85 m/s ▪ Temperature range: -50°C to +80°C ▪ Electrical output: potentiometric ▪ Hysteresis- + non wearing magnet clutch between vane and potentiometric axis ▪ Easy to be mounted and serviced ▪ Heatable
	THIES WIND VANE COMPACT Manufacturer: Thies Order-No: P 6245H / P 6245 Potentiometric wind vane ▪ Measuring range: 0 to 360°, no north gap ▪ 0.....2 k Ohm ▪ Accuracy: ± 5° ▪ Resolution: 90°, 45°, 22.5° ▪ Damping coefficient: > 0.3 ▪ Survival speed: max. 60 m/s ▪ Temperature range: -30 °C to +70 °C ▪ Electrical output: potentiometric ▪ Digital output signal: gray code ▪ Heatable
	THIES WIND VANE CLASSIC Manufacturer: Thies Order-No: P 6220H Very robust and reliable potentiometric wind vane ▪ Measuring range: 0 to 360° ▪ 0.....2 k Ohm ▪ Accuracy: ± 0.4 m/s, eg. 2.5% from measured value ▪ Damping coefficient: > 0.2 - 0.3 ▪ Survival speed: max. 0.3...60 m/s ▪ Temperature range: -35 °C to +80 °C ▪ Heatable

Ammonit will soon add the Thies TMR wind vane to the product range

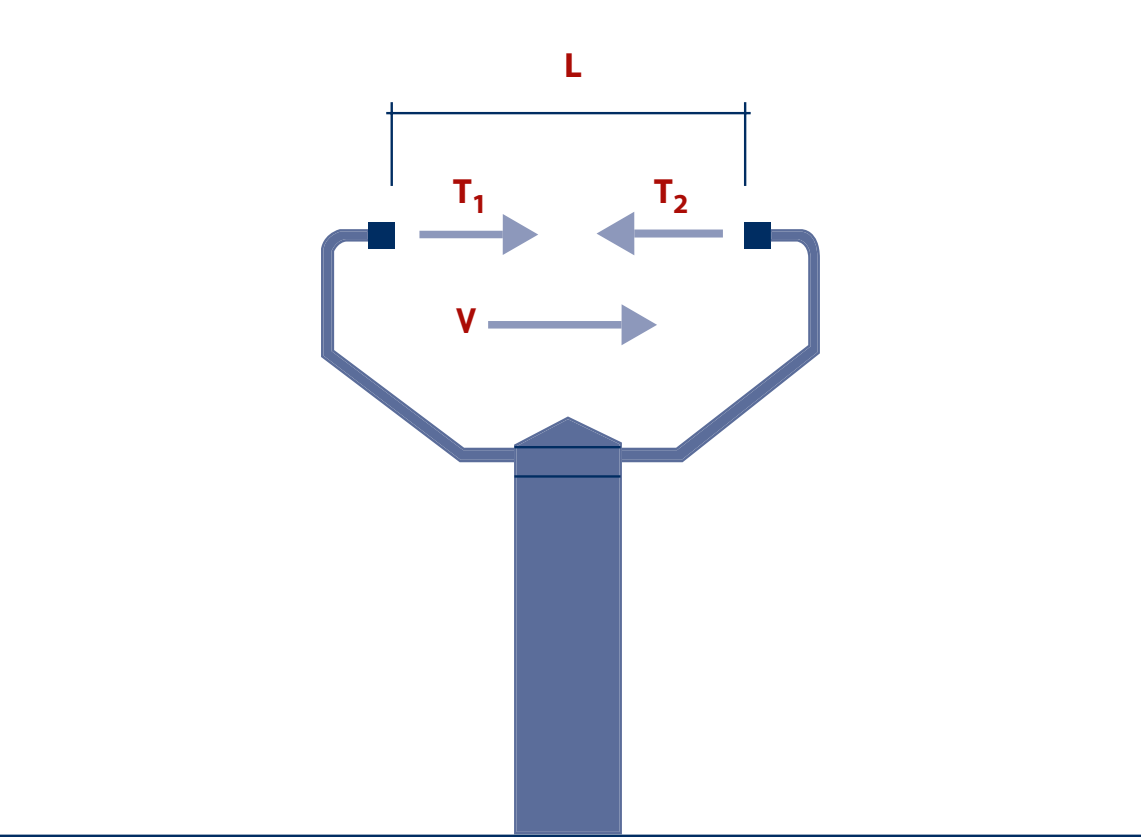


© Ammonit / Ecossem (Ammonit partner Spain): measurement system in Antarctica

Ultrasonic Anemometers

Ultrasonic anemometers measure horizontal wind speed and wind direction as well as the speed of sound and virtual temperature. However, because of their high power consumption, a connection to mains power supply is required and their application at self-contained, solar-powered measurement systems is sometimes not possible. Ultrasonics offer excellent performance ratings at well-powered measuring stations.

Ultrasonics are applied for wind farm monitoring on turbines and on offshore projects. Most ultrasonic anemo-meters can be fitted with electronically regulated heating. Our data logger Meteo-40 offers serial RS-485 Master, RS-485 Slave and RS-232 connections for the connections of smart sensors such as Ultrasonics and SCADA wind farm monitoring software.



$$T_2 = \frac{L}{C-V}$$

and

$$T_1 = \frac{L}{C+V}$$

therefore

$$V = \frac{L}{2} \left\{ \frac{1}{T_1} - \frac{1}{T_2} \right\}$$

C =

$$\frac{L}{2} \left\{ \frac{1}{T_1} + \frac{1}{T_2} \right\}$$

L= Distance between transducer faces
C = Speed of sound
V = Velocity of gas flow
T1 = Transit time of ultrasound
T2 = T2 = Transit time of ultrasound



