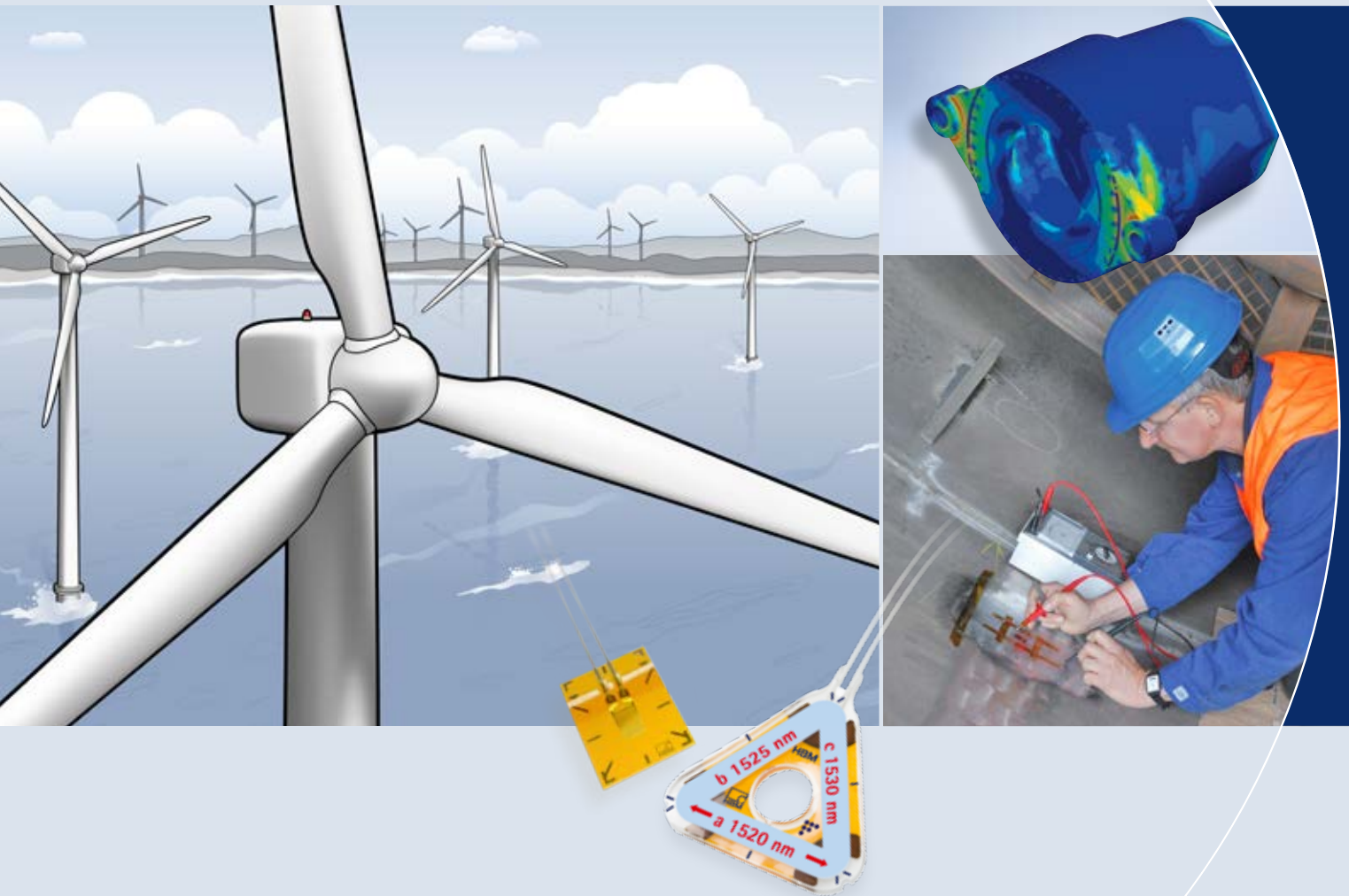


# Wind turbine and component testing

Extend service life and reduce downtime



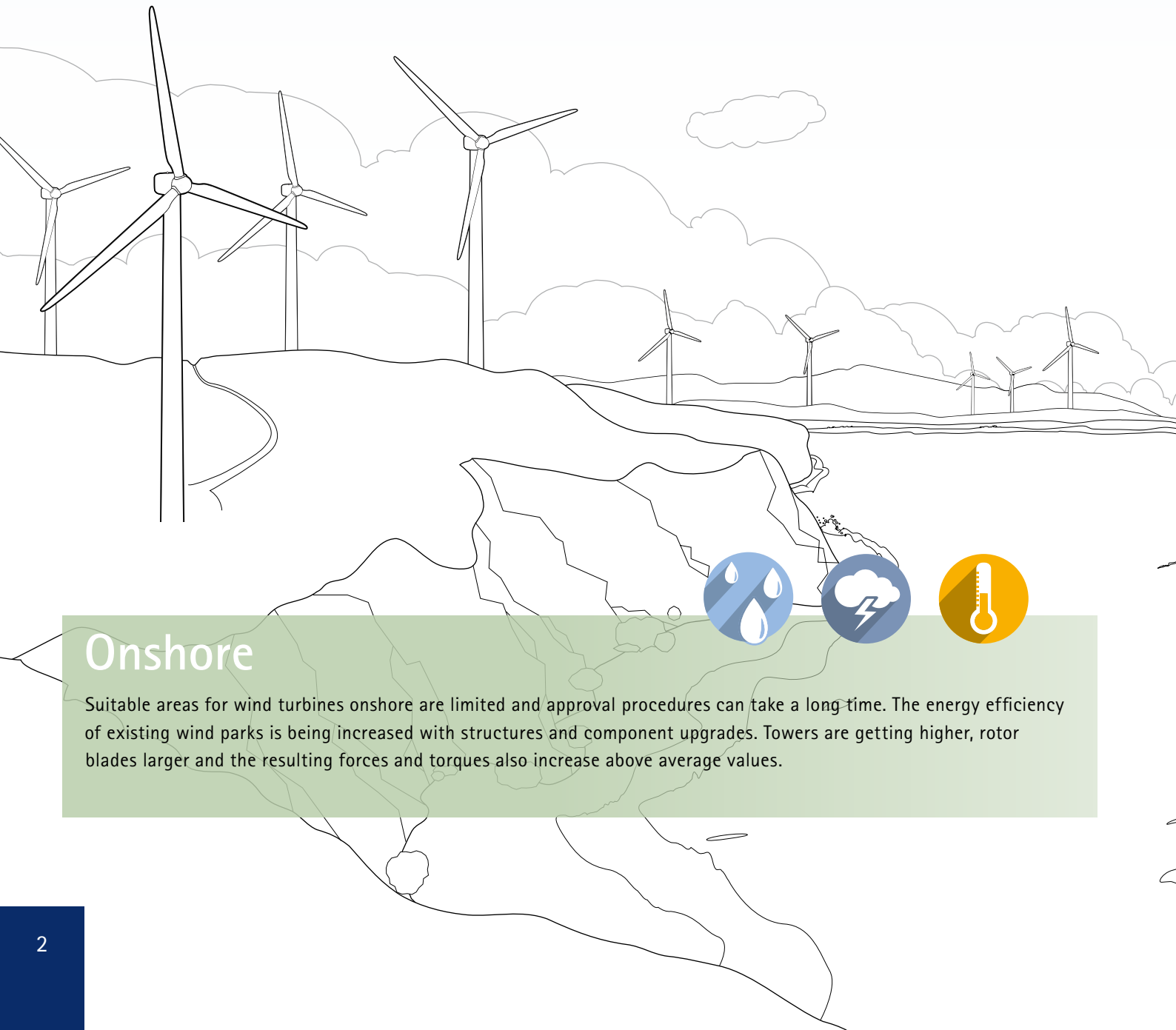
# Maximize service life. Minimize downtime

## From design to maintenance

The efficient use of your wind power system is paramount in ensuring a fast return on your investment. HBM provides you with the complete measurement solution for safe development, production, commissioning and operation of wind turbines.

## Increasing requirements

The requirements for both onshore and offshore wind power turbine designs are increasing. The efficiency of wind power depends on valid tests and measurement results – in the development and operation of components and complete wind power systems.



