



# Leaded Varistors

## SuperioR Series

<b>Series/Type:</b>	<b>SIOV-S20K150E3</b>
<b>Ordering code:</b>	<b>B72220S3151K101</b>
<b>Date:</b>	<b>2017-10-13</b>
<b>Version:</b>	<b>a</b>

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## Applications

Overvoltage protection

## Features

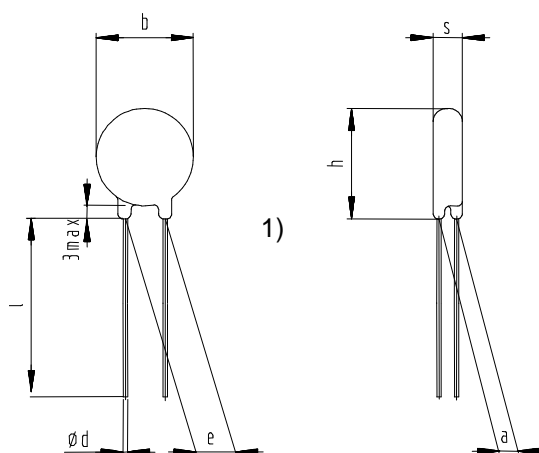
- UL approval to UL1449 (file number E321126).

## SIOV nomenclature

S	=	Disk type
20	=	Rated disk diameter
K	=	Tolerance of $V_V$ at 1mA: $\pm 10\%$
150	=	Max. AC operating voltage
E3	=	SuperioR series

## General technical data

Climatic category	to IEC 60068-1	40/105/56
Operating temperature		-40...+105 °C
Storage temperature		-40...+125 °C
Electric strength	to IEC 61051	$\geq 2.5 \text{ kV}_{\text{RMS}}$
Insulation resistance	to IEC 61051	$\geq 100 \text{ M}\Omega$

**Dimensional drawings in mm**


$b_{\max}$	=	21.5
$h_{\max}$	=	25.5
$s_{\max}$	=	5.0
$e$	=	$10.0 \pm 0.5$
$a_{\text{typ}}$	=	2.1
$l_{\min}$	=	25.0
$\varnothing d$	=	$1.0 \pm 0.05$