Ultrasonic sensors		THIES 2D	THIES 3D	THIES 2D COMPACT
Manufacturer: Thies		Order-No.: P 6004H	Order-No.: P 6007H	Order-No.: P 6000H
Coordinates		wind speed wind direction virtual temperature	wind speed in x,y,z wind direction virtual temperature	wind speed wind direction virtual temperature
Measure-ment range	wind speed: wind direction: virtual temp.:	0...75 m/s 0...360°, 0...540°, 0...720° -50°C to +70°C	0.01...65 m/s 0...360° -40°C to +70°C	0.01...60 m/s 0...360° -50°C to +70°C
Accuracy	wind speed: wind direction: virtual temp.:	< 5m/s: ± 0.1 m/s rms > 5 m/s ± 2% rms of meas. value ± 1.0° ± 0.5K to 35 m/s	< 5m/s: ± 0.2 m/s rms > 5 m/s ± 2% rms of meas. value ± 2.0° w/wind speed > 1m/s < 50m/s ± 0.5K	< 5m/s: ± 0.2 m/s rms > 5 m/s ± 2% rms of meas. value ± 2.0° w/wind speed > 1 m/s ± 2.0 K
Resolution	wind speed: wind direction: virtual temp.:	0.1 m/s (user-defined telegram) 1° 0.1 K	0.1 m/s (0.01 user-defined telegrams) 1° 0.1 K	0.01 (defined telegram) 0.1° (defined telegram) 0.1 K
Data output digital	interface	RS-485 / RS-422		
	output rate	1 per 1ms to 1 per 60s adjustable	1 per 1ms to 1 per 60s adjustable	1 per 1ms to 1 per 10 sec.
Data output analog	electr. output	0...+20mA / 0...+10V or 4...+20mA / 2...+10V		
	output rate	Updating rate 1 per 100 sec.	Updating rate 0.1Hz...100Hz	
Temperature	range	-50°C to +70°C	-40°C to +70°C	-40°C to +60°C (with heating) -20°C to +60°C (without heating)
Operating voltage	supply electr. without heating	8V to 78V DC typ. 1.5VA, max 2.5VA or 12V to 55V AC typ. 1.5VA, max. 2.5VA		8V to 60V DC or 12...42V AC max. 50 mA @24V
	supply elec. with heating of US-arms	24V AC/DC ±15%; typ. 80VA, max. 90VA @ 24V	24V AC/DC ±15%; typ.150VA	24V AC/DC ±15%; 250VA max. @24V
Internal measuring rate:		up to 400 measurement/sec. @+20°C	up to 285 complete meas. sequence/sec. @+20°C	up to 1000 runtime-measurements/sec. up to 250 complete meas. Sequences/sec. incl. calcul.
Protection		IP 67		

Please refer to our website for information about additional ultrasonics and relevant data sheets and technical information.
We offer for ultrasonics with special heating for extreme weather conditions (e.g. Arctic), up to 400W.

Smart Sensors

Smart sensors are becoming increasingly important in measurement technology. Through their advanced calculation methods, algorithms and signal processing, they offer increased accuracy, reliability and speed. Smart sensors allow for the same performance rates as impulse (analog) sensors, however with a much faster response. Digital data transfer is expected to gradually replace analog data transfer. Smart sensors take a pre-defined action when they sense the appropriate input (light, heat, sound, motion, touch, etc.).

The Ammonit data logger Meteo-40 provides serial connections RS-485 / RS-232 to connect smart sensors, such as the Thies TMR vane or various ultrasonic anemometers. We will soon also offer smart sensors to measure temperature, humidity and barometric pressure.

How do smart sensors work?

Smart sensors work by using advanced signal processing and conversion methods:

- Digital output signal (high output signal power)
- Digital signal communication
- Execution of logical functions and instructions
- High noise immunity
- High accuracy of frequency standards
- Wide dynamic range
- Simplicity of communication and interfacing
- Simplicity of integration and coding

Advantages and Disadvantages

Advantages

Smart anemometers have two advantages over impulse anemometers:

- All anemometers can be connected with a single cable (at a later stage this will apply for all sensors). Fewer cables means shorter cable installation time and simpler calibration effecting reduced cost.
- Smart anemometers communicate the following information to the logger:
 - Serial number
 - Calibration number
 - Calibration date
 - Slope and offset values

This helps avoid errors when installing the mast system and setting up the logger settings. With smart sensors it is possible to test that the appropriate sensor is connected correctly and has been calibrated within the required time frame.

These requirements are allocated in the MEASNET Evaluation of Wind-Site Specific Conditions Procedure.

Disadvantages

Smart anemometers also have to disadvantages compared with impulse anemometers:

- Potential increased cost of using more complex electronic equipment
- Higher power usage

We will increasingly be adding smart sensors to our product range. Please refer to our website for the most current information. Our sales team will be more than happy to answer your queries.

Impact of temperature, pressure and humidity on wind energy evaluations

Temperature, air pressure and air humidity have a significant influence on the accurate calculation of wind energy. The reference standard IEC 61400-121 for wind energy measurements states that the measurement of temperature and air pressure is required and recommends that, in high temperatures, air humidity should be measured.

Because the measurement of temperature, air pressure and air humidity is so important, we have prepared a Wind Info flyer on the subject. To learn more and to download our flyer - visit our website:
www.ammonit.com/en/support/downloads/217-ammonit/windinfo/en_w_impactairhumidity_pressure.pdf

Hygro-Thermal Sensors

Thermal sensors measure air temperature, while hygro-sensors measure air humidity. Both sensors are often applied in combination to reduce cost. The calculation of the air humidity does not directly influence a wind site assessment, but knowing this parameter helps assessing the potential danger of ice build-up at the measuring location. The temperature sensor should always be mounted at a height of at least 10m to ensure sufficient distance from heat radiating from the earth.



HYGRO-THERMAL SENSOR

Manufacturer: Galltec
Order-No: P 6311, Thermal sensor
Order-No: P 6312, Hygro- and thermal sensor

- Measuring range: - 30 °C to+70 °C and 0...100% RH
- Accuracy temperature: ± 0.2 K in the range -27°C to +70°C
- Accuracy humidity: ±2% rH in the range 5....95% rH at 10°C to +40°C
- Starting time: (calm air) < 20 s
- Measurement element temperature : (acc. to DIN EN 60751) PT 100 1/3 DIN

WEATHER- AND RADIATION SHIELD

Order-No: P 6300

Hygro-and thermal sensors are often applied in combination.
Both sensors are installed within a weather- and radiation shield.

Barometric Pressure Sensors

Barometric pressure sensors (barometers) measure the air pressure. Air pressure and air temperature should be evaluated for an accurate wind site assessment. However, because this data could be obtained from nearby weather stations, it is not considered an essential part of a measuring system. Even so, barometers are worth consideration, taking into account the savings made on the expense of supply, analysis and incorporation of external data over the course of a measuring campaign (at least 12 months). We generally would recommend the inclusion of an air pressure sensor as part of a measuring system.



BAROMETER AB 60

Manufacturer: Ammonit
Order-No: P 6330.2

Optional installation within a met-mast mounted steel cabinet

- Piezoelectric barometric pressure sensor
- Measuring range: 800 to 1100 mbar, hPa
- Offset calibration at lowest specified pressure -0.05V to +0.05V
- Full scale span min. 4.95V; typ. 5.0V; max.5.05 V
- Voltage output: 0 to 5 V DC
- Supply voltage: 9...32 V DC
- Low energy consumption: < 5mA @ 12 V DC
- Temperature range: -40° C to +85°C
- Humidity range: 0...98% RH
- Atmosphere: non-ionic, non-corrosive
- Thermal effects: -10° C to +65°C, offset 0.5% FS*, span 0.5% FS*
- Non-linearity, hysteresis (BSL) : ± 0.1% FS*
- Long-term stability: ± 0.1% FS*
- Repeatability: ± 0.5% FS*
- Response time 10 to 90 %, typ. 50 ms

*FS = Full scale



VAISALA PTB 110

Manufacturer: Vaisala
Order-No: P 6331.2, PTB 110.3
Order-No: P 6332.2, PTB 110.2
Order-No: P 6333.2, PTB 110.1

- Measuring range: 500, 600, 800....1100hPA
- Piezoelectric pressure sensor
- Several pressure ranges
- Total accuracy: ± 0.3 hPa at +20°C
± 1.0 hPa at -20°C to +60°C
± 1.5 hPa at -40°C to +60°C
- Output voltage: 0 to 2.5 or 0 to 5 V DC
- External on and off switch
- Low energy consumption ← 4mA @ 12 V DC
- Settling time: 1 sec. to reach full accuracy after power-up

Ammonit is gradually introducing a wide range of new smart sensors (RS-485 / RS-232) to our product range.
Visit our website for the most current information.

