

Encoders and sensors for wind turbines

Smart solutions for every environment



Baumer

Passion for Sensors



One-stop sensor solutions for wind turbines.

Pioneering reliable sensor technology

The Baumer Group has pioneered sensor technology and set new benchmarks, both in rugged design and performance. We anticipate our customers' needs and continuously add on our portfolio by innovative, market-oriented products. Our customers benefit from cross-technology synergies and profound industry application expertise. Powered by innovation, trend-setting concepts and sophisticated technologies, the Baumer engineers elaborate on robust and reliable solutions to boost turbine efficiency and system availability by intelligent encoder and sensor deployment. Benefit from the Baumer expert know-how, challenge our engineers and tell us what you need!

The close cooperation with our customers, together with own research, development and engineering has brought up leading technologies. We have also pioneered the miniature design. We specialize in building ever more dependable sensors – to us, innovation is an investment in partnership.

Precision and quality

We are relentlessly committed to quality. Our products master the application task with utmost reliability and precision. Exceptionally high quality standards are behind development and manufacture. The principles of Lean Management combined with the Six Sigma methodology for fail-safe process reliability which is the key prerequisite for continued striving for improvement. Baumer solutions have proved long-term high added value not only in wind power but also other industrial scenarios like port installations, logistics, mining, medical technology and mechanical engineering.



Contents.

Encoder for pitch and yaw systems	4
Speed feedback at the rotor shaft	6
Speed feedback at the generator shaft	8
Speed and position feedback at the slip ring	10
Tower vibration and shocks safely measured and monitored	12
Measuring rotor and tower stress, pressure and temperature	14
Monitoring levels, leakage, air gap and brakes	16
Robust sensors for offshore wind parks	18



Learn more.
Downloadable data sheets and more information
about our products is available at:
www.baumer.com/wind



Leading in absolute encoders.



1

Position and speed feedback at pitch motors (Series GM400)

- Absolute SSI multiturn encoder with diagnostics for preventive maintenance
- Absolute immunity against magnetic fields by all-optical sensing
- Precise speed control thanks to additional incremental signals with up to 2048 ppr SinCos, TTL or HTL
- Cold climate capabilities down to -40°C



1

Position detection at the blade's toothed wheel (Series GM400 with bearing flange)

- Absolute SSI multiturn encoder with bearing flange for particularly high shaft load
- Leading for 20 years ever more perfected for wind turbines
- Reliable and robust, gearless
- Cold climate design down to -40°C



2

Position feedback at the rotary limit switch (Series GXM2S)

- Absolute SSI multiturn encoder with hollow shaft for low-tolerance attachment to limit switches
- Precise optical sensing
- Cold climate design down to -40°C



2

Rotary limit switch integrated position feedback (Series BMMV 30R)

- Absolute SS multiturn encoder to be integrated into the limit switch
- Robust magnetic sensing
- Safe ShaftLock design allows for high shaft load
- Cold climate capabilities down to -40°C
- Compact size 30 mm



Encoders for pitch and yaw systems.

More than 20 years of collaboration with engineering offices, OEMs and component manufacturers have brought forth encoders with wind power-specific key attributes like sophisticated diagnostics for preventive maintenance and products with preset button for quick and easy commissioning. These encoders are also available with an extended temperature range down to -40°C and as offshore product variant.

1 Encoders for pitch control systems

Reputed vendors rely on the precise Baumer encoders for speed and position feedback at the pitch motor and on durable encoders for precise blade positioning straight at the blade's toothed wheel without backlash. The position information can be compared by the master control to increase the degree of diagnostic coverage and simplify implementation of the stringent safety requirements for pitch systems.

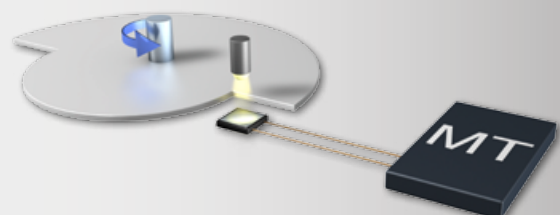
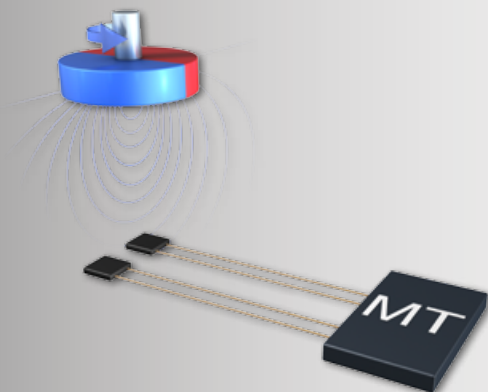
2 Encoders for rotary gear limit switches

Encoders with precise optical sensing are the perfect solution for accurate backlash-free position feedback at rotary limit switches with through-going shaft. For integration, compact encoders in 30 mm design with robust magnetic sensing are the optimum solution. Limit switches are deployed both in pitch and yaw systems.

