Failure-Free ISB Fusing: Why It Is the Industry Best

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The fusing of transient voltage suppression systems (TVSS) is a much discussed and often misunderstood critera when comparing and specifying suppression devices. This paper will examine:

- the purpose of fusing suppression filter systems,
- the role fusing plays in the performance of a TVSS device,
- different approaches to fusing, and
- how the Integrated Suppression Bus® (ISB) in the Current Technology EGPE2® Electronic Grade PanelBoards and Select®2 and TransGuard® suppression filter systems provides thew best reliability, safety and protection.

Why do TVSS devices need fusing?

The answer is a simple one: safety! Should a component failure, fault or short occur within the supression filter system, it is imperative that the event be resolved in a safe manner which ensures that no repercussions (damage or corruption) are experienced by adjacent loads or by the electrical distribution system itself.

What causes failure within a TVSS product?

Occurences that can lead to faults within a TVSS device include component failures (malfunction of MOVs, SADs, or capacitors, for example), printed circuit board failures, failure of modules, monitoring system malfunction or failure, installation mistakes and overvoltage conditions.

While no credible manufacturer would deliberately design a product with failure as an option, the reality is that the potential for malfunction is present in all electrical devices. Therefore, it is critical that failures – regardless of how infrequent – occur in a safe manner that minimizes damage and presents no risk to human life.

Dealing with faults and failures

Several approaches may be used in the attempt to provide fault current protection to an electrical device. The most common approaches are fuses and circuit breakers. Both are designed to halt the flow of current following the determination that too much current is flowing with respect to time. In the event of a fault condition, the fuse or circuit breaker opens and the flow of current is thereby interupted.

Overcurrent is another event that will cause a circuit breaker or fuse to operate. When the current rating of the breaker or fuse is exceeded – in other words, the load is drawing more current than the device and associated wiring are designed to safely withstand – the overcurrent device will open and, once again, stop the current flow. Since overflow events are a function of load-handling devices, they are typically not a concern for parallel-connected TVSS products.

Regardless of the cause, the goal is to clear the fault as quickly and as close to the point of occurance as possible, thereby isolating and confining the problem and preventing it from affecting the distribution system or other loads.

What can fail within a TVSS device and what happens if it does malfunction?

The most obvious weak links for electrical failure within a transient voltage suppression system are the suppression components – MOVs, SADs, etc. Shorting is typically the initial failure mode. Provided that the current is sufficient (and the fault current protection is slow enough), the MOV might blow itself open, which will result in an open circuit and take the MOV out of the circuit. This scenario is the exception rather than the rule. To ensure that MOV failure does not incapacitate a TVSS product, component-level failures must be isolated and removed from the system. How manufacturers choose to fuse their products can dramatically affect the long-term operation of the suppression device.

Fusing: Yesterday's weak link

Until recently, fusing has been a common weak link in virtually all TVSS products available in the marketplace. Industry manufacturers, including Current Technology, had to rely on the fusing made available by fusing manufacturers. These fuses would often open in the event of large magnitude transients. Testing conducted by Current Technology on competitive units and their fuses revealed that the competitors' fuses as well as on new Current Technology units and their fuses revealed that the competitors' fuses were likely to operate after a large impulse had passed through the suppression device. While the TVSS product may perform as designed by suppressing the transient, the device could be rendered offline until the fusing is replaced.

Fuses react to current over time. This data is commonly made available by fuse manufacturers in the form of I^2t curves. The likelihood of fuse operation rises as the amount of current increases with respect to time. It is important to remember that this is the intended function of the fuse, and that this characteristic is the reason that fuses may operate under transient conditions.

No fuse manufacturers have developed a fuse that can safely clear faults while allowing large ampacity transient currents to pass. That is why Current Technology committed extensive R&D resources to develop just such a revolutionary fuse – a fuse that would meet and exceed requirements unique to TVSS.

The result: The industry's first UL 248-1 recognized fuse

Current Technology produced the TVSS industry's first UL-248-1 Recognized fuse. Tested and UL Recognized at 200 kAIC (fault current rating), this exclusive and proprietary fuse design allows the suppression filter system to survive a full surge current rating transient event without failure or operation of a single fuse component. The fuse also provides a high level of safety and system protection for the user. No other TVSS manufacturer provides this advanced, performance-extending feature.

How does the fuse work?

This revolutionary fuse is the heart of the Current Technology EGPE2, TransGuard and selenium-enhanced SELect suppression systems. The devices incorporate the Current Technology Failure-Free ISB™ suppression filter assembly. Within the ISB, all suppression and filtering components are connected in series with individual fuses. Should a component fail (creation of a short), the fuse will operate (open) and remove the failed component from the system, thereby ensuring seamless, uninterrupted performance of the Currrent Technology TVSS product.

Using 10kA MOVs, it is a design constraint that each suppression component not to be subjected to more than its rated current value. Assuming proper product application along with worst-case design criteria, no suppression component will ever be subjected to more than 10kA of transient current. With these parameters in mind, the goal is a design that eliminates the fuse as source of product failure or downtime.

Within the Failure-Free ISB, a common copper collector bus receives the full magnitude transient current which is then sent to individual fuse chambers. The current traveling through each fuse is a function of the full magnitude surge current traveling down the collector bus divided by the total number of fuse elements. For example, an 80kA device subjected to a 40kA transient would permit each of the eight-fuse-plus-MOV combinations to see only one-eighth of the total current, or 5kA.

The net effect is the industry's first UL 248-1 Recognized fuse that is self-contained and self-encapsulated; has an electrical input and output; is tested at 200kAIC (fault current); and is able to survive the full rated surge current magnitude without fuse operation.

UL 248-1: The facts

Underwriters Laboratories standard 248-1 covers the general requirements for low-voltage fuses rated 1000 V or less, AC and/or DC, with interrupting ratings up to 200 kAIC. While the standard's intent is safety, it also demonstrates the integrity inherent in Current Technology's unique and exclusive design. Not only can Current Technology's fuse provide performance unequaled by any other fuse in existence, it also maintains all of the safety and coordination capabilities required in a fuse.

Conclusions

At R&B Enterprises, Current Technology's new UL 248-1 Recognized fuse successfully survived testing under full magnitude surge current conditions.

It is far superior to the external fusing approach previously used by Current Technology which was, at the time, the best fuse in the industry. Although the external fusing permitted fuse replacement and provided fuse failure notification, it could possibly have been a weak link under extreme transient conditions.

Integral to the SELect and TransGuard systems, Current Technology's UL 24-1 Recognized fuse (patent-pending) ensures permanent, continuous fuse operation. No other TVSS manufacturer provides products that deliver the maximum performance and proven reliability found in Current Technology suppression filter systems.

The ISB incorporates Current Technology's innovative internal fusing for uninterrupted protection at higher levels. The fusing is the first UL 248-1 UL recognized fuse and is integral to Current Technology TransGuard, EGPE2 and Select 2 (Select 2 300 shown here) surge suppression products.

Specifying engineers and end-users are encouraged to compare test results of Current Technology's Select 2 and TransGuard suppression filter systems which feature the ISB with competing products. Independent test data supports all claims made in this document and is available upon request to Current Technology factory-trained sales representatives.

To learn more about Current Technology products or discuss other power reliability issues with our Applications Engineers, call 1-800-238-5000 or 804-236-3300.

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