



ONE FIBER – ENDLESS POSSIBILITIES

Optical measurement solutions from HBK

HBK FiberSensing adds more than a decade of expertise in developing and producing advanced optical monitoring systems to over 60 years of experience in the area of test and measurement.

Bringing light to measurement

HBK advanced fiber optic technology solutions are centred around HBK FiberSensing. Operating from Porto, Portugal, our dedicated team specialises in the development, design, and manufacturing of Fiber Bragg Grating (FBG) based sensors and systems. Our extensive range of FBG standard products includes sensors, interrogators, and accessories, complemented by our ability to provide tailored solutions for diverse applications, catering to Original Equipment Manufacturers (OEMs), and beyond.

Our optical products are seamlessly integrated into HBK's comprehensive portfolio, ensuring compatibility across hardware families, software, and service offerings. This integration enhances the versatility and utility of our solutions, providing a cohesive experience for our customers. At HBK FiberSensing, we are dedicated to helping our customers push the boundaries of what's possible and drive progress across industries. Our goal is to contribute to a cleaner, healthier, and more productive world.

APPLICATIONS AND MARKETS

Optimising performance, enhancing safety, preventing failures.

Collecting meaningful and reliable data is crucial for supporting informed decisions in the primary markets where HBK FiberSensing solutions are implemented. Whether assessing cutting-edge designs or ensuring the ongoing safety and reliability of critical assets, fiber Bragg grating technology emerges as a logical choice. Monitoring critical infrastructures provides real-time insights on their structural integrity, enhancing safety, optimising maintenance, and extending the structure's service life.

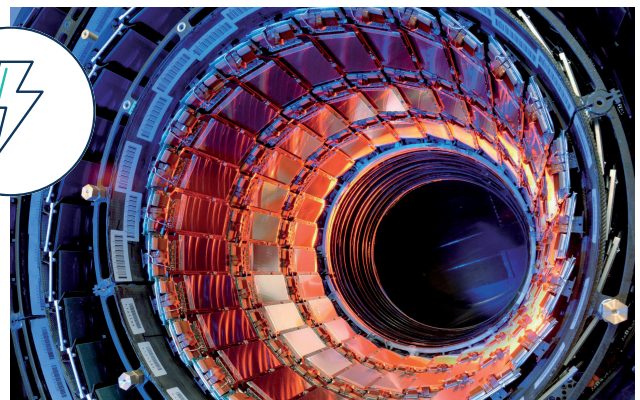
Structural health monitoring

FBG sensors excel in long-term monitoring across extensive distances or remote locations, offering proven signal stability and high efficiency in terms of installation and overall operating costs.



Energy

FBG sensors provide safe and noise-free measurements, making them ideal for high voltage areas in critical energy generation, transportation, or transformation. These passive components operate without active power, are fully dielectric, and are immune to electromagnetic and radio frequency interference.



Wind

The exceptional strain and fatigue resistance, combined with inherent protection against water and salt degradation, position FBG technology as an ideal choice for monitoring all components of wind turbines – blades, towers, foundations, and power transmission cables. Additionally, its non-conductivity renders it immune to lightning strikes.



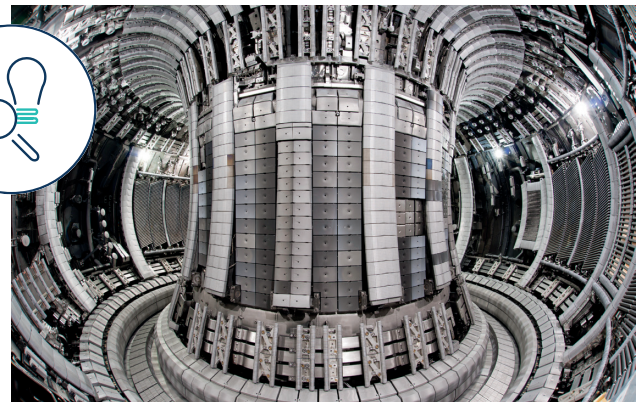
Transportation

Lightweight and safe FBG based sensors can be installed on train pantographs. These passive elements operate without active powering and the interrogator can be installed and powered on non-high-voltage areas.