## Onshore

Suitable areas for wind turbines onshore are limited and approval procedures can take a long time. The energy efficiency of existing wind parks is being increased with structures and component upgrades. Towers are getting higher, rotor blades larger and the resulting forces and torques also increase above average values.

## More than 30 years experience

Trust in HBM's more than 30 years experience in wind energy and benefit from reliable measurement technology for offshore and onshore applications! Our measurement technology is applied to wind turbine components such as:

- Rotor blades: Electrical and optical strain gauges for fatigue testing on rotor blades ensure long service life and optimal design.
- Gear units: High-precision torque transducers for test benches allow development of gear units with long service life, low wear and high efficiency.
- Generators: Torque transducers for maximum torque requirements (up to 5 MN) enable reliable determination of generator efficiency.
- Inverters: High end power analyzers to qualify inverters according to EN61400-21:2008 Wind turbines.



### Fundamental to your success:

- Optimization of critical components,
- Continuous monitoring of structural elements,
- Professional testing of the entire design



### Our solution:

Professional test and measurement technology that enables efficient development of wind turbine elements, through safe testing of critical components as well as condition and structural health monitoring of a wind turbine.

## Offshore

At sea, the components of a wind turbine must withstand around 2 billion load cycles over its total life time. They also need to withstand storms without damage. Performing maintenance and service is complicated and expensive – making it critical to have both reliable components and a maintenance schedule planned in advance.



# Safety for operation and development



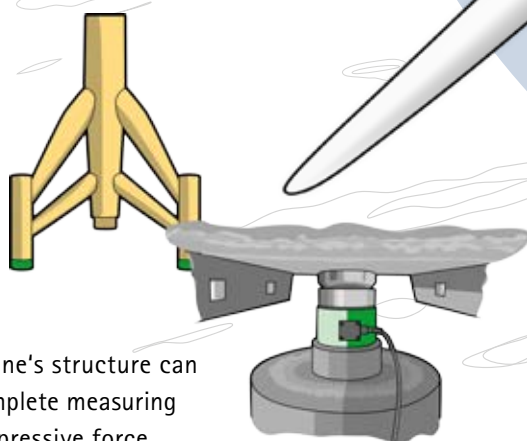
## Condition monitoring

Based on measurement results and the corresponding analysis, the condition of wind turbines can be determined exactly "with confidence."



## Structural analysis

Do you want to know more about the stability and efficiency of your wind energy facility? HBM measurement technology for strain, force and bending moments helps you to find the right solution for structural tests on foundations and structures.

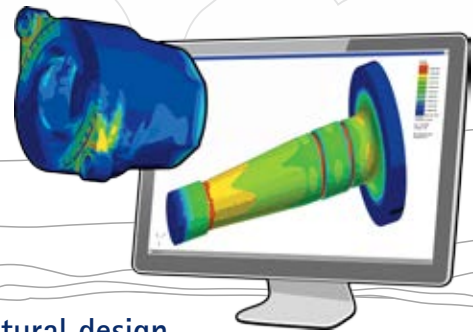


## Heavy duty weighing

The total mass of a wind turbine's structure can be measured using HBM's complete measuring service based on the C6A compressive force transducers with up to 5 MN load capacity per cell. Weighing is performed in accordance with Directive DIN EN ISO19901-5.

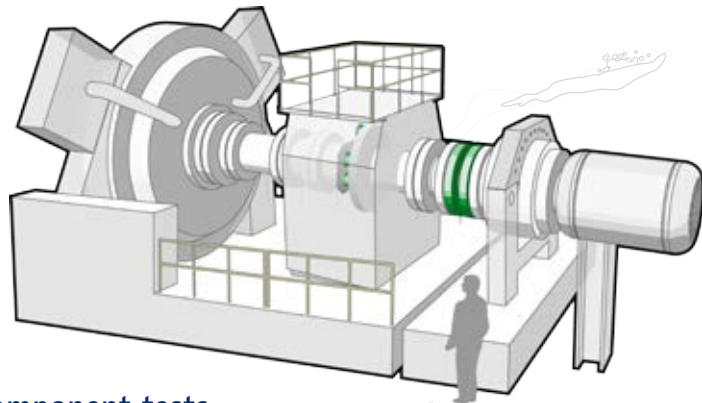
### Measurement engineering

From consulting through installation and documentation – the HBM measurement team handles complete measurement tasks in wind power systems.



