# How to Select the Right Bourns® IsoMOV™ Component for Maximum Protection

WHITE PAPER

Bourns® IsoMOV™ Hybrid Protectors

## INTRODUCTION

Bourns designed its IsoMOV™ hybrid protectors as versatile protection components that seamlessly blend the best of both worlds: the reliability of a Metal Oxide Varistor (MOV) and the durability of a Gas Discharge Tube (GDT). This hybrid design ensures long-lasting, effective protection for a wide array of applications.

But what is the right IsoMOV™ hybrid protector model for a particular application?

This white paper outlines the considerations developers should evaluate when selecting the ideal IsoMOV™ protector. It covers the following key factors:

- Surge Protection Needs: Assess the severity and frequency of anticipated surges.
- Voltage Levels: Determine the operating voltage range of your system.
- Energy Handling Capacity: Consider the maximum energy that the IsoMOV™ protector must absorb.
- Environmental Conditions: Verify temperature, humidity, and other environmental stresses.

This paper provides detailed explanations of these factors as a helpful guide to choosing the right model that best safeguards a specific system design.

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## UNIQUE CONSTRUCTION

The IsoMOV™ protector leverages the combined power of GDT and MOV technologies. This unique integration results in a device that offers superior surge protection and reliability.

By working in tandem, the GDT and MOV provide comprehensive protection where:

1. The GDT blocks leakage currents that could prematurely degrade the MOV.
2. The MOV suppresses follow-on currents that might damage the GDT.

This symbiotic relationship ensures optimal performance and extended lifespan, safeguarding electronic systems from a wide range of electrical threats.

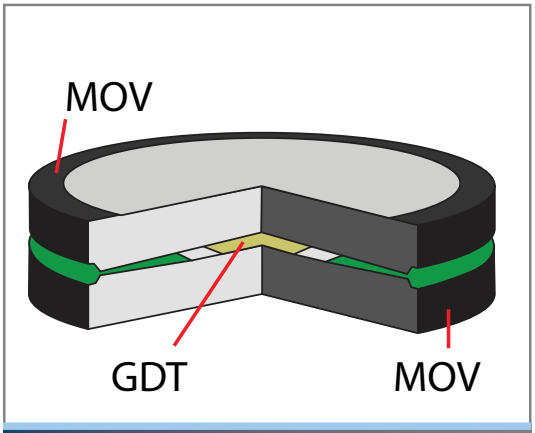


*Figure 1 - IsoMOV™ Contruction*

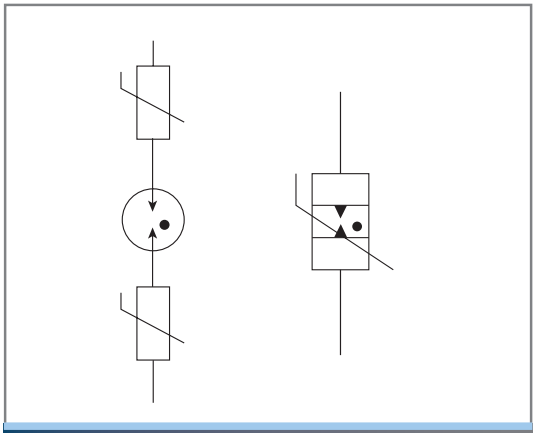

*Figure 2 - Circuit Diagram and Schematic Symbol*

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## STEP 1: UNDERSTANDING A SYSTEM'S VOLTAGE AND TYPE

### AC or DC Power

- **AC Systems:** AC systems often experience higher frequency transients.
- **DC Systems:** While typically lower voltage, DC systems can be susceptible to surges of longer duration.

### Nominal Voltage Rating

- **Maximum Continuous Operating Voltage (MCOV):** Ensure the IsoMOV™ protector's MCOV is higher than the system's nominal voltage to prevent accidental triggering.
- **Safety Margin:** A 1.1x multiplier is a common guideline for selecting the appropriate voltage rating. Example: For a 240 VAC system, it is recommended to select an IsoMOV™ with an MCOV of 275 $V_{rms}$ or higher.