Research and development

Resistant to harsh environments, from cryogenic temperatures to high radiation and vacuum, FBG based sensors are an interesting asset for research and development projects. Furthermore, their straightforward integration into composite materials facilitates the advancement of smart materials.



Industry

The compact size and robustness of FBG sensors facilitate the design of specialised transducers for confined spaces, long distances, and harsh environments, such as those containing rust, oil, and industrial dust.



Benefits of the technology

WHY USE FIBER BRAGG GRATING SENSORS?



Reduce total ownership costs

Optical sensors based on FBG technology can be combined in series over the same fiber, leveraging the multiplexing capability through the use of sensors with different wavelengths. Moreover, sensors for measuring different parameters can be connected if they are based on the same measuring principle. A single optical interrogator can then be used to acquire hundreds of sensors simultaneously, drastically reducing the cost per measuring point. Factory preassembled sensors in a series not only reduce the amount of cabling needed but also significantly decrease installation time and the need to perform connections on site. FBG sensors provide accurate and absolute measurements over long periods of time. Unlike some other sensors, they require no recalibration and exhibit zero drift over time.



Access remote locations

With optical sensor technology, the effects of distance and cable length do not compromise the test result. Even if your data acquisition system is located many kilometres away from the measuring points, you can still rely on high-quality measurement results.



Match new materials

New materials are getting stronger, and structures are becoming lighter. In-series sensor connection minimises cabling complexity, resulting in reduced weight and simplified sensing networks – even for large sensor counts. Due to their small size and light weight, FBG sensors can be embedded into composite materials used in innovative structures. They can handle high strain and have very high fatigue limits, making them suitable for new materials used in aeronautics, space, and other industries.



Operate in hazardous areas

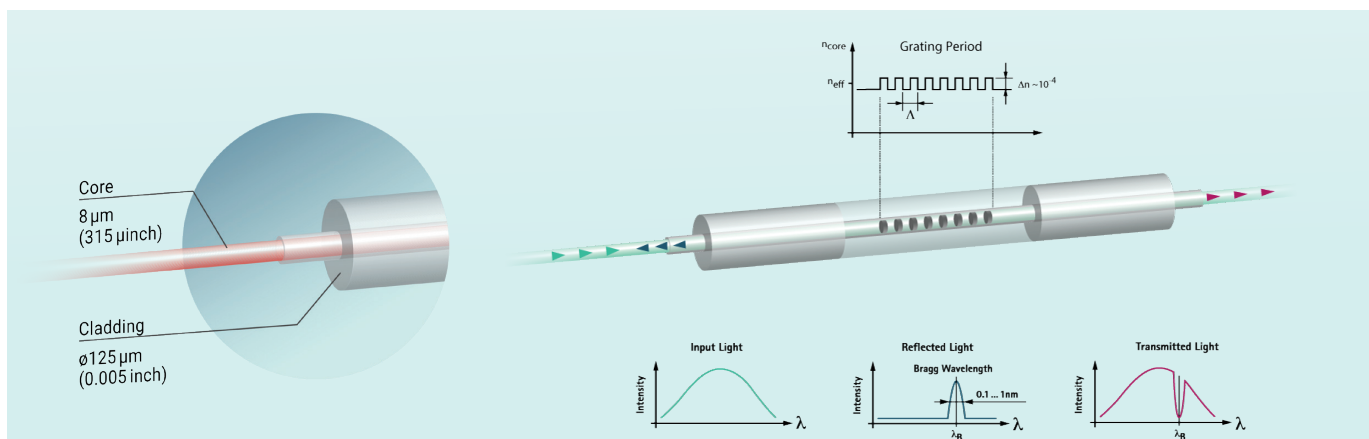
As the technology is completely passive, there is no active powering of the sensors, which means that they can be used in explosive areas without any risk. They are also well-suited for high-voltage environments because the signals experience no electromagnetic interference, and the sensors can be dielectric. Their robustness extends beyond safety considerations. In harsh environments, where humidity, salt, and high pressure combine, such as offshore structures, hydraulic pipelines or ship hulls, FBG based measurements remain stable and reliable, making them ideal for wet and marine applications.

