

## **UL 1449 VPRs and IEEE MLVs A Clarification**

The purpose of this article is to help clarify differences between the Voltage Protection Rating (VPR) marking provided as a result of the listing of a Surge Protective Device (SPD) to ANSI/UL 1449-2006 and the results reported from testing an SPD using IEEE Standard C62.62™-2010 (to be published in 2011, formerly published in 2000) and C62.41.2™-2002 as Measured Limiting Voltages (MLV).

The IEEE standards define MLV as follows:

- The maximum magnitude of voltage that is measured across the terminals of an SPD during the application of a series of impulses of specified wave shape and amplitude.

In basic terms, the MLV is simply the result of a test. It is very important for the user of this data to know the following parameters when considering and attempting to compare MLVs:

- The test waveform used.
- The amplitude of the test waveform.
- Was steady state voltage applied when the test was performed?
- How was the MLV measured? (For example, from the zero crossing reference or from the peak of the sine wave to the peak of the surge.)
- What sampling rate setting used for the oscilloscope when the MLV was recorded?
- What was the memory depth and bandwidth of the oscilloscope used to measure the MLV?
- Was filtering used to remove noise from the result? Was the measured noise subtracted from the MLV without using filtering?
- Is the result an average of several applications of the specified impulse? Or a single shot? The minimum result? The maximum result?
- Is the result the average of each mode of protection or a single mode of protection? For example, for a three-phase Wye connected SPD, there are three lines to neutral modes - Phase A to Neutral, Phase B to Neutral and Phase C to Neutral. If the result is reported as Phase to Neutral, how does that relate to the individual modes of protection?

These issues are discussed within C62.62™-2010. The standard requires that this information be detailed when the results are reported. However, the standard does not establish specific requirements for all of these parameters - only that this information is to be reported so that comparisons between SPDs can be made based upon the parameters reported. Inspection of the specification sheets and MLVs reported by Surge Suppression Incorporated will

reveal that the parameters discussed above are detailed as part of reporting these results so that users of the SPDs can properly evaluate the reported MLVs.

In contrast to the MLV discussed above, the VPR from ANSI/UL 1449-2006 is more clearly and specifically defined since it is not a direct result but a rating based on a particular surge test which includes several MLV results averaged together to determine the VPR.

The VPR is determined using the MLV measured during the pre-test of the Nominal Discharge Current Test. As part of the Nominal Discharge Current Test, the pre-test MLV is compared to a post-test MLV to determine if the SPD has suffered degradation during the Nominal Discharge Current Test. The pre- and post-tests are completed using a 6 kV / 3 kA Combination Wave with steady-state nominal system voltage applied during the test. The results are measured from the zero-crossing reference of the sine wave to the peak of the surge. This is repeated three times for each mode within a mode of protection; that is, each mode (A-N, B-N, C-N) within the Line to Neutral mode of protection (to continue with the same example from above). The three MLVs are then averaged together for each mode (A-N, for example) and then averaged again including each mode within a mode of protection (again, A-N, B-N, C-N for the Line to Neutral mode of protection).

The result is a composite average across a mode of protection that is the average of the three results for each mode for each of the three modes. Finally, this composite average is then compared to table of predetermined values (typically in increments of hundreds of volts) and the next highest value in the table is selected as the VPR for that particular mode of protection.

Although the VPR may seem to be a convenient rating for the comparison of SPDs, it should be understood that it only represents a single waveform and amplitude and it is not an actual result of a test but rather a rating based on an average of MLVs. In most cases, it is beneficial to understand the performance or make comparisons between SPDs using other wave shapes and amplitudes. A common example of additional data that is often of interest to the SPD user is the MLVs resulting from the application of IEEE Standard 100 kHz Ring Wave at various amplitudes. These results are more representative of what the SPD would encounter in its actual installation due to much more commonly occurring internally generated surges.

In summary, an MLV is a specific result from any number of tests specified by the manufacturer or user from the IEEE SPD standards. A VPR is a rating assigned from a list of predetermined values derived from the averaging of multiple MLVs based on the result of an impulse from a 6 kV / 3 kA Combination Wave surge generator. Either can be used for comparison or evaluation given that the parameters associated with a particular MLV are known while the parameters of the VPR are defined. It is likely beneficial to the user

**or specifier to consider more data points than just the VPR when comparing the performance of SPDs.**

**For additional information on the standard surge waveforms specified by the IEEE, please see IEEE Standard C62.41.2<sup>TM</sup>-2002 and C62.62<sup>TM</sup>-2010.**

**For additional information, contact your SSI representative or call **1-888-987-8877**.**