Precipitation Sensors

Precipitation sensors are designed to measure the quantity and intensity of precipitation striking the earth's surface. Precipitation is best measured with a tipping bucket device. Precipitation, collected over a surface of 200 sq cm, is conducted through an inflow sieve into a tipping bucket. When the bucket has collected 2 sq cm = 0.1 mm of precipitation, it tips over. This measurement principle is based on the "Guide to Meteorological Instruments No 8, WMO". Precipitation sensors are typically applied for meteorological assessments. This robust device can be equipped with heating when appropriate to the climatic conditions.



THIES PRECIPITATION SENSOR

Manufacturer: Thies

Order-No: P 6362 - Heatable

Order-No: P 6363 – Heatable for mountain regions

Measuring principle: tipping-bucket

- WMO-Standards
- Electrical output: pulses
- Intensity dependent linearity
- Catchment area: 200 sq cm
- Resolution: 0.1 mm NS
- Housing: stainless steel, non-corrosive
- Heatable
- Available with bird protection
- Accuracy: $\pm 3\%$
- Measurement range: 0-11 mm/min



YOUNG PRECIPITATION SENSOR

Manufacturer: Young

Order-No: P 6360 / P 6360H

Measuring principle: tipping-bucket

- WMO-Standards
- Catchment area: 200 sq cm
- Measurement range: 0-11 mm/min
- Electrical output: magnetic reed switch, rating 24 VAC/DC, 500mA
- Temperature range: -20 °C to +50 °C
- Dimensions: 180 x 300 mm (390 with mounting base)
- Resolution: 0.1 mm
- Heatable
- Available with bird protection
- Accuracy: 2% till 25 mm/h
3% over 25 mm/h

Pyranometers

Pyranometers (global radiation sensors) measure global radiation. They are also used as reference instruments due to their measurement precision. The use of this sensor is crucial for measurements with solar-powered applications. It is advisable to use only classified and calibrated pyranometers to ensure accurate results. Adjustable feet and a level allow easy horizontal adjustment.



PYRANOMETER CMP 3 / CMP 6 / CMP 11

Manufacturer: Kipp & Zonen

CMP 3: Order-No: P 6341

CMP 6: Order-No: P 6342

CMP 11: Order No: P 6343

CMP 3 & 6: Measuring value transmitter for the determination of global radiation.
Possible application as albedometer.

CMP 11:

WMO recommended measurement value transmitter for the determination of global -

CMP 3: „Second Class“ - WMO + ISO 9060

CMP 6: „First Class“ - WMO + ISO 9060

CMP 11: „Secondary Standard“ - WMO + ISO 9060

Easy to adjust horizontally due to adjustable feet and a level

- Sensitivity: CMP 3: 5 to 20 $\mu\text{V} / \text{W/m}^2$
CMP 6: 5 to 16 $\mu\text{V} / \text{W/m}^2$
CMP 11: 7 to 14 $\mu\text{V} / \text{W/m}^2$
- Spectral range: CMP 3: 300 to 2800 nm
CMP 6: 285 to 2800 nm
CMP 11: 285 to 2800 nm
- Non-Linearity: CMP 3: < 2.5% [0 to 1000 W/m^2]
CMP 6: < 1% [0 to 1000 W/m^2]
CMP 11: < 0.5% [0 to 1000 W/m^2]
- Internal resistance: CMP 3 & CMP6: 20 to 200 Ohm
CMP 11: 10 to 100 Ohm
- Response time [95%]: CMP 3: = 18 sec.
CMP 6: = 18 sec.
CMP 11: = 5 sec
- Measuring range: CMP 3: 0 to 2000 W/m^2
CMP 6: 0 to 2000 W/m^2
CMP 11: 0 to 4000 W/m^2
- Temperature range: -40 °C to +80 °C
- Delivery includes calibration certificate radiation

Please see our website for comprehensive and detailed information on our sensors and to download data sheets and other relevant technical information.



PYRANOMETER SUNSHINE SPN 1
Manufacturer: Delta-T Devices Ltd. Order-No: P 7341

- Measures global (total) and diffuse irradiance in W/m²
- WMO sunshine threshold: 120 W/m² direct beam
- No routine adjustment or polar alignment
- Near ideal spectral and cosine response
- Wideband thermopile sensors
- Measuring range: 0 to >2000 W/m²
- Resolution: 0.6 W/m² = 0.6 mV
- Temp. coefficient: ± 0.02% per °C typical (-20 °C to +70 °C)
- Non-Linearity: < 1%
- Spectral range: 400 to 2700 nm
- Temperature range: -40 °C to +70 °C



PYRANOMETER SR11
Manufacturer: Hukseflux Order-No: P 7351

- "First Class" solar radiation sensor
- Compliant with WMO and ISO standards
- Scientific grade meteorological observations
- Easy installation and maintenance
- Two glass domes
- Spectral range: 305 to 2800 nm
- Sensitivity (nominal): 15 µV / W/m²
- Measuring range: 0 to 2000 W/m²
- Temperature range: -40 °C to +80 °C
- Temperature dependence: < 0.1% / °C
- Non-linearity: ≤ ± 1%
- Calibration tracability: WRR



PYRANOMETER LP02
Manufacturer: Hukseflux Order-No: P 7352

- "Second Class" solar radiation sensor
- Compliant with WMO and ISO standards
- General meteorological observations
- Easy installation and maintenance
- Utilises thermopile sensor
- Spectral range: 305 to 2800 nm
- Sensitivity (nominal): 15 µV / W/m²
- Measuring range: 0 to 2000 W/m²
- Temperature range: -40 °C to +80 °C
- Temperature dependence: < 0.1% / °C
- Non-linearity: ≤ ± 2.5%
- Calibration tracability: WRR

Our website offers comprehensive and detailed information on our pyranometers. There you can download data sheets, software and all other relevant technical information.



© Ammonit / Ecossem (Ammonit partner Spain): measurement systems for all climates and the most remote regions

Obstacle Lights

Met masts increasingly reach heights that require the application of obstacle lights to protect air traffic, (on and offshore). National regulations regarding installation of obstacle lights differ from country to country.

Ammonit has designed a solar-powered warning light system that is controlled and monitored by our data logger. We strongly recommend the application of surge protection systems within the steel cabinet when obstacle lights are installed. Obstacle lights are usually maintenance-free for up to 5 years.



