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Innovative Digital Energy Meter with Overload Indication and Power Theft Monitoring

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Abstract:

An energy meter, also known as a watt-hour meter, is a device used to measure the quantity of electrical energy consumed by a home or building. It is typically installed by the utility company or a qualified electrician at the main electrical panel or circuit breaker box. Energy meters can be mechanical or digital in nature. Mechanical meters use rotating dials or a spinning disc to measure energy consumption, while digital meters use electronic sensors and display screens to provide real-time energy usage data. This paper explains the development of a smart energy meter with overload protection and power theft control features. The proposed meter employs a microcontroller-based system that monitors and records the energy consumption of a household or building. The system also incorporates an overload protection mechanism that automatically switches off the power supply when the load exceeds a safe limit, thereby preventing damage to the electrical appliances and wiring. In addition to the overload protection, the smart energy meter is equipped with a power theft control feature that detects and reports any unauthorized tampering with the meter. This is achieved by monitoring the voltage and current levels, and comparing them with the expected values based on the load and power factor of the connected appliances. If any discrepancies are detected, an alert is generated, and the utility company is notified.

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I. Introduction

Digital energy meters are advanced energy measuring devices that are becoming increasingly popular in modern times. These meters utilize the latest technology to measure the consumption of electricity with greater accuracy than traditional analog meters. They are widely used in commercial and residential buildings to monitor and measure energy usage, providing essential data that can be used to make informed decisions about energy usage, billing, and maintenance. The need for digital energy meters arose from the inadequacies of traditional mechanical meters that were prone to errors and tampering [1]. Traditional meters required manual reading and estimation, which could result in inaccurate billing and disputes between consumers and energy providers. The lack of accuracy in traditional meters meant that energy providers could not accurately measure and bill customers for their actual energy consumption. The advent of digital energy meters has revolutionized the energy industry, providing more accurate measurements and enabling more effective energy management [2]. Digital energy meters are electronic devices that measure energy usage in real-time and store data for later retrieval. These meters use a digital display to show the energy consumption in kilowatt-hours (kWh), which is a measure of the amount of energy consumed in a given time [3]. The digital display allows consumers to easily monitor their energy consumption and make changes to their energy usage to reduce their overall consumption. One of the most important advantages of digital energy meters is their ability to accurately measure energy usage, ensuring that consumers are billed for the exact amount of energy they consume [4]. The accuracy of digital energy meters is not affected by environmental conditions such as temperature and voltage fluctuations, which can cause errors in traditional mechanical meters. Digital energy meters are also resistant to tampering, making them more reliable and secure. Another advantage of digital energy meters is their ability to provide real-time data on energy consumption, enabling consumers to monitor their energy usage in real-time. This real-time data can be used to identify areas where energy consumption can be reduced, enabling consumers to make informed decisions about their energy usage [5]. This can result in significant cost savings and reduce the carbon footprint of the building. Digital energy meters can also be integrated with other energy management systems to provide a comprehensive overview of energy consumption. These systems can include building automation systems, renewable energy systems, and energy storage systems. By integrating digital energy meters with other systems, energy consumption can be effectively managed, resulting in reduced costs and improved energy efficiency. In conclusion, digital energy meters have revolutionized the energy industry by providing accurate and reliable measurements of energy consumption. These meters provide real-time data on energy usage, enabling consumers to monitor and manage their energy consumption effectively. Digital energy meters are becoming increasingly popular in commercial and residential buildings, and their integration with other energy management systems is enabling effective energy management and cost savings [6]. As technology continues to advance, digital energy meters will continue to play a vital role in the efficient management of energy consumption.

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