### Structural design

HBM nCode software solutions help you understand the key influencing factors that affect the structural integrity and reliability of wind turbine components.



### Component tests

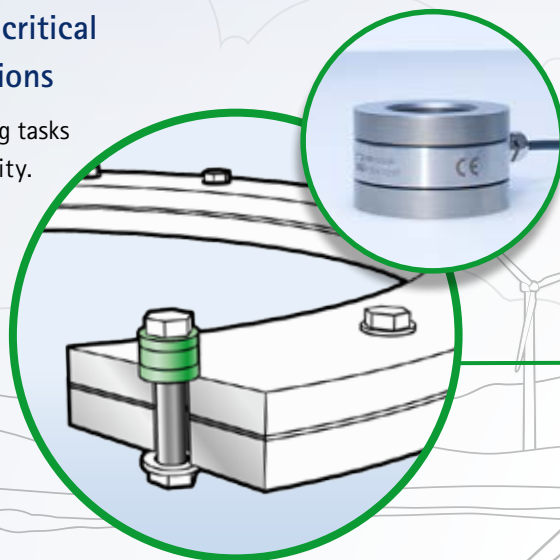
Place your trust in safety provided by modern measurement technology for your wind turbine component testing. With HBM, you benefit from products that support you throughout the entire measurement chain.



# Our sensors at work

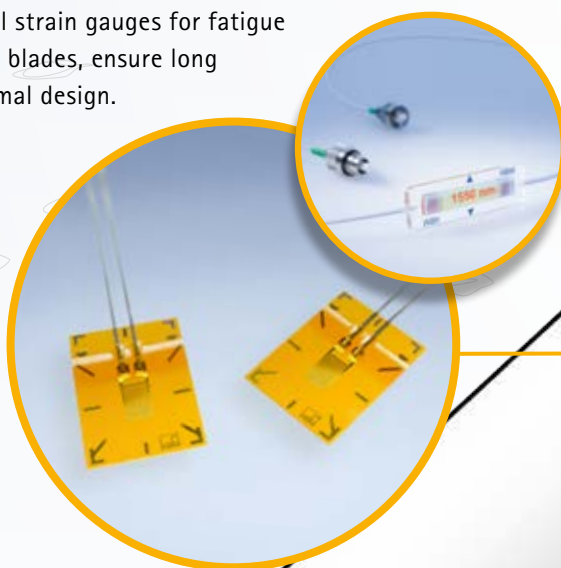
## Force washers monitor critical annular flange connections

