SIOV metal oxide varistors

Leaded varistors, AdvanceD-MP series

Series/Type: **S10, S14**

Date: December 2007

Construction

- Round varistor element, leaded
- Coating: epoxy resin, flame-retardant to UL 94 V-0
- Terminals: tinned copper wire

Features

- Wide operating voltage range 275 … 460 V_{RMS}
- Multiple pulse handling capability

  Detailed surge current specification (8/20 µs) is indicated as below:

Amplitude	Interval	Quantity
I_{nom}	60 s	15
0.10 I_{max}	30 min	1
0.25 I_{max}	30 min	1
0.50 I_{max}	30 min	1
0.75 I_{max}	30 min	1
1.00 I_{max}	30 min	1

Remarks		
S10K … E2K1	I_{nom} = 1.5 kA	I_{max} = 3 kA
S14K … E2K1	I_{nom} = 3 kA	I_{max} = 6 kA

Approvals

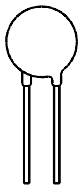
- UL
- CSA
- VDE
- CECC

Delivery mode

- Bulk (standard), taped versions on reel or in Ammo pack upon request.
- For further details refer to chapter “Taping, packaging and lead configuration” for leaded varistors.

General technical data

Climatic category	to IEC 60068-1	40/85/56	
Operating temperature	to CECC 42 000	–40 … + 85	°C
Storage temperature		–40 … +125	°C
Electric strength	to CECC 42 000	≥2.5	kV_{RMS}
Response time		<25	ns

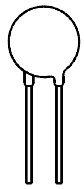


Maximum ratings (T_A = 85 °C)

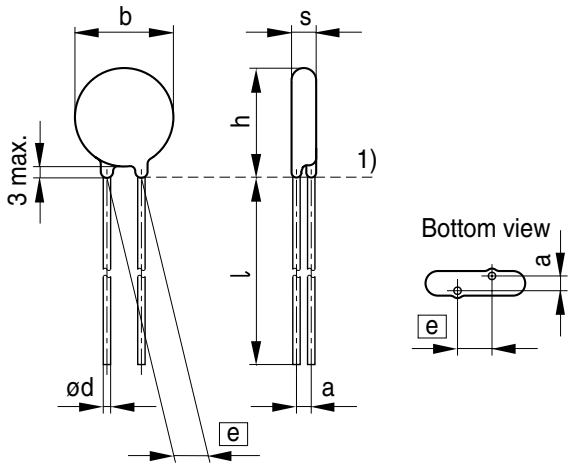
Ordering code	Type (untaped) SIOV-	V_{RMS} V	V_{DC} V	i_{max} (8/20 µs) A	W_{max} (2 ms) J	P_{max} W
B72210S2271K105	S10K275E2K1	275	350	3500	55.0	0.40
B72214S2271K105	S14K275E2K1	275	350	6000	110.0	0.60
B72210S2301K105	S10K300E2K1	300	385	3500	60.0	0.40
B72214S2301K105	S14K300E2K1	300	385	6000	125.0	0.60
B72210S2321K105	S10K320E2K1	320	420	3500	67.0	0.40
B72214S2321K105	S14K320E2K1	320	420	6000	136.0	0.60
B72210S2381K105	S10K385E2K1	385	505	3500	67.0	0.40
B72214S2381K105	S14K385E2K1	385	505	5000	136.0	0.60
B72210S2421K105	S10K420E2K1	420	560	3500	67.0	0.40
B72214S2421K105	S14K420E2K1	420	560	5000	136.0	0.60
B72210S2461K105	S10K460E2K1	460	615	3500	70.0	0.40
B72214S2461K105	S14K460E2K1	460	615	5000	150.0	0.60

Characteristics (T_A = 25 °C)

Ordering code	Type (untaped) SIOV-	V_v (1 mA) V	ΔV_v (1 mA) %	$v_{c, max}$ (i_c) V	i_c A	C_{typ} (1 kHz) pF
B72210S2271K105	S10K275E2K1	430	±10	710	25.0	235
B72214S2271K105	S14K275E2K1	430	±10	710	50.0	375
B72210S2301K105	S10K300E2K1	470	±10	775	25.0	215
B72214S2301K105	S14K300E2K1	470	±10	775	50.0	355
B72210S2321K105	S10K320E2K1	510	±10	840	25.0	205
B72214S2321K105	S14K320E2K1	510	±10	840	50.0	330
B72210S2381K105	S10K385E2K1	620	±10	1025	25.0	170
B72214S2381K105	S14K385E2K1	620	±10	1025	50.0	285
B72210S2421K105	S10K420E2K1	680	±10	1120	25.0	155
B72214S2421K105	S14K420E2K1	680	±10	1120	50.0	260
B72210S2461K105	S10K460E2K1	750	±10	1240	25.0	135
B72214S2461K105	S14K460E2K1	750	±10	1240	50.0	235