OBSTACLE LIGHT CARMANAH MODEL A650

Manufacturer: Carmanah Order-No: P 5501.05

- Up to 10cd (steady-on, green, equatorial)
- 18 cd peak intensity, flashing
- 12.5% duty cycle (Red LED's)
- Colours: blue, red, yellow, green and white, ICAO + SAE25050 (FAA) compliant chromaticity
- Colour indicator: Yes, FAA Eng. Brief 67, compliant
- Flashing pattern: 256+
- Solar supply, recyclable batteries
- Water-proof, corrosion protected
- Wind loading: 400 mph (180 m/s)
- Extreme weather proven
- Standards: MIL-STD-202G; MIL-STD-810G; EN60945: ESD, EMI, EMC; IP68; L70; A650 is acceptable for barricade and construction applications at Commercial Part 139 Airports under FAA Advisory Circular AC 150/5370-2E. The A650 Blue is compliant with the requirements of ICAO Annex 14, Volume 1, Fourth Edition, dated July 2004



OBSTACLE LIGHT CARMANAH MODEL 702-5

Manufacturer: Carmanah Order-No: P 5502.06

- Light intensity steady on, green 10 cd; red 6cd
- Visibility 5.4km (3 miles)
- Night vision goggle (NVG)
- Programmable via optional infrared remote control
- Features both 4 and 5 bolt mounting patterns
- Completely self-contained and sealed against environmental conditions
- Extremely rugged, waterproof and vandal resistant
- Colours: red, green, amber, white, blue
- 150 hours of operating capacity from a full charge
- Classified to: ISO 9001 Quality Assurance Practises



OBSTACLE LIGHT LANTHAN HF102

Manufacturer: Lanthan Order-No: P 5510

- Light intensity > 10 candela, colour: red
- Power consumption < 1.9 W
- Self contained
- > 50 000 hours operating capacity
- Low power consumption, ideal for emergency power use and stand-alone power solutions
- Wide operating voltage (10-50 V DC)
- Easy to be installed due to M12 HARAX connector

Our Website offers comprehensive and detailed information on our obstacle lights. There you can download data sheets and other relevant technical information.

Ammonit Software

Ammonit develops three different types of software programs to simplify data access and management:

Firmware for data loggers

This software is essential to run the data loggers and is delivered with every new data logger. Our firmware is regularly updated and can be downloaded from our website (Support and Software section).

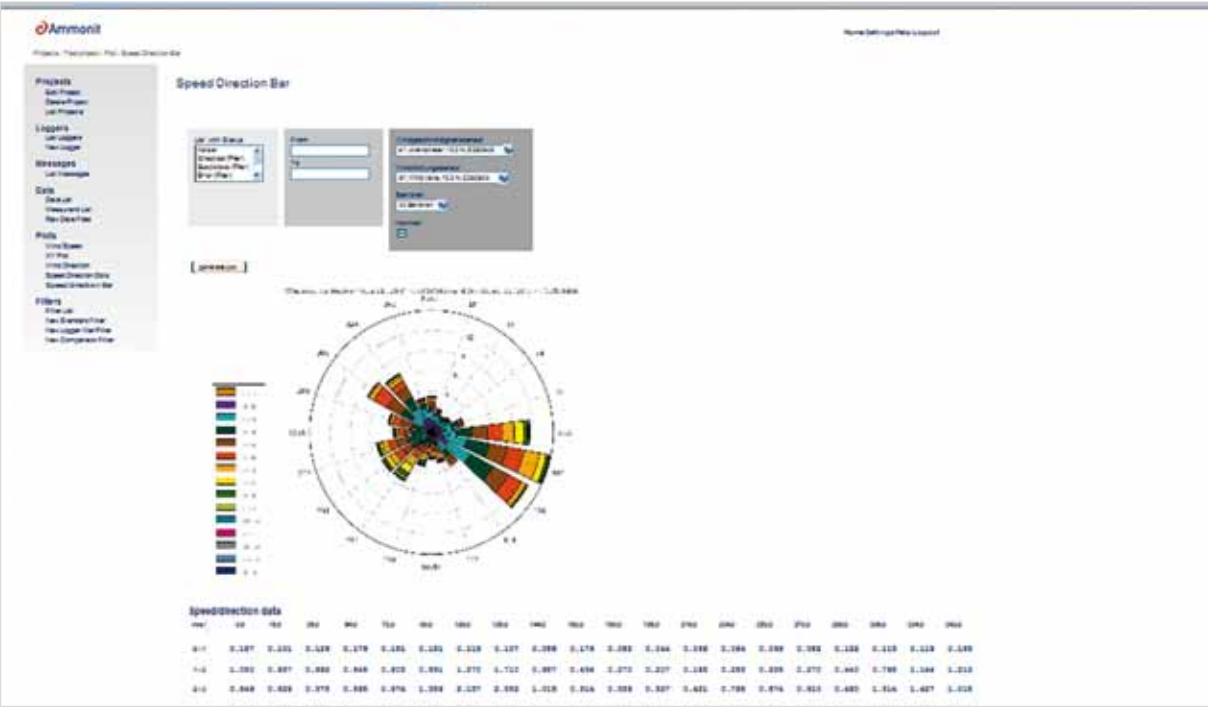
Communication software programs

We provide additional software programs to simplify communication between measuring stations and your PC/laptop. All software programs are available for free on our website (Support and Software section).

Online platform AmmonitOR

Our online platform AmmonitOR – Ammonit Online Report – allows you to access, manage, monitor and visualise your wind measurement data online, around-the-clock.

To learn more, visit our website www.ammonit.com/en/ammonit-customer-login



AmmonitOR: access, manage, monitor and visualise your data online with AmmonitOR

AmmonitOR – Online Platform

AmmonitOR – Ammonit Online Report

With our user-friendly online platform, AmmonitOR, you can access, archive, monitor and visualise your measurement data around-the-clock from wherever it suits you.

To learn more about AmmonitOR visit our website www.ammonit.com/en/ammonit.-customer-login

To register simply email us at ammonitor@ammonit.com.
Our service team will set up your personal account and send you the encrypted access data.

AmmonitOR features:

Global data access around-the-clock, via an encrypted login section

Automated, well-structured data archiving and storage for easy project navigation

Data quality checking on sensor default - such as for ice-effects, temperature, humidity, pressure performance or measuring system

Automatic warning emails or SMS alerting you to technical problems such as problems with sensors, power supply and data communication.