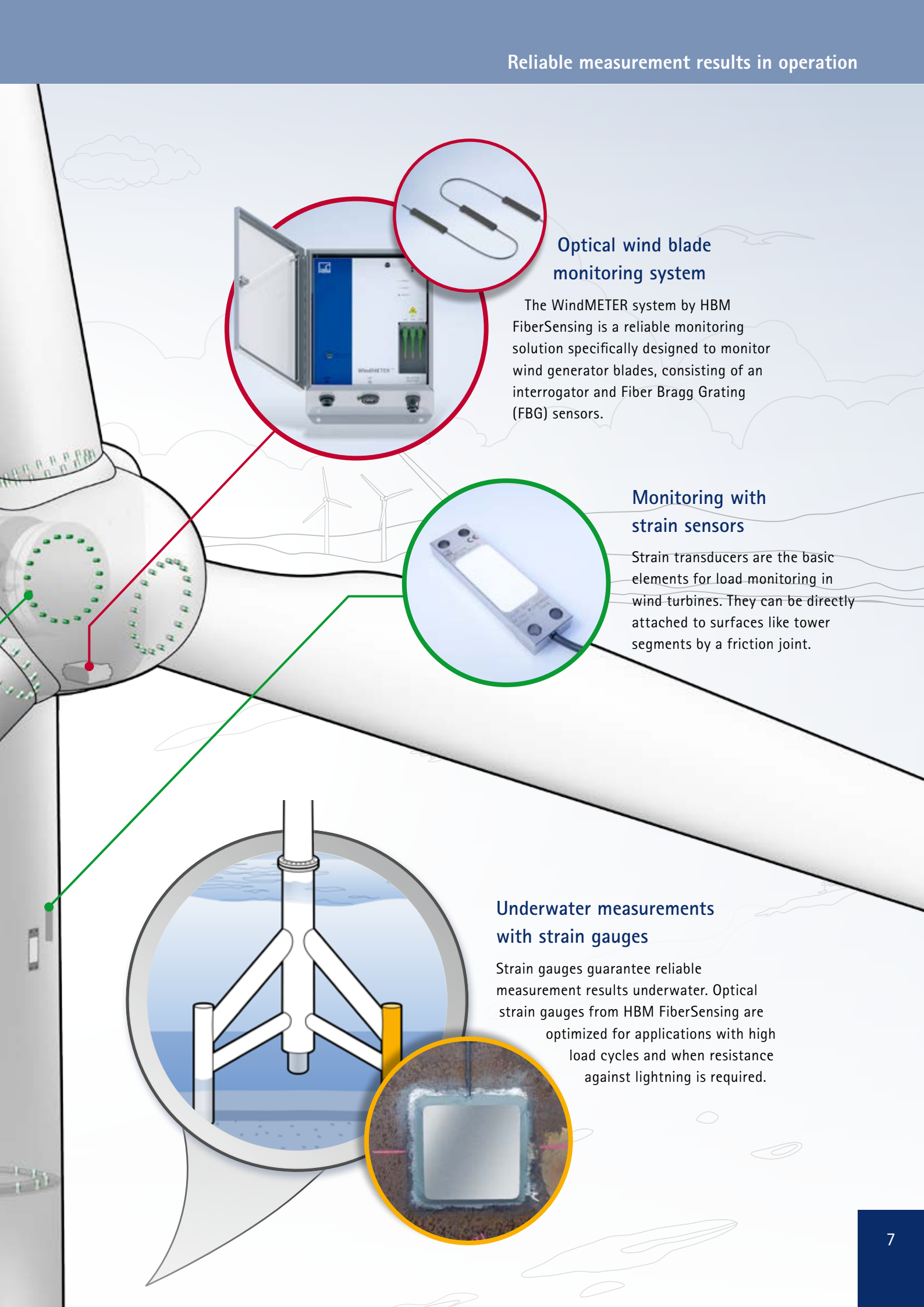
KMR force washer for monitoring tasks that require good reproducibility. Easy to integrate and reliable in thousands of applications.



## Fatigue testing with strain gauges

Electrical and optical strain gauges for fatigue testing, e.g. on rotor blades, ensure long service life and optimal design.





The diagram shows a wind turbine with three callout circles. A red circle at the top right points to the nacelle area and contains an image of the WindMETER system and its sensors. A green circle on the right points to the tower and contains an image of a strain sensor. A green circle at the bottom left points to the underwater section and contains an image of the underwater measurement setup. The background shows a stylized landscape with clouds and other wind turbines.

### Optical wind blade monitoring system

The WindMETER system by HBM FiberSensing is a reliable monitoring solution specifically designed to monitor wind generator blades, consisting of an interrogator and Fiber Bragg Grating (FBG) sensors.

### Monitoring with strain sensors

Strain transducers are the basic elements for load monitoring in wind turbines. They can be directly attached to surfaces like tower segments by a friction joint.

### Underwater measurements with strain gauges

Strain gauges guarantee reliable measurement results underwater. Optical strain gauges from HBM FiberSensing are optimized for applications with high load cycles and when resistance against lightning is required.

## Measure all over the turbine

HBM offers several data acquisition systems to meet the various challenges of wind turbine testing:

- **PMX:** The ideal control module thanks to the support of real-time communication via Industrial Ethernet, and modern browser-based user software.
- **Genesis High Speed:** The system enables testing of electrical components like generators and inverters including the generators' overall power and efficiency in combination with HBM torque transducers. It also allows certification of the inverters output according to EN61400-21:2008 Wind turbines – Part 21.
- **SomatXR:** The modules are specially developed for use in harsh environments. They provide a wide temperature range and are protected from humidity, dust, shock and vibration.
- **QuantumX:** The ideal measurement instrumentation for development, test bench, service and maintenance being capable of acquiring data in almost all physical quantities.



