

BALLUFF

Balluff in the Energy Industry
Reliable sensors and measuring systems for high efficiency





Torresol
Energy



With over 50 years of experience, Balluff GmbH is a leading global sensor manufacturer, and among the very best in terms of performance capability. Balluff offers comprehensive system expertise from a single source:

- Electronic and mechanical sensors
- Rotary and linear position sensing
- Identification systems
- Network and connection technology for industrial communication

With its corporate headquarters and development center in Germany, the owner-operated company's over 3000 employees worldwide ensure advanced technology, highest quality and continuous innovation. Balluff ensures maximum customer service by manufacturing and developing locally, such as in China and Brazil. In doing this, we comply with workplace safety regulations and social standards at our German and international locations.

Balluff – at Home in the World of Energy	4
Wind Energy – with the Wind at Its Back	6
Offshore Wind Power – Fighting the Wind and Waves	8
Solar Power Plants – Really Heating Things Up	10
Hydroelectric Power – in the Flow	12
Conventional Power Plants – the Reliable Basis	14
Oil and Gas Extraction – Operating Efficiency Counts	16
Hydraulics – Under High Pressure	18
Regulating and Controlling – Everything Under Control	20
Product Selector	22
Testing and Certification – Inspected Quality	27

Balluff – at Home in the World of Energy

**Energy production needs to be economical,
both today and tomorrow.**

Climate change, demographic trends and the limited availability of fossil fuels demand new, innovative solutions from the energy industry. These considerations demand new, innovative solutions. Whether offshore wind farms or solar energy plants in the desert, the distribution of power generation to a large number of individual systems and the immediate influence of extreme environmental factors place stringent requirements on the quality of the components used.

Balluff provides an important contribution for all areas of energy:

- With products for extracting oil and gas, for conventional energy generation and renewable energy from the wind, sun and water
- With components that feature outstanding safety, durability and reliability
- With a worldwide network made up of technical consulting, sales, after-sales service and spare parts supply
- With an international team specialized in the energy field, and
- With close cooperation with plant engineers, suppliers of subsystems and renowned research and development institutions

Wind power



Wind power generation is booming. In particular, offshore wind farms perform outstandingly well due to the high availability of wind resources and greater societal acceptance. Particularly there, however, the technical requirements for the installed components are especially high due to strong winds and the rough sea.

Solar power plants



Every year more and more efficient solar thermal power plants are going into operation. In order to generate power of up to 100 megawatts, several thousand parabolic reflectors are aligned precisely and track the sun continuously. As these power plants are primarily installed in desert regions, the sensors used must not only have accurate control, but also withstand harsh environmental conditions.



Visions – for energy of the future

Balluff is a partner in developing new energy concepts. We offer highly specialized products which can withstand the often extreme conditions that characterize energy production. And we develop project-specific solutions that are custom tailored to your requirements. With an international team responsible specifically for the energy industry, in contact with research centers and in close cooperation with you, the customer.

Hydroelectric



Hydroelectric power plants are the giants among the electric power plants. In addition to their primary function as an energy supplier, they are gaining in importance as energy accumulators to compensate for fluctuating electricity production from wind and solar power plants. Mastering the immense forces of the water requires reliable closed-loop systems that work with the utmost precision.

Conventional power plants



Despite the fast pace of developments in expanding systems for using regenerative energy sources, oil, gas and coal will continue to play an important role. In some regions, forecasts even predict growth in the use of fossil fuels to generate energy. Stringent requirements for safety standards and cost-effectiveness make the use of specifically designed components absolutely necessary.

Oil/gas extraction



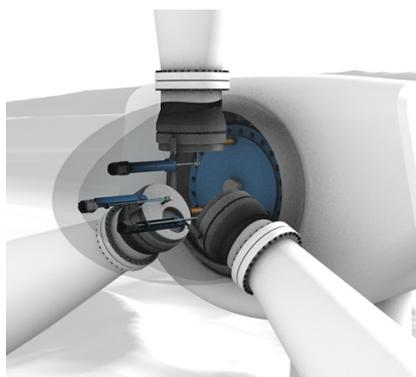
Extracting oil and gas as a preliminary stage for using the fossil fuels for transportation, electricity production and in the chemical industry is becoming increasingly difficult in the face of vanishing resources. Whether using new methods or advancing into increasingly inhospitable regions: the climatic and mechanical loads are high, permitting no compromises in quality or reliability.

Wind Energy – with the Wind at Its Back

**Wind power plants are high-tech power plants with high efficiency.
And the demand is growing dramatically.**

Modern wind power systems are characterized by extremely high efficiency. For example, the plants commonly in use today produce approximately 20 times more electricity than plants 20 years ago. While at the same time reducing costs. Still, wind farms are a large investment that require high availability. This can be attained only if all components are extremely reliable and feature fail-safe performance. To this end Balluff has long been working closely together with leading manufacturers. We offer industry-specific know-how and ensure the highest quality. Specially tailored to your particular requirements.

Greater performance

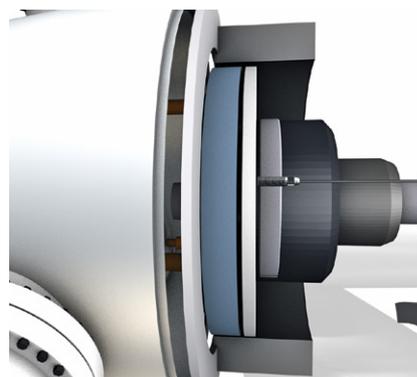


BTL magnetostrictive linear position sensors

Our magnetostrictive position measuring systems have been especially developed for use in the hydraulic cylinders of wind turbines. Using the systems' pitch adjustment, the rotor blade angles can be adapted accurately to the wind speed to maximize power generation and ensure system reliability.

- Contactless = low-maintenance
- Pressure rated to 600 bar
- Vibration and shock-resistant for use in adverse conditions without any problems

Longer service life



BAW inductive distance sensors

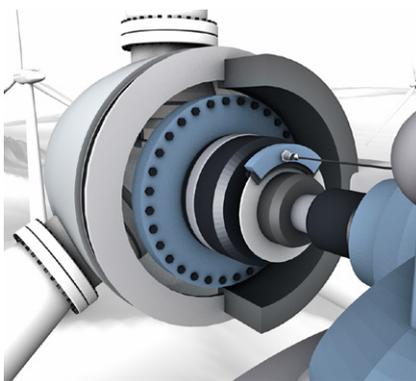
Imbalances and wind loads shorten the service life of the bearings and the drive train. BAW inductive sensors monitor compliance with tolerances at the critical locations (air gaps). Thus they help to reduce loads and thus maximize the service life.

- Non-contacting, wear-free
- Compact design
- Simple installation, large distances



©CHILL/fotolia.com

Better maintenance

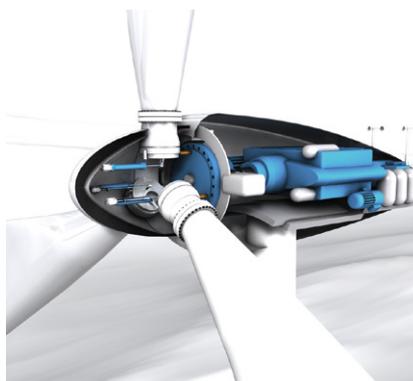


BAW inductive distance sensors

Disk brakes are used at various locations in wind power plants. With their durability and precise measurement, BAW inductive sensors monitor these brake disks continuously and provide a timely warning if the brake linings need to be changed.

