Dual-source fiber optic current sensor

Article Overview

A dual-source fiber optic current sensor (FOCS) uses optical fibers and the Faraday effect to measure electrical current with high accuracy, often employing dual channels or modulation techniques to enhance sensitivity and reduce cross-talk.

Working Principle

Dual-source or dual-channel fiber optic current sensors operate based on the Faraday effect, where the plane of polarization of light rotates in response to a magnetic field generated by the current in a conductor . The rotation angle is proportional to the current magnitude, allowing precise measurement. Optical fibers serve as the sensing medium, providing galvanic isolation, immunity to electromagnetic interference, and flexibility in sensor placement .

Modulation Techniques

Advanced dual-source FOCS often use dual modulation methods to improve performance:

o Acousto-optic modulators (AOM) generate pulsed light, controlling amplitude and duty cycle to optimize sensitivity and reduce backscattered light .
o Electro-optic modulators (EOM) apply phase modulation to enhance anti-interference capability and improve signal-to-noise ratio .
o Carrier-transposed modulation in dual-channel sensors eliminates cross-talk between channels, enabling multi-channel current measurement without additional hardware . These techniques allow the sensor to achieve high resolution and sensitivity, with some systems capable of detecting currents as low as a few milliamperes and ranges up to hundreds of amperes .

Advantages

Dual-source FOCS provide several benefits over traditional current transformers:

o High accuracy and repeatability, often +-0.02% for DC currents .
o Wide measurement range, suitable for microcurrents to high-power industrial currents .
o Bi-directional current measurement and detection of AC/DC currents .
o Immunity to stray magnetic fields and electromagnetic interference .
o Compact and flexible installation, adaptable to busbars or transformer windings .
o Digital and analog outputs, enabling integration with control systems and smart grids .

Applications

Dual-source fiber optic current sensor

Dual-source fiber optic current sensors are widely used in:

o High-voltage and ultra-high-voltage networks for precise current monitoring .
o Industrial processes, including electrochemical plants, where harsh environments require robust sensors .
o Pulsed current and plasma measurements, benefiting from high bandwidth and fast response .
o Smart grid and multi-channel monitoring systems, leveraging dual-channel designs to measure multiple currents simultaneously without interference .

Summary

Dual-source or dual-channel fiber optic current sensors combine the Faraday effect, optical fiber technology, and advanced modulation techniques to provide highly accurate, interference-resistant, and flexible current measurement solutions. Their ability to measure both AC and DC currents, along with multi-channel capability, makes them ideal for modern industrial, high-voltage, and smart grid applications .

This improvement by three orders of magnitude shows potential for magneto-optic waveguides to be used in ultra-high sensitivity

Abstract Optical fiber current sensor (OFCS) based on Faraday magneto-optic effect has many advantages of immunity against

In this paper, an approach to achieve simultaneous measurement of electric current and real-time vibration is proposed

Simultaneous alternating current (AC) and direct current (DC) measurement is demonstrated with a new fiber sensor

The new ABB Fiber-Optic Current Sensor is a development of a sensor first used in high-voltage substations. Now available for uni-

In this paper we demonstrate the design of a low-cost optical current sensor. The sensor principle is the Faraday

Now available for uni- or bi-directional dc current measurement up to 500kA, with corresponding sensor head sizes, it offers an easily

Abstract:Acousto-optic modulator (AOM) and electro-optical modulator (EOM) are applied to realize the all-fiber current sensor with

The FOCS system utilizes the Faraday effect to measure current. A simple loop of optical fiber is wound around the busbar in place

A fiber-optic current sensor (FOCS) is a device designed to measure direct current. Utilizing a single-ended optical fiber wrapped

An optoelectronic oscillator (OEO)-based fiber optic current sensor (FOCS) with greatly improved sensitivity is

A dual-channel fiber optic current sensor based on carrier-transposed modulation technique is proposed and demonstrated. The

We present a method to simultaneously measure the temperature and electric current, which can be applied for the all-fiber optic

In this paper, we propose a modulation - demodulation method based on dual closed-loop feedback to measure the

The proposed scheme provides a promising approach for dual-channel current measurement with the advantages of compactness

Highlights o A modulation and demodulation scheme for fiber optic current sensors with dual closed-loop feedback is

Web: https://www.kremgroup.co.za