The future is touchless

Magnetic and optical Touchless Multiturn technologies count the turns in a non-contact and gearless manner and hence free from wear. Forgoing any mechanical switching components allows for easy and efficient implementation of early diagnostics for quick error tracking and preventive maintenance.

- The optical principle utilizes pulse-triggered LEDs, photo diodes and an interruptor disc to count the number of turns. Detection and counting is that fast and energy-efficient that a turbine's expected 25-year service life will be easily endured.
- In magnetic multiturn sensing, a permanent magnet and Hall sensors take the place of LEDs and photodiode.

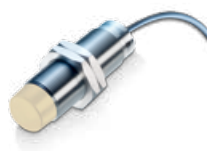


Revolutionary precision at large shafts.



Your encoder application all wrapped up (Series *HDmag flex*)

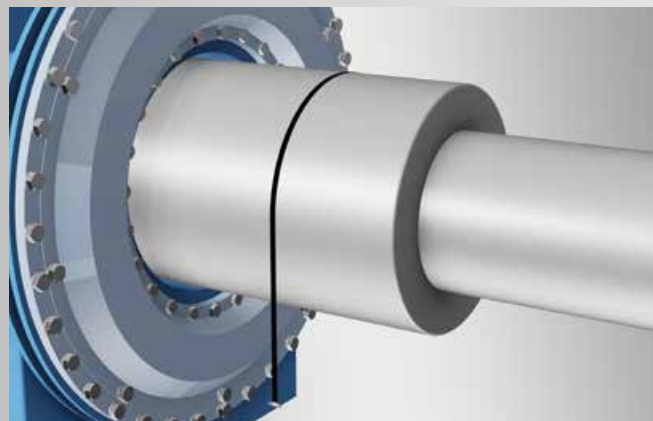
- Shaft Ø 3000 mm and more
- Durable and wear-free
- Incremental or quasi-absolute
- Easy transport
- Easy installation, no available shaft end required
- Ultimately high resolution and precision for slowly turning shafts



Robust inductive sensors for speed detection (Series *IFRR*)

- Robust and absolutely reliable, MTTF > 100 years
- *proTect+*, impermeability tested and approved even at frequent temperature fluctuations
- Easy, quick and flexible mounting capabilities thanks to high switching distance up to 12 mm

Installed in no time at all.



The adjustable magnetic strap is buckled like a belt on the drive or generator shaft and thus allows to work with even the largest diameters.

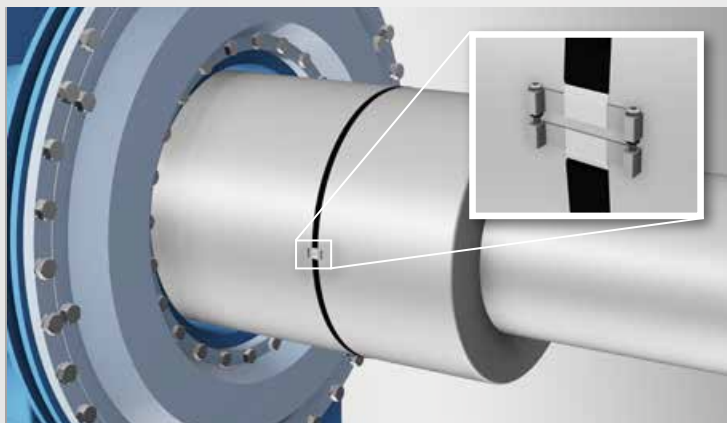


Precise speed feedback at the rotor shaft.

World innovation *HDmag flex* is the optimal solution for large shafts since speed and position are directly acquired at the shaft. The signals by *HDmag flex* are the basis for speed and position monitoring as well as rotor shaft positioning. At a 1000 mm shaft, the exact position information is supplied with an accuracy of $\pm 0.02^\circ$.

