Thomas&Betts

Power Solutions

WHITE PAPER

INTEGRATED VS. NON-INTEGRATED SPDs

Is an integrated surge protection device the best choice?

The purpose of this paper is to expose false claims made by panel-integrated surge protection device manufacturers.

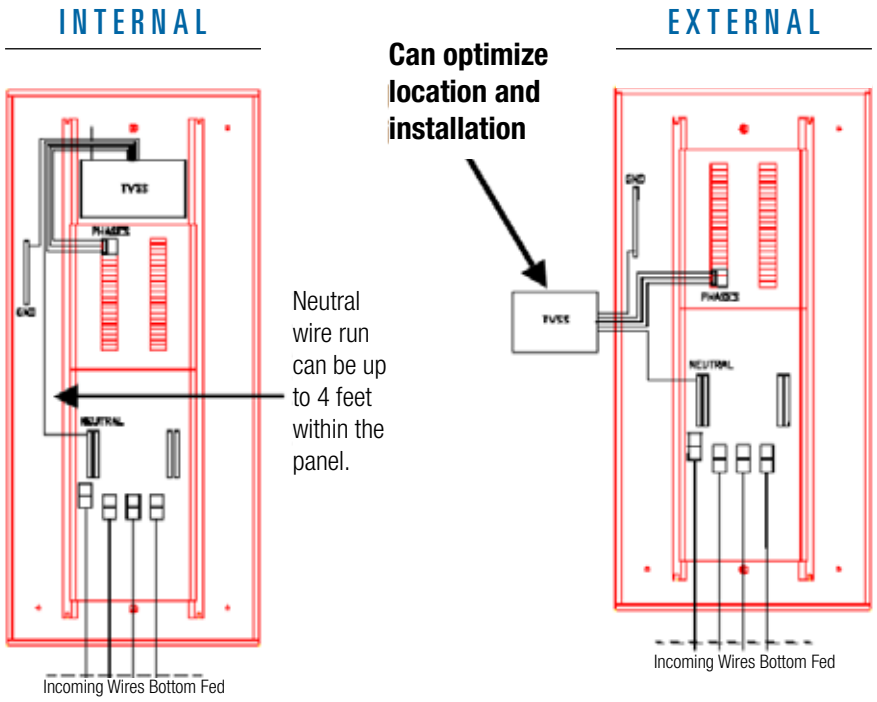
Thomas and Betts Power Solutions
Written by: Chris Martin, SPD Product Manager

For years, panel board manufacturers have been touting that their panel-integrated SPDs (Surge Protection Devices) outperform externally mounted SPDs because they have the shortest lead lengths. In fact, all SPD manufacturers suggest in their installation instructions to keep the lead length as short as possible. Per UL 1449 and IEEE C62.45, all surge manufacturers evaluate their products with six inches of lead length. **The six inch lead length is chosen so that all SPD products can be evaluated based on the same test setup and criteria.** Also, some modular based SPD products only advertise the clamping levels of the individual modules used in their systems, not the clamping levels of the entire system.

As a matter of practice in selecting surge protection devices, it pays to find out from the manufacturer if the test data provided is for the overall system and not just for the individual module. Tests have shown that every foot of standard cabling added to the installation length of an SPD increases the clamping levels, or let-through voltage, by as much as 60–100 volts per foot. This exposure to let through voltage can put your critical equipment at serious risk.

LEAD LENGTH

SPD testing is performed on each mode of the device. Per IEEE C62.45, the suppressed voltage rating of a 6kV, 500A surge or the voltage protection rating of a 6kV, 3kA surge are tested on units that have six inches of lead length external to the unit. As an example, the surge current's path during one of these tests would travel from a surge generator to the line or hot wire of an SPD. The surge would then travel six inches to the outside wall of the SPD. How far the surge travels inside the SPD depends upon the design and size of the SPD. The returning surge current exits the SPD and travels through an additional six inches of lead length back to the surge generator, which then displays a clamping voltage for the unit under test. The key point here is that the surge has to travel not only through the line conductor, but also through the neutral conductor. In this example, the surge current travels a minimum of twelve inches; the length of the neutral conductor plus the length of the hot conductor, and whatever lengths are internal to the SPD.



The overall installed system lead length dictates the let through voltage capability of the installed SPD. An integrated SPD tapped directly to the bus may have a very short connection to the phases but the installed clamping level must take into account the lead length of the Neutral and Ground conductors as well. Most integrated SPDs are installed at the top or bottom of an extended panel board and the Neutral and Ground buses are typically at the opposite end. If you follow the path the surge would have to take, the overall length for this type of installation can be up to six feet or longer, which are significantly longer lead lengths than most integrated surge manufacturers mention in their marketing material.

With proper installation, it is possible for an externally mounted SPD to be tapped to the bus or occupy a breaker position close to the Neutral and Ground bus. This provides a shorter overall system lead length, allowing for better clamping performance than an integrated SPD.