## nCode DesignLife™

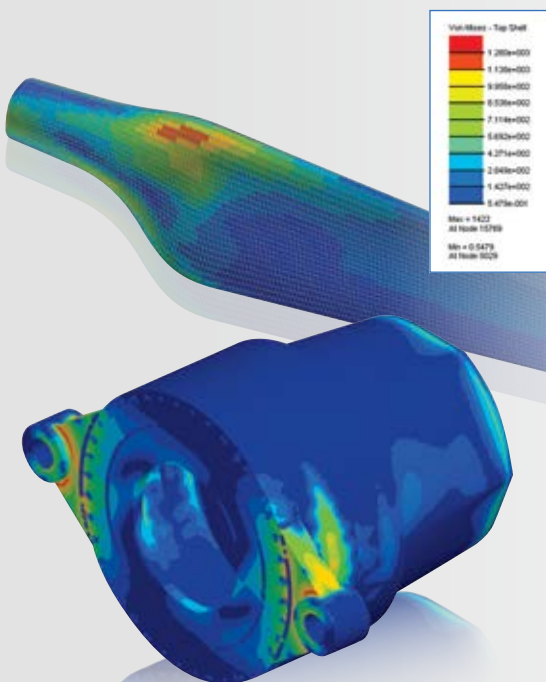
### Life time prediction

HBM nCode software solutions help you understand the key influencing factors that affect the structural integrity and reliability of wind energy facilities. HBM nCode solutions for fatigue and durability enable you to:

- Optimize structures in terms of weight, cost, and service life – based on real and simulated loads.
- Evaluate new designs and compare them to existing structures.
- Monitor and analyze wind turbines during operation to identify potential problems at an early stage.
- Generate and feed back valuable operating information for the design of next generation models.

### Certified by GL

The nCode DesignLife advanced fatigue solver is certified by GL Renewables Certification (GL RC) which assures customers that their component designs, such as wind turbine hubs and main shafts, can be analyzed in conformity with GL Renewables Certification's Guideline for the Certification of Wind Turbines (2010) by choosing the right settings in the software. This includes fatigue analysis under complex real world loading conditions specified in GL RC's guidelines or IEC 61400-1 international standard.