- Reliable condition monitoring
- Predictive maintenance

Decreased load

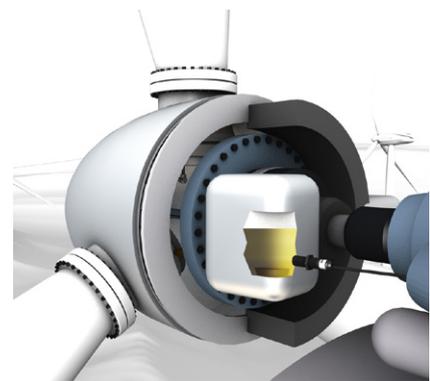


BSI inclination sensors

Particularly during strong gusts of wind, storms or a wind energy plant's start-up phase, a strong tilt of the tower can shorten the overall plant lifetime. BSI Inclination sensors from Balluff measure the absolute inclination angle reliably, preventing limit values from being exceeded and reducing the load on the system.

- Easy to install
- Temperature range $-40...+85^{\circ}\text{C}$
- Rugged metal housing

Reliable monitoring and control



BCS capacitive sensors

Optimum fill levels should always be present in the expansion tanks of the cooling system and of the gearbox and hydraulic system. Our BCS capacitive sensors detect the maximum and minimum fill levels without direct contact – through the container wall or with the help of adapters. They are installed in the oil pan as a leak sensor and reliably report an oil loss there.

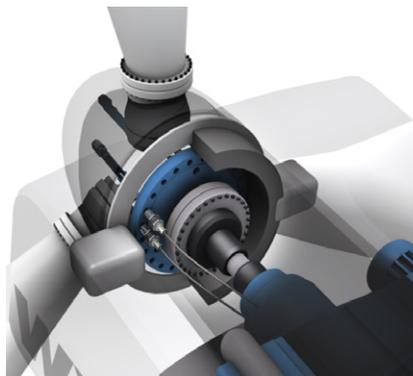
- HALT tested capacitive sensors
- Measure through plastic walls
- Detect oil and water

Offshore Wind Power – Fighting the Wind and Waves

With abundant available space, high acceptance and a large energy yield, offshore wind farms are up and coming.

Favorable inland locations for wind power plants are becoming scarce. Installation of more systems in densely populated areas is also coming under increasing resistance. Therefore, large offshore wind farms are coming increasingly into the spotlight. One reason is that the ocean offers plenty of space for even very large plants; another is that the energy yield is up to percent higher than on land. However, the advantages are offset by even higher requirements for the durability and quality of the wind power plants. Higher wind loads, permanent moisture and the salty air demand the uncompromising use of failsafe components.

High reliability

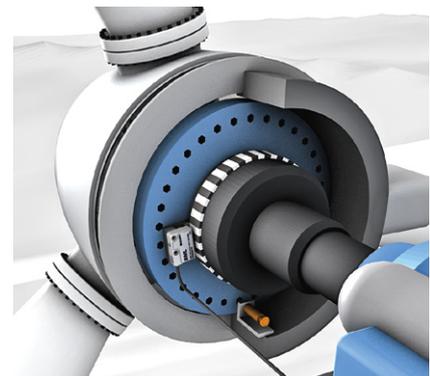


BES inductive sensors

BES inductive sensors from Balluff detect the rotor speed in wind power plants. Extremely reliable, even at temperatures up to -40°C . Two inductive sensors aimed at the locking disk are sufficient for detecting the speed and direction of rotation and protecting the plant from overspeed.

- High switching distance
- Extended temperature range
- Contactless detection
- Insensitive to contamination

Extreme accuracy



BML magnetic encoder

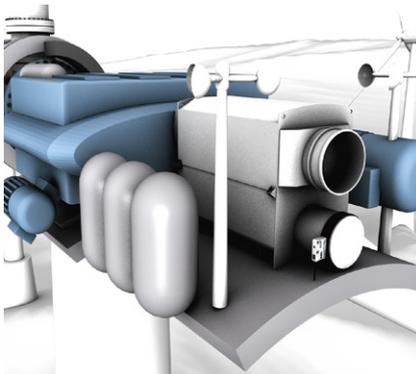
BML magnetically encoded measurement systems are also extremely precise at very slow speeds. They are simply attached to the main shaft. This allows them to not only detect the direction of rotation, but also the correct position for the rotor lock using reference points. All of this is non-contact and thus wear-free.

- Extremely accurate, even at very low speeds
- Non-contact = wear-free
- Approach of positions possible



©Carina Hansen/forolia.com

Optimal control quality

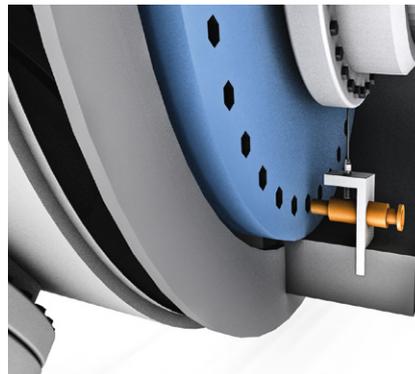


BML magnetic encoder

The generator speed is an important parameter for controlling the plant. Balluff sensors read the poles on the magnet ring without contact and can be used flexibly due to the variety of ring diameters or as band solutions, even on large-diameter shafts. Maximum durability and precision are the outstanding features of the BML measuring systems with magnet ring, which stand for optimal control quality for the power feed.

- Simple, space-saving installation
- Non-contact = maximum service life
- High precision thanks to high resolution

Reliable position determination



BHS high-pressure rated inductive sensors

The wind power plant must be at a standstill and the rotor blades are moved out of the wind for maintenance. The BHS inductive sensors help to reliably determine the piston position of the locking cylinder and the end position of the cylinder for hydraulic pitch systems.

- Pressure rated to 500 bar, can be installed directly
- Stainless steel housing
- Also available in analog version for soft stop

Cost-effective solution



BES inductive sensors

Our BES inductive sensors measure the position directly at the gear ring of the azimuth adjustment and are used (as in speed measurement) for the yaw system. The cost-effective BES sensors are particularly well suited as a redundant addition to the standard rotary encoder solution.

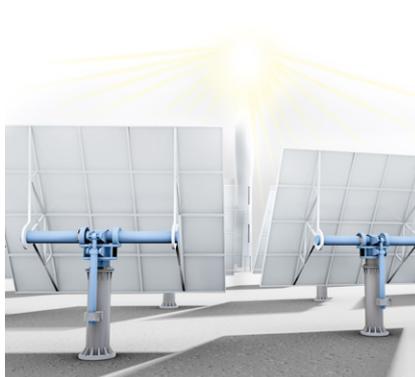
- Rugged, non-contact
- Suitable for wide temperature and humidity fluctuations
- Stainless steel housing
- Shock and vibration resistant

Solar Power Plants – Really Heating Things Up

The sun provides much more energy than the world needs. No other source of energy has as much potential.

Solar-thermal power plants today can deliver power outputs of 100 megawatts or more. To generate this energy, many thousands of mirrors need to be precisely and continuously aligned with the sun. This requires especially precise sensors which can also withstand the extreme environmental conditions found for example in desert regions. We have developed measurement systems with which you can reliably detect these movements and realize efficient plants.

Low wear

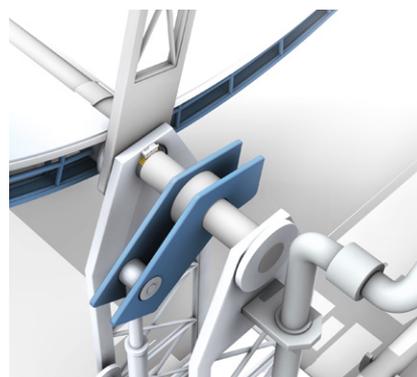


BML magnetic encoder

The positioning accuracy of the heliostats contributes substantially to the efficiency of the overall system. Particularly high demands are therefore placed on the sensors. Our magnetically coded position measurement system is up to the task even in desert regions. It operates contactlessly and is therefore very low-maintenance, thereby helping to prevent downtimes.