Visualisation of measurement data with diagrams or schedules (e.g. histograms, xy-plot, wind rose)

Multi-language functionality English, Spanish, French or German

Long-term data storage of up to 3 years on a dedicated Ammonit server or server of your choice

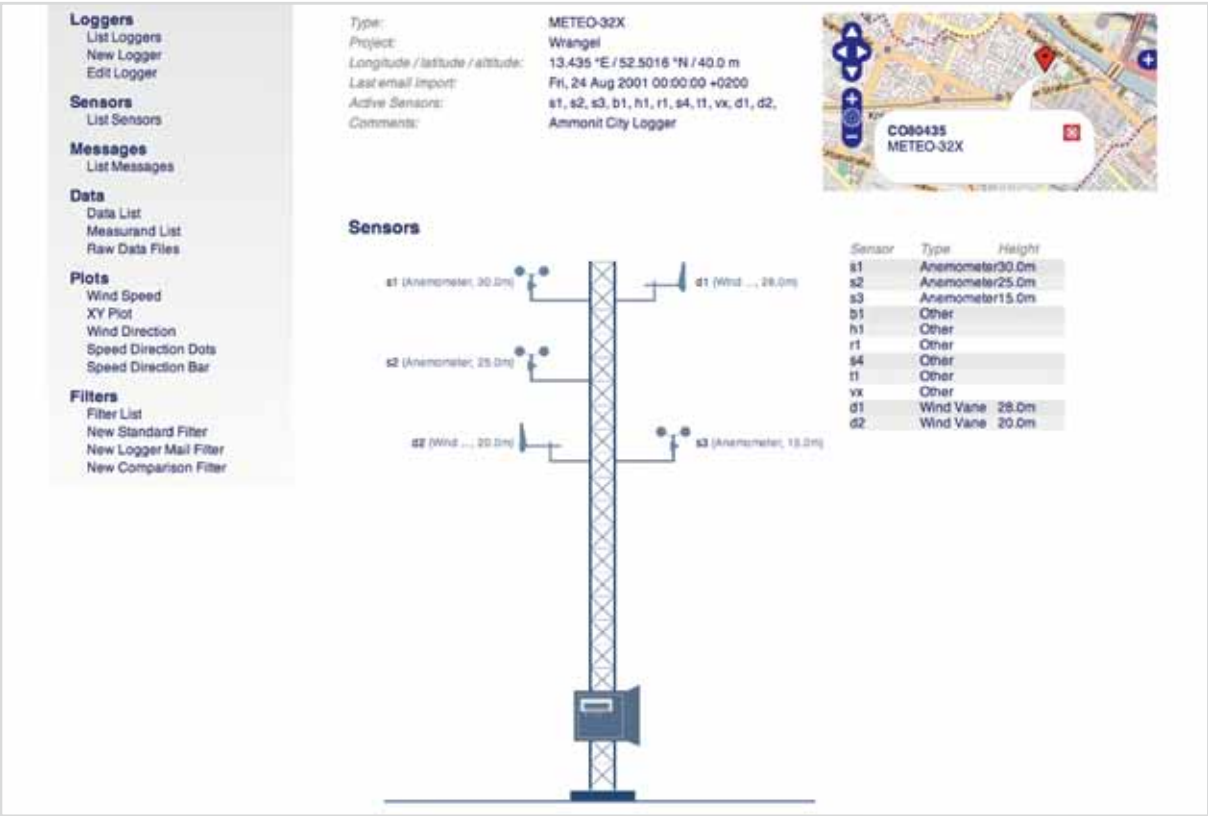
Open-source program allows for continual improvement

Access control you specify the level of access rights for individuals using your system

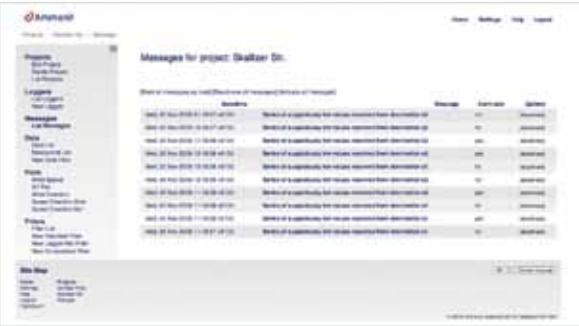
Requirements data logger, GSM/GPRS modem and firmware 1.9

AmmonitOR - Online Platform

Logger Detail



Messages List

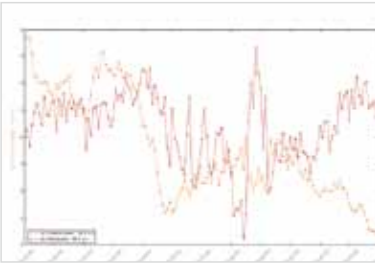


Filter List

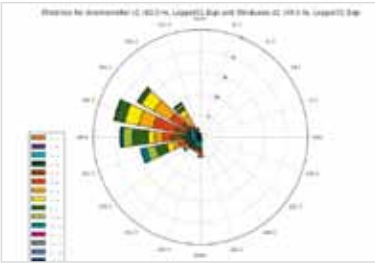


Visualise your measurement data with diagrams and schedules

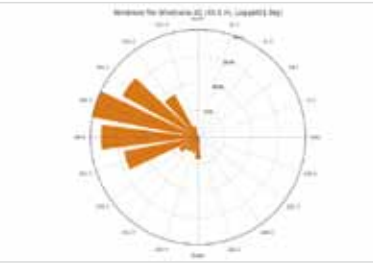
XY Plot



Wind Speed / Direction Wind Rose



Wind Direction



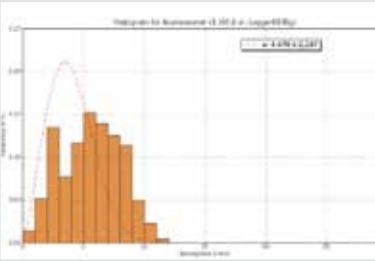
Measurand List



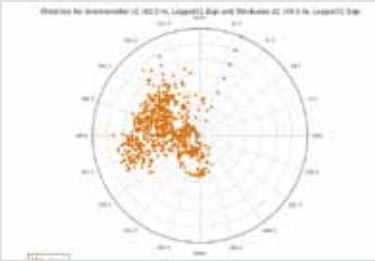
Project List



Histogram



Wind Speed / Direction Points





© Ammonit / DesamD (Ammonit partner Chile): typical solar measurement system in Northern Chile

Meteo & Solar Systems:

Products – Meteo & Solar Systems

Ammonit presents our new product range METEO & SOLAR SYSTEMS to meet an increasing demand from our partners and customers, especially for solar sensor systems in the field of radiation.

Solar Systems

Our selected high quality solar systems can be applied in all climates and various scenarios. We offer a large range of system solutions from very basic systems to highly precise systems for complex applications. This sector will be expanded continuously and will soon offer an even bigger range of product solutions and information.

Download our solar documentation on our website to learn more about our proposed solutions for solar systems www.ammonit.com/en/products/meteo-solar-systems/solar-systems

Meteo Systems

With our US co-operation partner Yes Inc we also offer meteorological systems, radiometers and upper air systems.

To learn more visit our website at www.ammonit.com/en/products/meteo-solar-systems/solar-systems or contact us for further information at info@ammonit.com, T +49-30-6003188-0.



© JUWI Group: wind farm PEG in Costa Rica

Juwi/Windhunter Costa Rica – Wind Farm PEG (Planta Eólica Guanacaste)

One of the largest wind energy projects in Latin America, PEG is a 55 turbine wind farm developed and operated by the JUWI Group in Costa Rica.

Costa Rica plans to generate its entire power supply via renewable energies by 2021; if it meets this target it will be the first country in the world to do so. With the local conditions of Costa Rica being ideal for it - a rainy season lasting from May to November followed by a dry season with strong wind from November to May - wind energy will be implemented on a par with hydropower.