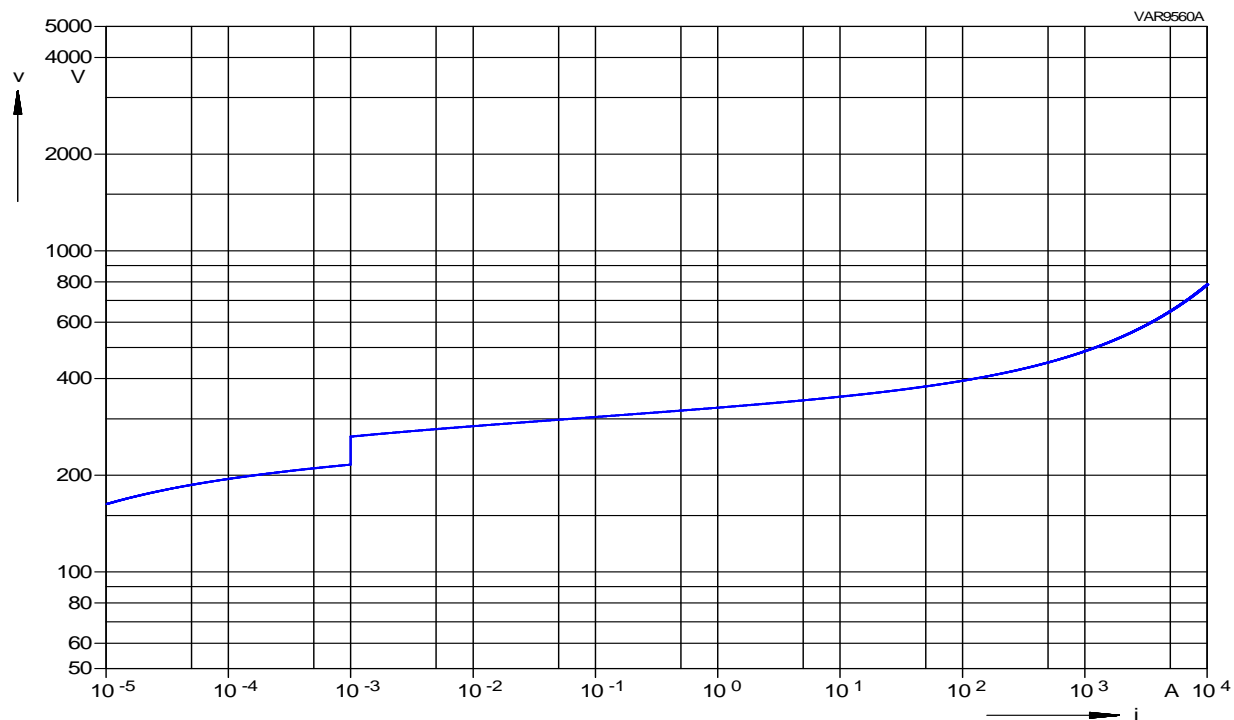
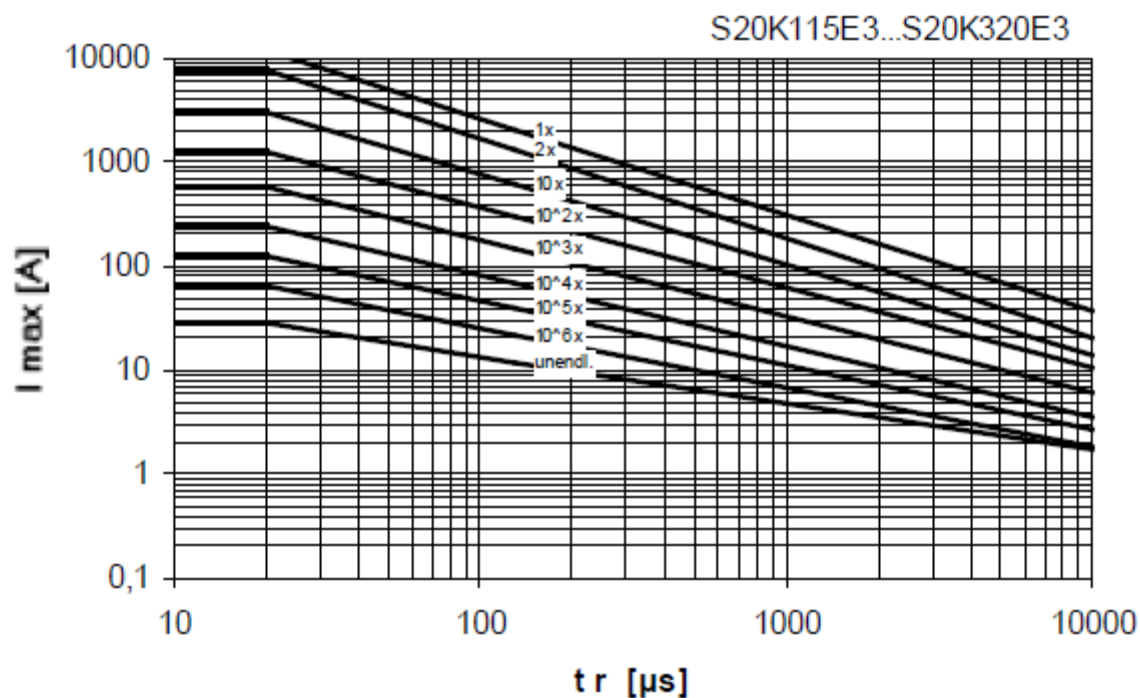
1) seating plane in accordance with IEC 60717

**Electrical data**
**Maximum Ratings (105 °C):**

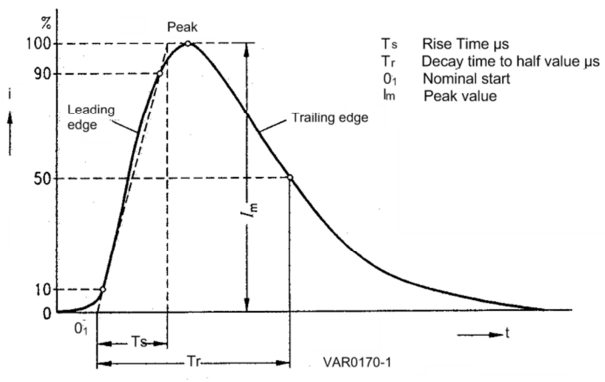
Max. AC operating voltage		$V_{\text{RMS}}$	=	150 V
Max. DC operating voltage		$V_{\text{DC}}$	=	200 V
Surge current (8/20 $\mu\text{s}$ )	1 time	$I_{\text{max}}$	=	12000 A
Energy absorption (2 ms)	1 time	$W_{\text{max}}$	=	155 J
Average power dissipation		$P_{\text{max}}$	=	1.0 W