- Non-contact, low-wear and low-maintenance
- Cost-effective installation
- High accuracy

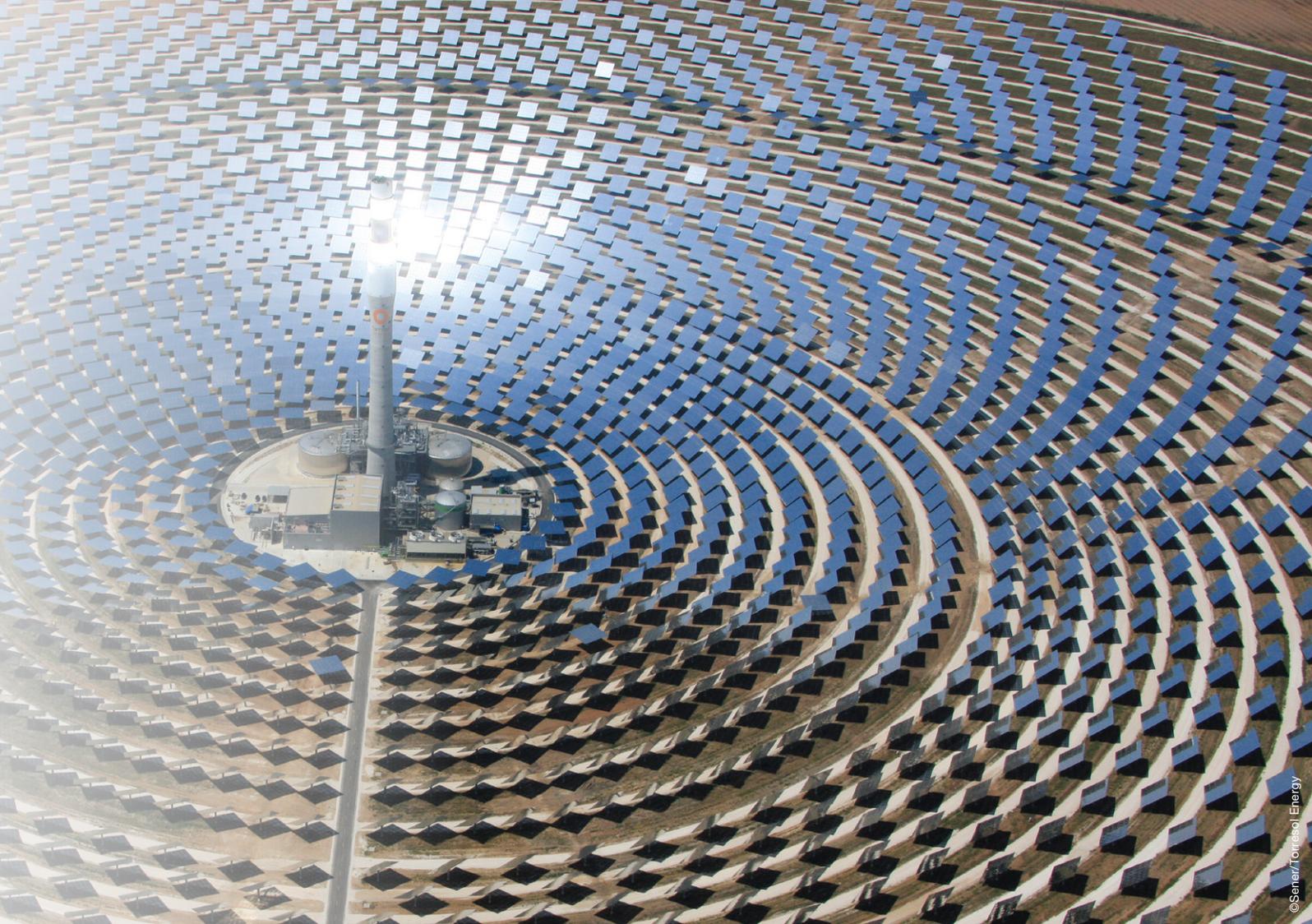
Direct measurement



BML magnetic encoder

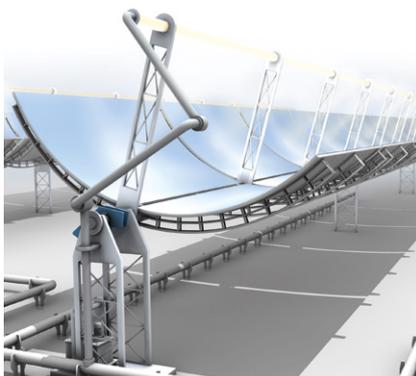
To achieve the highest possible level of efficiency in parabolic trough power plants, all troughs must continuously be adjusted to follow the sun's path. Our magnetically coded position measurement system stands out with its outstanding precision – even under high temperature loads.

- Direct measurement
- Precise position detection
- Determining reference points



©Sener/Torresol Energy

High accuracy

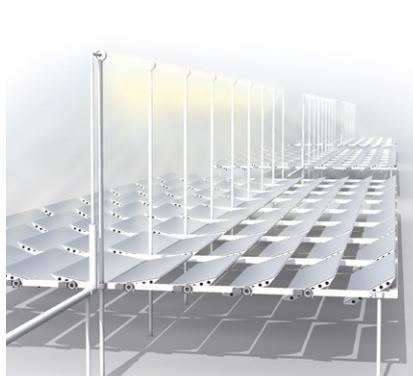


BSI inclination sensors

The required high temperatures can be achieved only by optimum alignment of the parabolic troughs to the position of the sun. BSI absolute inclination sensors ensure precise positioning and thus increase the efficiency of the solar energy system.

- Installation made easy by compact, robust metal housing
- Continuous position detection, even after a power failure
- High accuracy
- No reference run required

Easy to install

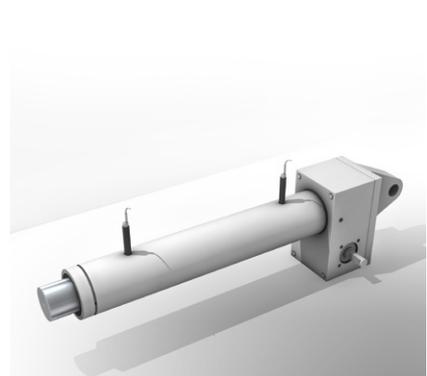


BSI inclination sensors

With Fresnel mirror collectors, the flat mirror strips arranged in parallel reflect the sunlight onto a fixed absorber tube and heat up the water flowing through it. For high efficiency, the BSI inclination sensors enable exact alignment of each individual mirror strip onto the common focal point.

- No reference run required
- High accuracy
- Compact dimensions
- Easy to install

Cost-effective solution



BES inductive sensors

For position detection in linear drives, the BES inductive sensor does not return an absolute position, but only detects the change of position by counting pulses. Inductive sensors are the most cost-effective solution for many position detection applications.

- Extended switching distance
- Extended temperature range

Hydroelectric Power – in the Flow

For over a thousand years, humans have used the power of water. Today, water power is an indispensable component of today's energy mix.

Hydroelectric power is indispensable among renewable energies these days and still harbors plenty of untapped potential. Mastering the immense forces of the water requires reliable closed-loop systems that work with the utmost precision.

Balluff supports and protects advanced turbine and control concepts with high-precision solutions comprising sensors and position measurement systems.



Reliable control

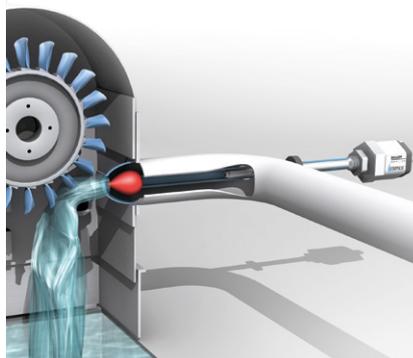


BTL magnetostrictive linear position sensors

For Kaplan turbines to run evenly, the position of the runner and guide vanes is adjusted to respond to needed changes. With our magnetostrictive linear position sensors you control your turbines efficiently and optimize their performance.

