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Fiber optic sensor for liquid level detection



Overview

Hydrostatic pressure measurement with optical sensors enables precise long-term monitoring of liquid levels.

Key Takeaways

Fiber optic sensors detect liquid levels using light reflection and refraction, offering high accuracy, non-contact measurement, and suitability for harsh environments.Working Principle

Fiber optic liquid level sensors operate based on total internal reflection. A fiber optic cable transmits light from a source to a receiver. When the light encounters a boundary between the fiber core and cladding, a portion of it escapes depending on whether the fiber is in contact with a liquid. This change in light intensity is measured to determine the liquid level. Some advanced systems use wavelength and intensity multiplexing (IWDM) to monitor multiple points with a single sensor, enhancing accuracy and reducing costs .

Advantages
• Non-contact Measurement: Eliminates corrosion, contamination, and mechanical wear, making them ideal for hazardous or corrosive liquids .

• High Accuracy and Precision: Capable of detecting small changes in liquid levels with high repeatability .

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• Temperature and Environmental Resistance: Can operate reliably in extreme temperatures and harsh industrial conditions, including oil, gas, and chemical processes .

• Flexibility and Compactness: Small size allows installation in confined spaces and integration into existing systems .

• Low Maintenance: No moving parts reduce downtime and maintenance costs .

Applications

Fiber optic liquid level sensors are widely used in:

• Oil and Gas: Tank monitoring, leak detection, and fluid control .

• Chemical and Petrochemical Industries: Handling corrosive or hazardous liquids safely .

• Water and Fuel Storage: Accurate monitoring in reservoirs and transport systems .

• High-Speed Industrial Processes: Real-time monitoring where rapid response is critical .

Advanced Techniques

Modern systems often incorporate deep neural networks (DNNs) to improve accuracy in multiplexed setups, where multiple sensors monitor several points simultaneously. This approach reduces cross-talk and enhances prediction of liquid levels compared to traditional machine learning methods like random forests or support vector machines .

Example Products

• KEYENCE FU-95Z Fiber Unit: Designed for precise liquid level detection in industrial applications, part of the FS-N40 series .

• Custom IWDM-based FBG Sensors: Allow multiple-point monitoring with a single sensor, suitable for cost-effective and high-accuracy setups . Fiber optic liquid level sensors combine high-speed response, environmental resilience, and precise measurement, making them a superior choice for modern industrial and hazardous applications.

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Article Content

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FU-95Z, Liquid-level-detection Fiber Unit in FS-N40 series by KEYENCE America.

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Liquid level sensor using fiber bundle

Abstract Liquid level sensors can be constructed using a pair of bundle probe based on fiber-optic displacement

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Fiber Sensors

Detection Principles Optical fiber is comprised of a central core with a high refractive index surrounded by cladding with a low

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