Technology

THE FIBER BRAGG GRATING

A fiber Bragg grating is a microstructure that is typically a few millimetres in length and is written by using laser light to locally change the core of a standard, single-mode telecom fiber. The applied changes are periodic with a fixed distance and alter the refractive index of the optical fiber.

When broadband light is inserted into the fiber, the inscribed Bragg gratings act as mirrors that reflect a narrow spectrum of the incident light centred at the Bragg wavelength dictated by the period and by the effective refractive index of the grating. The remaining light will continue to be transmitted.



MEASUREMENT WITH FBG SENSOR TECHNOLOGY

The measurement of an FBG is then based on the changes of the reflected Bragg wavelength.

Intrinsic measurements: strain and temperature

The FBG is intrinsically sensitive to changes in strain applied to the fiber. When strain occurs, the period of the FBG changes. FBGs are also responsive to temperature changes – the effective refractive index changes with temperature, and thermal expansion leads to a slight change in the FBG period.

Sensors for different parameters

When sensors are installed, they are affected by external parameters like strain or temperature. These influences are transmitted to the optical sensor, resulting in a wavelength shift proportional to the measurand of interest. This shift is detected by the interrogator (data acquisition system). Sensors can be designed to convert other measurands into the FBGs, such as displacement, acceleration, tilt, and force.

Temperature compensation

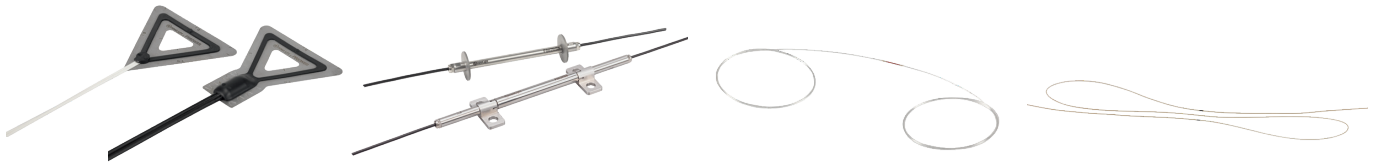
Given that FBGs are sensitive to both strain and temperature, thermal compensation becomes a critical consideration using this technology. Temperature sensors are designed to isolate any mechanical influence on the FBG, ensuring that only temperature is felt by the sensor. For other measurands, temperature must be compensated by other methods. A temperature compensation sensor, or sensor designs incorporating two FBGs, can be used to compensate the effect of temperature on the FBG.

Strain sensors



| | FS62PSS | FS62PSR | FS62CSS | FS62WSS | |
|-----------------------|---|----------------------|--|--|------------------|
| | Patch Strain Sensor | Patch Strain Rosette | Composite Strain Sensor | Weldable Strain Sensor | |
| | Straightforward and uncomplicated installation even for inexperienced users. Fully dielectric sensor to be glued to flat or curved surfaces and suited for high strain and high fatigue measurements. | | Glueable sensor for all types of surfaces, including inhomogeneous materials. Available with aramid cables without any metallic components or armored cables for rougher environments. | Fast and easy installation by spot welding to metallic structures for immediate and accurate measurements. Available with different cable types (braided, aramid or armor). Weldable strain sensors were designed to meet the operating demands of the most modern steels. | |
| Measurement Range | ±20 000 µm/m | ±10 000 µm/m | ±5 000 µm/m | ±10 000 µm/m | ±5 000 µm/m |
| Typical Sensitivity | 1.2 pm/(µm/m) | | 1.2 pm/(µm/m) | 1.2 pm/(µm/m) | |
| Operating Temperature | -40°C to 100°C | | -20°C to 80°C | -40°C to 100°C | -20°C to 80°C |
| Cable Type | Braided | | Aramid or Armor | Braided | Aramid or Armor |
| Mounting | Glue | | Glue | Weld | |
| Dimensions | 40 × 12 × 2 mm | 50 × 47 × 2 mm | 50 × 47 × 2 mm | 83 × 23 × 6 mm | 60 × 12 × 2.5 mm |