- Extremely reliable
- No reference run required after voltage interruption
- Rugged, non-contacting

Especially high reliability

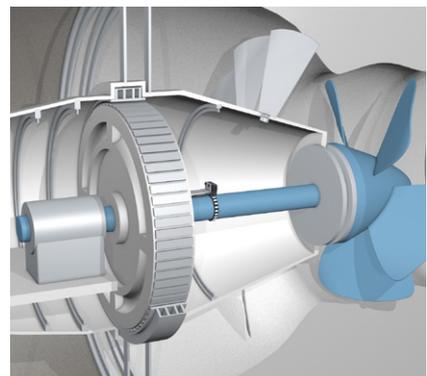


BTL magnetostrictive linear position sensors

In Pelton turbines, the speed of the impeller, and thereby the output produced, is controlled via nozzles in the water jet. At several inlet nozzles there is high pressure of up to 200 bar, which has to be adjusted quickly and evenly. This is done by Balluff's BTL magnetostrictive linear position sensors with high reliability.

- Reliable and rugged
- Compact design

Exact speed



BML magnetic encoder

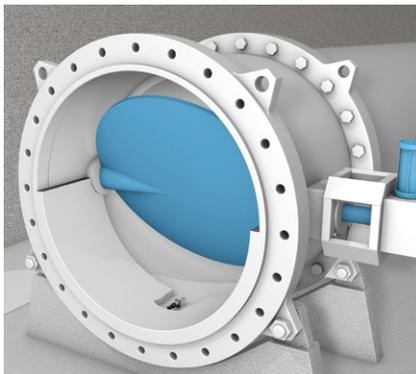
Our magnetically coded position measurement system is also extremely precise at low speeds. This means it provides the exact shaft speed in hydro-turbines. Or can monitor the stopped condition of hydro-dynamic bearings in stand-by mode to prevent damage from insufficient lubrication.

- Exact speed measurement
- Non-contact = wear-free
- Can monitor stop condition



©Stock/menabrea breiter

Reliable closed position

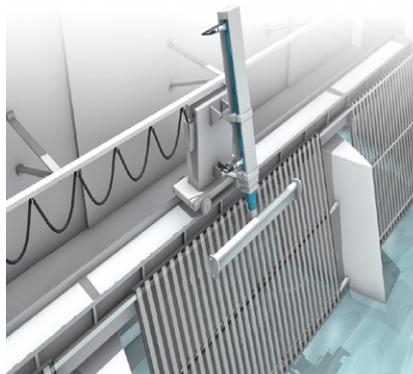


BHS high-pressure rated inductive sensors

Butterfly valves in hydroelectric plants are used to reliably regulate the flow of water. High-pressure rated inductive sensors from Balluff can be installed directly at the sealing edge to verify that the valve is fully closed.

- High pressure rating
- Variety of housing and thread variations
- With cable or connector

High pressure rating



BHS high-pressure rated inductive sensors

Floating debris at the inlet of hydroelectric power plants causes efficiency losses and thus impairs the cost-effectiveness. The worst-case scenario could result in plant downtimes with high costs. With the high-pressure rated BHS inductive sensors, the end positions on the rake can be easily and reliably detected.

- High pressure rating
- Easy to install

Compact design



BSI inclination sensors

Today's requirements on a weir far exceed the mere opening or closing of a gate. In addition to preparing paths directed upstream for fish, fully automatic control of the water level has become standard. Here the BSI inclination sensors reliably enable precise detection of intermediate positions.

- Large temperature range
- Analog output 4 to 20 mA

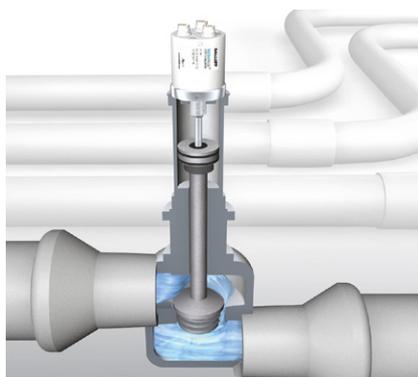
Conventional Power Plants – the Reliable Basis

Oil, coal and gas are still indispensable sources of energy. And they will continue to be so for the foreseeable future.

Efficient and environmentally friendly combustion processes in conventional power plants require turbines and generators that can be controlled with great accuracy. At the same time the efficiency needs to be continually increased while ensuring availability. The requirements for accuracy are extremely high here. Balluff sensors meet them without any problems. Because we have developed our solutions for exactly these applications.

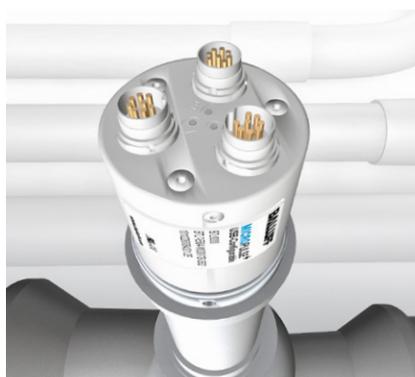


Highest up-time



BTL magnetostrictive linear position sensors

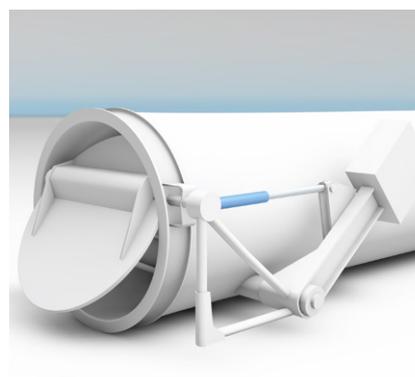
Quick-acting control valves are subject to the highest requirements that often can only be met by a redundant system. We have therefore compactly integrated up to three independent measurement sections and three independent electronics systems in one rod in the BTL 7 magnetostrictive linear position sensor. The robust, non-contact and absolute position measuring system is freely configurable. Another advantage: thanks to its compact dimensions, it can easily replace already installed, non-redundant position measuring systems.



Startpoints and endpoints can be set comfortably with a computer. And parameter-sets are easy to apply. For you, this means that startup is fast and uncomplicated.

- 2 or 3 completely separate systems in one housing = Maximum availability
- With a measuring range of up to 7620 mm, it is also suitable for large valves
- Compact, space-saving housing
- Fast startup
- Non-contact and wear-free
- Monitoring of all channels via LEDs

Exact closure verification



BTL magnetostrictive linear position sensors

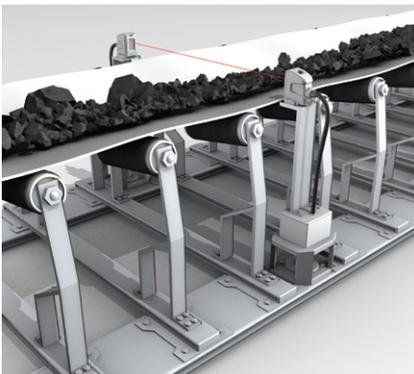
Flaps are used in all areas of power plants to control gases and fumes. Robust hydraulic cylinders with the BTL magnetostrictive linear position sensor reliably open and close the flaps and support safe operation of the power plant.

- Wide temperature range for outdoor use
- Can be installed in the cylinders
- Reliable



©Vattenfall

Reliable conveyor belt monitoring



BOS photoelectric sensors

Harsh conditions are typical for conveyor or belt systems in power plants. Optical sensors in the rugged housing are ideally protected to ensure reliable monitoring of the conveyor belts. As an option they can be fitted with an air nozzle to keep the optics from becoming contaminated.