Integrated real-time signal processing supplies the selected position and speed resolution at all times, at any shaft diameter, regardless lock gap and operating tolerances. The bearingless encoder with non-contact sensing is virtually free from wear.

The magnetic belt encoder is quickly attached to the shaft without any mechanical modifications. The belt with magnetic encoding is simply buckled on the shaft and secured by lock.



The lock is firmly welded to the magnetic belt for maximum tractive force, holding the belt securely on the shaft.



The sensing head offers a superior resolution despite high mechanical tolerances for displacement.

Precise speed feedback at the generator shaft.

As a result of more than 20 years of experience in wind power, Baumer encoders will meet any of the ever-increasing demands of this industry. We have continuously perfected our HeavyDuty encoders in close collaboration with generator manufacturers. Extremely robust, the encoders are designed to endure the maximum expected 25 year service life of a wind turbine.

All encoder functionalities come under the integrated function monitoring EMS (Enhanced Monitoring System) which is also an installation aid to signal correct encoder wiring and proper interface activity. Robust, insulated bearings or extremely durable hybrid bearings prevent the bearing from damage by induced shaft currents. The lightning discharge path between shaft and housing avoids electrostatic charge and lightning damage.



Tough where it's rough, precise in performance.

Former Hübner Berlin company, now Baumer Hübner, is the Baumer Group Competence Center for HeavyDuty sensors in drive engineering. The brand defines new international benchmarks for reliable encoders, tacho generators and speed switches with HeavyDuty technology. Our unrivalled robust products merge long-year expertise with cutting edge technology and are perfectly tailored to demanding applications.

HÜBNER
BERLIN
A Baumer Brand



No. 1 in HeavyDuty.



The leading encoder for generators (Series HOG 86)

- Extremely durable and robust in harsh environments
- Up to 5000 ppr
- Top signal quality up to 500 m transmission length (TTL)
- Quick commissioning and reduced downtime by integrated EMS function monitoring



Redundant HeavyDuty encoder (Series HOG 86 M)

- Redundant acquisition of position and speed
- Two sensing systems with galvanic isolation
- Independent signal outputs
- Flexible mounting capabilities by two swivel terminal boxes
- Optional with double integrated function monitoring EMS.
- Separate signal evaluation for better error identification



Uncompromising durability (Series *HDmag*)

- Wear-free by non-contact sensing
- Incremental or absolute
- Reliable operation due to wide air gap
- Space-saving design
- Easy installation



Standard encoder with hybrid bearings (Series *OptoPulse* EIL580)

- Hybrid bearings for extended service life and improved resistance to shaft currents
- Resolution max. 5000 ppr
- Blind or through hollow shaft up to 15 mm

Safety with certificate.



Absolute encoder with digital, high-resolution speed information (Series GBA2W)

- Absolute position SSI
- High-resolution speed signal via SSI



SIL2/PLd certified encoder with sine signals (Series ITD22H0 SIL)

- SIL2/PLd certified speed detection by incremental signals SinCos
- Up to 2048 sine periods per turn
- Space-saving design due to through-hollow shaft and tangential cable outlet



SIL2 certified encoder with rectangular signals (Series GI357)

- SIL2 certified speed detection by incremental signals HTL or TTL
- Up to 5000 ppr
- Reliable ShaftLock design allows for high shaft loads



Absolute encoder with SSI and incremental signals (Series GA240)

- Efficient speed and position feedback
- SSI interface and additional incremental signals (SinCos, TTL or HTL)
- Reliable ShaftLock design allows for high shaft loads



Speed and position feedback at the slip ring.

Maximising yield and availability

Thanks to high-performance signal processing based on FPGA, absolute encoder GBASW provides also a high-precision speed signal besides the absolute position information. Complex algorithms and high-order filters suppress respectively compensate speed signal errors caused by vibration. This way they allow for more rigid pitch regulation and operation closer to the rated speed. At the same time, system availability is improved, since speed measurement without such high-performance may cause a faulty activation of the safety chain due to "excessive rotor speed".

Precise rotor speed monitored simply and safely.

A PLd certified encoder combined with a suitable speed monitor will simplify the safety assessment of an installation, and thus the implementation of the safety function "protection against excessive rotor speed". Safe and certified components cut down overall costs, since redundant sensors and more elaborate cable routing effort are eliminated.



