

Varistors Satisfy the Extended UL 1449 Standard

The current used for the test is six times greater in the 3rd Edition than in the 2nd Edition

In recent years, the European electrical and electronics industry has reworked the safety standards for surge protective devices (SPDs) several times – in some cases with significant changes: thus the first edition of EN 60950-1 specified the mandatory use of surge suppressors. They additionally had to satisfy the then applicable UL 1449 standard on transient voltage surge suppressors (TVSS).

The second edition of EN 60950-1 stipulates that a varistor used in a primary circuit must satisfy either IEC 61051-2 or the new UL 1449 3rd Edition.

By Wolfgang Dreipelcher, Epcos

A broad range of Epcos varistors satisfies the extended requirements of the reissued UL® 1449. The third edition of this overvoltage protection standard went into effect on September 29, 2009.

Surge suppressors of non-VDR (voltage dependent resistor) type must still satisfy the requirements of the new UL 1449 when used in other applications approved by UL and classified as safety-critical components.

Changes stipulated by UL 1449 3rd Edition

As the latest standard, Underwriter Laboratories (UL) published UL 1449 3rd Edition for protective components of the SPD type in September 2009, completely superseding the preceding edition. From this time, all equipment brought onto the market must satisfy these new requirements in order to qualify for the UL label. Among other things, this results in three important changes for buyers and developers:

In the first place, some terminology has been changed. Henceforth the term TVSS (transient voltage surge suppressors) has been superseded by the term SPD (surge protective devices). In addition, UL 1449 3rd Edition is now an American National Standard (ANSI).

Second, the nominal discharge current was included in the specification. The voltage limitation is now measured at 6 kV and 3 kA.

Third, SPDs have been subdivided into type classes 1, 2, 3 and 4. The test current as well as the voltage test procedures have also been revised, with the duty cycle now being run at the nominal discharge current.

Effects on currently used designs

The new requirements on SPDs have significant effects, because for the first time IEC 60950-1 also concerns the general use of components designed to suppress surges in IT equipment. These requirements must be considered by manufacturers of power supplies for



the IT sector and other IT equipment that are designed to be connected to the power supply and incorporate a corresponding power supply with SPDs in the primary circuit.

Because primary circuits must make exclusive use of varistors for surge suppression, this standard will have significant consequences. Thus, other protective components such as gas discharge tubes or semiconductor components with nonlinear voltage-current characteristics are not classified as VDRs. Thus, their use in the primary circuit is now subject to restrictions.

UL 1449 3rd Edition applies to equipment that must repeatedly limit transient voltages in 50/60-Hz circuits to 1000 V. Depending on whether the equipment is located inside the electrical system, UL 1449 3rd Edition now makes a distinction between four types of SPD.

Type 1 specifies equipment with a permanent connection to the power line installed before or behind the main fuse. It refers to SPDs that are as a rule used without external surge-current protection. This means that they are located between the secondary side of the trans-

former and the power side of the fuse. This type of SPD is closest to those components that were designated as secondary surge arrestors before the introduction of the UL 1449 3rd Edition and were used primarily in the USA.

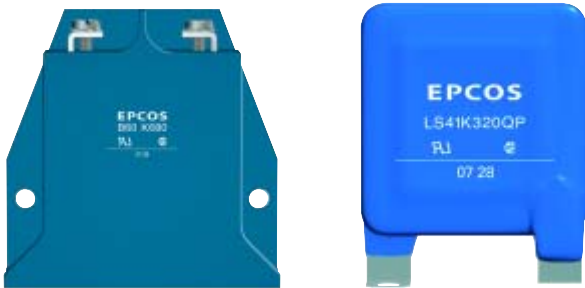


Figure 1: Type 1 Block and strap varistors

Block and strap varistors of Type 1

Block varistors

B40 with voltages from 130 V_{rms} to 750 V_{rms}
 B60 with voltages from 75 V_{rms} to 1100 V_{rms}
 B80 with voltages from 130 V_{rms} to 1100 V_{rms}
 These varistors are listed for type 1 applications with an I_N of 20 kA.

B32 with voltages from 75V to 750 V_{rms}
 B40 with a voltage from 75 V_{rms}
 These varistors are listed for type 1 applications with an I_N of 10 kA.

EPCOS block and strap varistors are designed for rated voltages of up to 1100 V rated currents of up to 20 kA.

Strap varistors

L*40/41/42 and L*50 with voltages from 130 V_{rms} to 750 V_{rms}
 These varistors are listed for type 1 applications with an I_N of 20 kA.

