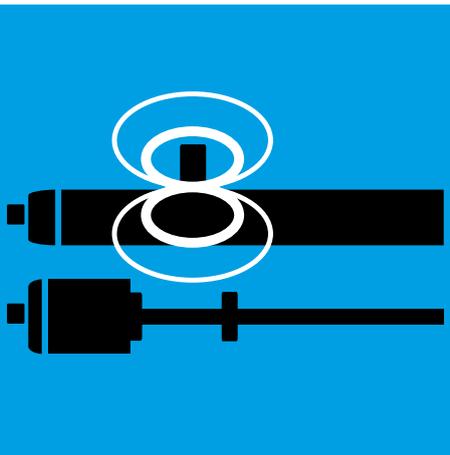


# BALLUFF

sensors worldwide

## The Micropulse<sup>®</sup> Advantage

Linear position sensors that enhance your competitive position



# The **MICROPULSE**<sup>®</sup> Advantage

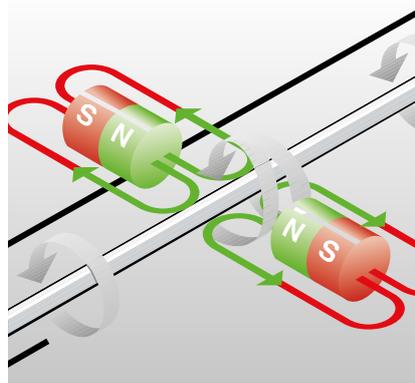
Superior technology, features that matter,  
rigorous testing, global reach



Balluff Micropulse<sup>®</sup> linear position sensors have achieved a worldwide reputation for accuracy, stability, and rock-solid reliability. This doesn't happen by chance. Micropulse sensors are designed from the ground up to exceed expectations in demanding industrial environments. Balluff understands that quality, performance, and reliability are only part of the story. Diverse applications require diverse products with features that enhance usability and improve process efficiency.

- Industry-proven magnetostrictive technology
- Rigorous, uncompromising quality testing
- Usability features that really matter
- Standard and specialty form factors to cover virtually any application requirement
- Balluff's global presence means worldwide support and service
- Industry-leading delivery including unmatched same-day and next-day expediting
- Not just linear position sensing: Balluff's extensive offerings of industrial sensors and systems provide complete solutions

## Enhanced Magnetostrictive Technology (EMT)



Balluff Micropulse linear position sensors take industry-proven magnetostrictive technology to new levels to provide unparalleled performance in industrial applications. Balluff's EMT technology lives at the core of every Micropulse linear position sensor.

