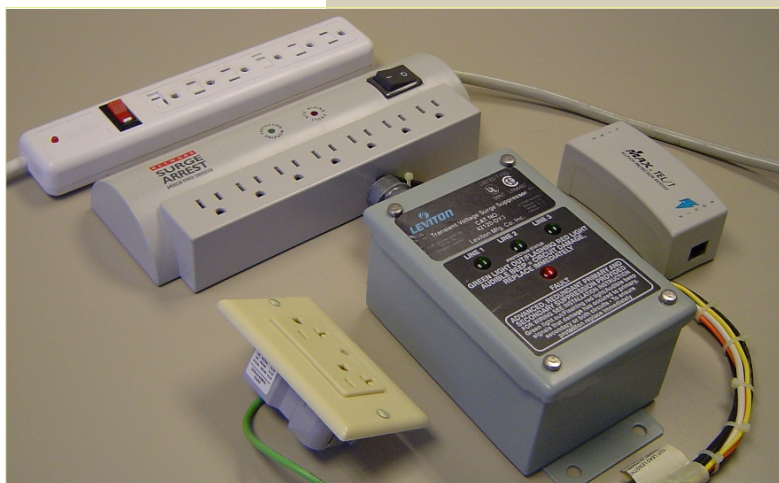


TESTING OF PLUG-IN TRANSIENT VOLTAGE SURGE SUPPRESSORS



BACKGROUND

Sensitive electronic equipment has come into widespread use in residential and commercial power systems. Many electronic loads need supplemental protection from damaging transient voltage surges which may be present on the power system. Surges have a number of origins, most notably lightning. However, many surges are the result of switching loads or circuits on or off. The need for surge protection has spawned the development of a wide variety of transient voltage surge suppression products. One popular method for providing protection against transient voltage surges for small sensitive electronic loads is the use of plug-in transient voltage surge suppressors (TVSS).

These TVSS products plug into a standard 120 V outlet, and the sensitive load is plugged into the TVSS.

OBJECTIVE

The objective of the following tests was to determine the electrical performance of three plug-in TVSS products on the market today. Tests were conducted on TVSS products to determine surge clamping levels, durability, tolerance to steady-state voltage variations, and device failure modes. Other characteristics, such as consumer safety and packaging integrity, that may be included in product safety listing agency tests (such as UL 1449), were not evaluated as part of the tests.

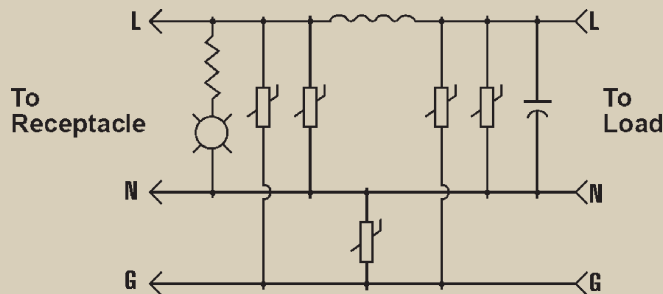


Figure 2. Typical Configuration of Plug-In TVSS

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TEST RESULTS

■ CLAMPING VOLTAGE TESTS

Three samples of each brand were surge tested eight times in each mode (L-N, L-G, and N-G) with ANSI/IEEE C62.41 1.2/50 ms, 6 kV peak open circuit, 8/20 ms, 500 A peak short-circuit combination waves. The average let-through (clamping) voltages for each brand tested varied from 310 V to 400 V.

The average let-through (clamping) voltages for each brand tested varied from 87 V to 466 V for line-to-neutral surges, and from 300 V to 423 V for line-to-ground and neutral-to-ground surges.

■ DURABILITY TEST

Three samples of each brand were surge tested 24 times in each mode (L-N, L-G, and N-G) with ANSI/IEEE C62.41 1.2/50 ms, 6 kV peak open circuit, 8/20 ms 125 A peak short circuit combination waves. All samples withstood the repetitive surges without degradation, indicating reasonable durability.

■ STEADY-STATE VOLTAGE TESTS

The products were operated with the supply voltage at 120% of nominal to test their tolerance to possible overvoltage conditions. For products with 130 V MOVs, the applied voltage exceeded the MOVs rated voltage. Operation above the MOVs rated voltage increased the standby current and can result in loss of life.

■ FAILURE MODE TESTS

Samples of each brand were intentionally operated at a controlled increasing voltage to initiate thermal runaway, thus causing device failure. The voltage at which thermal runaway began for all brands was approximately 180 V. Each brand was tested with an available RMS shortcircuit current of 1700 A. Upon failure, one brand caused the test setup branch breaker to trip. One brand caused slight charring of the cheesecloth wrapped around the units during the test to detect potential fire hazard. All brands emitted some smoke when the MOV(s) failed. Some product status lights did not indicate that the unit had failed.

For more information,
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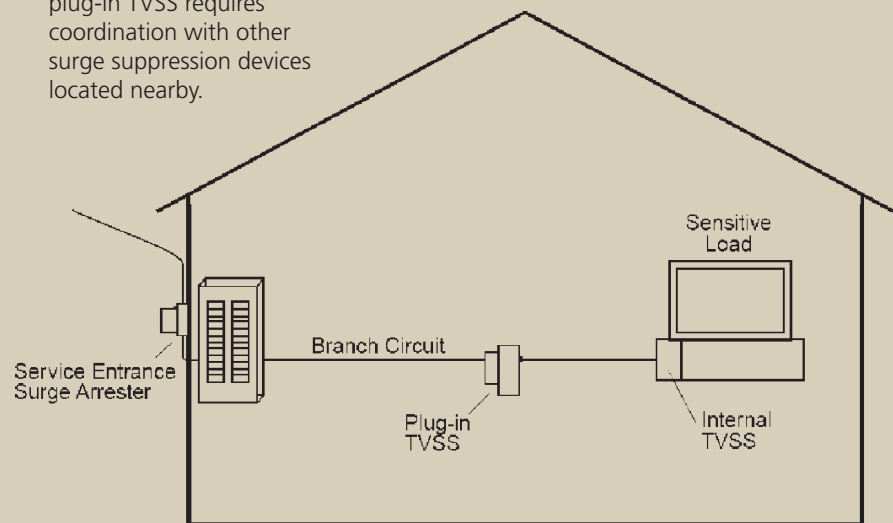
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DISCUSSION

There is a great variety of TVSS products on the market today; most use MOVs as the surge suppressing technology. One temptation is to seek out low surge clamping voltage performance. However, lower clamping voltages are not necessarily better if they are accompanied by lower MOV voltage ratings. Too low an MOV voltage rating leaves the MOV vulnerable to high line voltage conditions and swells, increasing the likelihood of premature failure. Additionally, too low a clamping voltage can cause surge coordination problems with other TVSS devices. These may be located throughout the building, such as service entrance TVSS devices or TVSS embedded in sensitive electronic equipment, (see Figure 2). Generally, 150 V MOVs are recommended to be used in 120 V applications.

With plug-in TVSS products, unit overcurrent protection is not mandatory if the product is designed for the rating of the branch circuit outlet or overcurrent protection (e.g. 15 A product for a 15 A receptacle). The product, however, should be designed with fusing for the MOVs or with other means to prevent a hazardous condition from occurring when the MOV fails.

Figure 2. The application of plug-in TVSS requires coordination with other surge suppression devices located nearby.



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