PLd certified encoder



Speed monitor

Less sensors. More safety.



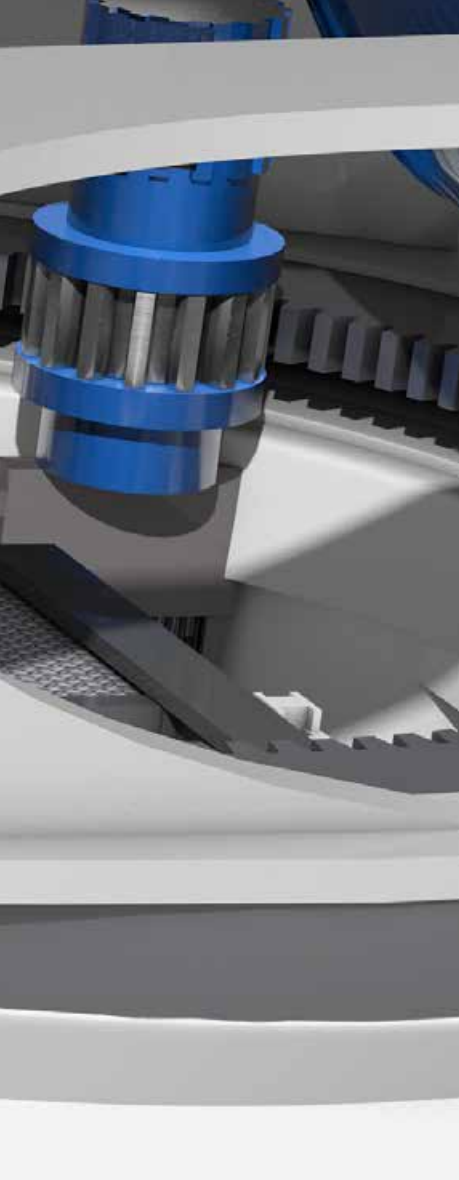
Vibration and shock precisely detected and safely monitored (Series GAM900S)

- Safe detection of vibration and shocks by diverse redundant MEMS sensors
- Safe embedded software with signal processing compliant to IEC 61508-3
- Safe switching output by redundantly implemented relays
- Acceleration output via CANopen or Analog interface
- High resolution $< 0,04 \text{ m/s}^2$
- Individually configurable filters enhance precision while eliminating errors
- Up to 3 additional relay outputs as an option
- Plastic or aluminium housing
- Offshore-capable
- Temperature range $-40 \dots +85^\circ\text{C}$



Precise detection of acceleration (Series GAM900)

- Second GAM900 sensor to acquire nacelle torsion in the system control
- 6 user-configurable frequency bands with versatile filter options
- Convenient configuration using PC software GAM900 Configurator or via CANopen



Monitoring tower vibration and shock.

Less sensors

SIL2/PLd certified acceleration sensor GAM900S precisely acquires and monitors tower vibration and shocks. Redundant relay outputs are triggered as soon as the defined limit is exceeded. This 2-in-1-functionality replaces at the same time dedicated acceleration sensors for vibration measurement and mechanical limit switches. The result: Minimizing cost by fewer components and less effort in cabling and logistics.