SURGE HANDLING CAPABILITY

Some internally mounted surge protection devices are being listed as Type2 SPDs to the UL1449 3rd Edition standard. Type2 SPDs must be installed behind an upstream, over current protection device because the SPD cannot pass UL1449 without it. These devices are relying on the upstream device to trip or fail, removing the SPD from the circuit before it fails destructively. If an SPD that is rated at 200kA per mode is installed behind a 30A breaker, the single surge rating of that system will be reduced to the lowest single surge rated component. Figure1 below depicts circuit breakers trip and fail kA levels when subjected to an 8x20 microsecond wave shape. A 200kA SPD installed behind a 30A breaker would only be able to handle a 40kA surge before the breaker trips and removes it from the circuit.

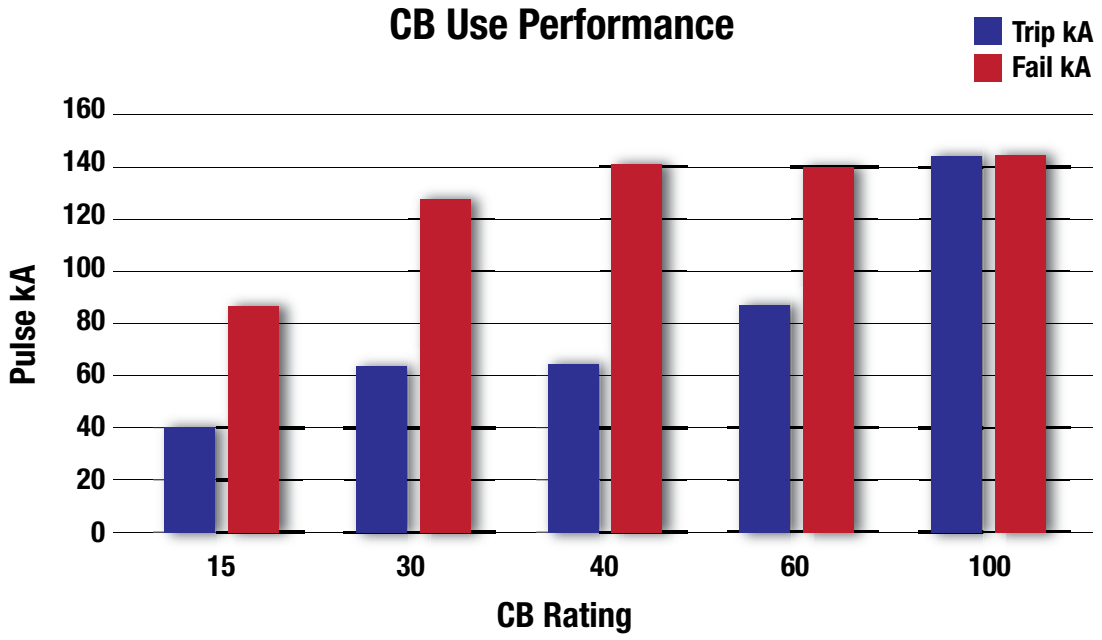


Figure 1

SPD FAILURES

SPD devices have a finite life. In UL 1449 (February, 2007), changes to the safety regulations that pertain to SPDs addressed real world concerns regarding catastrophic failures of SPDs. Prior to the introduction of intermediate fault currents that were included to expose the metal oxide varistors weakness to temporary over voltage events, SPDs subjected to a temporary over voltage event would continually conduct and go into a thermal runaway condition,

catching fire and causing damage. SPDs internal to the gear that failed in this manner ended up, in most cases, taking out the entire panel. Fortunately UL1449 was changed to include testing that would ensure this kind of failure would not happen. However even a benignly failed SPD device must be replaced at some point in time. Replacing any part of an internally mounted SPD device leaves three options.

Option 1: Shut down the main breaker to the panel so that all power is off during repair and or replacement of the internally mounted SPD.

Option 2: Leave the failed SPD installed and do nothing. It is common for failed integral SPDs to be left un-repaired.

Option 3: The operator must work on the panel live because critical equipment connected to the panel cannot be shut down. The operator must wear the appropriate personal protective equipment based on the equipment ratings and available fault current, which may require tinted glasses or a hood. Add bulky, cumbersome gloves and a dimly lit closet where most panel boards are located and you have the makings for an on-the-job accident. Statistics based on hospitalization records suggest that every day in the United States, five to ten arc flash events involve a fatality or serious injury to an employee.

OSHA and the NFPA are taking arc flash issues very seriously and suggest to all building owners that personnel working on live gear must wear the appropriate protective personal equipment.

SUMMARY

Contrary to widely held beliefs internally mounted SPDs do not actually have the better performance suggested by their claimed shorter lead lengths. In actuality the total surge path of the integral SPD is longer because it includes the long run to the neutral. Internally mounted SPDs may fail in a safe, benign manner, but that does not diminish the unnecessary exposure to the worker who must repair or replace the unit. Type 2 SPDs must be mounted behind an over current protection device, limiting the overall surge current rating of the installation. Externally mounted SPDs can have lead lengths just as short, if not shorter, than integrated SPDs. The repair or replacement of an externally mounted SPD does not require the shut down of the entire panel or unnecessary exposure to live voltage. A Type 1 SPD externally mounted offers a more robust SPD without limiting the surge rating of the device by requiring an upstream over current protection device.