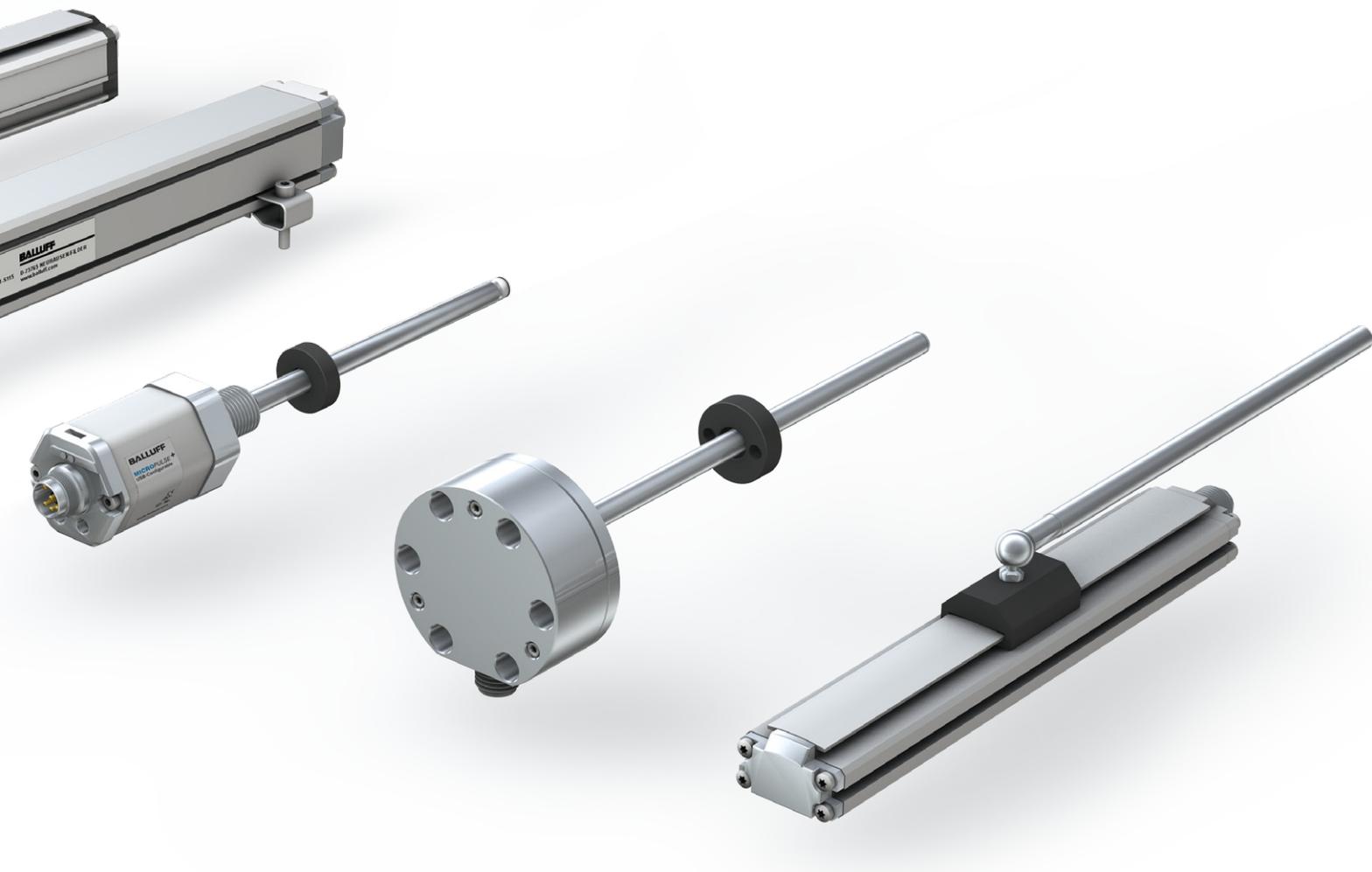
## Easy Teach<sup>™</sup> Set Up Tools



Micropulse sensors' easy-to-use field set-up and configuration make it simple and quick to adapt the sensor to specific application requirements.

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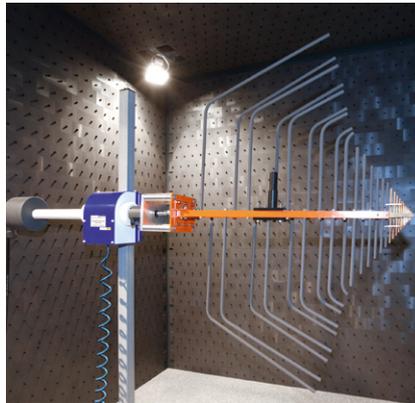
## Complete Application Coverage



Standard products for standard applications, specialty products for specialty applications, and in-house customization capability for the rest. Micropulse transducers are available in configurations to satisfy virtually any application requirement. Whatever your application, Balluff Micropulse sensors have it covered.

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## Engineered Reliability



Cutting-edge technology and performance are great. But industrial applications require sensors that deliver performance under severely demanding conditions. Micropulse sensors are designed for reliability, and rigorously tested to ensure long life and trouble-free performance, even in the most demanding applications.

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## Innovating The Way You Automate



Balluff is much more than linear position sensors. With a complete line of sensors, systems, service, and support unparalleled in the industry and a strong, growing global footprint, Balluff is your trusted partner for innovative automation products and solutions.

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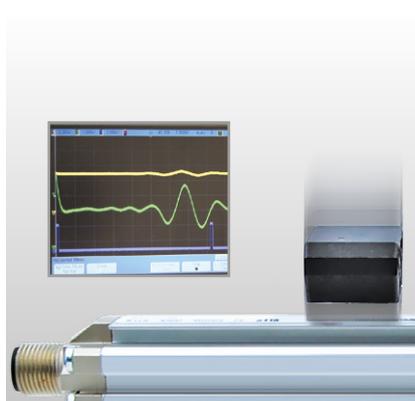
# EMT – Enhanced Magnetostrictive Technology

Industry-proven measurement technology – made even better

Magnetostriction. It's the industry-proven technology at the core of Micropulse position sensors. Magnetostrictive technology has been used for decades in industrial linear measurement sensors. But Balluff engineers have taken magnetostriction to new levels by employing innovative technological and design improvements.

- Patented Autotuning technology assures optimal sensor performance under changing application variables
  - Equivalent performance with free-floating or captive sliding position marker magnets
  - Dynamically compensates for varying magnet-to-sensor gap distance
  - Functions automatically: no need to calibrate for individual magnets
- Advanced linearization algorithms optimize positional accuracy, even over extremely long stroke lengths
- Custom-designed ASICs and exhaustive testing ensure optimal performance