## Condition monitoring and structural health monitoring

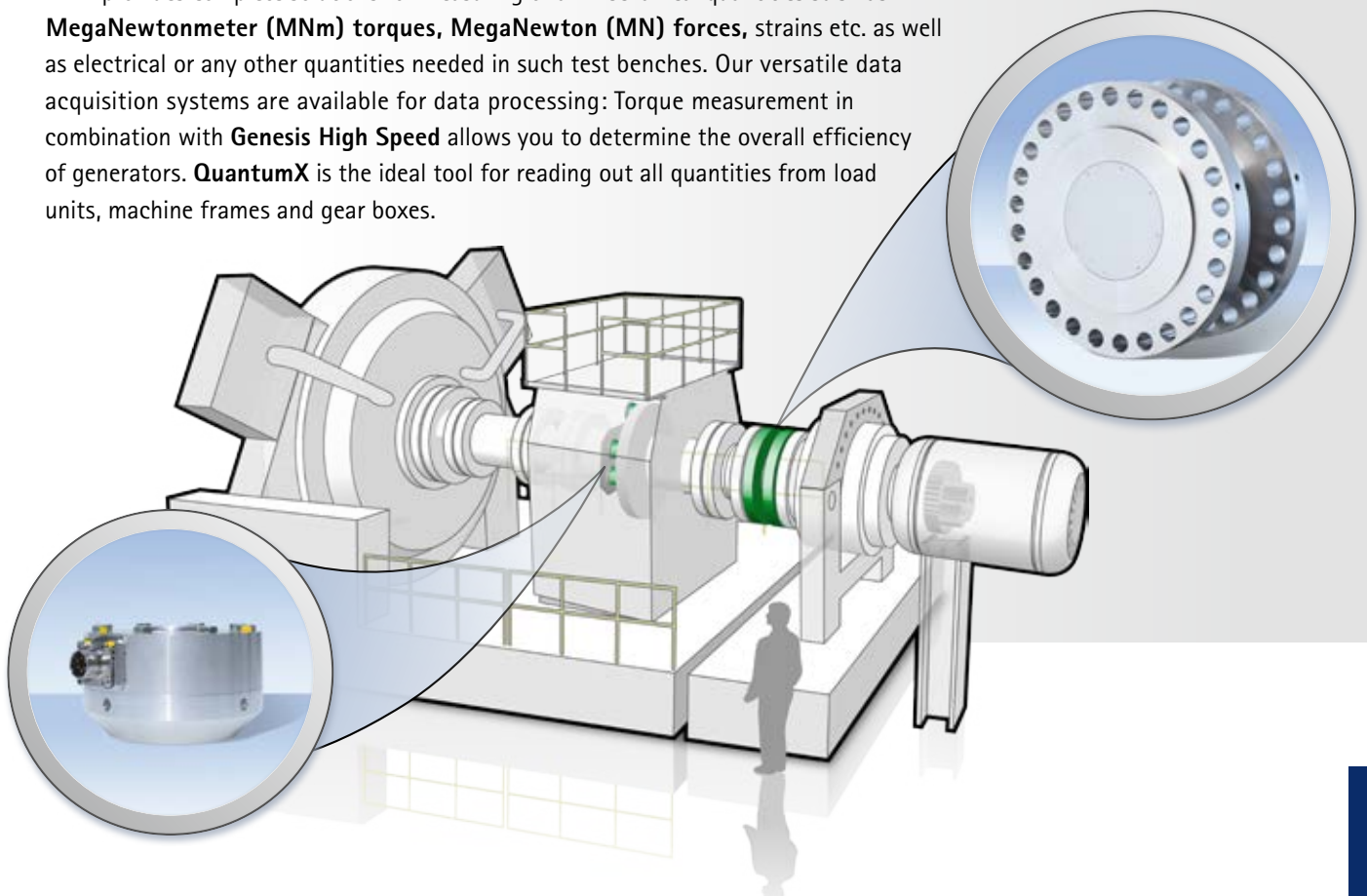
Does the wind turbine run safely and efficiently? Condition Monitoring Systems (CMS) monitor the condition of wind turbines based on measurement results and the corresponding analysis.

- **HBM FiberSensing**, our subsidiary, offers WindMETER, a cost-effective optical system that benefits solutions such as control and monitoring of rotor blades.
- **Brüel & Kjaer Vibro** ([www.bkvibro.com](http://www.bkvibro.com)), our sister company, offers classical condition monitoring on the drive train that enables you to detect faults in the system at an early stage and thus prevent expensive complete failures.
- **nCode Automation** incorporates the mathematical analysis features seen in HBM nCode's test and CAE applications to automatically validate, process and trend measured data from hundreds of installed turbines.



## Complete measurement solutions for test benches including MNm torque and MN force measurement







HBM provides complete solutions for measuring of all mechanical quantities such as **MegaNewtonmeter (MNm) torques**, **MegaNewton (MN) forces**, strains etc. as well as electrical or any other quantities needed in such test benches. Our versatile data acquisition systems are available for data processing: Torque measurement in combination with **Genesis High Speed** allows you to determine the overall efficiency of generators. **QuantumX** is the ideal tool for reading out all quantities from load units, machine frames and gear boxes.