- Protection from heat, dust, moisture (IP69 K)
- Optional air nozzle for cleaning
- Optional air or water cooling
- Also available as Ex-version

Monitoring coal mills

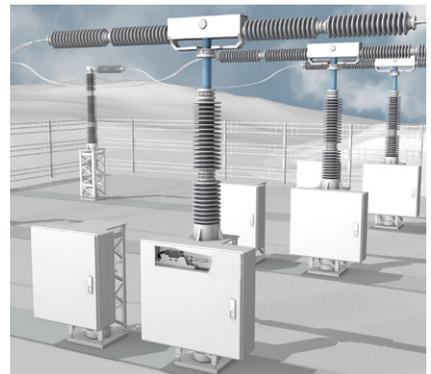


BTL magnetostrictive linear position sensors

In coal mills the rollers are subject to wear or can be damaged by foreign bodies in the actual material. Ensure continuous monitoring of the rollers with the BTL profile style magnetostrictive linear position sensor. This ensure reliable operation of your coal mill.

- Easy to install
- Also simple to retrofit
- Cost-effective solution

Fast switching operations



BML magnetic encoder

When it comes to power switches, it is important to get exact data on the time characteristics of the switching movement: for startup, maintenance work or in-process. Magnetically coded measurement systems handle this reliably. This allows you to detect damage early or even prevent it.

- For high-dynamic processes
- Absolute or incremental versions
- Connection and guide elements available as accessories

Oil and Gas Extraction – Operating Efficiency Counts

The extraction of fossil fuels needs to remain competitive.

Oil and gas still make a critical contribution to the generation of energy. The increasing price pressures demands the use of new, more efficient extraction technology. Only then can energy production from natural resources remain economical. Raw ambient conditions and hard mechanical strains are a tough endurance test for people and material. Balluff makes an important contribution here with robust, precise and low-maintenance sensors. Explosion protection with numerous international certifications is a matter of course for us.

Explosion protection

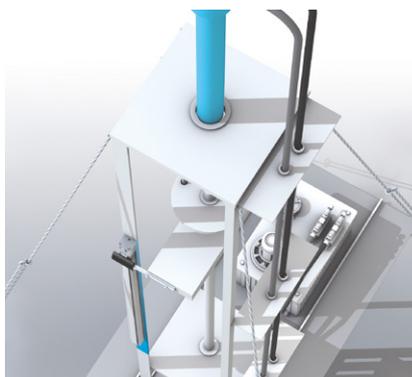


BTL magnetostrictive linear position sensors

Control and shutoff valves are used in many areas of oil and gas extraction, in refineries as well as in petrochemical plants. In addition to high reliability even in very harsh environments, explosion protection in particular has the utmost priority in a hazardous environment. Reliable and safe use is assured using our certified magnetostrictive linear position sensors.

- High reliability
- With IECex, ATEX, NEC 500/505 and additional international approvals

Highly accurate position measurement

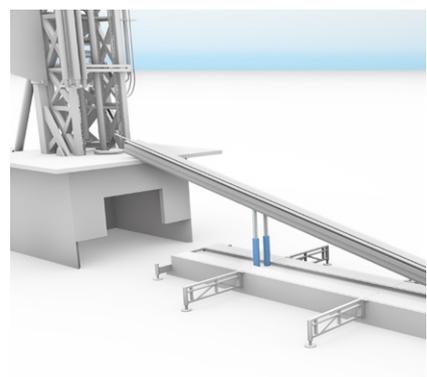


BTL magnetostrictive linear position sensors

After tapping an oil field, discharge pumps do their work entirely autonomously for the most part. Pump parameters are continuously monitored via sensors and, usually, via automated remote systems. Balluff BTL magnetostrictive linear position sensors in the profile housing prove themselves in the difficult application directly on the pump and guarantee reliable monitoring of position and path.

- Robust design
- Exact measurement of path and position

Rapid positioning



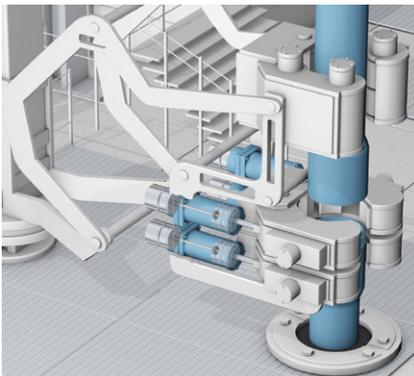
BTL magnetostrictive linear position sensors

Pipe handlers take drill strings out of the magazine and position them directly over the borehole. Quick and efficient drilling is thus ensured. Powerful hydraulics move the heavy rods with ease and bring them directly into place and position. Balluff magnetostrictive linear position sensors are critical for prompt, correct positioning.

- High temperature range
- Long-lasting
- Rugged



Efficient handling



BTL magnetostrictive linear position sensors

Iron roughnecks maximize the efficiency in making up or breaking down pipe. In spite of enormous weights, making up or breaking down the pipes requires very precise movements. Magnetostrictive linear position sensors measure reliably and with absolute exactness. And you will be on the safe side when using the explosion-protected versions.

- For explosion hazard environments
- With IECex, ATEX, NEC500/505 and additional international approvals
- Rugged stainless steel design

Precise drill position



BTL magnetostrictive linear position sensors PF

Always know where the driller is: When searching for a new raw material supplies, soil samples are taken with mobile drillers to confirm potential deposits. BTL magnetostrictive linear position sensors PF ensure reliability for the correct drilling depth.

- Flat design, space-saving for mobile machines
- Robust profile housing
- Wear-free, since it is contact-free with up to 15 mm distance from the position encoder to the transducer

Exact alignment



BSI inclination sensors

To minimize load and wear, discharge pumps have to be aligned exactly over the drill hole. Our BSI inclination sensors are ideal for use in harsh outdoor environments. Thanks to their analog angle values, the pumps can be positioned with extreme precision.

- High IP67 rating – harsh conditions
- Precise, absolute angle measurement
- Compact housing

Hydraulics – Under High Pressure

**Regardless of how energy is generated:
Hydraulic systems always play an important role.**

In power plants, hydraulic systems are used for regulating and controlling numerous processes. The powerful heart of these systems is the hydraulic unit, which generates the required pressure. Equally stringent are the requirements for the sensors: they must be extremely accurate, capable of being integrated, and highly reliable. Sensors from Balluff meet all of these demands with ease and feature an excellent price/performance ratio.

Fast configuration of parameters

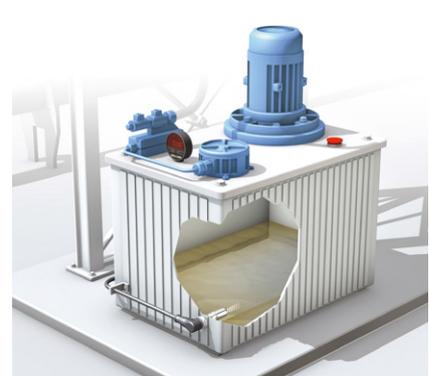


BSP pressure sensors

With their large display and a simple operating concept in accordance with VDMA, Balluff BSP pressure sensors are simple and quick to configure. Since the display and electrical output can be turned into a position independent of the flange, Balluff pressure sensors can be installed flexibly and in a space-saving manner.