## Autotuning

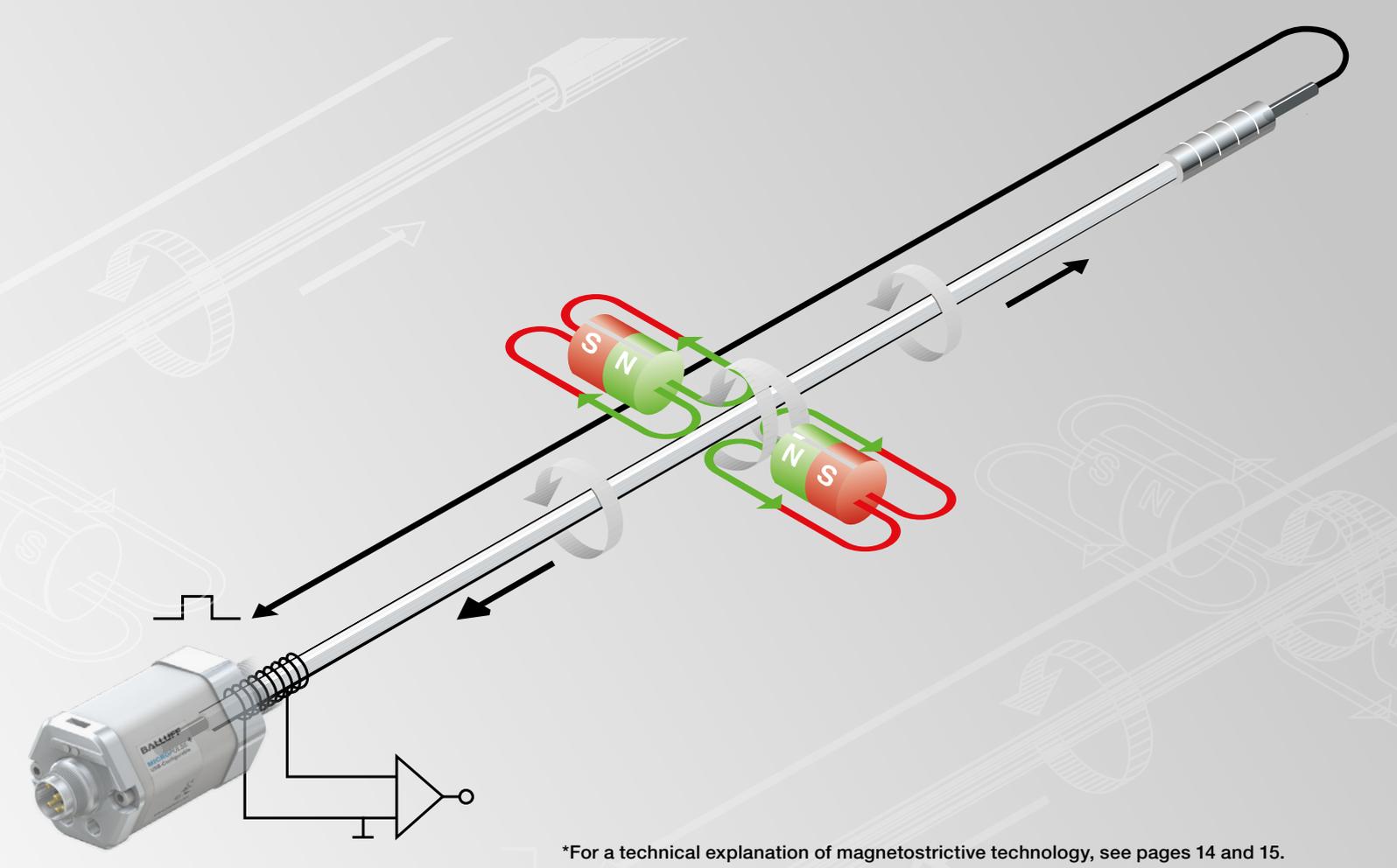


Patented Autotuning technology continuously monitors and adjusts the magnetic return signal as temperature and/or magnetic field strength changes. The result – more stable performance in dynamic, real-world applications.

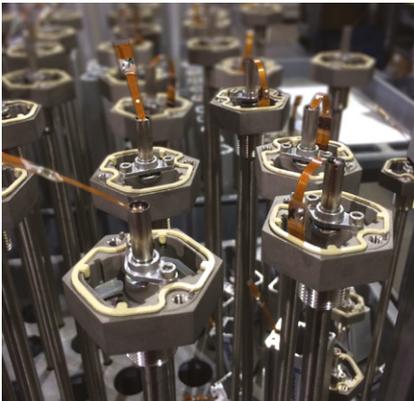
## Linearization



Accuracy matters. Micropulse linear position sensors deliver enhanced accuracy thanks to proprietary factory linearization.



### Custom Stroke Lengths



Built to order at Balluff's manufacturing facilities around the globe, Micropulse position sensors are available in stroke lengths ranging from 25 mm (2") to 7620 mm (300"), in 1 mm increments in many cases. You won't incur a delivery penalty for ordering "custom" lengths.

### Advanced Technical Design



Advanced PCB design incorporates custom-engineered ASIC technology and state-of-the-art electromagnetic compatibility hardening to ensure maximum performance in real-world industrial applications.

# Easy Teach™

## User-friendly field configuration + intelligent usability features

Cutting-edge technology is only useful if it's also easy to use and adaptable to your application. Micropulse sensors incorporate carefully designed and intelligently implemented field configurability features that simplify installation and set-up, and allow the sensors to be customized and optimized, if necessary, to specific application requirements.

- Innovative and simple-to-use clip-on scaling tool for in-cylinder rod-style Micropulse sensors enables fast, easy stroke scaling in the field
- Bi-color LEDs support set-up, operational status, and troubleshooting diagnostics
- Optional in-line, pushbutton teach box, with integrated LCD display makes stroke scaling and set-up an incredibly simple process
- PC-based configuration software, available for BTL7 Plus sensors, provides powerful configuration options yet is simple to use