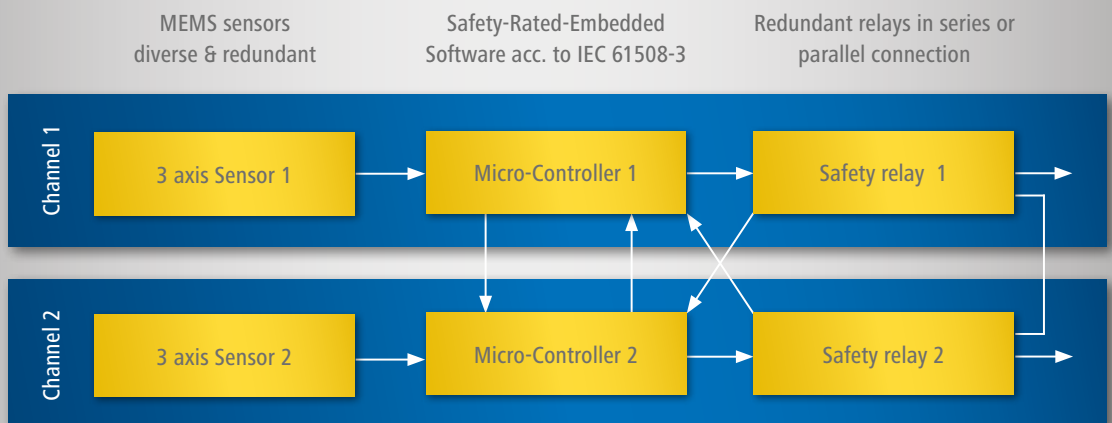
More safety

According to the EC type-examination of the TÜV Rheinland (German Technical Inspection Agency), the monitoring functionality of the GAM900S is fully compliant to safety integrity level SIL2 and PLd, respectively. This will simplify implementation of the safety function "protection against excessive vibration and shocks" while speeding up safety certification of the installation.



GAM900S – Safety with certificate

Safety-Rated-Embedded-Software and 2- channel hardware with EC type-examination.



Detection of blade and tower stress, pressure and temperature.

1 Improving system safety and maximising yield by reliable and fast load measurement

Tower and blades of a wind power station are permanently exposed to strong impacts. Condition monitoring by Baumer strain sensors, vision systems or *AlphaProx* inductive sensors is a robust long-term solution for predictive maintenance cycles to maximize power production while minimising downtime.

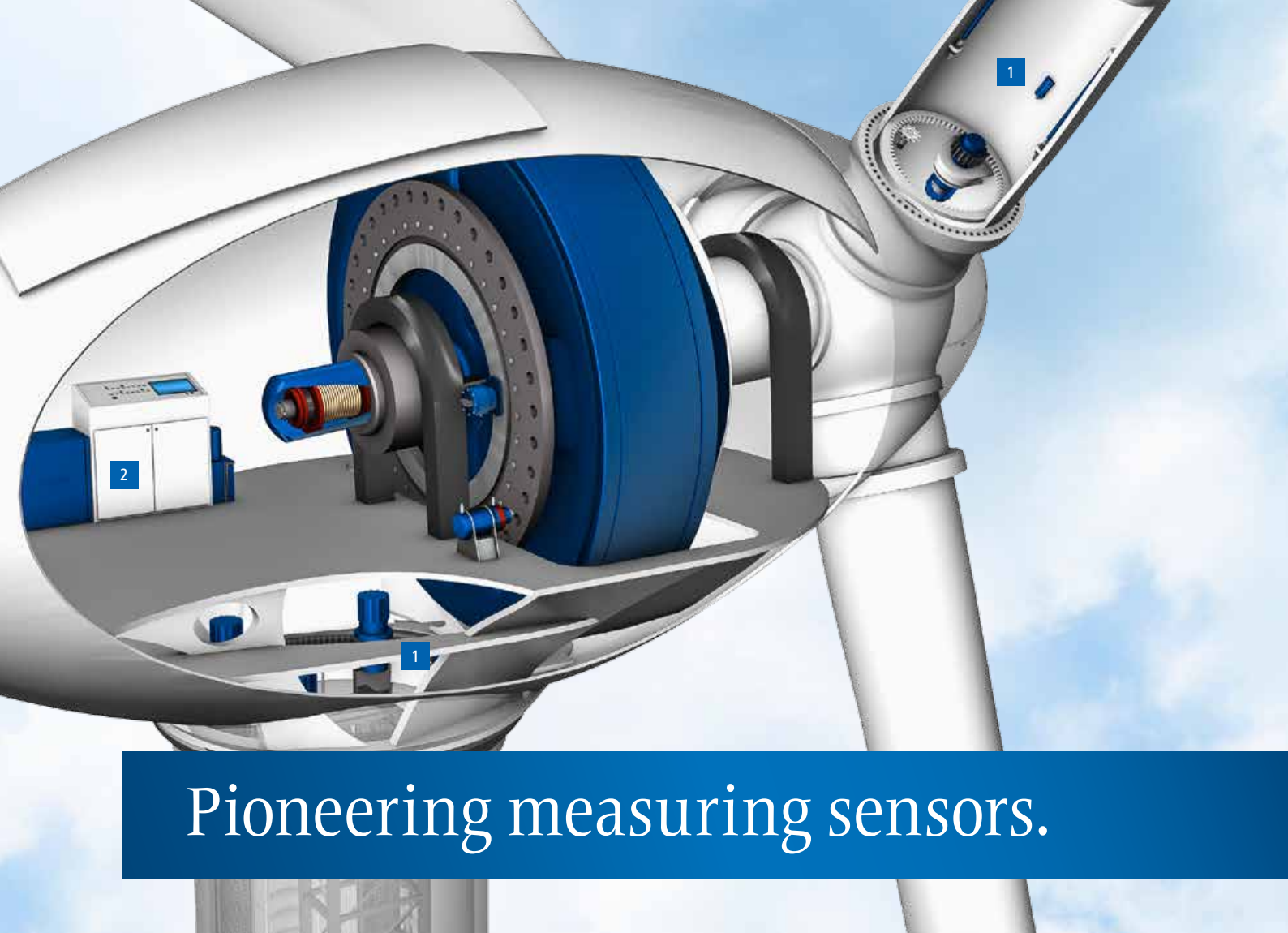
2 Precise acquisition of pressure and temperature in gearing and hydraulic components