- Compact housing design
- Local pressure display
- Binary switching outputs
- Analog output signals – also with IO-Link
- Optionally up to $-40\text{ }^{\circ}\text{C}$

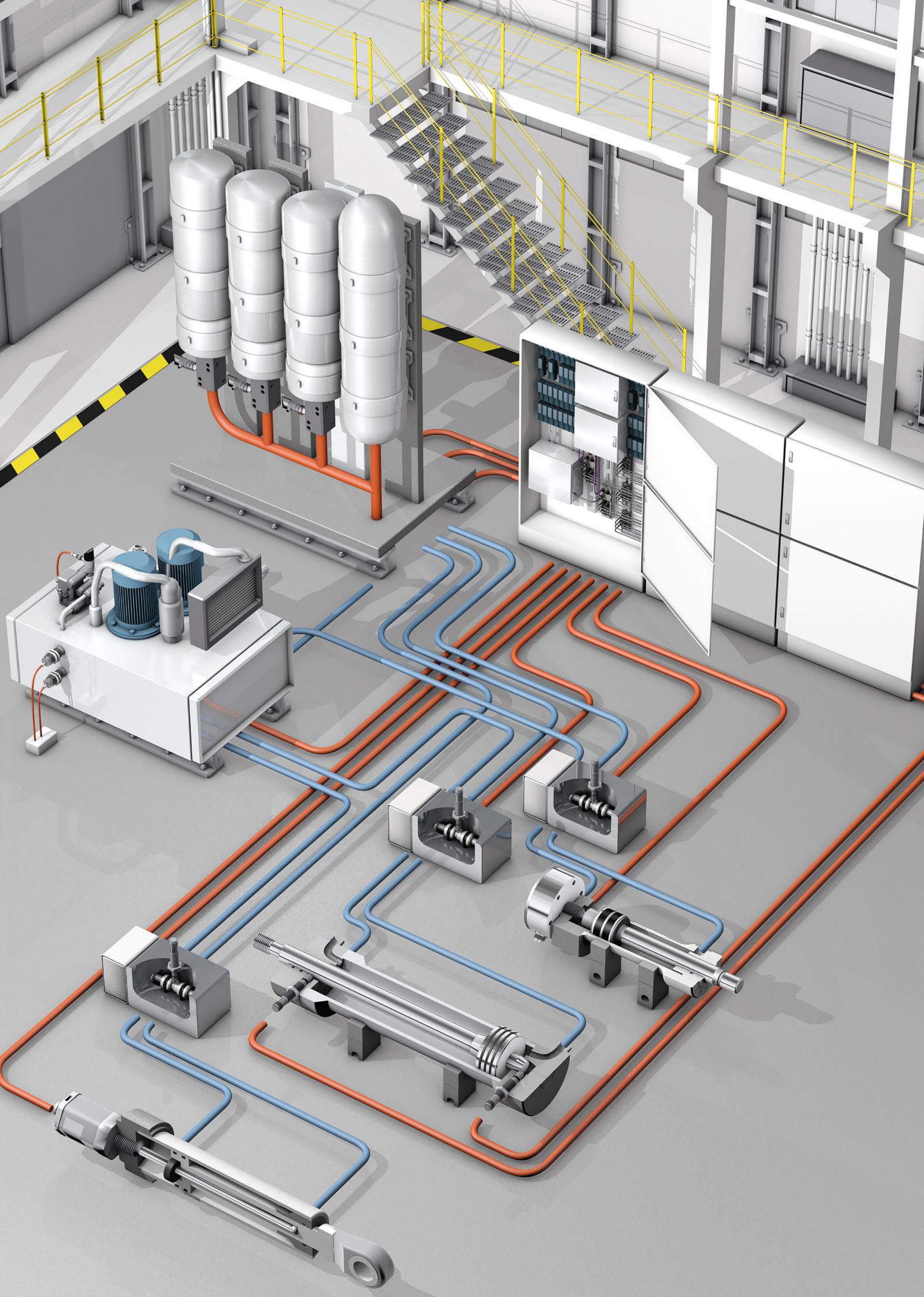
Reliable level measurement



BCS capacitive sensors

A sufficient hydraulic fluid level is prerequisite for interference-free operation of a hydraulic system. Therefore continuous level monitoring plays an important role. The BCS capacitive sensors from Balluff reliably detect the maximum filling level in hydraulic tanks. They reliably report leaks when installed in the oil pan as a leak sensor.

- Reliably record minimum and maximum levels
- Usage in a broad temperature range

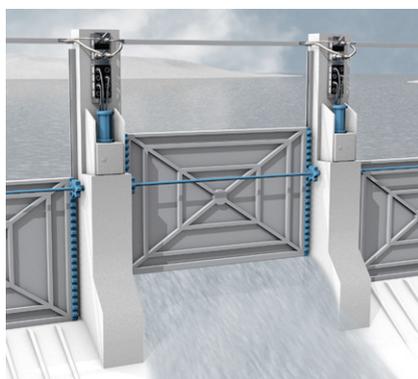


Regulating and Controlling – Everything Under Control

A system is only as good as the technology controlling it. The significance of individual components is often underestimated here.

When we talk about the reliability of plant and control engineering, we often think first of the quality of the large components. Frequently, however, it is the less-noticed components in the background that are responsible for interruptions or even failures. Primarily the power supply, with implications for all system components. Yet cables and electrical connections also play an important role. After all, they transmit the sensor signals and report position and pressure as well as other parameters to the controller.

A single concept for field installation



BNI IO-Link network modules

System building often requires connecting sub-components to the controller over long distances. With IO-Link just one concept is capable of handling field installation for various markets. To adapt the bus system, simply deploy the desired master. The circuit diagrams remain unchanged.

- One fieldbus/IP address for up to 136 I/O signals and diagnostic points
- Digitized analog values instead of analog signals (no shielded cable necessary)
- Control actuators with up to 2 A

More information:
www.balluff.de/io-link

Intelligent network monitoring



Power supply units BAE

A reliable power supply is prerequisite for particularly efficient operation of systems and machines. Heartbeat power supplies from Balluff guarantee a high degree of reliability. LEDs for Load and Stresslevel allow you to immediately determine the performance and estimate the remaining useful life.

- Continuous monitoring of machines and systems
- Easy monitoring via LEDs
- Reliable power supply units guarantee efficient operation
- Optimized use of devices and a longer service life
- Maintenance planning

Secure connection



BCC connectors

Each system is only as good as its weakest component. This also applies to electrical systems. It is often the connections whose significance for signal quality and reliability is underestimated. Here as well, Balluff makes no compromises, but instead pursues the same quality demands for plug connectors and cables as for its sensors and components.

- The right cable for each sensor
- Up to -40 °C when fixed installed
- Made of PUR or PVC



Product Selector

Suitable sensors for every application. Based on the energy sector and application, the selection table tells you the associated product family and the sample product. At www.balluff.com you can find detailed technical information after entering the product family or sample product.

	Application	Product group	Example product	Temperature range	Functions / interfaces
Wind turbines					
	Measure pitch adjustment	Magnetostrictive linear position sensors	Rod version BTL-...-B-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) output analog 0...10 V, 4...20 mA; SSI, Profinet, EtherCAT, digital pulse Start/Stop Measuring range up to 4000 mm: Output (alternative) IO-Link, CANopen, Profibus
			Rod style BTL-...-E2-...	-40...+85 °C IP67	Measuring range up to 2000 mm: Output (alternative) analog 0...10 V, 4...20 mA; digital pulse Start/Stop
	Detecting imbalance	Inductive distance sensors	BAW002W	-10...+70 °C IP67	M30 × 1.5, measuring range 2...10 mm, output analog 0...10 V
			BAW0051	-40...+80 °C IP68	M12 × 1, measuring range 0.2...3.5 mm (teachable), output analog 4...20 mA
	Monitoring condition of brakes	Inductive distance sensors	BAW002H	-10...+70 °C IP67	M18, measuring range 1...5 mm/ output analog 4...20 mA
			BAW004T	-25...+70 °C IP68	M12 × 1, measuring range 0.2...7 mm (teachable), output analog 4...20 mA
		Inductive sensors	BES03UZ	-40...+85 °C IP68	M12 × 1, switching distance 2 mm, PNP/normally open, flush mountable
			BES01H6		M12 × 1, switching distance 4 mm, PNP/normally open, non-flush mountable
	Monitoring tower tilt	Inclination sensors	BSI0002	-40...+85 °C IP67	-45...+45°, resolution 0.01°, output analog 4...20 mA, low temperature drift (< ±0.01 %/10 K)
	Measuring level	Capacitive sensors	BCS00EL	-40...+85 °C IP67	M18 × 1, switching distance 15 mm, through container wall/switching
	Measuring the speed of the main shaft	Inductive sensors	BES02H0	-40...+85 °C IP68	M18 × 1, switching distance 8 mm, PNP/normally open, flush mountable
			BES02YM	-25...+70 °C IP67	M30 × 1.5, switching distance 22 mm, PNP/normally open, quasi flush mountable
	Monitoring rotor position and speed	Magnetically coded measuring systems	BML-S2E0-...	-20...+80 °C IP67	Read distance 2 mm, speed max. 20 m/s, output HTL, TTL
	Measure generator speed	Magnetically coded measuring systems	BML-S2E0-...	-20...+80 °C IP67	Read distance 2 mm, speed max. 20 m/s, output HTL, TTL
	Detecting the rotor lock position	High-pressure rated inductive sensors	BHS001L	-25...+80 °C IP68	M12 × 1, switching distance 1,5 mm, PNP/normally open, pressure rated to 500 bar, flush mountable
Inductive sensors		BES03W0	-40...+85 °C IP68	M12 × 1, switching distance 4 mm, PNP/normally closed, flush mountable	
Detecting the gondola position	Inductive sensors	BES02F0	-40...+105 °C IP69K	M30 × 1.5, switching distance 10 mm, PNP/normally open, flush mountable	