Dimensional drawing



1) Seating plane to IEC 60717

VAR0408-C

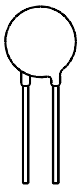
Weight

Nominal diameter mm	V_{RMS} V	Weight g
10	275 … 460	1.7 … 2.7
14	275 … 460	2.8 … 4.7

The weight of varistors in between these voltage classes can be interpolated.

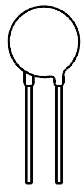
Dimensions

Ordering code	e ±1 mm	a ±1 mm	b_{max} mm	s_{max} mm	h_{max} mm	l_{min} mm	d ±0.05 mm
B72210S2271K105	7.5	2.8	12.0	5.9	16.0	25.0	0.8
B72214S2271K105	7.5	2.8	16.0	5.9	20.0	25.0	0.8
B72210S2301K105	7.5	2.9	12.0	6.1	16.0	25.0	0.8
B72214S2301K105	7.5	2.9	16.0	6.1	20.0	25.0	0.8
B72210S2321K105	7.5	3.0	12.0	6.3	16.0	25.0	0.8
B72214S2321K105	7.5	3.0	16.0	6.3	20.0	25.0	0.8
B72210S2381K105	7.5	4.0	12.5	7.7	16.5	25.0	0.8
B72214S2381K105	7.5	4.1	16.5	7.7	20.5	25.0	0.8
B72210S2421K105	7.5	4.2	12.5	8.1	16.5	25.0	0.8
B72214S2421K105	7.5	4.3	16.5	8.2	20.5	25.0	0.8
B72210S2461K105	7.5	4.4	12.5	8.4	16.5	25.0	0.8
B72214S2461K105	7.5	4.5	16.5	8.5	20.5	25.0	0.8



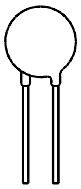
Reliability data

Test	Test methods/conditions	Requirement
Varistor voltage	The voltage between two terminals with the specified measuring current applied is called V_v (1 mA_{DC} @ 0.2 … 2 s).	To meet the specified value.
Clamping voltage	The maximum voltage between two terminals with the specified standard impulse current (8/20 µs) applied.	To meet the specified value.
Max. AC operating voltage	CECC 42 000, test 4.20 1000 h at UCT After having continuously applied the maximum allowable voltage at UCT ±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.	$\lvert\Delta V/V$ (1 mA)$\rvert \leq 10\%$
Surge current derating, 8/20 µs	CECC 42 000, test C 2.1 100 surge currents (8/20 µs), unipolar, interval 30 s, amplitude corresponding to derating curve for 100 impulses at 20 µs	$\lvert\Delta V/V$ (1 mA)$\rvert \leq 10\%$ (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	CECC 42 000, test C 2.1 100 surge currents (2 ms), unipolar, interval 120 s, amplitude corresponding to derating curve for 100 impulses at 2 ms	$\lvert\Delta V/V$ (1 mA)$\rvert \leq 10\%$ (measured in direction of surge current) No visible damage
Electric strength	CECC 42 000, test 4.7 Metal balls method, 2500 V_{RMS}, 60 s The varistor is placed in a container holding 1.6 ±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

Test	Test methods/conditions	Requirement
Climatic sequence	CECC 42 000, test 4.16 The specimen shall be subjected to: a) dry heat at UCT, 16 h b) damp heat, 1st cycle: 55 °C, 93% r. H., 24 h c) cold, LCT, 2 h d) 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 according to CECC 42 000, test 4.8 at V = 500 V.	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 10\%$ $R_{ins} \geq 1\ M\Omega$
Fast temperature cycling	IEC 60068-2-14, test Na, LCT/UCT, dwell time 30 min, 5 cycles	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Damp heat, steady state	The specimen shall be subjected to 40 ±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 according to CECC 42 000, test 4.8 at V = 500 V.	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 10\%$ $R_{ins} \geq 1\ M\Omega$
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.