Temperature sensors reliably monitor gearbox, gear oil cooling and circulation in the nacelle at high temperature stability. The sophisticated modular architecture of the Baumer products provides ultimate flexibility to meet the customer-specific requirements. High-precision and overpressure-proof Baumer sensors monitor the condition of hydraulic components.



1 New vision system for high-precision blade Monitoring (Series ZHDM)

- Precise detection of the blade bending stress for individual pitch alignment
- Early identification of structural damage and icing
- Unique acquisition technique, inward the blade without electrical cabling



Pioneering measuring sensors.



1

Robust strain sensor on DMS basis (Series DSRT)

- DMS technology for long-term dependable and robust blade stress measurement
- High reproducibility
- Integrated electronics
- Overload protection by wind load measurement
- Add-on sensor for CMS systems



1

Inductive sensors *AlphaProx* with extended temperature range (Series IWRR)

- Immediate reaction to any load change by short response time of <2 ms
- Easy and quick installation thanks to high measuring distance up to 7 mm
- Smart product design in stainless steel housing (V4A)
- Corrosion proof compliant to C5M



2

Measuring hydraulic pressure in extreme environments (Series PB)

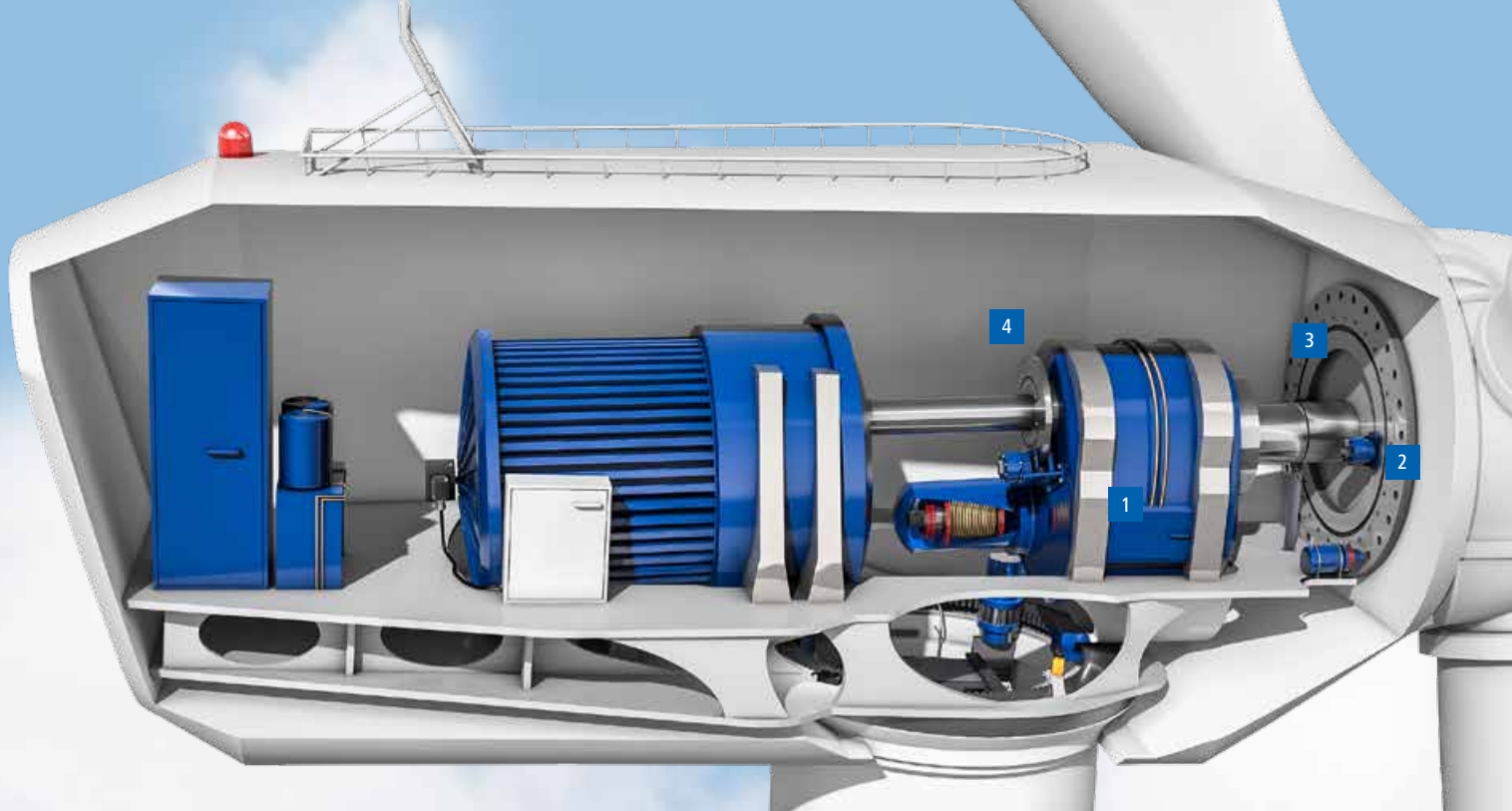
- Excellent long-term stability
- Extremely precise output of the measured value within a wide temperature range
- Very robust thanks to fully welded design without any seal
- 100 mbar to 1600 bar