Clip-on Scaling Tool

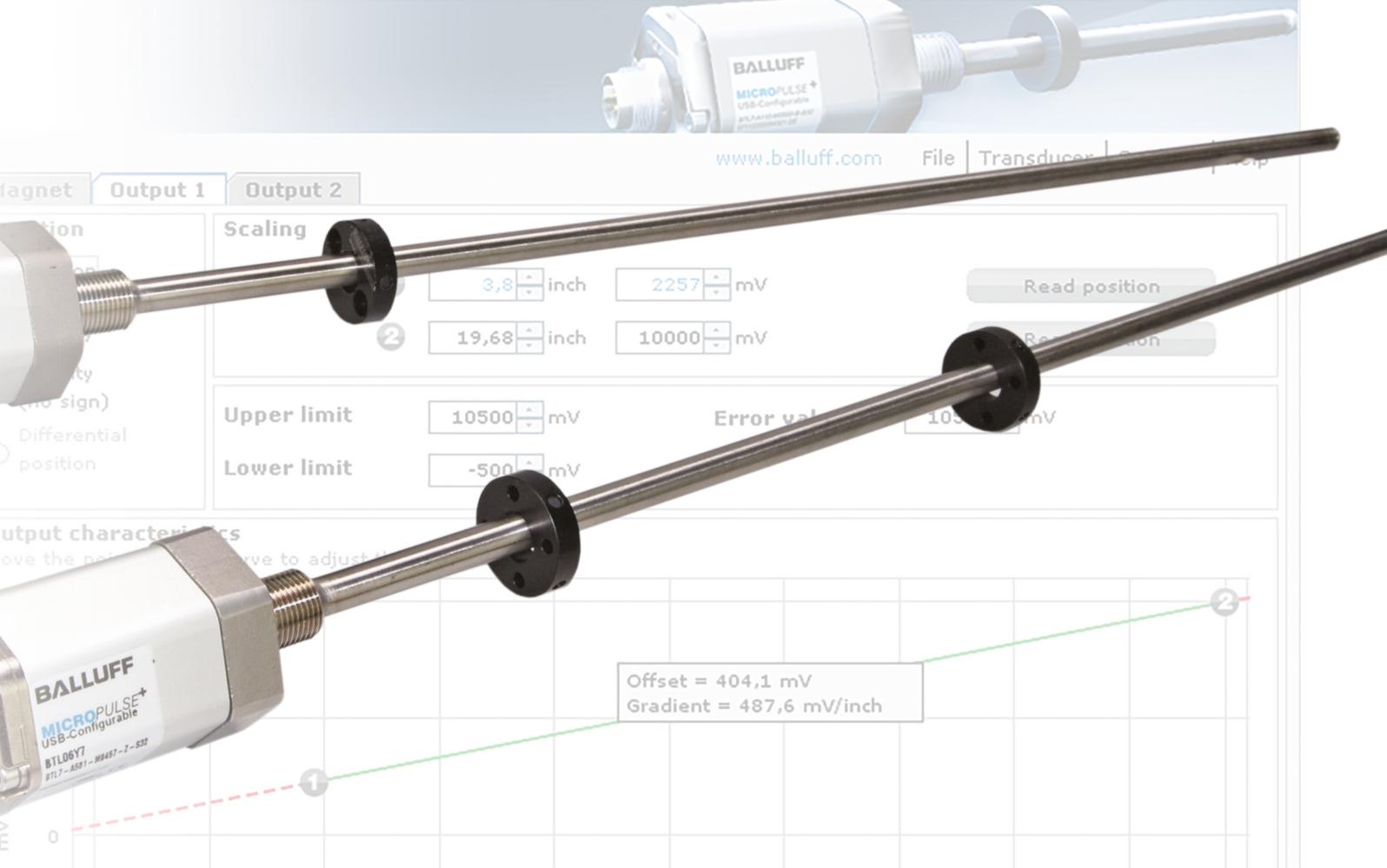


Innovative clip-on stroke scaling tool uses non-invasive magnetic technology to allow in-the-field adjustment of factory stroke range. After the adjustments are completed, the tool can be removed to prevent tampering.

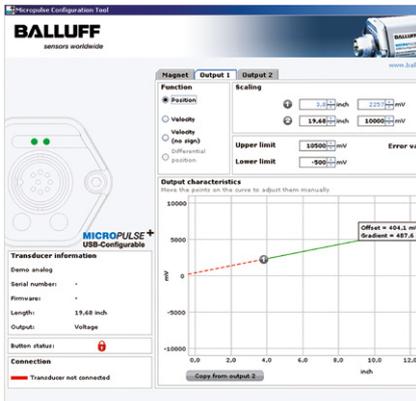
Integrated Status/Diagnostic LEDs



Intelligently-implemented user aids, such as the integrated bi-color LEDs on Micropulse sensors simplify initial set-up and commissioning, and provide at-a-glance runtime diagnostics. This helps take the guesswork out of system troubleshooting.



### Advanced USB Configuration



Micropulse Configuration Software allows unprecedented configurability and customization options for Micropulse+ sensors. Powerful, yet simple to install and use, the Micropulse Configuration Software is available for free on the Balluff website. Upload and download configurations offline, email configuration files to remote locations.

### In-line Teach Mode



In-the-field stroke scaling is quick and easy thanks to the optional in-line teach module functionality available on many Micropulse linear position sensors. The built-in LCD display eliminates the need for external meters.

### Rapid Replacement Module



Micropulse BTL7 in-cylinder rod style sensors with the Rapid Replacement Module (RRM) option reduce potential downtime by allowing super quick and easy replacement of the electronics and sensing element without the need to break the hydraulic seal. No need to de-pressurize the system, and no worries about oil spillage. Spare modules can be pre-configured offline, saving time during replacement and setting equipment back into service faster.

# Complete Application Coverage

**Standard products + special-duty products + in-house customization capability = optimal solutions for nearly every application**

Applications for industrial linear position sensors are diverse, ranging from in-cylinder position sensing, to externally-mounted general machine automation tasks, to position sensing in extreme environments such as explosive atmospheres and high-pressure washdown areas. Whatever the application, there is a Micropulse position sensor that's up to the task. And if the application has even more specialized requirements, Balluff's in-house design and engineering team can provide custom solutions tailored to application specifics. Balluff has your application covered.