L*40/41/42 with a voltage of 75 V_{rms}
 L*3422 with voltages from 75 V_{rms} to 750 V_{rms}
 L*32 with voltages from 75 V_{rms} to 750 V_{rms}
 These varistors are listed for type 1 applications with an I_N of 10 kA.

Type 2 designates equipment connected permanently to the power line and mounted after the main fuse. These elements are also designed for the load side of the fuse inclusive of the junction boxes. Type 2 thus replaces hardwired TVSS. External circuit breakers and fuses in combination with type 2 elements can then be used. This SPD type most closely corresponds to the protective components previously designated as TVSS before the introduction of UL 1449 3rd Edition. Devices belonging to type 2 include automatic circuit breakers, hand dryers, motors as well as power supplies.

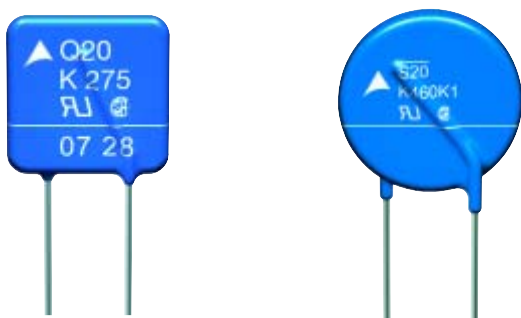


FIGURE 2: Type 2 Disk varistors

Disk varistors of Type 2

S25: B72225S* with voltages from 115 V_{rms} to 750 V_{rms}
 These varistors are listed for type 2 applications with an I_N of 5 kA.

Q20: B72220Q* with voltages from 150 V_{rms} to 680 V_{rms}
 These varistors are listed for type 2 applications with an I_N of 5 kA.

Q14: B72214Q* with voltages from 130 V_{rms} to 680 V_{rms}
 These varistors are listed for type 2 applications with an I_N of 3 kA.

UL status: approval granted with the exception of types K175 to K440, for which approval has been applied.

Typical disk varistors for type 2 applications. The varistor on the right offers improved derating and multipulse capability. This is indicated by the marking K1 on the varistor.

EPCOS multipulse varistors with improved derating

S14 MP: B72214P2*K101
 Disk diameter: 14 mm
 Voltages from 130 V_{rms} to 680 V_{rms}
 These varistors are listed for type 2 applications with an I_N of 3 kA.
 As identification, they bear the marking K1.

S20 MP: B72220P3*K101
 Disk diameter: 20 mm
 Voltages from 130 V_{rms} to 680 V_{rms}
 These varistors are listed for type 2 applications with an I_N of 5 kA.
 As identification, they bear the marking K1.

Ordering code	UL classification	V _{RMS} [V]	I _{max} [A]	Number of pulses (8/20 μs)	
				8/20 μs	3 kA
B72214P2* K101	S14K to E2K1	130 to 460	6000	40	800
B72214P2* K101	S14K to E2K1	510 to 680	6000	15	500

The varistors of the S14 MP and S20 MP series offer the following benefits:

Repeated pulse impacts with a stable terminal voltage possible
 Suitable for applications with frequently recurring overvoltage pulses of low amplitude

Suitable for type 2 applications to UL 1449 3rd Edition
 They correspond to IEC 60950-1 Rev 2 Annex Q and IEC 60065:2002 section 14.12

Ordering code	UL classification	V _{RMS} [V]	I _{max} [A]	Number of pulses (8/20 μs)	
				8/20 μs	3 kA
B72220P3* K101	S20K to E3K1	130 to 460	12000	100	1600
B72220P3* K101	S20K to E3K1	510 to 680	10000	40	1600

Type 3 specifies SPDs used directly on the power line and connected to the service panel via a conductor at least 10 m long (to IEEE C62.41-199 Category A). This 10 m of conductor length does not include conductors used to attach the SPD. Type 3 includes SPDs that are cord-connected, plugged directly into the socket or integrated in the outlet. Type 3 elements are not subject to a nominal current

discharge test as long as they are not tested as type 2 elements. Other examples are multiple sockets with integrated SPDs or power supplies for electronic equipment. It should also be noted that these measurements are conducted with the short-circuit current I_k and not with the rated current I_N .

Disk varistors of Type 3

S10 MP: B72210P2xxxK101

Disk diameter: 10 mm

Voltages from 130 V_{rms} to 680 V_{rms}

These varistors are listed for type 3 applications with an I_k of 3 kA.

As identification, they bear the marking K1.