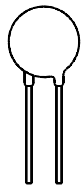


Reliability data

Test	Test methods/conditions	Requirement
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 ±5 °C to a point 2.0 to 2.5 mm from the body of the specimen, be held there for 10 ±1 s and then be stored at room temperature and normal humidity for 1 to 2 h. The change of V_v shall be measured and the specimen shall be visually examined.	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 5\%$ No visible damage
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: 0.8 mm = 10 N	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 5\%$ No break of solder joint, no wire break
Vibration	IEC 60068-2, test Fc Frequency range: 10 … 55 Hz Amplitude: 0.75 mm or 98 m/s² Duration: 6 h (3 · 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 specimen shall be visually examined.	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Bump	IEC 60068-2-29, test Eb Pulse duration: 6 ms Max. acceleration: 400 m/s² Number of bumps: 4000 Pulse: half sine	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Flammability	IEC 60695-2-2 (needle flame test) Severity: vertical 10 s	5 s max.

Note:

UCT = Upper category temperature
LCT = Lower category temperature
R_{ins} = Insulation resistance to CECC 42 000, test 4.8

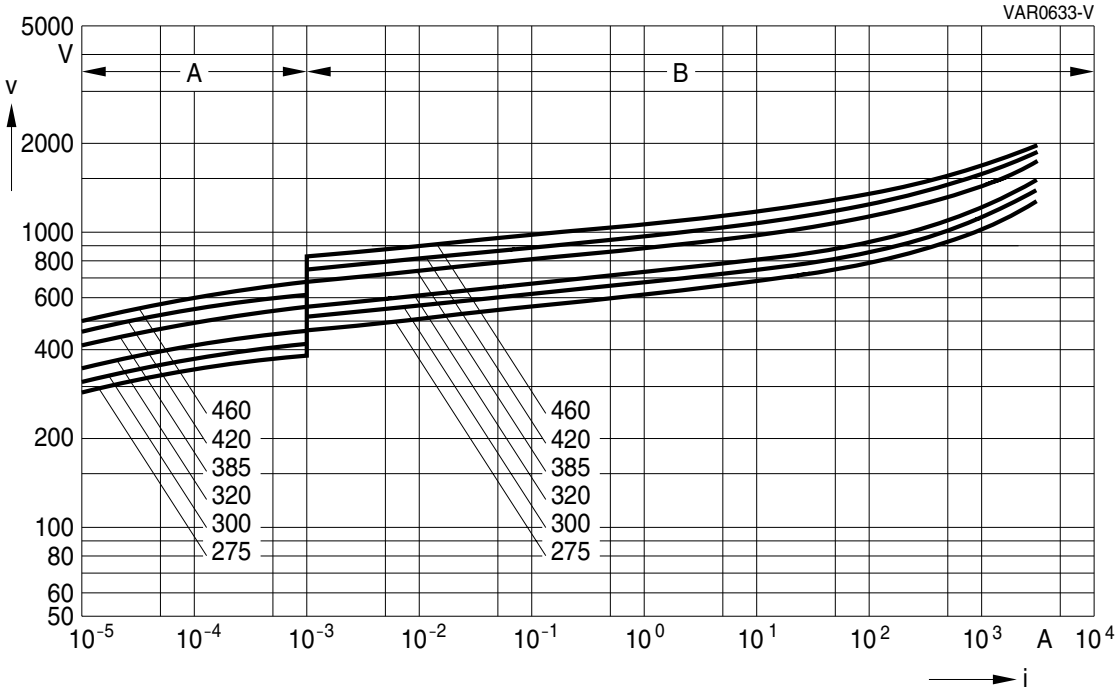


v/i characteristics

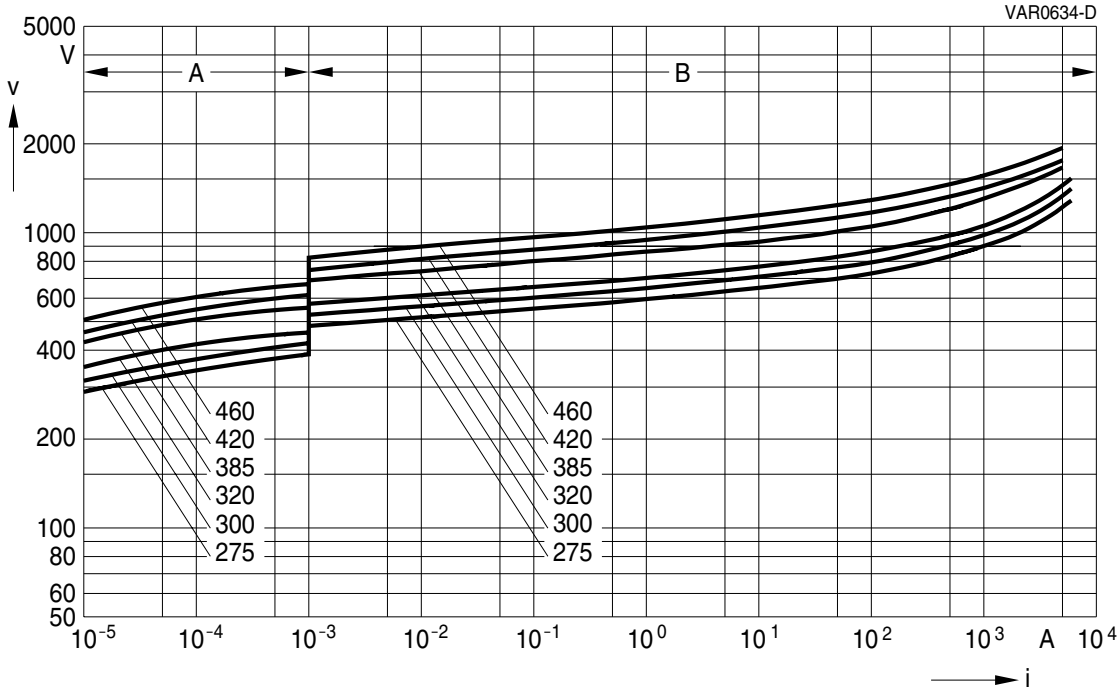
v = f (i) – for explanation of the characteristics refer to “General technical information”, 1.6.3

A = Leakage current
B = Protection level

} for worst-case varistor tolerances

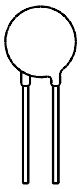


SIOV-S10 … E2K1



SIOV-S14 … E2K1

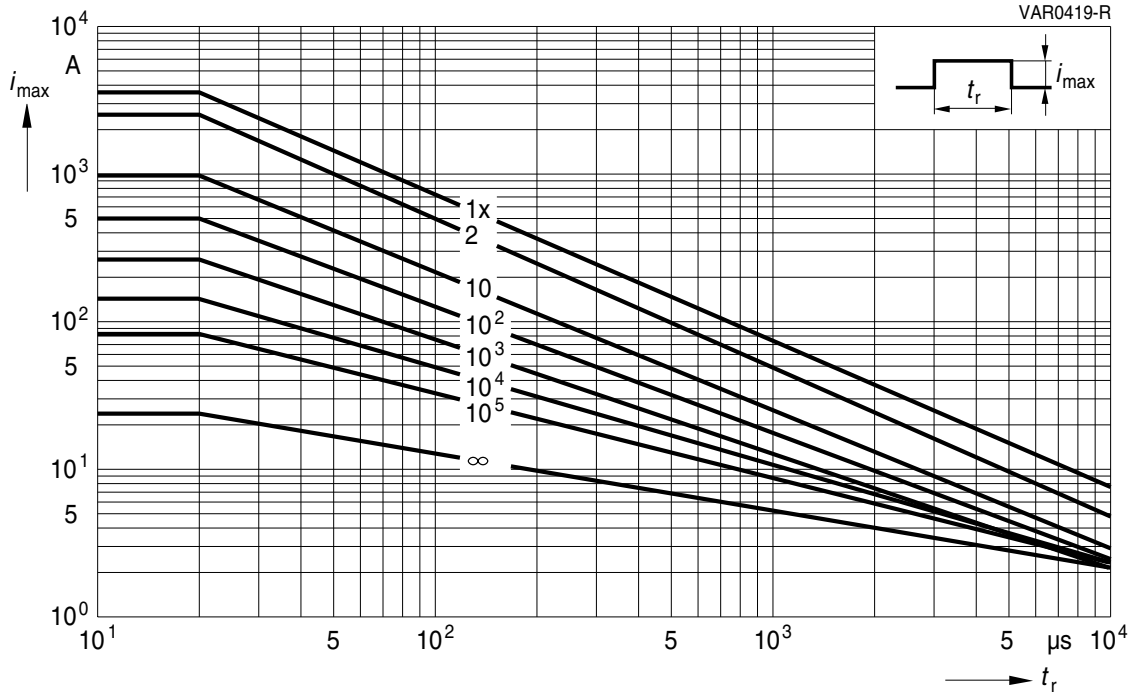
Please read *Cautions and warnings* and *Important notes* at the end of this document.