Specifications are subject to modifications. For detailed information please refer to the available datasheets on our website www.hbkworld.com.



| FS62WSR | | FS62RSS | | FS70FBG | FS70PKF |
|---|-----------------|---|--------------------|--|--|
| Weldable Strain Rosette | | Rugged Strain Sensor | | FBG array | FBG array in peek coated fiber |
| Fast and easy installation by spot welding to metallic structures for immediate and accurate measurements. Available with different cables types (braided, aramid or armor). Weldable strain sensors were designed to meet the operating demands of the most modern steels. | | Strain measurement solution for embedding in concrete or for bolting into flat surfaces. Measurement ranges compatible with common concrete structures under the serviceability design state. | | Several FBG on the same fiber with high-performance coating that ensures optimal strain transmission and enhanced stability for all sorts of strain measurement applications. To be bonded to different surfaces and materials, embedded in composite (with customisation) or mechanically attached to structures. | Several FBG on the same fiber with high-performance coating and an additional peek layer for ruggedised operation. Several FBG in series on the same fiber to be bonded to different surfaces and materials for multipurpose measurements. |
| ±2 000 µm/m | | ±2 500 µm/m | ±5 000 µm/m | > ±20 000 µm/m | ±7 000 µm/m |
| 1.2 pm/(µm/m) | | 1.5 pm/(µm/m) | 1.1 pm/(µm/m) | 1.2 pm/(µm/m) | 1.2 pm/(µm/m) |
| -40°C to 100°C | -20°C to 80°C | -20°C to 80°C | | -268.9°C to 200°C | -40°C to 130°C |
| Braided | Aramid or Armor | Armor | | Braided | Aramid or Armor |
| Weld | | Embed | Surface | Glue | Glue |
| 61 × 67 × 2.6 mm | 72 × 67 × 6 mm | 140 × Ø 30 mm | 240 × 50 × Ø 16 mm | 5 × Ø 0.195 mm | 5 × Ø 0.7 mm |

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Temperature sensors



| | FS63DTP | | FS63LTS | FS63CTS | FS63WTS | FS63RTS |
|--|---|---------------|---|--|--|---|
| | Dielectric Temperature Probe | | Laboratory Temperature Sensor | Composite Temperature Sensor | Weldable Temperature Sensor | Rugged Temperature Sensor |
| | For safe temperature measurements under high voltage or other environments that require dielectric materials. Fits in tight spaces with its small probe dimensions. | | Small diameter sensor for applications where space is limited. Use adhesives or cable ties for sensor fixing. | Glueable sensor for all types of surfaces. | Fast and easy installation by spot welding to metallic structures. | Rugged sensor for general purpose temperature measurements. To be embedded in concrete structures before concrete pouring for monitoring projects. Attach with glues that ensure thermal transfer, or simply tie with cables. |
| Measurement Range | -40° to 100°C | -40° to 200°C | -40°C to 100°C | -20°C to 80°C | -20°C to 80°C | -20°C to 80°C |
| Typical First Order Sensitivity | 10 pm/°C | | 30 pm/°C | 30 pm/°C | 30 pm/°C | 30 pm/°C |
| Max. Calibration Error | ±1° C | ±1.5° C | ±0.5° C | ±0.5° C | ±0.5° C | ±0.5° C |
| Cable Type | PTFE | | Braided | Aramid or Armor | Aramid or Armor | Armor |
| Dimension | 20 × Ø 1 mm | | 65 × Ø 2.6 mm | 130 × 20 × 6 mm | 100 × 23 × 6 mm | 100 × Ø 10 mm |