	Application	Product group	Example product	Temperature range	Functions / interfaces
Solar power plants					
	Adjusting heliostats (biaxial)	Magnetically coded measuring systems	BML-S2B0-...	-20...+85 °C IP67	Read distance 2 mm, system accuracy ±50 µm, output RS422 (level same as operating voltage)
	Positioning parabolic troughs (single-axis)	Magnetically coded measuring systems	BML-S2E0-...	-20...+80 °C IP67	Read distance 2 mm, system accuracy ±100 µm, output RS422 (level same as operating voltage)
	Positioning parabolic troughs (single-axis)	Inclination sensors	BSI0004	-40...+85 °C IP67	0...360°, low temperature drift (< ±0.01 %/K), output analog 4...20 mA
	Adjusting fresnel mirrors	Inclination sensors	BSI0003	-40...+85 °C IP67	0...360°, overall accuracy ±0.15° over the entire temperature range, Modbus output
	Detect end positions	Inductive sensors	BES0068	-25...+70 °C IP68	M12 × 1, switching distance 4 mm, PNP/normally open, flush mountable
	Guiding PV panels (Solar Tracker)	Inclination sensors	BSI001A	-40...+85 °C IP67	-90...+90°, resolution 0.01°, output analog 4...20 mA
Hydroelectric power plants					
	Adjusting the impeller	Magnetostrictive linear position sensors	Rod version BTL-...-B-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA; SSI, Profinet, EtherCAT, digital pulse Start/Stop Measuring range up to 4000 mm: Output (alternative) IO-Link, CANopen, Profibus
	Adjusting the guide vanes	Magnetostrictive linear position sensors	Profile version BTL-...-P-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA; SSI, Profinet, EtherCAT, digital pulse Start/Stop Measuring range up to 4000 mm: Output (alternative) CANopen, Profibus, DeviceNet
	Controlling nozzles (Pelton)	Magnetostrictive linear position sensors	Compact BTL-...-H-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, CANopen, digital pulse Start/Stop
	Monitoring shaft position and speed	Magnetically coded angle measurement systems	BML-S2C...	-20...+80 °C IP67	Read distance 5 mm, speed maximal 10 m/s, output digital A/B signals, HTL
	Monitoring shut-off valves (sealing edge)	High-pressure rated inductive sensors	BHS005U	-25...+90 °C IP68	M12 × 1, switching distance 2.5 mm, PNP/normally open, pressure rated to 500 bar, flush mountable
	Hydraulic steel structures	Magnetostrictive linear position sensors	ProCompact BTL-...-HB-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, digital pulse Start/Stop
	Detecting the rake cleaner position	High-pressure rated inductive sensors	BHS001L	-25...+80 °C IP68	M12 × 1, switching distance 1.5 mm, PNP/normally open, pressure rated to 500 bar, flush mountable
	Measuring the inclination angle on weirs	Inclination sensors	BSI0004	-40...+85 °C IP67	0...360°, low temperature drift (< ± 0.01 %/10 K), output analog 4...20 mA

	Application	Product group	Example product	Temperature range	Functions / interfaces	
Conventional power plants						
	Adjusting control valves	Magnetostrictive linear position sensors	Compact BTL-...-K-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, CANopen, digital pulse Start/Stop	
			BTL-...-NEX-...	-40...+60 °C IP68 with cable IP67 with connector	e.g. for use in explosion hazard areas/Zone 2* Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA; SSI	
			BTL-...-DEXB-...	-40...+80 °C IP68 with cable	e.g. for use in explosion hazard areas/Zone 1* Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, digital pulse Start/Stop	
			BTL-...TB2-...	-40...+85 °C IP67 with connector	2× redundancy Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA	
			BTL-...TB3-...	-40...+85 °C IP67 with connector	3× redundancy Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA	
	Monitoring flaps	Magnetostrictive linear position sensors	Rod version BTL-...-B-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA; SSI, Profinet, EtherCAT, digital pulse Start/Stop Measuring range up to 4000 mm: Output (alternative) IO-Link, CANopen, Profibus	
	Monitoring conveyor belts	Photoelectric sensors	Emitter	BOS016E	-20...+60 °C IP67/IP69K	23.0 × 52.4 × 51.0 mm, red light LED
			Receiver	BOS01FP	-20...+60 °C IP67/IP69K	
		Protective housing (disc material)		BAM029M (PMMA)	-5...+90 °C* IP67	Protection against heat, dust, chemicals and water. Mechanical stability, extended service life, optional air or water cooling, optional air nozzle. e.g. for use in explosion hazard areas/Zone 22* for glass versions.
				BAM029L (glass)	-5...+90 °C* IP67 * (with water cooling +160 °C)	
		Photoelectric sensors	Emitter	BOS01CN	-5...+55 °C IP67/IP69K	28.5 × 62.0 × 80.5 mm, red light LED
			Receiver	BOS01CK	-5...+55 °C IP67/IP69K	
		Protective housing (disc material)		BAM02H4 (PMMA)	-5...+90 °C* IP67	Protection against heat, dust, chemicals and water. Mechanical stability, extended service life, optional air or water cooling, optional air nozzle. e.g. for use in explosion hazard areas/Zone 22* for glass versions.
				BAM029C (glass)	-5...+90 °C* IP67 * (with water cooling +160 °C)	
		Photoelectric sensors	Emitter	BOS0235	-25...+70 °C IP68/IP69K	M18×1, red light LED
Receiver			BOS01KM	-25...+70 °C IP68/IP69K		
Photoelectric sensors	Emitter	BOS0237	-25...+70 °C IP68/IP69K	M18 × 1, infrared (infrared is especially suitable for dirty environments)		
	Receiver	BOS023A	-25...+70 °C IP68/IP69K			

