



APPLICATION NOTE

Enhancing Smart Meter Protection with Bourns® IsoMOV™ Hybrid Protectors



Bourns® IsoMOV™ Hybrid Protectors

Introduction

Smart meters have become indispensable tools in modern energy management. They enable precise, real-time monitoring of power usage and facilitate efficient distribution. As key components of the smart grid, smart meters bridge the gap between utility providers to consumers, enabling two-way, instantaneous communication.

However, the increasing complexity of the technologies integrated into smart meters presents new challenges in safeguarding their sensitive components from electrical disturbances. These components require robust circuit protection to help ensure continuous, reliable operation, especially as they are more vulnerable to damaging surges and transients.

This application note outlines the components in a smart meter design, the challenges in protecting them, and the advanced solutions provided by Bourns® IsoMOV™ Hybrid Protectors. Readers will gain insights into the common threats to smart meter reliability, the limitations of traditional protection methods, and how IsoMOV™ technology addresses these challenges to enhance the durability and performance of smart meters.

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Inside a Smart Meter

Smart meters are comprised of several interconnected components that work in tandem to deliver real-time energy monitoring and communication. Key components include the power system, communication module, analog front-end (AFE), and microcontroller unit (MCU).

The power system typically consists of a switched-mode power supply that converts incoming AC power into the DC power required to operate the smart meter's electronics. Additionally, a battery backup system is usually installed to help maintain uninterrupted operation during power outages.

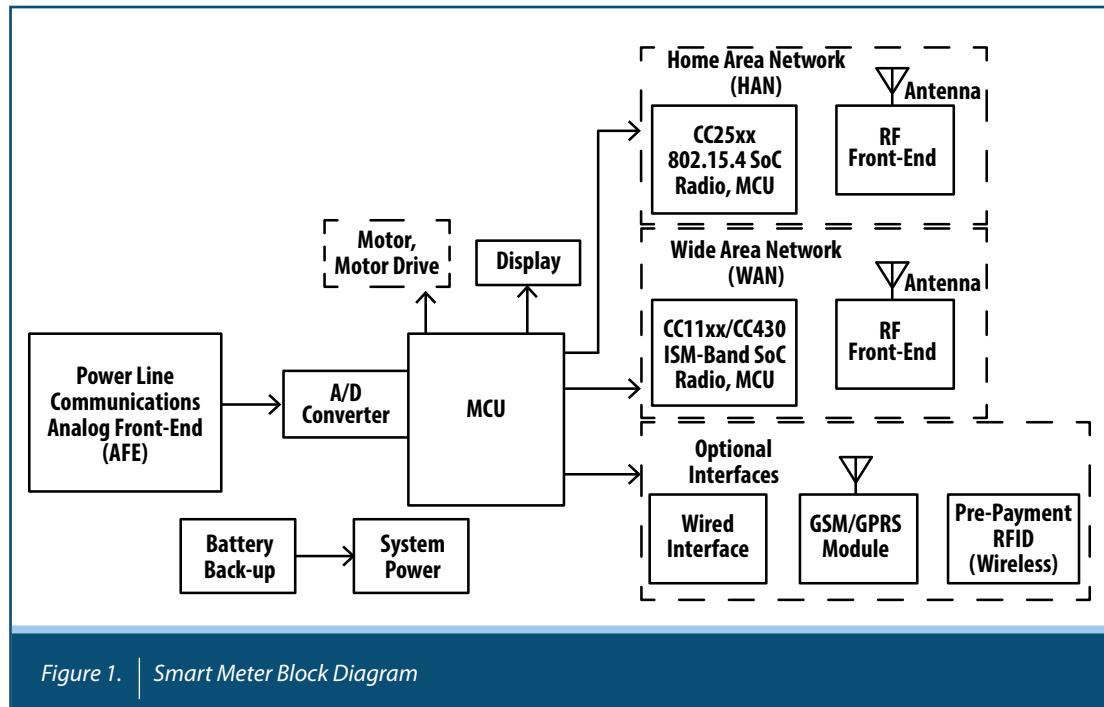


Figure 1. | Smart Meter Block Diagram

These components work together to enable the smart meter to provide continuous monitoring, accurate power measurement, and seamless data communication, making them an essential part of modern smart grid infrastructure.



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Challenges in Smart Meter Protection

Smart meters often operate in environments with fluctuating electrical conditions.