The JUWI Group has developed the wind farm project PEG (Planta Eólica Guanacaste), which is currently one of the largest wind energy projects in Latin America. 55 wind turbines (Enercon E44 900 kW, 45m hub height) generate an installed capacity of 49.5 MW and an annual energy output of 240 million kW hours. The entire wind park was built over a period of two years and started operating in 2009 (construction start: February 2008). The JUWI group will develop and operate the wind park over a period of twenty years, thanks to a BOT (build, operate, transfer) contract together with GDF Suez. The project was put out for tender in early 2006 by the ICE (Instituto Costarricense de Electricidad) with the objective to reduce annual CO₂ emissions by 240,000 tons.

In September 2006, Windhunter (the Polish partner of Ammonit) installed three fully equipped wind measurement systems to carry out accurate wind site assessments on PEG's vast site. The towers were fitted with Ammonit data loggers and Thies sensors to perform wind measurements in the harsh climatic conditions, with strong seasonal wind speeds (on average < 10 m/s in hub height).

The construction of the infrastructure and the first wind turbine (Enercon 28 E44) took place in 2008 within a brief time slot, due to the extremely strong winds of the dry season. After the erection of all turbines, the measuring system for the wind site assessment was replaced by three measuring systems fully equipped for monitoring the operating wind farm. The met-masts provide continuous online wind data to the SCADA system at the services building via glass fibre cable.

www.juwi.de
www.windhunter.com



© Cube Engineering GmbH: wind measurement in Ras-al-Kaimah

Cube-Engineering GmbH - Desert Project in Ras-al-Kaimah

Seven fully equipped measuring stations in an inaccessible desert region. Objectives: site development and subsequent construction of futuristic urban development project Ras-al-Kaimah Eco City.

The internationally active wind consultancy firm, CUBE Engineering GmbH, was appointed by the national utility company of the Arabian emirate Ras-al-Kaimah to evaluate the country's wind potential and to identify potential sites for pilot projects. Ras-al-Kaimah is one of seven sheikdoms of the United Emirates of Arabia (UEA). Its landscape consists of fertile coastal regions as well as harsh regions, such as the Hadshar mountains, which are up to 3,000 m high and bare of vegetation, and the sand dunes of the Rub-al-Khali desert, in the southern territories - one of the largest sand deserts on our planet.

The emirate has great potential for the use of renewable energies and ambitious plans for the future. Ras-al-Kaimah Eco City is characteristic of the futuristic urban development projects for which the Emirates is known. A completely new, sustainable metropolis, supplied entirely by solar energy, is planned for completion by the year 2012. The sole use of local building materials will create an urban development that sets new design standards.

It was not easy to find potential sites for wind power generation in this area because no references or data were available. The planned 15 wind measurement stations were reduced to 7 due to inadequate

or non-existent access. Many remote spots were accessible only via helicopter. All measuring stations were fully equipped with Ammonit Meteo-32 data loggers and anemometers, wind vanes from Thies, and suitable solar panels and GSM Modems for the data transfer. The components were mounted on 50 m high lattice towers.

The geographic conditions of the region required a self-contained measurement technology of the highest standard and an especially high degree of flexibility. The measuring campaign lasted for two years. Access to the wind measurement data was achieved with the help of an online software program called "Windycator", developed by EOL GmbH, which provided an automated remote enquiry function and an output protocol in the format of text documents, graphics and schedules to support and simplify the administration and visualisation of measurement data. Ammonit offers a similar online platform, AmmonitOR, which can be obtained for free by emailing us at: **ammonitor@ammonit.com**

The measuring campaign for Ras-al-Kaimah Eco City was completed in early 2009. In addition to the wind site assessment, CUBE Engineering GmbH has assembled a wind resources map for the emirate in co-operation with the Anemos Gesellschaft für Umweltmeteorologie mbH.

www.cube-engineering.com
www.cube-america.com

Advice on how to set up your system

How to install your measurement system successfully

This section will give you a brief introduction on what is important when setting up your wind measurement system. It is crucial to choose and to set up the measurement system in the best possible manner. Installation and maintenance should always be carried out by specialists. A small discrepancy of only 3 % in the evaluation of wind speed data can multiply drastically during assessment calculations and result in a 7 digit economic loss.

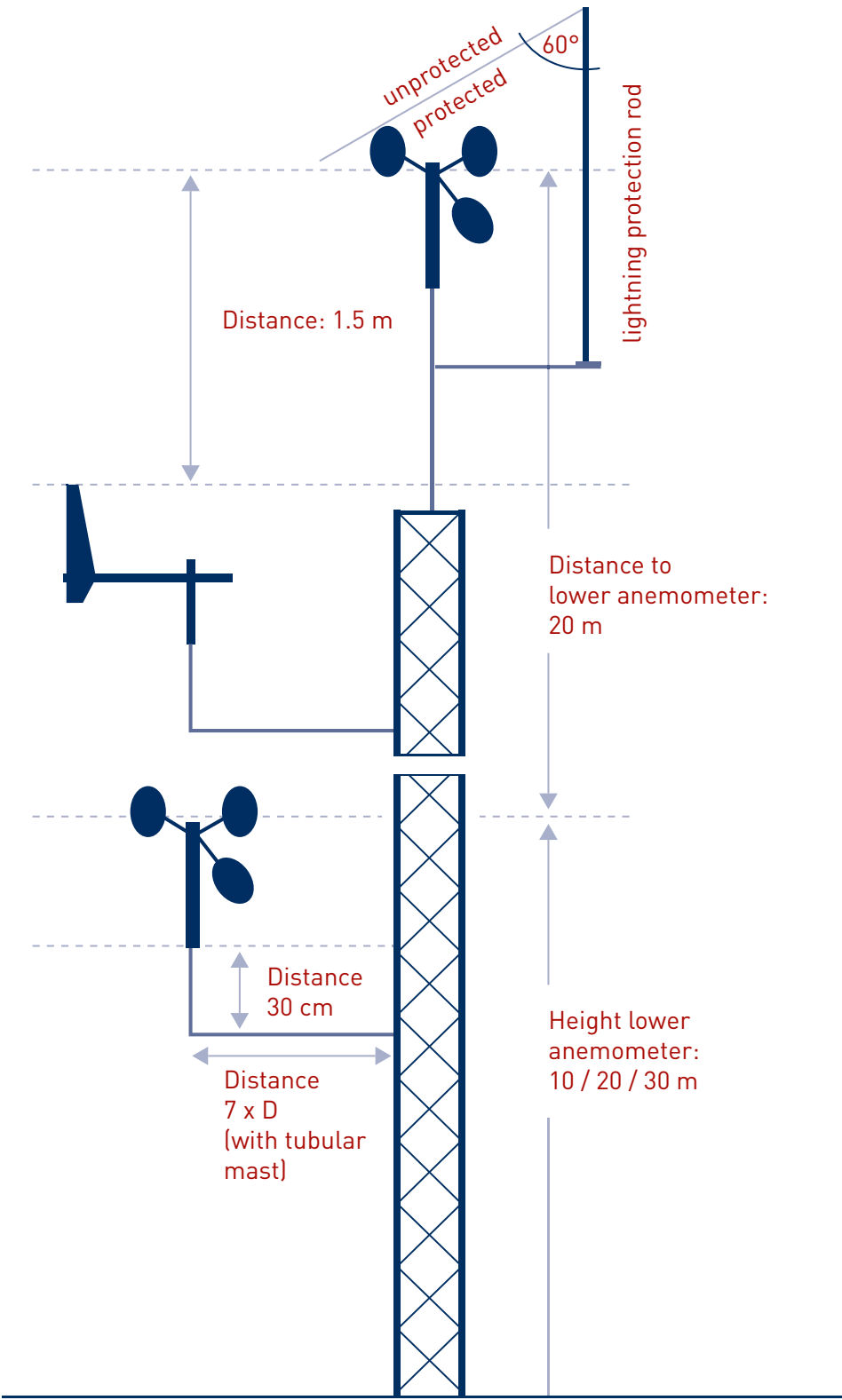
To learn more, visit our website www.ammonit.com/de/windinfo

