

Article Overview

A Fiber Optic Current Sensing System (FOCS) measures high DC currents using the Faraday effect, offering high accuracy, immunity to electromagnetic interference, and safe galvanic isolation.

Principle of Operation

FOCS operates based on the magneto-optic Faraday effect, where polarized light traveling through an optical fiber experiences a phase shift proportional to the magnetic field generated by the current in a conductor. In interferometric designs, circularly polarized light traverses a loop around the conductor, and the resulting interference pattern is analyzed to determine the current magnitude. This optical approach ensures complete electrical isolation, making FOCS ideal for high-voltage or high-current environments.

Key Features

- o High Accuracy and Sensitivity: FOCS can measure uni- or bi-directional DC currents up to 600 kA with accuracy within $\pm 0.1\%$.
- o Wide Bandwidth: Capable of detecting current ripples, transients, and fast changes in current.
- o Compact and Lightweight: Small sensor heads allow integration into existing devices like switches, bushings, or HVDC lines.
- o Electromagnetic Immunity: Optical fibers are unaffected by stray magnetic or electric fields, ensuring reliable measurements in industrial environments.
- o No Magnetic Overload: Unlike conventional current transformers, FOCS avoids saturation and distortion even under high short-circuit currents.
- o Digital and Analog Outputs: Supports full digital processing and easy integration with control systems.

Applications

FOCS is widely used in industrial and power systems:

- o High-Voltage DC (HVDC) Transmission: Monitoring and protection of long-distance DC lines.
- o Electrochemical and Metallurgical Processes: Measuring currents in electrolyzers for aluminum, copper, manganese, and zinc production, often exceeding hundreds of kiloamperes.
- o Substations and Switchgear: Provides precise current measurement and protection without opening bus bars, simplifying installation and maintenance.

Advantages Over Conventional Sensors

Principle of Fiber Optic Current Sensing System

- o Galvanic Isolation: The optical fiber provides electrical separation from high-voltage conductors .
- o Reduced Installation Time: FOCS can be installed without extensive disassembly, often in hours instead of days required for Hall effect or conventional transformers .
- o Robustness: Resistant to environmental factors like dust, dirt, and temperature variations .
- o Enhanced Safety: No direct electrical contact reduces risk to personnel and equipment .

Advanced Designs

Some FOCS systems use recirculating fiber loops to enhance sensitivity, achieving phase shifts of 11.5-21.2 degrees per ampere depending on fiber length . These designs allow precise measurement even with long fiber runs, making them suitable for large-scale industrial applications. In summary, Fiber Optic Current Sensing Systems provide highly accurate, interference-free, and safe current measurement, making them indispensable in modern high-current and high-voltage applications across power generation, transmission, and industrial processes .

The basic principle of Fiber Optic Current Sensors (FOCS) and Optical Current Transformers (OCTs) is to measure

The fiber optic sensor working principle is that transducer changes some optical fiber system parameters like

It is difficult to measure the large current, especially the low frequency component, which flows in a power system under the accident

Optical fibre sensors are an essential subset of optical fibre technology, designed specifically for sensing and measuring several

In FOCS, a fiber optic coil is used as the sensing element, and the current to be measured is passed through the coil,

The monitoring of current in real time is crucial for the maintenance of the power grid system. In this paper, we propose and

Yes, fiber optic current sensors are highly suited for hazardous environments, including those with explosive gases,

In principal, different modulation/demodulation principles can be used for sensing multiple external physical

Optical current sensors are not plagued by magnetic ferro-resonance or saturation problems and there is no

Principle of Fiber Optic Current Sensing System

potential

Fiber optic current sensing exploits the Faraday effect within optical fibres to measure electric currents by detecting magnetically

Explore fiber optic sensors: their working principles, types (intrinsic, extrinsic, hybrid), and diverse applications in mechanical,

Brief theory of sensing principle, fabrication method, applications, advantages and disadvantages of the different fiber

Optical fiber sensors (OFSs) have emerged as essential tools in the monitoring of physical, chemical, and bio-medical

Fiber optic current sensors work by detecting changes in light as it interacts with a magnetic field created by an

This article deals with the measurement of electric current in the energy via optical fibers.

Furthermore, multiple sensing elements can be integrated to create a distributed fiber optic sensing system that can simultaneously

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