### UL 1449 Compliance and LCAOV

- **Unstable AC Networks:** For applications connected to AC networks with frequent overvoltage events (swells), it is important to consider the network's Limited Current Abnormal Overvoltage (LCAOV) rating.
- **LCAOV Rating:** This parameter indicates the device's tolerance to overvoltage for a limited duration (typically less than 7 hours). Example: The Model ISOM5-275 IsoMOV™ protector can withstand 400 $V_{rms}$ for up to 7 hours.

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## STEP 2: IDENTIFY SURGE REQUIREMENTS

### Assessing Surge Current and Energy Handling ($I_{max}$ & $I_{nom}$)

Bourns offers multiple models; each is available with varying surge current capabilities:

- **IsoM3:** Nominal surge rating of **3 kA**
- **IsoM5:** Nominal surge rating of **5 kA**
- **IsoM8:** Nominal surge rating of **8 kA**

### Distinguish Surge Sources

- **Lightning Strikes:** Direct or indirect strikes can generate high-energy surges.
- **Switching Transients:** Electrical switching operations can cause transient voltage spikes.

### Evaluate Surge Frequency and Intensity

- **High-Frequency Surges:** In environments with frequent switching events (e.g., industrial settings with large motors), select an IsoMOV™ hybrid protector with a higher energy handling capacity.

### Overall Surge Protection Guidelines

By carefully analyzing the system's specific surge characteristics, it is possible to select the right IsoMOV™ model that provides reliable protection against potential damage.

- **Surge Current Rating:** Ensure the IsoMOV™ protector's surge current rating exceeds the maximum expected surge current in your system.
- **Energy Handling Capability:** Consider the frequency and intensity of surges to select a model with adequate energy absorption capacity.

### Determine the Optimum Nominal Discharge Current ($I_{nom}$) Rating

Determining the $I_{nom}$ rating necessary for a particular system allows designers to select the correct IsoMOV™ component that provides the right level of robust protection without sacrificing longevity.

- **Surge Protection Level:** Choose an IsoMOV™ model with an $I_{nom}$ rating that aligns with the desired level of protection.
- **Safety Margin:** Ensure the $I_{nom}$ rating is significantly higher than the typical surge current to avoid overloading the device and compromising its lifespan.
- **Example:** For a system with regular 3 kA surges, an IsoM5 model with a 5 kA $I_{nom}$ provides an appropriate safety margin.

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## STEP 3: EVALUATE ENERGY ABSORPTION CAPABILITY

Understanding the energy handling requirements of the system is essential in selecting the most appropriate IsoMOV™ model that provides reliable protection and longevity.

### Energy Handling

- **Surge Energy:** Assess the energy levels of potential transients and surges.
- **GDT Advantage:** Incorporating a GDT into the hybrid design of IsoMOV™ protectors enhances energy dissipation compared to MOV-only devices.
- **Surge Frequency and Duration:** Consider the frequency and duration of surge events, as repeated exposure to high-energy surges can impact the device's lifespan.

### Selecting the Right Energy Rating

- **High-Energy Environments:** For applications in certain harsh environments (e.g., outdoor installations, thunderstorm-prone areas), it is recommended to use Bourns® IsoMOV™ Model IsoM8 with higher energy absorption capacities.
- **Energy Rating Unit:** The energy rating is typically measured in joules (J).
- **Lifespan:** A higher energy rating ensures longer operational life, especially in environments with frequent surge events.

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## STEP 4: CLAMPING VOLTAGE AND LET-THROUGH VOLTAGE

The careful consideration of both clamping voltage and let-through voltage enables designers to choose the correct IsoMOV™ component that provides optimal protection for a specific application and operating environment.

### Clamping Voltage ($V_c$)

- **Voltage Limitation:** The clamping voltage is the maximum voltage the IsoMOV™ protector allows during a surge. This value depends on the surge current rating. To calculate the maximum clamping voltage at different current levels, the I-V curve should be referenced.
- **Component Protection:** Ensure the clamping voltage is low enough to protect sensitive components without causing damage.
- **Surge Current Impact:** Clamping voltage can increase with higher surge currents.
- **Example:** For a circuit tolerating 800 V, select an IsoMOV™ model that maintains this clamping voltage during peak surges.