- In-cylinder rod style sensors for hydraulic cylinder position feedback
- High-pressure stainless steel sensor probe
- Extruded aluminum profile housings for external-mount machine monitoring
- Special-duty form factors for applications such as off-road mobile hydraulics, sanitary fill, and position feedback in areas with explosive gasses and dust
- In-house customization and modification capability for specialized, unique applications

## Hydraulic Cylinder Position Feedback



Micropulse rod style linear position sensors represent the new standard for hydraulic cylinder position sensing. The high-pressure stainless steel sensor probe is optimized to withstand hydraulic pressure up to 600 bar. Micropulse rod-style sensors are available in a variety of form factors and are built to order in lengths up to 7620 mm.

## Machine Position Monitoring



Extruded aluminum profile and low profile form factors are ideal for external-mount machine position monitoring applications. Patented Autotuning technology allows free-floating magnet operation, while the proprietary hard-anodized coating ensures nearly frictionless operation of the rod-operated sliding type magnet.

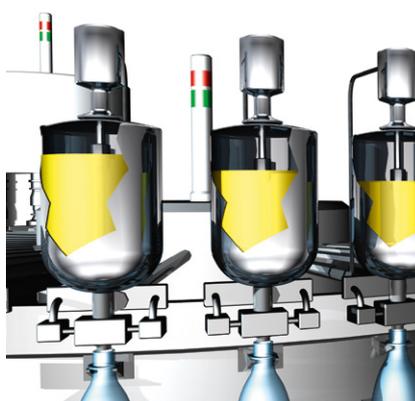


### Special Duty Products



Not all applications for linear position sensors are run-of-the-mill. Does your application require built-in redundant operation? Exposure to high-pressure washdown? Operation in locations with explosive gases or dust? No problem. Balluff has a Micropulse position sensor for your application.

### Sanitary Fill & Washdown



Precision dispensing and sanitary filling applications require precision performance and purpose-designed features. The Micropulse SF sanitary fill sensor is constructed from high-grade stainless steel and conforms to 3-A Sanitary Standards.

### Customization



Balluff's range of standard and special-duty Micropulse position sensors solve most application challenges. But for truly unique requirements, Balluff can provide custom engineered solutions. Challenge Balluff to help you solve your difficult application.

# Engineered Reliability

## Designed for industry, tested by industry, proven by industry

Advanced technology and features are only useful if the products perform as expected day in and day out. Reliability is everything. Sensor failures equal downtime and downtime equals lost revenue. Micropulse linear position sensors are intelligently designed to survive the demands of industrial applications, and prevent costly downtime. With Balluff's Industrially Hardened Design (IHD™) process, product designs are validated by rigorous shock, vibration, temperature, and EMC testing to identify potential weak points. Designs are then improved based on the test results. At Balluff, "good enough" simply isn't good enough. Micropulse linear position sensors are built to take a beating, and still deliver precision performance.

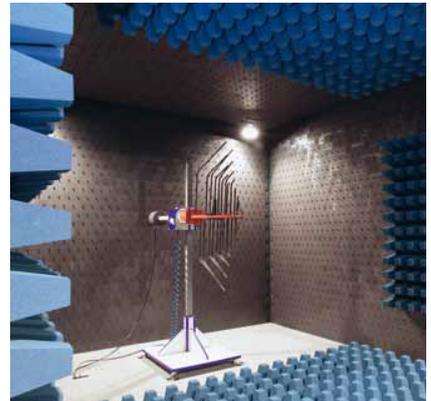
- Industrially Hardened Design (IHD™) process identifies potential failure points and allows in-cycle design improvement before the product is released
- In-house, accredited EMC test lab certifies that all Micropulse position sensors meet or exceed the most stringent Electromagnetic Compatibility (EMC) standards
- Highly-Accelerated Life Time (HALT) Testing identifies potential weaknesses, allowing in-process design improvements
- Intelligent product evolution provides the latest technology, features, and performance improvements, while maintaining backward compatibility with legacy products