Avoidable mistakes

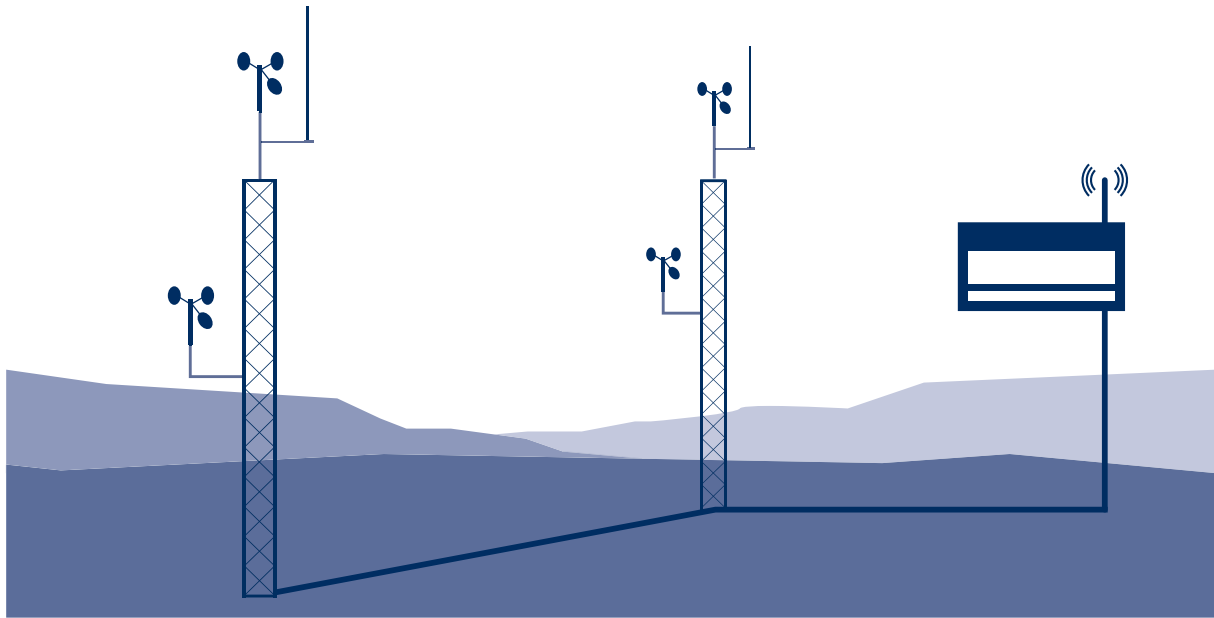
- Wrong choice of sensors
- Uncalibrated anemometers
- Incorrect installation of mast and sensors
- Wrong length of traverses/booms
- Shelter effect/shading
- Incorrect measurement of heights

Download our Wind Info brochure “Measuring wind – know how for a successful wind measurement” from our website www.ammonit.com/en/wind-info/wind-measurement

It provides some useful background information on what is important when measuring wind and when setting up your measurement system.



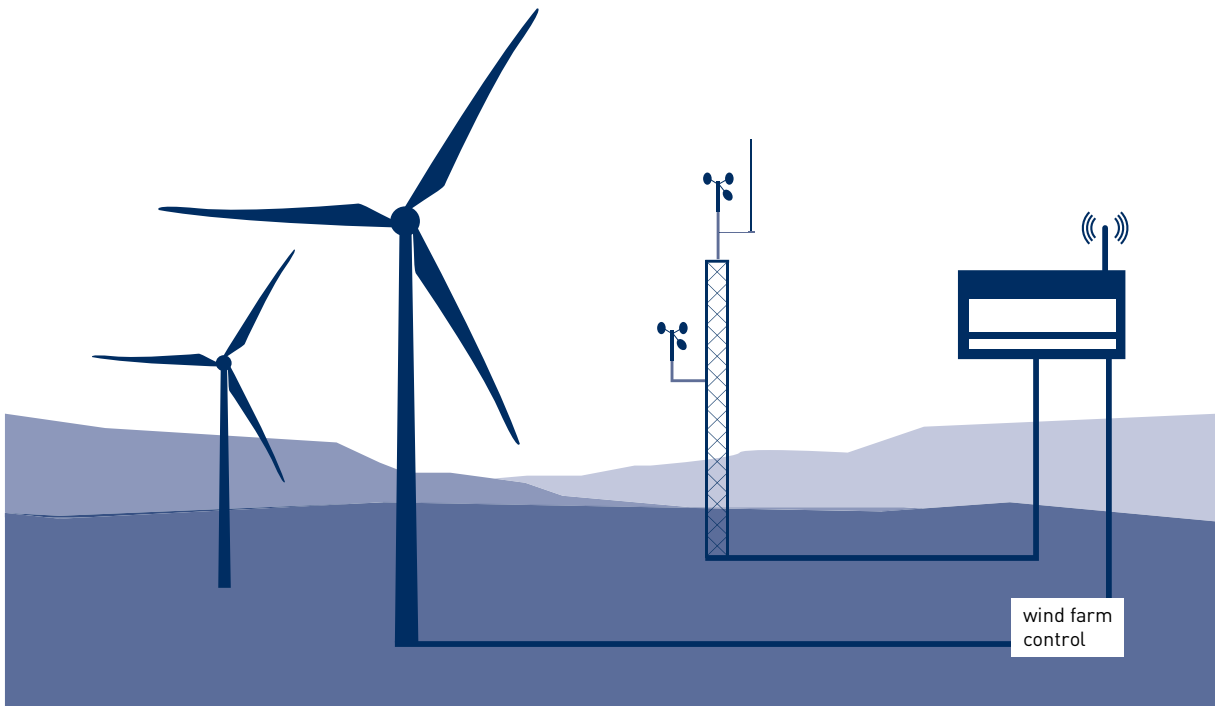
Advice on how to set up your system



Wind site assessment
prior to setting up a wind farm

The installation of a complete, state-of-the-art measuring system at one or (less often) several significant locations on a potential site will give the best assessment of the site’s wind conditions and help to determine its suitability for a wind farm. The measuring system should always be installed by professionals.