# Product solutions for testing and monitoring

					
<b>SLB</b>	<b>U10, KMR</b>	<b>T10FH, T40FM, T40MAR</b>	<b>Electrical</b>	<b>Optical</b>	<b>SomatXR</b>
<b>Strain transducers</b>	<b>Force transducers</b>	<b>Torque transducers</b>	<b>Strain gauges</b>		
For monitoring strain in statically and dynamically loaded units. The ruggedized SLB700A strain transducer can be attached directly to plane surfaces by a friction joint.	<p>The KMR force washer measures static and dynamic compressive forces.</p> <p>The rotationally symmetric U10 force transducers feature a low-profile measuring body and individual electrical bending moment compensation.</p>	Digital torque transducers with high capacity (T10FH, T40FM) as well as customized transducers with MNm range (T40MAR)	Electrical strain gauges measure strain on different materials very precisely	Strain and temperature optical sensors, available in combinations of different parameters in a single chain	The SomatXR data acquisition system with web interface is specially developed for use in harsh environments. The modules provide a wide temperature range and are protected from humidity, dust, shock and vibration
<b>Component test</b>	<b>Component test (KMR)</b>	<b>Component test</b>	<b>Structural test</b>	<b>Structural test</b>	<b>Structural test</b>
Monitoring of stress states, e.g. on towers, foundations, nacelles and hubs during operation to increase the reliability of the entire system	<ul style="list-style-type: none"> <li>Monitoring of critical annular flange connections</li> <li>Creating load histories</li> </ul> <p><b>Test bench applications (U10)</b></p> <p>Multiple uses focusing on test bench applications:</p> <ul style="list-style-type: none"> <li>Tensile and compressive forces</li> <li>Flange or foot adapter version</li> <li>TEDS option available</li> <li>100 % or 200 % calibration</li> </ul>	<ul style="list-style-type: none"> <li>Transmission test rigs</li> <li>Tests for determining generator efficiency</li> <li>Determination of the generators' overall efficiency in combination with the Genesis High Speed data acquisition system</li> </ul>	<ul style="list-style-type: none"> <li>Measurements on the surface of different components</li> <li>Special versions for underwater measurements</li> <li>Special version weld-on strain gauges</li> </ul>	<ul style="list-style-type: none"> <li>For underwater measurements</li> <li>At high load cycles</li> <li>When resistance against lightning is required</li> <li>On blades, towers and foundations</li> </ul>	Structural testing and monitoring in harsh environments, transmission of measured values via WLAN, access to the measurement data everywhere and at any time

HBM offers solutions for every level of wind turbines' product life cycle. Be it component tests or monitoring of wind turbines – the products guarantee precise measurement results, from sensor to software.

					
<b>QuantumX</b>	<b>Genesis High Speed</b>	<b>PMX</b>	<b>WindMETER</b>	<b>nCode DesignLife</b>	<b>nCode Automation</b>
<b>Data acquisition systems</b>			<b>Optical interrogator</b>	<b>Software</b>	
For reliable data acquisition of signals from different measurement quantities and sensor technologies	Transient recorder, data acquisition system and data recorder for electrical and mechanical parameters with highest sample rates	The measurement and automation system PMX acquires various measurement quantities with a high sample rate and enables real-time communication via Industrial Ethernet	WindMETER can be used to implement solutions for pitch control, condition monitoring, load assessment, blade design validation and ice detection	Advanced fatigue solver utilizes finite element results to predict fatigue damage of key components such as gearboxes, hubs, shaft and frame	Web-based data management system helps determine what loads a wind turbine encounters in real time
<b>Structural test / Component test</b>	<b>Component test</b>	<b>Operational monitoring</b>	<b>Blade monitoring</b>	<b>Fatigue analysis</b>	<b>Data management</b>
<ul style="list-style-type: none"> <li>Functional and performance testing of generators or rotor blades</li> <li>Structural and component tests in the field, including transmission of measured values via WLAN</li> </ul>	<ul style="list-style-type: none"> <li>Electrical testing of high-voltage components</li> <li>Determination of the generators' overall efficiency in combination with HBM torque transducers</li> <li>Inverter certification according to EN61400-21:2008 Wind turbines – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines.</li> </ul>	<ul style="list-style-type: none"> <li>Suitable for collecting different data</li> <li>Versatile field-bus connection</li> </ul>	<ul style="list-style-type: none"> <li>Prepared to perform under harsh environmental conditions, due to its NEMA4X stainless steel enclosure</li> <li>Ideal for simultaneous acquisition of tens of sensors up to 100 S/s</li> <li>Operates over extended temperature range</li> </ul>	<ul style="list-style-type: none"> <li>Identify when and where failure could occur</li> <li>Directly correlate between FE and test data</li> <li>Certified under GL Renewables Certification for the Certification of Wind Turbines (2010)</li> </ul>	<ul style="list-style-type: none"> <li>Understand usage severity by automatically validating and characterizing measured data</li> <li>Collaborate by using secure data access from anywhere in the world</li> </ul>

[www.hbm.com](http://www.hbm.com)

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measure and predict with confidence