UL Status: Approval has been granted for types S10K275E2K1 to S10K680E2K1. Approval for types S10K130E2K1 to S10K250E2K1 has been applied for.

S20: B72220

Voltages from 115 V_{rms} to 1000 V_{rms}

These varistors are listed for type 3 applications with an I_k of 3 kA.

These varistors are offered for rated voltages of between 115 V_{rms} and 1000 V_{rms} and designed for short-circuit currents of up to 3 kA.



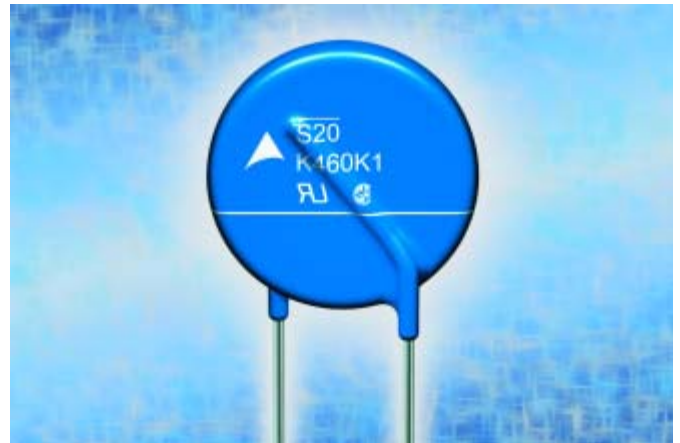
Figure 3: Type 3 disk varistors

Type 4 designates SPDs in the form of discrete components or component assemblies. A type 4 element can thus be a EPCOS single discrete metal oxide varistor, or it can also be a module or subsystem consisting of several SPD components. These components include EPCOS metal oxide varistors, capacitors and surge protective components. Type 4 is thus an SPD at component level or an SPD subsystem comprising several components that is tested in accordance with its application environment (Types 1, 2 or 3). See also: www.epcos.com/varistors.

Nominal discharge current

Further innovations included within the scope of UL 1449 3rd Edition are the nominal discharge current test and the subsequent duty cycle test. The nominal discharge current is selected by the manufacturer and can have a value of either 10 kA or 20 kA for a type 1 SPD, whereas a type 2 SPD may have values of 3 kA, 5 kA, 10 kA or 20 kA. The component is subjected to 15 pulses corresponding to the nominal discharge current selected by the manufacturer.

In order to pass this test, the component must not constitute any risk of electric shock or fire during the test. In addition, no gaps may occur in the overvoltage path. This includes all supplementary internal or external surge protective elements such as fuses or circuit breakers.



The test with a nominal discharge current includes all internal or external surge-current elements. Many developers specify and use external surge-current elements in order to protect the overvoltage component during overvoltages of longer duration. In order to pass the new tests, the external or internal surge-current element must be exposed to the same 15 pulses at the nominal discharge currents selected by the manufacturer. The nominal discharge current is noted on the type plate of the SPD.

Limitation voltage test

The measured limiting voltage test in UL 1449 3rd Edition uses a 6 kV/3 kA combination wave surge to determine the voltage protection rating (VPR) of the SPD. This test is similar to the one determining the suppressed voltage rating (SVR) in UL 1449 2nd Edition. The key difference between the tests of the 2nd and 3rd Editions is that the specified magnitude of the current used for the test is six times greater in the 3rd Edition than in the 2nd Edition. This much higher current level means that the measured limiting voltage is also significantly greater. Higher currents lead to higher limiting voltages. This means that an element tested to UL 1449 3rd Edition with a VPR of 700 V does not show a higher limiting voltage than one tested to UL 1449 2nd Edition with an SVR of 400 V.

Summary

Manufacturers of drives and large compressors that previously used varistors with small diameters, or sometimes no varistors at all, may require an upgrade to type 2 varistors. SPD (TVSS) manufacturers who use 5-mm, 7-mm, 10-mm or 14-mm varistors, or even Cu-encapsulated SMT varistors, may consider upgrading to varistors suitable for type 3 applications.

Apart from customers who work directly to UL 1449 3rd Edition, the UL 508C, UL 840, UL/EN 60950 and UL/EN 60065 terminal standards may be affected. A wide selection of Epcos components offered for overvoltage protection are suitable for almost all applications.

In order to ensure the correct type classification for an application or equipment, it is recommended that developers contact their local UL partners.

A continuously updated overview of all UL-approved varistors from EPCOS may be found under:

www.epcos.com/varistors