### Highly-Accelerated Life Time (HALT) Testing

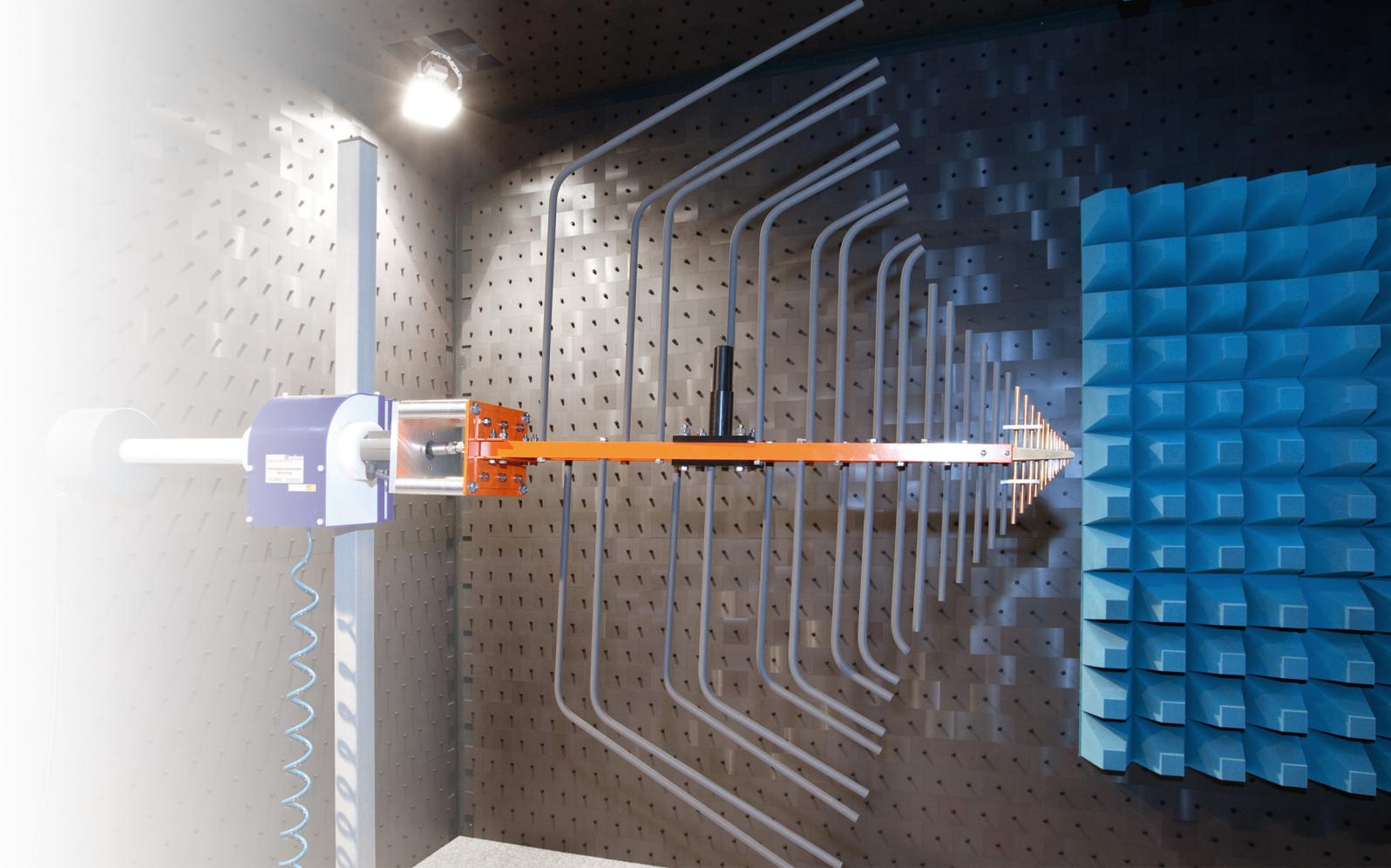


Design and build a prototype, abuse it until it fails, analyze the failure, improve the design, test it again. That's what Highly-Accelerated Life Time (HALT) Testing is all about. In-house HALT testing assures that potential design weaknesses are identified and subsequently eliminated.

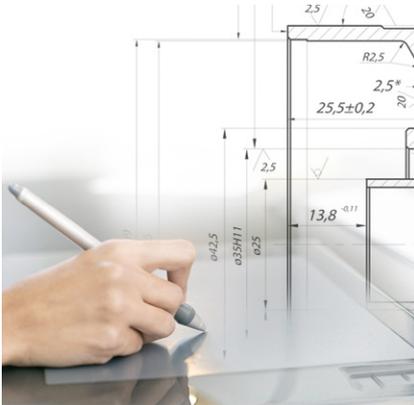
### EMC Testing



Micropulse sensors undergo stringent testing in Balluff's own accredited Electromagnetic Compatibility test lab, ensuring that the products meet all applicable EMC standards. Most importantly, it means that Micropulse sensors will perform in electromagnetically dense environments.



### Expert Engineering



It's not a coincidence that Micropulse sensors are among the mostly highly-advanced position sensors available anywhere. Balluff design engineers have decades of experience and unmatched technical knowledge. Legendary, uncompromising attention to every detail of design means performance you can count on.

### Field Experience



Balluff constantly monitors and evaluates the performance of Micropulse sensors in actual applications. Extensive analysis and testing of returned products from the field is another method of identifying opportunities to improve product performance and reliability.

### Intelligent Evolution



Balluff is continuously finding ways to improve sensor performance. Next-generation products incorporate the latest features, technology and performance, but maintain plug-and-play backward compatibility with legacy products.

# Innovating The Way You Automate

## Improving your competitive position and that of your customers

As global markets continue to become more competitive, there is a rising level of expectation regarding quality, productivity, cost, usability, and support. It's no longer an option to stand pat on past achievements and accomplishments.

It's a constant challenge to offer more value and better performance year after year.

Thankfully, you're not alone in the pursuit of continuous improvement.

Balluff is committed to helping our customers innovate the way they automate, to help them deliver on promises, and fulfill the market's expectations. And over time as requirements change, expand, and become more extreme, you can count on Balluff to be prepared to help you meet the challenge. Balluff never stops its quest for new product development and to introduce new control system concepts to support the demands of your market.