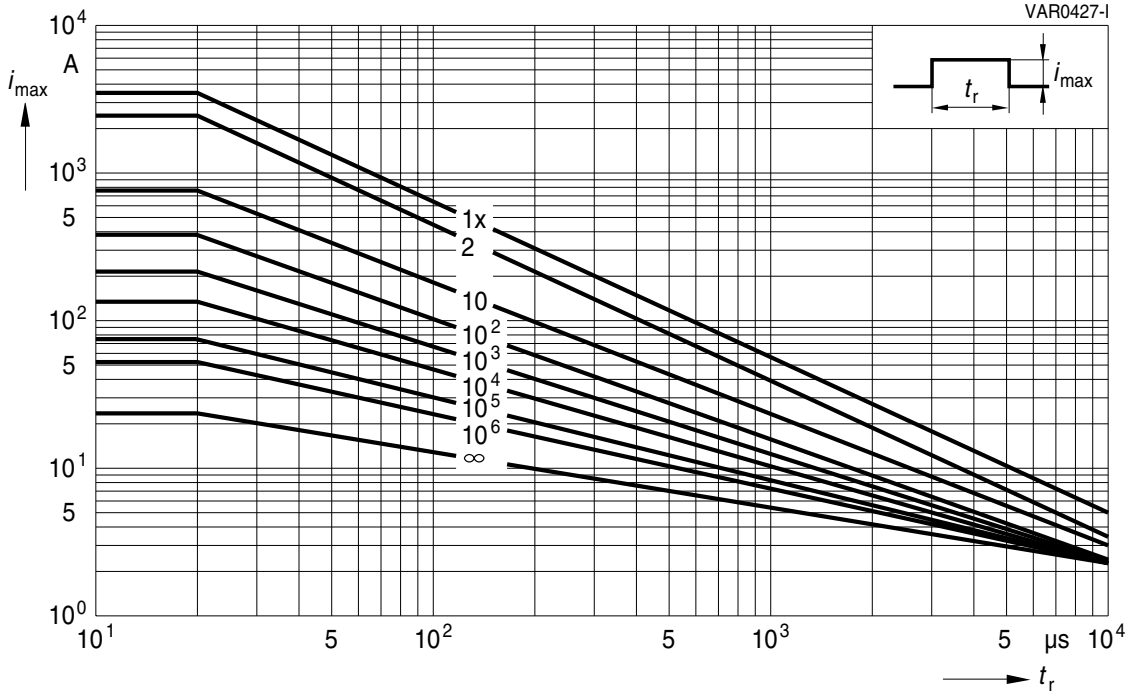
Derating curves

Maximum surge current $i_{max} = f(t_r$, pulse train)

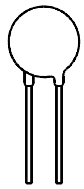
For explanation of the derating curves refer to “General technical information”, section 1.8.1



SIOV-S10K275 … K320E2K1



SIOV-S10K385 … K460E2K1



Derating curves

Maximum surge current $i_{max} = f(t_r$, pulse train)