Key threats include:

- **Overvoltage Events:** Variations in the power supply can stress smart meter components, potentially leading to failure.
- **Transient Voltage Spikes:** These brief, high-energy pulses on the power line can disrupt communication and measurement functions. Power surges and transients caused by events such as lightning strikes, switching operations, and other power line disturbances can damage internal components.

Traditionally, Metal Oxide Varistors (MOVs) have been widely used for overvoltage protection in smart meters. While effective, MOVs have limitations, such as degradation over time due to continuous exposure to line voltage, surge events, and temperature fluctuations. This degradation can lead to increased leakage currents, reduced performance, and ultimately, device failure.

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A Better Approach to Overcoming Protection Challenges

Bourns designed its IsoMOV™ Hybrid Protectors to provide a superior solution that combines the strengths of Gas Discharge Tube (GDT) and MOV technologies in a single integrated package. This hybrid design offers an elevated level of protection by:

- **Addressing MOV Degradation and Ensuring Reliability:** By integrating GDT technology, IsoMOV™ protectors address the common degradation issues typically associated with standard MOV-only designs, which are prone to thermal runaway under prolonged stress. This hybrid approach not only enhances application longevity but also ensures superior reliability, a critical factor for smart meter manufacturers obligated to provide long-term warranties. In demanding environments such as unstable AC networks, IsoMOV™ protectors minimize the risk of failures, saving customers from potential brand erosion. This enhanced reliability aligns with the primary driver of e-meter demand, ensuring consistent performance even under the most challenging conditions.
- **Handling High Surge Events:** IsoMOV™ devices are engineered with features that can withstand severe transients and overvoltage conditions. These features safeguard the essential continuous operation smart meters demand even in challenging environments.

The hybrid design of the IsoMOV™ protector enables this innovative device to address the traditional drawbacks of MOVs, providing an advanced alternative that meets the demands of high performance smart meters and other critical infrastructure equipment.

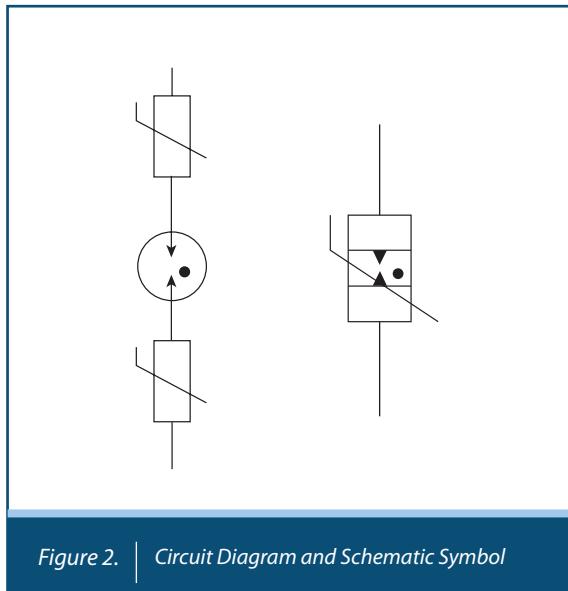


Figure 2. | Circuit Diagram and Schematic Symbol

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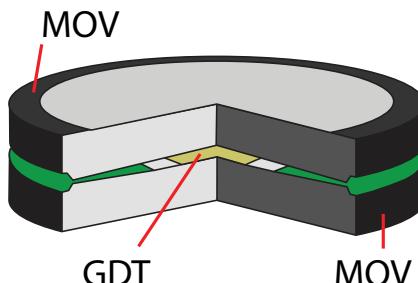
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IsoMOV™ Protector Technology: Features and Benefits

The combination of device technologies designed into IsoMOV™ protectors offer several benefits for smart meter applications:

- **Integrated Design: Drop-In Solution for Enhanced Protection:** The integrated GDT-MOV design of IsoMOV™ protectors not only minimizes leakage current and extends the lifespan of the protection component but also simplifies implementation. While the benefits of a hybrid approach can be achieved with a discrete solution, IsoMOV™ protectors offer these advantages without the hassle of redesigning the e-meter circuit. As a drop-in solution, they seamlessly integrate into existing designs, providing a straightforward and efficient upgrade path for enhanced reliability and protection.
- **Superior Surge Ratings with Optimized Form Factor:** Bourns® IsoMOV™ protectors offer surge ratings of 3 kA, 5 kA, and 8 kA (IsoM3, IsoM5, and IsoM8), combining enhanced performance with a compact design. They allow designers to maintain surge ratings with a smaller size or increase ratings without changing the form factor, making them ideal for space-constrained applications.
- **High Voltage and Temperature Tolerance:** With an operating temperature range of -40 °C to +125 °C, IsoMOV™ protectors can reliably perform in extreme temperatures, making them suitable for outdoor and industrial environments.
- **Enhanced Reliability:** IsoMOV™ protectors feature a safe end-of-life failure mode that ensures connected equipment remains protected. The device is designed to cleanly disconnect by blowing the line fuse when it reaches the end of its operational life.

These features are a distinct benefit of IsoMOV™ protectors, boosting them as a reliable, long-lasting protection solution with minimal maintenance requirements.



FEATURES

- AC voltage ratings: 175 V - 555 V
- Nominal surge ratings: 3 kA - 5 kA - 8 kA
- -40 °C to +125 °C operation
- Low leakage current
- Low capacitance
- Stable performance over life
- UL Listed UL 1449 Type 4 CA
- IEC 61051-2/ IEC 61051-1 Certified (TÜV Rheinland)
- RoHS compliant*

*RoHS Directive 2015/863, Mar 31, 2015 and Annex.

Figure 3. | The Construction of The IsoMOV™ Protector Offers Functionality and Protection Advantages

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Where Protection is Needed in Smart Meter Designs

IsoMOV™ protectors deliver various crucial protection functions within smart meter design:

- **Power Supply Lines:** Safeguards the primary power input from voltage spikes, protecting the meter's power system and ensuring continuous operation.
- **Sensitive Electronics:** Effectively shields essential components, such as the microcontroller, from overvoltage events. By mitigating high-energy surges, it ensures the integrity of critical measurement and processing functions.

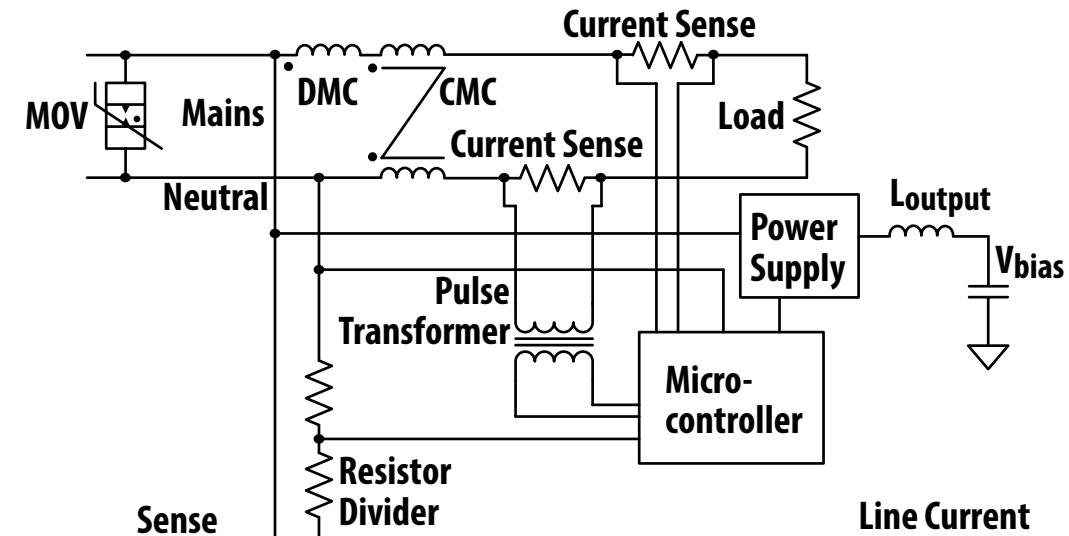


Figure 4. | Surge protection in the AFE interface

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Conclusion

By integrating IsoMOV™ hybrid protection technology into smart meter designs, developers are able to significantly enhance reliability and longevity of the essential energy assets. Addressing the limitations of traditional MOV-only protection, IsoMOV™ protectors provide a solution that withstands certain harsh conditions, reduces maintenance needs, and supports the long-term functionality required in smart grid applications. As a versatile and robust protection component, IsoMOV™ protectors help ensure that smart meters are consistently protected against surges and transient threats, contributing to a more stable, effective and efficient energy infrastructure.

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