**Characteristics (25 °C):**

Varistor voltage at 1 mA		$V_V$	=	$240 \text{ V} \pm 10\%$
Clamping voltage at 100 A (8/20 $\mu\text{s}$ )		$V_{\text{C,max}}$	=	395 V
Typ. capacitance at 1 kHz		$C$	=	2050 pF

**V/I Characteristic**

**Derating**


**Reliability Data Electrical**

Characteristics	Test Methods/Description	Specifications
Varistor Voltage	The voltage between two terminals with the specified measuring current applied is called $V_V$ (1 mA <sub>DC</sub> @ 0.2 ... 2 s).	To meet the specified value.
Clamping Voltage	<p>The maximum voltage between two terminals with the specified standard impulse current (8/20μs) illustrated below applied.</p>  <p>The graph shows a standard impulse current waveform. The y-axis represents current percentage (0 to 100%) and the x-axis represents time (t). Key points include: O<sub>1</sub> (Nominal start), T<sub>s</sub> (Rise Time μs), Peak (Peak value), T<sub>r</sub> (Decay time to half value μs), and E (Peak value). The waveform is labeled VAR0170-1.</p>	To meet the specified value.
Surge current derating, 8/20 μs	10 surge currents (8/20 μs), unipolar, interval 30 s, amplitude corresponding to derating curve for 10 impulses at 20 μs	$ \Delta V/V (1 \text{ mA})  \leq 10\%$ (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	10 surge currents (2ms), unipolar, interval 120s, amplitude corresponding to derating curve for 10 impulses at 2 ms	$ \Delta V/V (1 \text{ mA})  \leq 10\%$ (measured in direction of surge current) No visible damage

**Reliability Data Mechanical**

Characteristics	Test Methods/Description	Specifications
Tensile strength	IEC 60068-2-21, test Ua1 After gradually applying the force specified below and keeping the unit fixed for 10 s, the terminal shall be visually examined for any damage. Force for wire diameter: 0.6 mm = 10 N 0.8 mm = 10 N 1.0 mm = 20 N	$ \Delta V/V (1 \text{ mA})  \leq 5\%$ No break of solder joint, no wire break
Vibration	IEC 60068-2-6, test Fc, method B4 Frequency range: 10 .... 55 Hz Amplitude: 0.75 mm or 98 m/s <sup>2</sup> Duration: 6 h (3 x 2 h) Pulse: sine wave After repeatedly applying a single harmonic vibration according to the table above, the change of $V_v$ shall be measured and the part shall be visually examined.	$ \Delta V/V (1 \text{ mA})  \leq 5\%$ No visible damage
Solderability	IEC 60068-2-20, test Ta, method 1 with modified conditions for lead-free solder alloys: 245°C, 3 s: After dipping the terminals to a depth of approximately 3 mm from the body in a soldering bath of 245 °C for 3 s, the terminals shall be visually examined.	The inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 times. The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pinholes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area.

Characteristics	Test Methods/Description	Specifications
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A, 260 °C, 10 s: Each lead shall be dipped into a solder bath having a temperature of $260 \pm 5$ °C to a point 2.0 to 2.5 mm from the body of the unit, be held there for $10 \pm 1$ s and then be stored at room temperature and normal humidity for 1 to 2 hours. The change of $V_v$ shall be measured and the part shall be visually examined.	$ \Delta V/V (1 \text{ mA})  \leq 5\%$ No visible damage
Bump	IEC 60068-2-29, test Eb Pulse duration: 6 ms Max. acceleration: $400 \text{ m/s}^2$ Number of bumps: 4000 Pulse: half sine	$ \Delta V/V (1 \text{ mA})  \leq 5\%$ No visible damage
Fire hazard	IEC 60695-11-5 (needle flame test) Severity: vertical 10 s	5 s max.
Electric strength	IEC 61051-1, test 4.9.2 Metal balls method, 2500 $V_{\text{RMS}}$ , 60 s The varistor is placed in a container holding $1.6 \pm 0.2$ mm diameter metal balls such that only the terminations of the varistor are protruding. The specified voltage shall be applied between both terminals of the specimen connected together and the electrode inserted between the metal balls.	No breakdown

