Fiber Optic Partial Discharge Sensor



Overview

OptiFender simplifies asset management with advanced, maintenance-free partial discharge (PD) monitoring.

Key Takeaways

Fiber optic partial discharge sensors detect and localize electrical insulation defects in real-time using optical fibers, offering high sensitivity, remote monitoring, and minimal maintenance.

Overview

Fiber optic PD sensors are advanced devices used to monitor partial discharges in electrical equipment such as transformers, high-voltage cables, and cable joints. Partial discharges are small electrical arcs that occur within insulation materials, which, if undetected, can lead to insulation degradation and eventual equipment failure. Fiber optic sensors provide a non-intrusive, highly sensitive, and maintenance-free solution for continuous PD monitoring.

Working Principles

Acoustic Emission-

Based Sensors: Systems like OptiFender detect PD by measuring acoustic emissions generated by discharges. The passive fiber optic sensors transmit these signals through standard optical fibers to an acquisition unit, where software analyzes and localizes the PD source with centimeter-level accuracy.

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Interferometric Fiber-

Optic Sensors: These sensors, including Mach–Zehnder (MZ), Sagnac, and Fabry–Perot interferometers, detect PD by measuring phase changes in light caused by ultrasonic waves from discharges. They offer high-frequency detection, anti-interference capability, and multiplexing potential, making them suitable for precise PD localization in complex electrical systems. Distributed Fiber Optic Sensing (DAS): Solutions like FEBUS FOGrid use distributed acoustic sensing along the entire length of a fiber to detect PD events in cables.

This allows continuous, real-time monitoring and precise localization of PD along long cable runs.

Advantages

High Sensitivity: Capable of detecting very low PD levels, down to picocoulomb ranges in cable joints. Remote Monitoring: Optical fibers allow 24/7 monitoring from centralized locations without on-site presence.

Non-

Intrusive Installation: Passive sensors can be installed on existing equipment without requiring shutdowns. Data Integration: Systems provide real-time alerts, PD classification, and actionable insights for predictive maintenance. Enhanced Asset Management: Combining PD sensors with techniques like Dissolved Gas Analysis (DGA) improves transformer health assessment and reduces maintenance costs.

Applications

Transformers: Detect internal and surface PD to prevent catastrophic failures.

High-

Voltage Cables: Monitor cable joints and insulation integrity over long distances. Smart Grids: Integrate with predictive maintenance systems for proactive risk mitigation.

Conclusion

Fiber optic PD sensors represent a reliable, high-precision, and cost-effective approach to monitoring electrical insulation. By leveraging acoustic emissions, interferometry, or distributed sensing, these sensors enable early detection, precise localization, and continuous monitoring, significantly enhancing the safety, reliability, and lifespan of critical electrical assets.

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Article Content

OptiFender

OptiFender simplifies asset management with advanced, maintenance-free partial discharge (PD) monitoring. Its passive fiber-optic sensors and real-time analytics ensure accurate PD localization,

Partial discharge detection | FOGrid solution | FEBUS Optics

Our integrated software solution, FOGrid Suite, generates an alert when a partial discharge occurs. A real-time notification that precisely locates the event on a map is sent.

Optical fiber sensor-based detection of partial discharges in power ...

In this paper, a fiber optic acoustic sensor system is designed and tested for on-line detection of the partial discharges inside high voltage power transformers.

OSENSA Innovations | Fiber Optic Temperature

Leading developer of fiber optic temperature sensing and partial discharge monitoring solutions for switchgear, data centers, energy, and life sciences,

Distributed Partial Discharge Locating and Detecting

This provides a new method for a multipoint-distributed optical fiber sensor used for detecting and locating a long-distance electrical equipment

Acoustic-Enhanced Fiber-Optic MZI Sensing Technology for Partial ...

First, an acoustic-enhanced fiber-optic sensor (AFS) was developed based on the theory of the acoustic black hole (ABH). This sensor was then integrated with MZI sensing technology to

Ultrasonic detection of partial discharge in oil-paper insulation based ...

To further analyze the ability of the five F-P ultrasonic sensors and the piezoelectric ultrasonic sensor to detect partial discharge signals from a metal tip, the frequency spectrum of the

Development of Intensity Modulated Optical Fiber Based Partial ...

This article presents an intensity-modulated fiber optic sensing principle that provides a more simplistic approach toward acoustic wave detection, as it does not require any specialized light source and

Research on Partial Discharge Acoustic Emission Sensing Using Fiber ...

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A strategy using oblique fiber winding rings is proposed to eliminate the problems of strain cancellation and non–accumulation of displacement in transverse and longitudinal resonant

Partial Discharge (Pd) Monitoring System | Optics11

Detect and monitor partial discharge using fiberoptics. OptiFender is an innovative fiber optic sensing solution which enables partial discharge monitoring of high voltage assets in challenging environments.

Fiber Optic Mach-Zehnder Interferometer Sensor With Acoustic ...

The application prospects of fiber optic Mach-Zehnder interferometer (MZI) acousto-sensing technology in the field of partial discharge (PD) detection are promising. However, current external fiber optic

Highly Sensitive Optical Fiber Ultrasonic Sensor for Partial Discharge ...

Optical fiber ultrasonic sensor based on Fabry-Perot cavity and micro-electromechanical-system diaphragm was proven to be suitable for partial discharge detection, which shows frequency

Fiber-optic sensing for partial discharge acoustic detection on power ...

Fiber-optic acoustic sensors have been increasingly applied in the condition monitoring of power equipment for their high sensitivity and strong immunity to electromagnetic interference. The Sagnac

Fiber optic Fabry–Perot sensor that can amplify ultrasonic ...

Ultrasonic wave is a powerful tool for many applications, such as structural health monitoring, medical diagnosis and partial discharges (PDs) detection. The fiber optic extrinsic

Interferometric Fiber-Optic Sensor for Electrical Partial Discharge ...

We propose an interferometric fiber-optic sensor and investigate its ability to measure the partial discharge in electrical applications. Preferable performance can be achieved under system self-noise

Optical-only Detection of Partial Discharge with Fluorescent Polymer ...

Abstract This paper reflects recent progress in the field of fluorescent polymer optical fiber sensors (F-POF) for partial discharge (PD) detection in high voltage (HV) cable accessories using

Novel Approach for Partial Discharge Localization Based on Fiber-Optic ...

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Accurately and sensitively detecting and locating the partial discharge (PD) inside transformers is of great significance for ensuring the safe operation of transformers. Due to the obstruction of the

Partial discharge detection in HV and MV terminations with fiber optic ...

This study presents a novel approach to detect partial discharges (PD) in a medium-voltage (MV) cable termination using fiber optic-based acoustic PD sensors. The sensing system is

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