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Accelerometers



| | FS65ACC | FS65HSA | FS65HDA |
|-----------------------------|---|---|--|
| | Accelerometer | High Sensitivity Accelerometer | Heavy Duty Accelerometer |
| | Single axis accelerometer for measuring vibration levels on flexible structures where high acceleration and low frequencies coexist, for example, bridge suspension cables. Can be combined with other accelerometers for bi- or triaxial measurements. | Highly sensitive single axis accelerometer for detection of very small movements as commonly observed on ambient vibration of large structures. Can be combined with other accelerometers for bi- or triaxial measurements. | Small size and light weight accelerometer designed to be installed in railway pantographs. EN45545 certified. Uses special dual fiber cable and rugged connectors. |
| Measurement Range | ±10 g | ± 2g or 5 g | ±20 g |
| Typical Sensitivity per FBG | 59 pm/g | 1300 pm/g | 40 pm/g |
| Frequency Range | 0 to 50 Hz | 0 to 75 Hz | 0.5 to 200 Hz |
| Flatness | <2 % | < 25Hz 1.5% < 50Hz 3% < 75Hz 10% | <10 % |
| Operating Temperature | -20°C to 80°C | -20°C to 80°C | -40°C to 75°C |
| Temperature Compensation | None (0.4 g/°C) | Dual FBG (<0.003 deg/°C) | Dual FBG (<0.04g/°C) |
| Cable Type | Armor | Armor | Railway |

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Other sensors



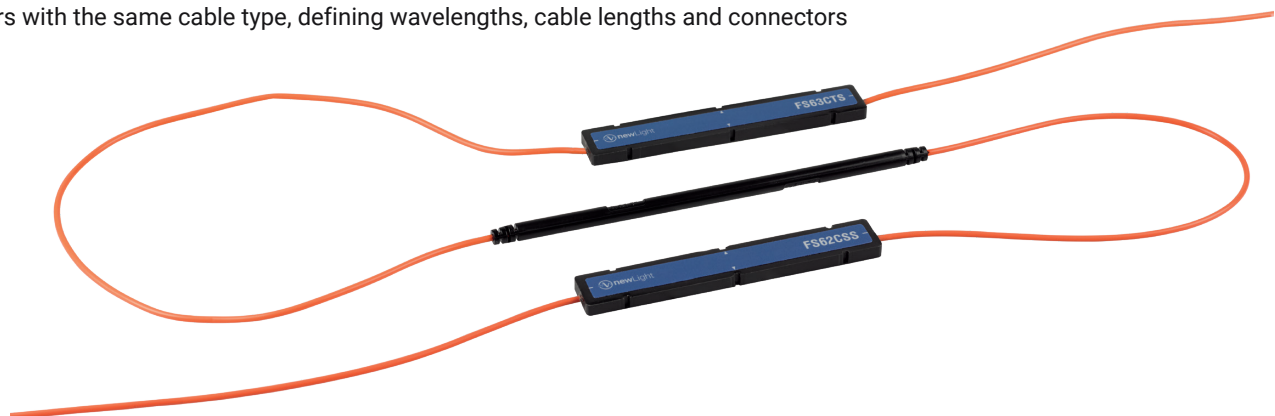
| | FS61DSP | FS64TLS | FS66HDL |
|-----------------------------|---|---|---|
| | Displacement Sensor | Tilt Sensor | Heavy Duty Force Sensor |
| | For measuring linear position variation in monitoring projects of civil structures such as bridges or tunnels. It offers easy and fast installation with provided accessories for bolting into flat surfaces. The dual cables allow for in-series connection. | Designed to measure small angle variations towards the vertical, this robust and completely passive sensor offers high multiplexing capability, making it well-suited for remote sensing in demanding or hazardous areas. It can be combined with other sensors for biaxial measurements. | Small size and light weight force sensor designed to be installed in railway pantographs. EN45545 certified. Uses special dual fiber cable and rugged connectors. |
| Measurement Range | ±40 mm | ±5 deg | 0 to 500 N |
| Typical Sensitivity per FBG | 29 pm/mm | 185 pm/deg | 1.1 pm/N |
| Max. Calibration Error | ±0.4 mm | ±0.05 mm | ±5 N |
| Operating Temperature | -20°C to 80°C | -20°C to 80°C | -20°C to 75°C |
| Temperature Compensation | Dual FBG (<0.01 mm/°C) | Dual FBG (<0.003 deg/°C) | Dual FBG (<0.05 N/°C) |
| Cable Type | Armor | Armor | Railway |
| Dimension | Ø 40 × 210 mm | 220 × 143 × 43 mm | 112 × 30 × 20 mm |