### Let-Through Voltage ($V_{fp}$)

The careful consideration of both clamping voltage and let-through voltage enables designers to choose the correct IsoMOV™ component that provides optimal protection for a specific application and operating environment.

- **Hybrid Component Consideration:** Due to an IsoMOV™ protector's hybrid nature, the $V_{fp}$ parameter becomes important.
- **$V_{fp}$ Definition:** $V_{fp}$ is the voltage that appears across the device during the initial phase of a surge before the main discharge channel fully forms. It corresponds to the initial surge impulse response of a GDT, typically lasting less than 300 ns with very low energy.
- **Impact on Sensitive Devices:** A lower $V_{fp}$ is beneficial for protecting highly sensitive components.

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## STEP 4: CLAMPING VOLTAGE AND LET-THROUGH VOLTAGE (Continued)

### Front Protection Voltage ($V_{fp}$)

It is highly advised to be aware of the $V_{fp}$, which occurs during the initial phase of a surge. The $V_{fp}$ is essentially a transient voltage spike that can last less than 300 ns and results from the combined impulse voltage of the GDT and MOV, in series. While $V_{fp}$ is typically high when no load is present, it becomes attenuated with a load connected. Designers need to evaluate the sensitivity of equipment to these initial transients. If equipment is highly sensitive, it is necessary to manage the $V_{fp}$ effectively by considering load conditions. Understanding this will help to select the correct IsoMOV™ model that has the appropriate $V_{fp}$ characteristics.

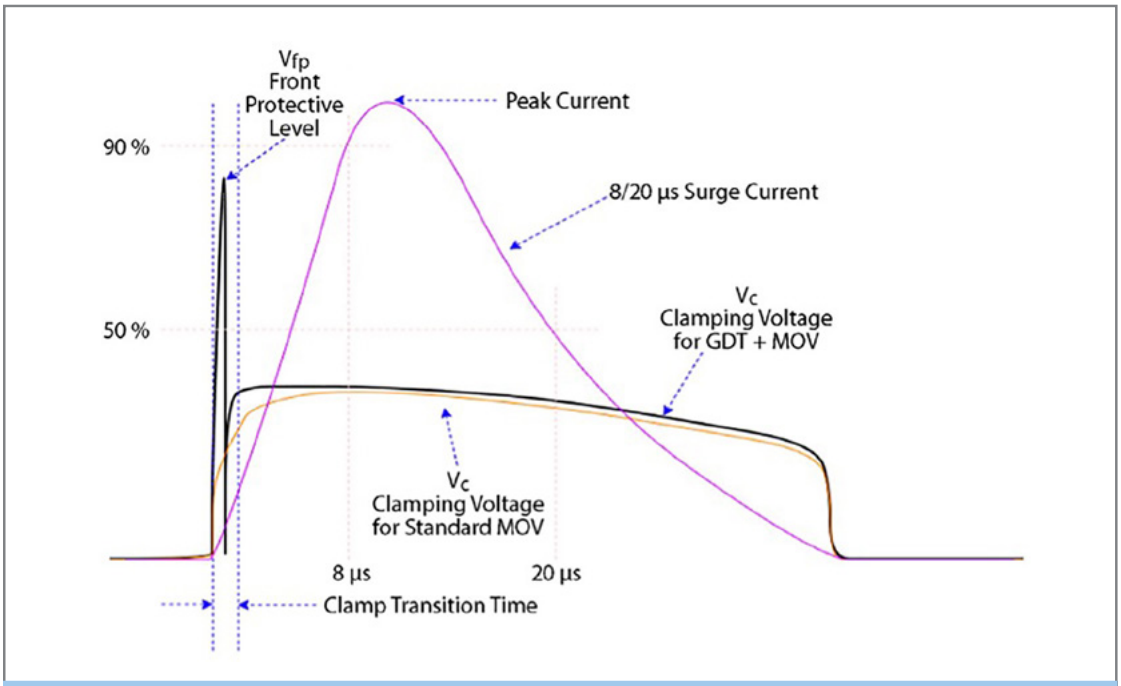


*Figure 3 - Comparison Between a Standalone MOV and a Hybrid Component Like an IsoMOV™ Protector*

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## STEP 5: ENVIRONMENTAL CONSIDERATIONS

Thorough evaluation of the application's environmental factors is a key step in selecting the right IsoMOV™ model that will help ensure long-term reliability and system performance.