	Application	Product group	Example product	Temperature range	Functions / interfaces
	Monitoring rollers in coal mills	Magnetostrictive linear position sensors	Profile version BTL-...-P-...	-40...+85 °C IP68 with cable IP67 with connector	Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA; SSI, Profinet, EtherCAT, digital pulse Start/Stop Measuring range up to 4000 mm: Output (alternative) CANopen, Profibus, DeviceNet
	Monitoring power switches	Magnetically coded measuring systems	BML-S2B0...	-20...+80 °C IP67	Read distance 2 mm, speed maximum 20 m/s, output digital A/B signals, HTL
Oilgas extraction					
	Monitoring hydraulic drives, e.g. control and check valves, flow pumps	Magnetostrictive linear position sensors	BTL-...DEXC-TA12	IP68	Especially developed for the oil and gas industry, e.g. for use in explosion hazard areas/Zone 1*, Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, digital pulse Start/Stop, Profibus, CANopen
	Monitoring the drilling process	Magnetostrictive linear position sensors	BTL-...-PF-...	-25...+70 °C IP67	Measuring range up to 4572 mm, Output (alternative) analog 0...10 V, 4...20 mA; IO-Link, VARAN
	Measuring drill inclination	Inclination sensors	BSI0002	-40...+85 °C IP67	-45...+45°, resolution 0.01°, low temperature drift (< ±0.01%/10K), output analog 4...20 mA
	Monitoring hydraulic cylinders	Inductive sensors	BHS004K	-25...+70 °C IP68	e.g. for use in explosion hazard areas/Zone 1* (with the appropriate isolating amplifier)
		Isolating amplifiers	FHW004P	-20...+60 °	2-channel
	Monitoring tank systems	Magnetostrictive linear position sensors	BTL-...-DEXA-...	IP67	e.g. for use in explosion hazard areas/Zone 1 (float is Zone 0)* Measuring range up to 7620 mm: Output (alternative) analog 0...10 V, 4...20 mA Measuring range up to 4000 mm: Output (alternative) SSI, digital pulse Start/Stop
Hydraulics					
	Monitoring pressure	Pressure sensors	BSP002N	-40...+85 °C IP67	G1/4", 0...10 bar, 4...20 mA and (+1 × PNP/normally open) also with IO-Link interface
			BSP00A9 (IO-Link)		
			BSP002Y		
			BSP00AJ (IO-Link)		
			BSP0030		
		BSP00AL (IO-Link)	G1/4", 0...250 bar, 4...20 mA (+1 × PNP/normally open) also with IO-Link interface		
		Pressure transmitters	BSP00H1	-40...+85 °C IP67	G1/4", 0...10 bar, 4...20 mA G1/4", 0...10 bar, 1 × PNP and IO-Link interface
			BSP00H5 BSP00PU (IO-Link)		
	BSP00F3 BSP00PW (IO-Link)				
	Monitoring level	Capacitive sensors	BCS006M	-30...+125 °C IP67	R 3/8", PNP/normally open (adjustable switching point), pressure rated to 10 bar
			BCS006H		M18 x 1", PNP/normally open (adjustable switching point), pressure rated to 10 bar

	Application	Product group	Example product	Temperature range	Functions / interfaces
Controller 	Field installation concept	Profibus network modules	BNI005R	-5...+70 °C	Profibus-IO-Link-Master, 8 × M12 ports, 4 × IO-Link-Ports, maximum 16 configurable in-/outputs
			BNI003P	-5...+70 °C	Profibus-IO-Link-Master, 4 × M12 ports, 4 × IO-Link ports, maximum 8 configurable in-/outputs
		Profinet network modules	BNI007M	-5...+70 °C	Profibus-IO-Link-Master, 16 × M12 ports, 16 × IO-Link ports, maximum 32 configurable in-/outputs
			BNI005H	-5...+70 °C	Profibus-IO-Link-Master, 8 × M12 ports, 8 × IO-Link ports, maximum 16 configurable in-/outputs
			BNI0052	-5...+70 °C	Profinet fieldbus block, 8 × M12 ports, maximum 16 configurable in-/outputs
		CC-Link network modules	BNI0040	-5...+70 °C	CC-Link-IO-Link-Master, 8 × M12 ports, 4 × IO-Link ports, maximum 12 configurable in-/outputs
			BNI002A	-5...+70 °C	CC-Link fieldbus block, 8 × M12 ports, maximum 16 configurable in-/outputs
		EtherNet/IP network modules	BNI004A	-5...+70 °C	Ethernet/IP-IO-Link-Master, 8 × M12 ports, 4 × IO-Link-Ports, maximum 16 configurable in-/outputs
			BNI006A	-5...+70 °C	Ethernet/IP-IO-Link-Master, 8 × M12 ports, 8 × IO-Link-Ports, maximum 16 configurable in-/outputs
			BNI004F	-5...+70 °C	Ethernet/IP fieldbus block, 8 × M12 ports, maximum 16 configurable in-/outputs
		IO-Link hubs	BNI007Z	-5...+70 °C	IO-Link hub, plastic, 16 × M12 ports, configurable and expansion port
			BNI0035	-5...+70 °C	IO-Link hub 1.0, zinc die-cast, 16 × M12 ports, configurable and 7/8" supply
		IO-Link analog converters	BNI0042	-5...+70 °C	1 × AI, 0...10 V DC
			BNI0041	-5...+70 °C	1 × AI, 4...20 mA
			BNI004T	-5...+70 °C	1 × AI, Pt100
			BNI004C	-5...+70 °C	1 × AO, 4...20 mA
			BNI004E	-5...+70 °C	1 × AO, 0...10 V DC
		SmartLight	BNI0072	-5...+50 °C	5-segment display, IO-Link interface
			BNI0083	-5...+50 °C	5-segment display with sound, IO-Link interface
			BNI007T	-5...+50 °C	1-segment display, IO-Link interface
	BNI0087		-5...+50 °C	1-segment display with sound, IO-Link interface	
	Safeguarding the power supply	Power supply units	BAE00EN	-40...+80 °C	Heartbeat with predictive maintenance function (Load, Stresslevel and Lifetime)
			BAE00T4	-40...+80 °C	
			BAE00TM (IO-Link)	-40...+80 °C	
	Secure connection	Plug connector		-40...+80 °C (fixed installation)	in PUR or PVC as well as other materials

* For detailed information regarding use in explosion hazard areas, please refer to our homepage, the corresponding product catalogs, data sheets and the associated manuals and guides.

Testing and Certification – Inspected Quality

Safe, low-maintenance, robust – components for power plants have to meet stringent requirements.

At Balluff, high product reliability, low maintenance effort and a long service life are not empty promises, but the result of many years of experience and systematic quality control. As early as the development phase, the sensors are subjected to an accelerated aging process in our in-house testing facility to identify weak points at an early stage. In this HALT (High Accelerated Lifetime) test, a gradual

temperature increase, fast temperature changes and vibration tests simulate the loads to which a sensor is exposed over its entire product life. Numerous certifications such as CE, CCC, UL, cULus and TR (formerly GOST) are proof of the high quality standards at Balluff.

Certifications



IEC IECEx ATEX



In-house testing laboratory



Many years of experience, comprehensive design engineering expertise and high production standards are the prerequisites for first-class products. However, only the use of intensive test methods even during design engineering, as well as during and after production, guarantees compliance with the promised product characteristics. Therefore, Balluff has an in-house testing laboratory that is approved by German accreditation body DAkkS for testing electromagnetic compatibility. Furthermore, shock, sine-wave and noise testing can be carried out, as well as product-specific testing including x-ray analysis and HALT testing.



HALT test



During the HALT (High Accelerated Lifetime) test, modules are subjected to an accelerated aging process. This allows weak points in the product design and manufacturing process to be discovered quickly, with just a few prototypes. In a special chamber, the test objects are subjected to alternating increments of very low and very high temperatures as well as an extreme temperature change. This makes it possible to attain a temperature range of -100 to $+200$ °C with a temperature gradient of up to 70 K/min. This is followed by vibration tests with a maximum load of 50 G until the unit finally reaches its limit and is destroyed. The toughest test procedure is the combination of the temperature and vibration test.

BALLUFF

Headquarters

Balluff GmbH
Schurwaldstrasse 9
73765 Neuhausen a.d.F.
Germany
Phone +49 7158 173-0
Fax +49 7158 5010
balluff@balluff.de



www.balluff.com