**Reliability Data Environmental**

Characteristics	Test Methods/Description	Specifications
Endurance at upper category temperature	1000 h at UCT After having continuously applied the maximum allowable voltage at UCT $\pm 2$ °C for 1000 h, the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of $V_v$ shall be measured.	$ \Delta V/V (1 \text{ mA})  \leq 10\%$
Damp heat, steady state	IEC 60068-2-78, test Ca The specimen shall be subjected to $40 \pm 2$ °C, 90 to 95 % r.H. for 56 days without load / with 10% of the maximum continuous DC operating voltage $V_{DC}$ . Then stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of $V_v$ shall be measured. Thereafter, insulation resistance $R_{ins}$ shall be measured at $V = 500 \text{ V}$ (insulated varistors only).	$ \Delta V/V (1 \text{ mA})  \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$
Climatic sequence	The specimen shall be subjected to: a) IEC 60068-2-2, test Ba, dry heat at UCT, 16 h b) IEC 60068-2-30, test Db, damp heat, 1st cycle: 55 °C, 93% r.H., 24 h c) IEC 60068-2-1, test Aa, cold, LCT, 2 h d) IEC 60068-2-30, test Db, damp heat, additional 5 cycles: 55 °C/25 °C, 93% r.H., 24 h/cycle. Then the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of $V_v$ shall be measured. Thereafter, insulation resistance $R_{ins}$ shall be measured at $V = 500 \text{ V}$ .	$ \Delta V/V (1 \text{ mA})  \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$
Rapid change of temperature	-40°C to 125°C, dwell time 10 min, 1000 cycles	$ \Delta V/V (1 \text{ mA})  \leq 5\%$ No visible damage

**Note:**

UCT = Upper category temperature

LCT = Lower category temperature

$R_{ins}$  = Insulation resistance



## Cautions and warnings

### General

1. EPCOS metal oxide varistors (SIOVs) are designed for specific applications and should not be used for purposes not identified in our specifications, application notes and data books unless otherwise agreed with EPCOS during the design-in-phase.
2. Ensure suitability of SIOVs through reliability testing during the design-in phase. The SIOVs should be evaluated taking into consideration worst-case conditions.
3. For applications of SIOVs in line-to ground circuits based on various international and local standards there are restrictions existing or additional safety measures required.

### Storage

1. Store SIOVs only in original packaging. Do not open the package before storage.
2. Storage conditions in original packaging:  

Storage temperature:	-25 °C ... +45 °C
Relative humidity:	<75% annual average, <95% on maximum 30 days a year.
Dew precipitation:	Is to be avoided.
3. Avoid contamination of SIOVs surface during storage, handling and processing.
4. Avoid storage of SIOVs in harmful environments which can affect the function during long-term operation (examples given under operation precautions).
5. The SIOV type series should be soldered after shipment from EPCOS within the time specified.  

SIOV-S, -Q, -SNF, -LS	24 months.
ETFV and SFS types	12 months.

### Handling

1. SIOVs must not be dropped.
2. Components must not be touched with bare hands. Gloves are recommended.
3. Avoid contamination of the surface of SIOV electrodes during handling, be careful of the sharp edge of SIOV electrodes.

**Soldering (where applicable)**

1. Use rosin-type flux or non-activated flux.
2. Insufficient preheating may cause ceramic cracks.
3. Rapid cooling by dipping in solvent is not recommended.
4. Complete removal of flux is recommended.

**Mounting**

1. Potting, sealing or adhesive compounds can produce chemical reactions in the SIOV ceramic that will degrade the component's electrical characteristics.
2. Overloading SIOVs may result in ruptured packages and expulsion of hot materials. For this reason the SIOVs should be physically shielded from adjacent components.

**Operation**

1. Use SIOVs only within the specified temperature operating range
2. Use SIOVs only within the specified voltage and current ranges.
3. Environmental conditions must not harm the SIOVs. Use SIOVs only in normal atmospheric conditions. Avoid use in the presence of deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas, etc), corrosive agents, humid or salty conditions, Avoid contact with any liquids and solvents

## Important notes

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