Comparing TVSS Protective Characteristics - UL 1449, Second Edition SVR vs. Cat. B3 and C3 Clamping Voltages

Although UL 1449 has made significant improvements to testing TVSS devices (herein referred to as SPDs – Surge Protective Devices) and developing a Suppressed Voltage Rating (SVR) system that puts all manufacturers on an even playing field, there is still confusion in the industry. Manufacturers continue to strive for better "looking" ratings in order to differentiate themselves from the pack and many consultant specifications include "typical clamping voltage" data that is not in a format that can be compared easily with other manufacturers. Unfortunately, many ratings are based on testing that is not clearly defined and appear to be something that they are not. The only way to compare the protective characteristics from one manufacturer to the next is to compare the UL 1449, Second Edition SVR, but this can often be difficult to recognize.

Defining the Rating

The Suppressed Voltage Rating (SVR) is a value that is assigned to an SPD by UL to indicate its protective characteristics. Each mode of the SPD is subjected to three impulses of a 1.2/50μs, 6kV voltage waveform and a 8/20μs, 500A current waveform. The "measured limiting voltage" is measured at the ends of 6" leads extending from the terminals of an OEM product or 6" extending from the enclosure of a wall-mounted SPD. The average of these three measurements is then compared to the following chart and an SVR is assigned per each mode.

Average Measured Limiting Voltage	Assigned SVR
330V or less	330V
331V – 400V	400V
401V – 500V	500V
501V – 600V	600V
601V – 700V	700V
701V – 800V	800V
801V – 900V	900V
901V – 1000V	1000V
1001V – 1200V	1200V
1201V – 1500V	1500V

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One of the more significant changes made to UL 1449 is way the Suppressed Voltage Rating (SVR) is measured and assigned. The changes are two-fold:

- The peak current magnitude is now 500A versus the prior value of 3kA.

- The measured limited voltage is now measured at the ends of 6" leads that extend from the terminals of an OEM product or 6" from the enclosure of a wall-mounted product.

It is important to note that the SVR is not a clamping voltage, let-through voltage or a voltage that the protected equipment will experience. It is simply an assigned value based on testing that is useful when comparing the protective characteristics of different SPDs. The voltage that the protected equipment experiences is a function of:

- MOV protective characteristics
- SPD parasitic inductance
- Lead lengths when installed on the facility system
- Magnitude and rate of rise of the surge event
- How the surge event attenuates in the facility system.

The Significance

The changes in UL 1449 are a step in the right direction because it allows the evaluator the luxury of knowing that all manufacturers have tested in the same way. Prior to the Second Edition changes, few manufacturers tested a *complete* SPD but, instead, tested a single module or only the part of the SPD that housed the Metal Oxide Varistors. This meant that testing *excluded* the parasitic inductance of the SPD. Parasitic inductance is made up of internal leads, connections, fuses, etc. In fact, this practice could eliminate 24" or more of lead length from the tests. This is substantial because the added inductance produces additional voltage drop that is added to the clamping voltage of the MOV module. (See Figure 1 below). It is interesting to note that some manufacturers no longer supply UL 1449, SVR information in their literature which implies that their numbers have changed dramatically. **Instead, literature refers to "Typical Clamping Voltage Data" based on B3 and C3 waveforms.**

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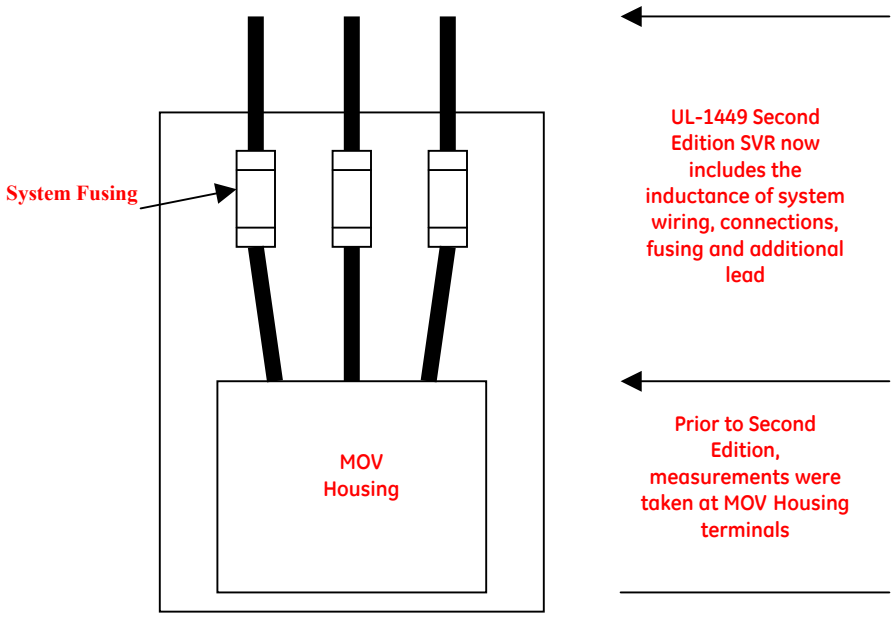
Figure 1 – Typical OEM TVSS



The issue with Category C3 and B3 data is that there are no standards that dictate where the measurements are to be made. At first glance, the numbers look attractive but it becomes evident that they do not include the voltage drop created by parasitic inductance in the SPD or any additional lead. Because there are no standards that dictate where to measure, it is likely that the measurements are made, once again, at the module terminals or directly off the MOV housing. The changes in the UL-1449 standards clearly indicate that the practice of providing protective characteristic data that ignores the SPD parasitic inductance and cable leads is not acceptable.

Conclusions

It's evident that the standards need to be updated so those include additional guidance on where protective ratings are to be measured. The meaning of some ratings is anybody's guess without a clear definition. As a rule, ANSI/IEEE C62.41 Category B3 and C3 ratings should only be used when it is clear that all manufacturers are measuring the same way. Until the standards change it is imperative that the evaluator ask the right questions, such as, "where are these measurements made?" **The only way to equally compare the protective characteristics today is to use the UL 1449, Second Edition SVR**.

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