### Temperature Range

- **Operating Temperature:** It is key to make sure that the IsoMOV™ protector's operating temperature range (-40 °C to +125 °C) aligns with the application's requirements.
- **Extreme Temperatures:** For applications that operate with extreme temperature fluctuations (e.g., outdoor installations, rooftop solar inverters), select a model tested for stability and reliability in such conditions.

### Humidity and Environmental Conditions

- **Harsh Environments:** The IsoMOV™ protector's integrated design provides reduced leakage current and low maintenance, which is especially advantageous in challenging environments.
- **Protective Measures:** For high-humidity or corrosive environments (e.g., marine applications, coastal installations), designers should choose models with appropriate protective coatings or encapsulation.

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## STEP 6: APPLICATION-SPECIFIC REQUIREMENTS

To select the appropriate IsoMOV™ protector model, developers need to verify application-specific requirements in order to ensure optimal protection for the system.

### AC Power, DC Power, and Motor Drives

- **Industrial Applications:** IsoMOV™ protectors are well-suited for industrial applications due to their ability to protect against AC and DC power surges.
- **Motor Drives:** The inductive nature of motor loads can generate high back EMF. The hybrid GDT and MOV design delivers effective protection against these surges.

### Power Line Communications and Sensitive Electronics

- **Low Capacitance:** The IsoMOV™ protector's low inherent capacitance makes it ideal for power line communication and high-speed communication line applications.
- **Signal Integrity:** It is necessary to select an IsoMOV™ model with a capacitance rating that minimizes interference with the communication signal.

### DC Applications

- **Solar Power Inverters and Battery-Powered Equipment:** DC applications require a surge protection solution that features an appropriate breakdown voltage to prevent conduction during normal operation.
- **High-Energy Transients:** The hybrid IsoMOV™ component design is capable of effectively handling high-energy transients commonly found in DC systems.

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## STEP 7: COMPARING ISOMOV™ HYBRID PROTECTOR MODELS

Determine the features needed to adequately protect a given system design.

### IsoM3 Series

- **Moderate Surge Requirements:** Suitable for general-purpose equipment with low to medium surge exposure.
- **Nominal Discharge Current:** 3 kA

### IsoM5 Series

- **Moderate to High Surge Requirements:** Ideal for environments with moderate surge risks, such as light industrial applications and control panels.
- **Nominal Discharge Current:** 5 kA

### IsoM8 Series

- **Frequent or Severe Surges:** Recommended for industrial applications with frequent or high-intensity surge exposure, such as outdoor installations and motor drives.
- **Nominal Discharge Current:** 8 kA

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## CONCLUSION

Selecting the right IsoMOV™ hybrid protector involves a careful assessment of a system's specific surge protection needs. By considering factors such as surge requirements, operating voltage, energy handling capacity, and environmental conditions, designers can better choose the solution that gives them the most optimal protection to increase system reliability and longevity.

### Overview of Key Considerations

- **Surge Requirements:** Evaluate the severity and frequency of anticipated surges.
- **Operating Voltage:** Choose a model with an appropriate voltage rating.
- **Energy Handling Capacity:** Select a model that can handle the maximum energy of potential surges.
- **Environmental Conditions:** Consider temperature, humidity, and other environmental factors.

For more product information, please refer to the Bourns website to view the IsoMov™ data sheet. Additional assistance is available by working with a Bourns application engineer, who can help guide designers to the right IsoMOV™ hybrid protector model.


www.bourns.com

**Americas:** *Tel* +1-951 781-5500
*Email* americus@bourns.com

**EMEA:** *Tel* +36 88 520 390
*Email* eurocus@bourns.com

**Asia-Pacific:** *Tel* +886-2 256 241 17
*Email* asiacus@bourns.com

**Mexico:** *Tel* +52 614 478 0400
*Email* mexicus@bourns.com