- Improved measuring performance through ongoing R&D investments in technology and design evolution
- Increased physical and electrical robustness with Enhanced Magnetostrictive Technology
- Strengthening your field support capabilities with remote sensor configuration, tamper proofing, and rapid replacement electronic modules
- Broadened application coverage with products engineered to meet the diverse demands of heavy-duty industrial hydraulics, light-duty machine positioning, hazardous locations, sanitary washdown locations, and more
- Enhanced survivability, robustness, durability, and reliability to better tolerate higher levels of shock, vibration, and extremes of temperature brings added performance to your application

### When Linear Position Sensing Isn't the Answer



Linear position sensors aren't the right choice for every application. Fortunately, Balluff offers a complete range of products and sensing technologies. Balluff's portfolio includes inductive, capacitive, photoelectric, magnetic and ultrasonic sensors, as well as networking and vision systems to satisfy any application requirement.

### Your Unique Application, Solved



When your linear displacement application doesn't fit the status quo, Balluff is invested in innovation and willing to customize a Micropulse product to meet the rigors of your application.



**We Are  
Where You Are**



Balluff provides local support across the whole world with a staff of sales professionals and distributors who are highly skilled at applying Micropulse technologies to enable customers to innovate their processes.

**We Are  
Where You Need To Be**



Global presence, local service. Balluff is represented in 62 countries, and maintains 9 manufacturing locations around the globe. Balluff is there to support you with service, support, and expedited delivery, wherever you happen to be.

**You Need  
It Now**



Time is money. If a machine goes down, getting a replacement component quickly is critical. Micropulse linear position sensors are built and shipped in 5 days or less. If you need it even faster, Balluff also offers next-day and same-day expedited delivery.

# Magnetostrictive Technology

## A superior non-contact sensing principle

Magnetostriction is a property of ferromagnetic (iron-based, magnetizable) materials that causes them to change their shape or dimensions in the presence of a magnetic field. In addition to numerous other practical uses, this magnetostrictive effect is ideally suited for use in industrial linear position measurement sensors. Magnetostrictive linear position sensors use an iron-alloy sensing element, typically called a waveguide. Referring to the diagram at right, the waveguide ① is housed inside a pressure-rated stainless steel tube or in an aluminum extrusion. The position magnet ② is attached to the moving part of the machine, or the piston of a hydraulic or pneumatic cylinder.

Measurements are initiated by applying a short-duration electrical pulse to a conductor ③ attached to the waveguide. The current creates a magnetic field ④ along the waveguide.

The magnetic field from the position magnet interacts with the generated magnetic field, inducing a torsional mechanical strain on the waveguide. When the current pulse stops, the strain is released, causing a mechanical pulse to propagate along the waveguide. This mechanical pulse travels at a constant speed, and is detected at the signal converter ⑤.

The time between the initial electrical pulse and the received mechanical pulse accurately represents the absolute position of the position magnet and, ultimately position of the machine or hydraulic cylinder. The position of the magnet along the waveguide is calculated by very accurately timing the interval between the initial current pulse, also known as the Interrogation Pulse, and the detection of the mechanical return pulse.

### Rugged and Wear-Free

- No mechanical contact between magnet and sensing element
- Immune to dirt, dust, and other potential contaminants
- Available in many different form factors for many different applications

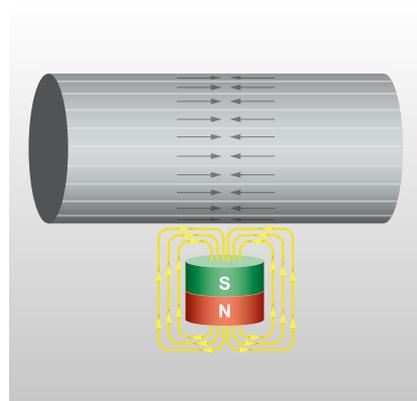
### Absolute

- Resulting time measurement represents absolute position of machine
- Available in many analog and digital interface types
- No need to re-home after power interruption