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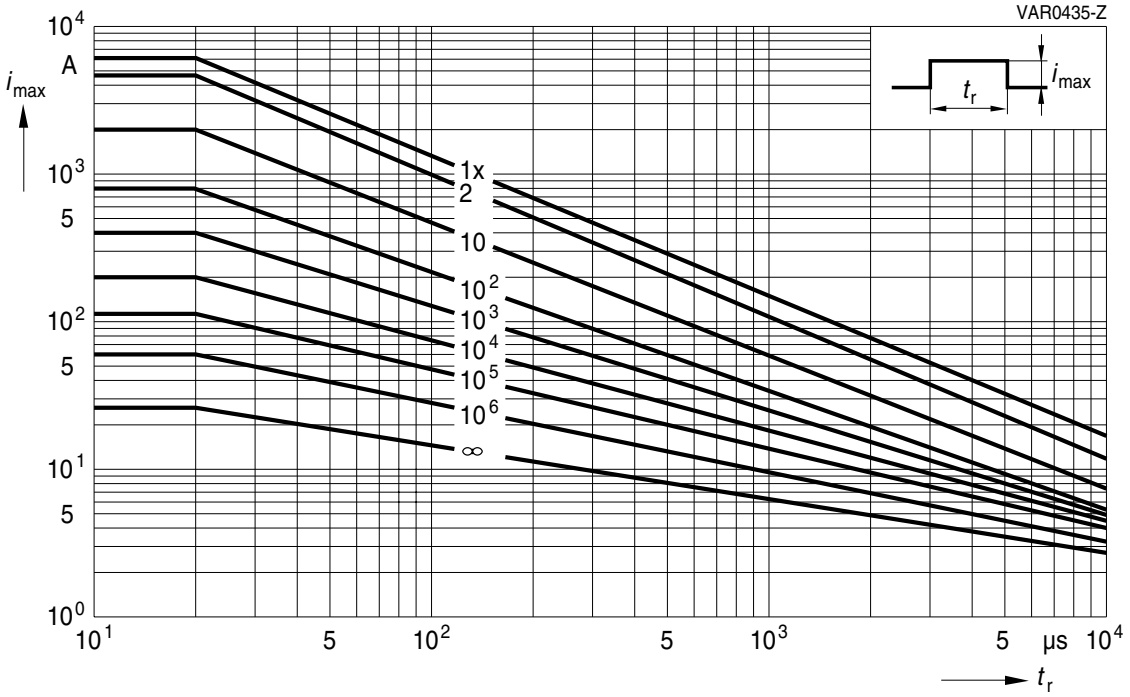
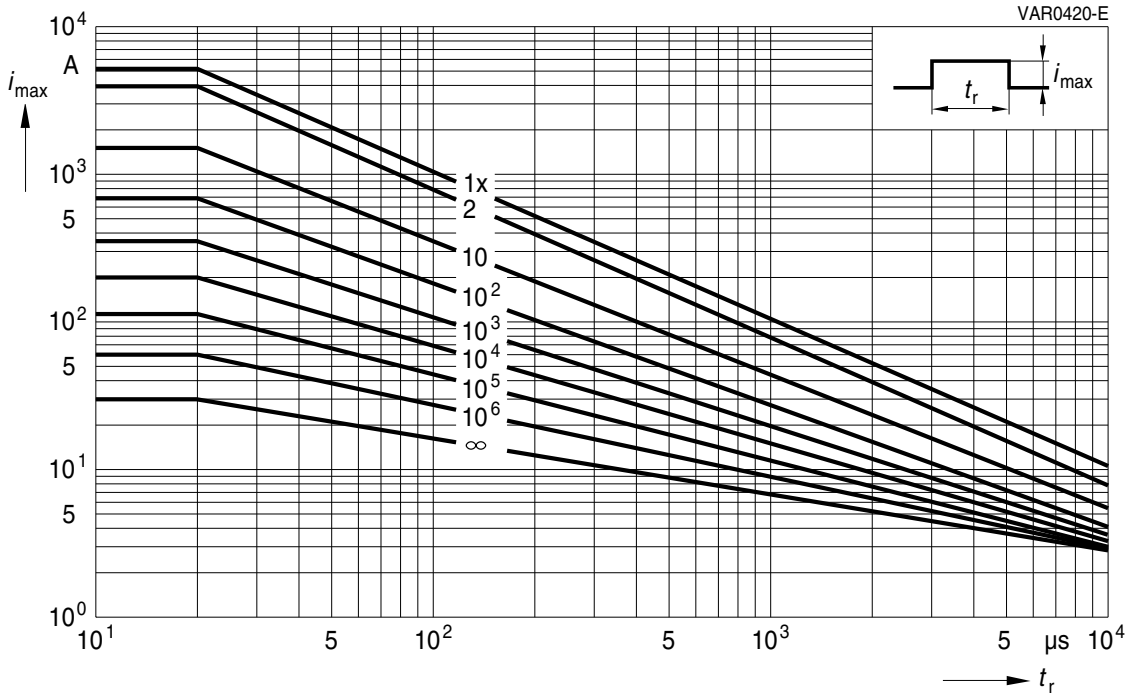


SIOV-S14K275 … K320E2K1



SIOV-S14K385 … K460E2K1

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. 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 an SIOV's surface during storage, handling and processing.
4. Avoid storage of SIOVs in harmful environments that can affect the function during long-term operation (examples given under operation precautions).
5. The SIOV type series should be soldered within the time specified:

SIOV-S, -Q, -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 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 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

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of passive electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of a passive electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of a passive electronic component.
3. **The warnings, cautions and product-specific notes must be observed**.
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
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