2

Precise measurement of gear oil temperature (Series TE2)

- Field-tested and durable
- High signal output accuracy thanks to quickly responding sensor tip
- Easy installation by DIN or M12 connector



Setting benchmarks in reliability and robustness.



1

Leakage monitoring Optical sensor (Series FODK)

- Early leakage identification, 1 ml liquid will suffice
- Clever mounting clip made of PFA or PVC enables quick sensor attachment without tools
- Integrated fail-safe behavior, e.g. for broken wire identification



1

Detection of gear oil level *CleverLevel* switch (Series LBFS)

- Safe operation by reproducible switching point
- Detection of any liquid
- Wear-free, robust design
- Quick and easy installation



1

Gear oil level monitoring by capacitive sensors (Series CFAK)

- Easy and quick installation directly in the oil sump
- Robust design resistant to gear oils with IP67 protection
- Different housing variants provide the ever matching solution for any installation scenario



2

Detection of piston position by high-pressure proof inductive sensors (Series IFRP)

- For use under extreme conditions up to a pressure of 500 bar
- Absolute durability by the stainless steel housing and active surface of zirconium oxide
- Robust product design with IP68 protection, resistant against hydraulic oils



Dependable monitoring of liquid levels, leakage, air gap and brakes.

1 Process safety enhanced by level and leakage monitoring
Liquid level sensors are directly installed at gearbox or oil sump. Robust leakage sensors installed below the oil sump will identify even tiniest amounts of liquid.

2 Monitoring limit positions in hydraulic pitch systems and locking cylinders
High-pressure and temperature-proof inductive sensors will reliably identify the piston position in the locking cylinder as well as limit positions in hydraulic pitch systems.

3 More efficiency and safety by monitoring the air gap
The tremendous impact on the rotor blades is directly imposed on the hub and hence the drive train's main bearing. In gearless systems, the air gap between rotating shaft and stationary nacelle may be reduced by asymmetrical load. *AlphaProx* inductive sensors monitor air gap tolerances at the critical points as load control.

4 Efficient brake maintenance by continuous, precise pad monitoring
Robust and yet precise inductive sensors monitor the brake pads and will give an early warning when they have to be exchanged. They allow for predictable maintenance cycles and help to ensure system efficiency. Inductive distance sensors with analog interface can be combined with inductive sensors to directly signal the limits.