The mast should be set up, free of obstruction, on a carefully selected position on the site. It should be fully stocked with high-quality measuring components to measure in particular the wind speed (velocity), the wind direction and its allocation. An analysis of the surrounding topography and ground conditions should be taken into account. Values such as air density, air pressure and humidity should be taken into account they are however less crucial.



Wind farm monitoring
once the wind farm is operating

Once a wind farm is in operation wind measurement is required to monitor the turbines, ensuring they operate properly and generate the best possible energy yield, for example with SCADA systems. Our systems are compatible with SCADA systems.

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It provides some useful background information on what is important when measuring wind and when setting up your measurement system.



© Ammonit / Windup (Ammonit partner Portugal): wind farm in Portugal

Impact of sensor accuracy on estimated wind energy resources

Sensor	Measurement of	Impact of sensor error on estimated wind energy resources (EWER) error	Sensors with high accuracy, supplied by Ammonit	Example of sensors with lower accuracy	Worst case impact of non-optimised choice of sensor on estimated wind energy resources (EWER)	Importance
type	type	value	value	value	calculation	
anemometer	wind speed (Class A simple landscape)	Δ 1% wind speed → ~ Δ 3% EWER ($P. = \frac{1}{2} \rho A v^3$) [*5]	Thies FCA [*2] 0.9% max.error [*1]	NRG 40C 2.4% max.error [*1]	$(2.4 - 0.9) \times 3$ = 4.5% of EWER	crucial
anemometer	wind speed (Class B complex landscape)	Δ 1% wind speed → ~ Δ 3% EWER ($P. = \frac{1}{2} \rho A v^3$) [*5]	Thies FCA 3.0% max.error [*1]	Vaisala WAA151 11.1% max.error [*1]	$(11.1 - 3) \times 3$ = 24.3% of EWER	crucial
barometer	air pressure	Δ 1% pressure → ~ Δ 1% EWER ($\rho = P/RT$) [*5]	Vaisala PTB 110 ± 1.5 hPa $\approx \pm 0.15\%$; range -40°C to +60°C	± 1.5 kPa $\approx \pm 1.5\%$; range -10°C to +90°C	$\pm(1.5 - 0.15) \times 1$ = $\pm 1.35\%$ of EWER	significant
thermometers	air temperature	Δ 1°C → ~ Δ 0.35% EWER ($\rho = P/RT$ and T in Kelvin) [*5]	Galltec P 6312 ± 0.2 K; range -27°C to +70°C	± 1.1 K; range -40°C to +52.5°C	$\pm (1.1 - 0.2) \times 0.35 =$ $\pm 0.32\%$ of EWER	significant
wind vane	wind direction		Thies wind vanes [*3] no North gap	with North gap (dead band): 8° max. 4° typical)		important for wind farm modelling [*4]

* 1) Please refer to ACCUWIND Study, [RisØ-R-1563-EN, table 4-4 horizontal wsp definition], and classification according to IEC 61400-12-1 (2005-12) by Deutsche Windguard. Download available on our website www.ammonit.com/en/support/downloads/211-testberichte.
* 2) FCA = First Class Advanced
* 3) Thies wind vanes First Class, compact and classic
* 4) Wind direction data from the met-mast is important in order to extrapolate correctly the wind conditions of the met-mast surroundings for the future wind farm, with CFD, WAsP or other modelling tools.
* 5) P. = power; ρ = air density; v = wind speed; A = a constant; P = air pressure; R = universal gas constant; T = temperature in K

Wind Consultants & Services

Acciona (ES)
Australian Radio Towers (AU)
Beijing Leviathan/Topwind (CN)
Climatik (MX)
Cube Engineering GmbH (DE)
Cube Engineering America (USA)
DESAMD (CL)
ECOSEM (ES)
ENCIS WIND (FR)
Energiewerkstatt (AT)
ENISOLAR (TR)
Enviwisegroup (SYR)
Geo-Net Consulting GmbH (DE)
Gervis SA (Romania)
IEM Intercâmbio Elétro Mecânico (BR)
Interwind AG (CH)
NAI AD (BG)
Nexgen (GB)
Oelsner Group (ZA)
Oenko (CA)
Proviento/Eole (EC/PE)
Re-Consult (TR)
SIPRO Ökopower (AT)
SME Wind Consult (BG)
Studio Rinnovabili (IT)
TECNOVEX S.A. (UY)
TUEV-Sued Industrie Service GmbH (DE)
Wind-Consult (DE)
Windhunter SC (PL & DE)
WINDUP (PT)

Manufacturers of Wind Turbines

Aerogeneradores Canarios (ES)
Aventa (CH)
DeWind (DE)
Ecotecnia (ES)
Enercon (DE)
Gamesa (ES)
GE Wind Energy (DE)
Fuhrländer AG (DE)
Nordex (DE)
REpower Systems AG (DE)
Siemens AG (DE)
Suzlon (IN)
Vergnet (FR)
Vestas (DK)

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EnerSys (DE)
Erelis (FR)
EnXco (UK)
Eolica (IT)
Endesa Finerge (PT)
GEO (DE)
Iberdrola (ES)
JUWI Group (DE)
Lahmeyer International (DE)
MVV Energie AG (DE)
Ostwind International (FR)
red project management (DE)
Reetec (DE)
RES (UK)
Volkswind (DE)
WKN Windkraft Nord (DE)
WPD AG (DE)

Research Institutes & Universities

CDER Marrakech (MA)
C. v. O. Uni. Oldenburg (DE)
Cubasolar (CU)
Czech Technical University Prague (CZ)
Deutsche Windguard (DE)
DEWI Deutsches Windenergie Institut (DE)
DLR (DE)
ENEA Renewable energy sources department (IT)
Fraunhofer IWES (DE)
Hohot Livestock Machinery Research Inst. (CN)
Training Institute for Science Hanoi (VN)
INEGI (PT)
ISET Kassel (DE)
LAPAN National Institute of Aeronautics Jakarta (ID)
LNEG (PT)
Natinoal Engineering Research Centre of Sri Lanka (CL)
Polytechnical Institute of Bucarest (RO)
Lithuanian Energy Institute (LV)
TU Berlin (DE)
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University van Amsterdam (NL)
University of Engineering & Technology Bangladesh (BD)
Wind Consult (DE)

Public Energy Utilities

CRE Cooperativa Rural de Electrificacion (BOL)
EDF (FR)
Eesti Energia AS (EST)
E.on (DE)
EPM Medellin (CO)
Electricidade dos Acores (PT)
INEL Empresa de Ingeniería Para La Electricidad (CU)
Latvian Power Society Riga (LV)
Petrobras (BR)
RWE Energie AG (DE)
Union Electrica (CU) and more than 25 municipal and regional electricity companies in Germany

National/International Institutions

GTZ Gesellschaft für Technische Zusammenarbeit (DE)
KfW Kreditanstalt für Wiederaufbau (DE)
United Nations Industrial Development Organisation (UNIDO)

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