

UL 1449 Standard for Safety for TVSS (eff. February 16, 1998)

An overview of the second edition requirements for transient voltage surge suppression and the impact of the revisions to the standard.

Introduction:

Underwriters Laboratories satisfied a much called for need to the industry at large when the first edition of UL 1449, the Standard for Safety for Transient Voltage Surge Suppressors was published August 25, 1985. The standard adopted select test waveforms from the IEEE C62.41 . However, soon after the introduction of the standard it became evident that certain issues needed to be addressed, most notably with regard to the „fail-safe“ operation of surge suppression components contained in these devices under abnormal service conditions or „end-of-life“ degradation modes specific to metal-oxide varistors.

After a number of years the proposed second edition of UL1449 was published August 25, 1996. The effective date assigned to these new and revised requirements is February 16, 1998. It should be noted however that Hardwired products (panels and receptacles) have been extended to August 17, 1998.

It is the responsibility of manufacturers and specifiers to make available the safest product to the end-user and consumer. The following outlines a comparison of the „old“ versus „new“ UL1449 and the impact of these Second Edition requirements.

The Scope of UL1449:

A good place to start a review of UL1449 is the scope of the standard. This is where issues can be clearly defined as to what does and does not apply to the Listing of a product bearing the UL – TVSS mark. It should be noted that unlike most other standards bodies including ANSI, IEEE, NEMA and IEC; UL has elected not to use the term Surge Protective Device (SPD). It is generally accepted that the terms TVSS and SPD are one in the same.

The Scope of UL1449 contains the following:

1. The requirements cover transient voltage surge suppressors intended for permanently connected, cord-connected and direct plug-in applications on 50 or 60 Hz power circuits not exceeding 600v ac.
2. These requirements are intended for installation on the load side of the main overcurrent protection.
3. These requirements do not cover the interconnection of multiple field installed TVSS.
4. These requirements cover TVSS employing circuit components specifically intended to function as filters for conducted electromagnetic interference (EMI) or noise, in addition to limiting transient voltage surges.
5. These requirements do not cover Secondary Surge Arresters intended for use on the line side of the main overcurrent protection.

Test Requirements:

UL1449 has basic safety tests no different from most UL standards for safety. These tests include leakage current, dielectric withstand, insulation resistance, temperature rise and mechanical integrity tests such as impact, drop, crush and mold stress relief distortion for plastics among others. For the sake of this discussion only tests specific to surge protectors will be covered here.

Measured Limiting Voltage Test:

Suppressed Voltage Ratings (SVR) are assigned based on subjecting products to the following waveforms. These waveforms are combination impulses described in IEEE C62.41. The rise and decay wavforms are; 1.2 by 50 us for open-circuit voltage and 8 by 20 us for short-circuit current. Ratings are measured from zero ground to the peak of the „clamped“ transient level.

Product Type	The „Old“ Table Voltage / Current Impulse	The „New“ Table Voltage / Current Impulse
Panels & Receptacles	6 kV 500 A	6 kV 500 A
Strips & Plug-ins	6 kV 3000 A	6 kV 500 A

It is also important to note that Hardwired products are measured at the end of Six inches of lead length recommended in the manufactures installation instructions.

The „old“ UL1449 would measure directly at the terminals of hardwired equipment; devices with integral leads were always measured at six inch lead length.

Duty Cycle:

SVR is assigned based on the before and after levels described in the table below.

It should be noted that three samples are tested and the before and after duty cycle measurements shall not deviate by more than ten percent. The rating is then assigned based on the average of the total of six before and after measurements.

Product Type	The „Old“ UL1449 24 Shots	The „New“ UL1449 20 Shots
Panels & Receptacles	6 kV / 750 A	6 kV / 3000 A
Strips & Plug-ins	6 kV / 125 A	6 kV / 500 A

Maximum Surge Current Test:

This is a new test added to UL1449 with the intent for a device to withstand a relatively high surge current and not be degraded to the point of causing a risk of fire or shock hazard. Panels and receptacles are subject to two shots of a 10 kA / 6kV impulse. Strips and plug-ins are subjected to a 3 kA / 6 kV impulse.

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Abnormal Overvoltage Tests:

These are the most notable of new tests introduced in the standard. There are three:

1. *Temporary Over Voltage:* The device is connected to 125 percent of the normal system voltage for seven hours and must not result in risk of fire or shock hazard
2. *Full-Phase System Overvoltage:* This test subjects the device under test to a simulated „Loss of Neutral“. For example, a device intended for 120/240v systems will be connected to 240v. Again, after the test the device shall not exhibit evidence of a risk of fire or shock hazard.
3. *Limited Current Overvoltage:* This test subjects the device under test to increasing levels of „standby current“ through each mode where an MOV is connected within the device. The test basically simulates an „end-of-life“ degradation, or thermal runaway scenario. Again, at the conclusion of the test there shall be no evidence of a risk of fire or shock hazard. Verify also includes a dielectric withstand (hipot) and leakage current tests.

There may be various approaches in design of a product to pass these tests including several methods of properly fusing MOVs, or just over-rating the maximum continuous operating voltage for the MOVs employed in the device. Obviously the latter design will result in a safe, but high SVR, or clamping level.

Product Markings:

Believe it or not, UL has elected not to require any changes in the „UL – Listed TVSS“ marking. In the case of the consumer purchasing a basic surge strip it will be left to honest labeling on packaging to state any claims to compliance to the new, second edition UL1449.

Fortunately for the specification community, compliance to the new UL 1449 can be verified by the actual UL Listing Card. UL has changed the format for the TVSS Listing Card from merely listing catalog numbers of Listed products under the TVSS category to providing a table with suppressed voltage ratings (SVR) for each model by mode.

Suppressed Voltage Ratings are required to be marked on the product by each mode. The measured limiting voltage is rounded up to the following SVR assigned levels:

330v pk	600v pk	900v pk	1500v pk	2500v pk	5000v pk
400v pk	700v pk	1000v pk	1800v pk	3000v pk	6000v pk
500v pk	800v pk	1200v pk	2000v pk	4000v pk	

SUMMARY:

UL1449, the Standard for Safety for Transient Voltage Surge Suppressors – 2nd Edition

- A UL Listed TVSS must be installed on the LOAD side of the main service disconnect. Devices connected LINE side are Secondary Surge Arresters which are Listed by UL under „desk“ standard ANSI/IEEE C62.11.
- A UL Listed TVSS may be install OUTDOORS if evaluated to UL50 with appropriate NEMA Type rating assigned to the device.
- A UL Listed Series-operated/connected TVSS must be tested and assigned an Available Fault Current Withstand rating (AIC). Series-operated devices are also known as Two-Port Surge Protectors.
- A UL Listed Parallel-operated/connected TVSS does not require an AIC rating.
- The term SVR denotes Suppressed Voltage Rating. This is the assigned „Clamping“ voltage with respect to zero volts (ground) to the peak of the „clamped“ voltage.
- Cord-connected and Direct plug-in TVSS are assigned SVR based on 6kV / 500A (Duty Cycle (20 shots))
- Hardwired Panel and Receptacle TVSS are assigned SVR based on 6kV / 500 A at the end of 6 inch leads.