3 **4**

Inductive sensors *AlphaProx* with
Extended temperature range
(Series IWRR)

- Immediate reaction to changing loads due to short response time of < 2 ms
- Easy and quick installation thanks to high measuring distance up to 7 mm
- Smart product design in stainless steel (V4A)
- Corrosion proof compliant to C5M

The entire offshore portfolio.



Offshore absolute encoder
(Series GM400-C)

- SSI interface
- Wear-free, non-contact multiturn sensing
- Dependable and robust without gears
- Reliable ShaftLock design allows for high shaft loads
- High-end, optimized materials
- Capable of corrosive environments of the C5M category



Offshore incremental encoder
(Series GI355-C)

- Up to 6000 ppr with HTL or TTL interface
- Reliable ShaftLock design allows for high shaft loads
- High-end, optimized materials
- Capable of corrosive environments of the C5M category



Bearingless design for large shafts to Ø 740 mm
(Series *HDmag*)

- Det Norske Veritas (DNV) MHGE certification
- Durable and wear-free thanks to non-contact sensing
- Operational safety by wide air gap
- Space-saving design with shallow installation depth
- Easy and flexible in installation



Offshore encoder, field-proven more than 10 years (Series HOG 131)

- Housing with specific surface protection and special seals
- Integrated lightning protection
- Installation flexibility by terminal box swiveling within 180°
- Extremely durable by hybrid bearings as protection against shaft current



Field-tested offshore solutions.

The Baumer industry leading experience in the development of durable encoders for offshore applications has built over decades. Long before first offshore wind parks went onto the grid, Baumer HeavyDuty encoders had been proving their reliability time and time again at gantry cranes in most important ports worldwide. Since then, we have continuously expanded our portfolio of corrosion-proof encoders, thoroughly tested by exposure to salt spray and condensing humidity for use in C5M environments. Today, leading manufacturers of offshore wind parks rely on the durability of our dependable offshore encoders.

Our inductive sensors feature the specifically developed impermeability concept *proTect+*. To comply with the requirements of corrosion category C5M, they underwent extensive salt spray and humidity testing. Incorporating high-end materials like stainless steel and Teflon as well as high IP 69K protection ensure outstanding resistance in aggressive environments.



Robust inductive sensors for position and speed feedback (Series IFRR)

- Robust and absolutely reliable, MTTF > 100 years
- *proTect+*, impermeability tested and approved even at frequent temperature fluctuations
- Easy, quick and flexible mounting capabilities thanks to high switching distance up to 12 mm
- Capable of corrosive environments of the C5M category

Essential, but not visible.

Offshore capabilities of a sensor are not visible from the outside. The difference is revealed in tests: Baumer offshore encoders have proved corrosion-resistant in many tests, for example after exposure to salt spray according to IEC 60068-2-52, followed by mechanical resistance and functional tests. They are perfectly suited for longterm operation in most aggressive environments of the C5M category.

After the salt spray test:



Non-corrosion proof encoder



Corrosion-proof encoder

Worldwide presence.

The Baumer Group is leading at international level in the development and production of sensor solutions. We strive to be close to our customers all around the world. We listen to them, and then after understanding their needs, we provide the best solution. About 2300 people worldwide in 38 locations and 19 countries are at your service. Worldwide customer service for us starts with on-the-spot personal discussions and qualified consultation. Our application engineers speak your language and strive from the start, through an interactive problem analysis, to offer comprehensive and user-compatible solutions. The worldwide Baumer sales organizations guarantee a high level of readiness to deliver.



Africa

Algeria
Cameroon
Côte d'Ivoire
Egypt
Morocco
Reunion
South Africa

America

Brazil
Canada
Colombia
Mexico
United States
Venezuela

Asia

Bahrain
China
India
Indonesia
Israel
Japan
Kuwait
Malaysia
Oman
Philippines
Qatar
Saudi Arabia
Singapore
South Korea
Taiwan
Thailand
UAE

Europe

Austria
Belgium
Bulgaria
Croatia
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Italy
Malta
Martinique
Netherlands
Norway
Poland
Portugal
Romania
Russia
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Turkey
United Kingdom

Oceania

Australia
New Zealand



For more information
about our worldwide
locations go to:
www.baumer.com/worldwide

 **Baumer**
Passion for Sensors

Baumer Group
International Sales
P.O. Box · Hummelstrasse 17 · CH-8501 Frauenfeld
Phone +41 (0)52 728 1122 · Fax +41 (0)52 728 1144
sales@baumer.com · www.baumer.com