GE Energy
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Power Quality
Surge Protective Devices (SPD)

application notes: response time ratings

A limited number of surge suppression manufacturers continue to publish ratings that include "Response Time" as a measure of SPD performance. However, this rating primarily serves to confuse instead of validating the true speed of response for an SPD. Therefore, speed of response ratings for SPD assemblies should not be promoted as a critical SPD requirement for the following reasons:

Response time ratings that are found within SPD specification documents are not based on actual testing performed on SPD assemblies. Instead, these ratings are derived from the manufacturer ratings for discrete suppression components that are used within the SPD assembly. These discrete component manufacturers of MOV, diodes and other suppression components test for response times at the component substrate level without connecting leads or wires. It should be fully understood that this rating, in no way represents a complete SPD assembly test, nor how an SPD will react to a fast rising transient in application.

Neither NEMA™, UL nor IEEE® has chosen to endorse response time as a valid SPD rating parameter. NEMA removed reference to speed of response prior to the 1991 release of the LS-1 guideform standard for a couple of reasons. First, there are no universally accepted test procedures for accurately measuring speed of response that would be suitable for the complete SPD assembly. Second, and more important, speed of response is not critical unless the SPD were to utilize suppression components that are "too slow" to react to surges that have peak voltage rise-times that are measured in microseconds as defined in IEEE C62.41.2 – "Characterization of Surges in Low-Voltage AC Power Circuits".

Most SPDs use conventional protection technology of MOV's and/or diodes. These components have more than an adequate response time to "turn on" and mitigate voltage surges within the electrical distribution environment. The response time of a typical MOV component is 1000 times faster than the time it takes for a surge to reach it's peak voltage potential as defined by IEEE C62.41 surge test waveforms. (approximately 1.2 microseconds). Manufacturers that claim assembly response times in the sub micro-second, nano-second or even pico-second ranges are promoting a requirement that nature itself would struggle to meet as light cannot even travel a distance of one meter that fast! A voltage potential could not sustain a rise time on the order of a nano-second while propagating through electrical wiring conductors that have intrinsic inductive characteristics that impede the speed and affect the waveshape of the impulse.

A manufacturer who uses Silicon Avalanche Diode (sad) or Avalanche Breakdown Diode (abd) technology may push "response time" as a critical performance parameter. However, it is well -documented that the actual response-time performance of an sad-based SPD is no better than that of an MOV-based SPD. This is because the "response time" of any parallel-connected SPD is affected more by the internal wiring/connection than the speed of the sad (or MOV) components themselves. For example, a sad may be able to react with sub-microsecond speed, but the internal wiring and external connecting leads within the SPD add inductance (about 1 to 10 nanohenrys per inch). This inductive effect is by far the dominating factor in overall response time - not the sad or MOV reaction time.

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Manufacturers, who proclaim response time ratings based on discrete sub-components with the intent to maintain that their SPD assembly will have a greater level of performance based solely on these ratings, are doing so with intent to gain a marketing advantage. However, these same manufacturers are not able to produce any proof, based on reliable empirical study of a complete SPD assembly that backs up speed or response performance claims.

The domain in which Avalanche Diodes provide response-time benefits associated with their speed is the arena where there are small distances between the source of a surge and the device to be protected from a surge.

Additional commentary can be found on the NEMA Surge Protection website. Below is an excerpt from the NEMA site (http://www.nema.org/) on the subject of SPD response speed:

Speed of response: Is this important in itself?

Yes and No. The ability of a surge protective device (SPD) or surge component to respond to a voltage which exceeds its "turn-on" threshold, will govern the residual clamping voltage which the downstream equipment will be required to withstand. If the device is too slow, the clamping voltage will be high and the equipment may not be adequately protected. This said, too much is often made of manufacturers of "speed-of-response". What is more important is the "clamping or residual voltage" performance of the SPD. It is also worth noting that nanosecond transients can not travel far on power wiring, thereby limiting their occurrence in practice".

imagination at work

DET-733 (8/10)

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