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Sensor arrays

Preassembled chains of sensors with splices performed and protected from factory at customer-defined distances

- Reduce installation time and cost with ready to install optical sensor arrays consisting of strain and temperature sensors
- Combine sensors with the same cable type, defining wavelengths, cable lengths and connectors



Interrogators



| | MXFS | | FS22 | | FS42 |
|-------------------|---|-----------------------------|----------------------|---|----------------------------|
| | SI | DI | SI | DI | PI |
| Acquisition Rates | selectable 1 or 10 S/s | selectable 100 or 2 000 S/s | 1 S/s | selectable 50, 100, 200, 500 or 1 000 S/s | 1 S/s |
| Resolution | 0.5 pm | 1 pm | 0.5 pm | 1.5 pm | 0.5 pm |
| Stability | 1 pm | 3 pm | 1 pm | 5 pm | 1 pm |
| Dynamic Range | >50 dB | >20 dB | >50 dB | >25 dB | >50 dB |
| Software | catman, MX Assistant | | catman, BraggMONITOR | | BraggMONITOR PI |
| Communication | Ethernet, Firewire (others available when combined with other QuantumX modules) | | Ethernet | | Ethernet, USB, Touchscreen |

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Solutions

Comprehensive solutions, designed to meet specific application needs.



Pantograph and catenary monitoring

Ensure safe, reliable, and efficient railway operations with continuous pantograph-catenary monitoring.

HBK's fiber optical measurement solution can support the evaluation of the overhead power line condition, or be used to characterise, homologate and test pantographs.

The optical accelerometers, force sensors and accessories developed for this application, together with the QuantumX BraggMETER, create a full system rated for operation under high voltage and suitable for the railway industry. This system can easily be integrated with other measuring or control systems.



OEM and strategic accounts

Join the many industry leaders who trust our specialised optical measuring solutions tailored to your needs. Whether you require simple customisation or fully dedicated development, you can benefit from our expertise. As a leader in optical sensing, we leverage our extensive knowledge to create innovative OEM products that seamlessly integrate into your solutions. Additionally, we offer strategic contracts for volume business of standard products or small customisations ensuring you receive the best solutions for your specific requirements.

We provide exceptional sensing and insights to create solutions for a cleaner, healthier and more productive world

CONTACT US



SERVICES

HBK provides comprehensive support for customised and dedicated solutions, specifically tailored to meet our customers' unique needs.

Our commitment extends to customer training, whether conducted remotely, at our facilities, or on-site. We ensure that customers become proficient in deploying and utilising our cutting-edge technology.

Additionally, our specialised engineering team manages installation and project coordination for bespoke projects, drawing upon extensive experience and relevant certifications for offshore or elevated works.



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