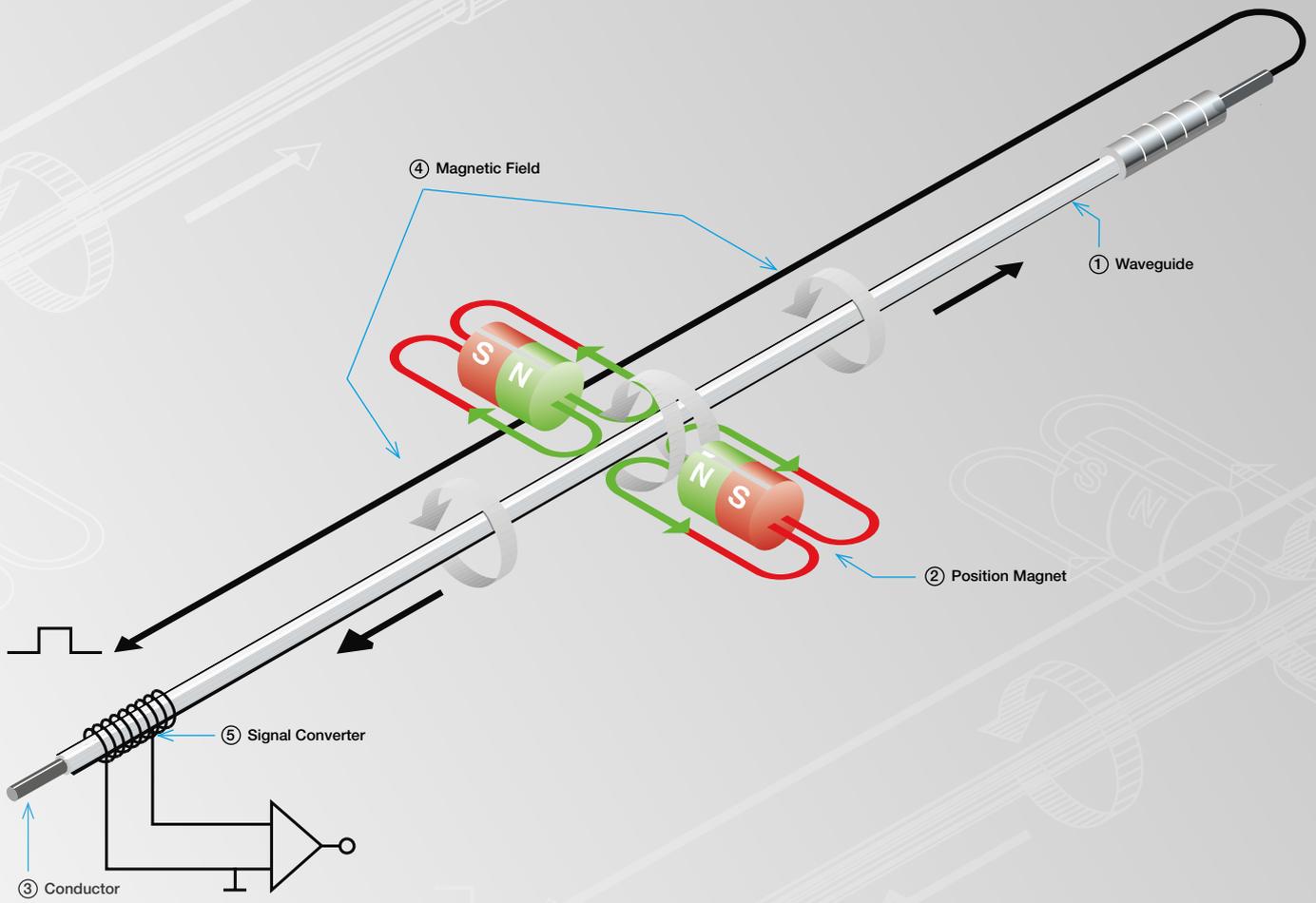
### Accurate

- Can detect position changes as small as 1 micrometer (1/1000th of a millimeter)
- Absolute positional accuracy to  $\pm 30$  micrometers

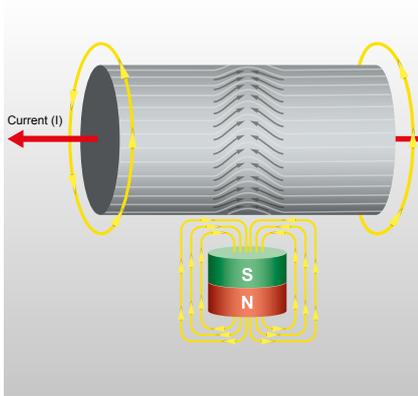
### Initial Condition



The waveguide tube is magnetized only at the position of the permanent, moving magnet. In practice, the permanent magnet is attached to the moving part of the machine or the piston of a hydraulic or pneumatic cylinder.

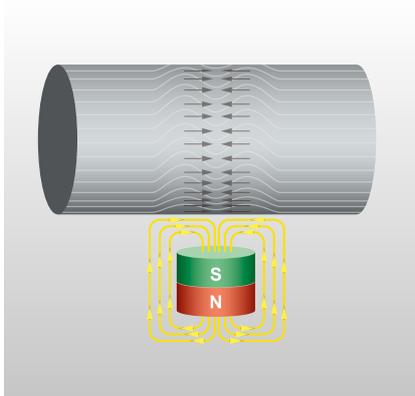


**Current Pulse Applied**



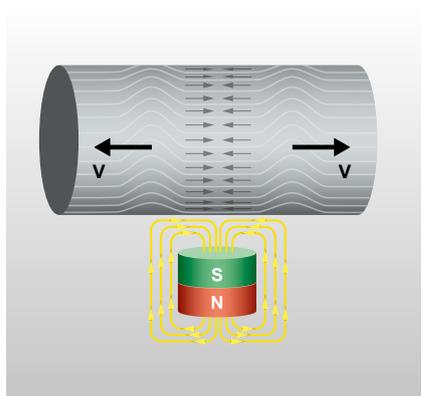
A short duration, (1-3  $\mu$ sec) current pulse is applied to the waveguide conductor. The magnetic field of the permanent magnet and the magnetic field created by the current pulse interact, causing torsional deflection of the waveguide element.

**Current Pulse Turned Off**



The torsion on the waveguide element abruptly relaxes, and the mechanical wave propagation begins.

**Wave Propagation**



The mechanical wave propagates in both directions along the waveguide at a nominal velocity of 2850 meters/second. The detection of the mechanical wave in the signal converter completes one measurement cycle. Measurement cycles are typically repeated at rates of 0.5 to 5 milliseconds, depending on the length of the sensor.

# BALLUFF

sensors worldwide



Systems and Service



Industrial Networking and Connectivity



Industrial Identification



Object Detection



Linear Position Sensing and Measurement



Condition Monitoring and Fluid Sensors



Accessories

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