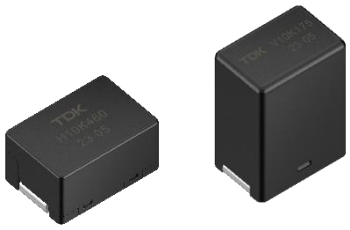
SIOV Metal Oxide Varistors

SMD high surge series

Series/Type:	**V10K*, H10K***
Ordering code:	**B72210M*K00***
Date:	2024-06-19
Version:	3

Features

- Suitable for surface mount device assembly
- AEC-Q200-Rev E qualified
- Optional for vertical version or horizontal version



Applications

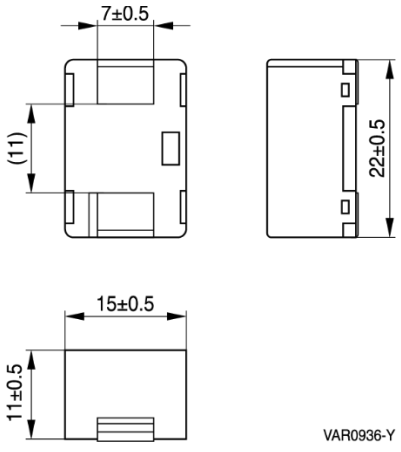
Overvoltage protection, especially on-board chargers

SIOV nomenclature

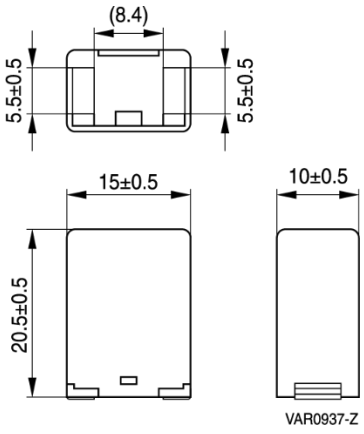
V(H)	Vertical version or horizontal version
10	Rated disk dimension
K	Tolerance of V_V at 1 mA: ±10%
175 – 460	Max. AC operating voltage
*	Optional, typical design of customer

Dimensional drawings in mm

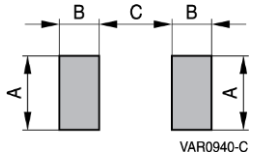
Horizontal version



Vertical version



Recommended solder pad layout in mm



Type	A	B	C
V10K*	8.5	5.3	6.4
H10K*	10.0	7.5	9.0

Electrical specifications and ordering codes

Maximum ratings (T_A = 125 °C)

Type	Ordering code	V_{RMS} V	V_{DC} V
V10K175	B72210M0171K000	175	225
H10K175	B72210M0171K001	175	225
V10K210	B72210M0211K000	210	270
H10K210	B72210M0211K001	210	270
V10K230	B72210M0231K000	230	300
H10K230	B72210M0231K001	230	300
V10K250	B72210M0251K000	250	320
H10K250	B72210M0251K001	250	320
V10K275	B72210M0271K000	275	350
H10K275	B72210M0271K001	275	350
V10K300	B72210M0301K000	300	385
H10K300	B72210M0301K001	300	385
V10K320	B72210M0321K000	320	420
H10K320	B72210M0321K001	320	420
V10K350	B72210M0351K000	350	460
H10K350	B72210M0351K001	350	460
V10K385	B72210M0381K000	385	505
H10K385	B72210M0381K001	385	505
V10K420	B72210M0421K000	420	560
H10K420	B72210M0421K001	420	560
V10K460	B72210M0461K000	460	615
H10K460	B72210M0461K001	460	615

Characteristics (T_A = 25 °C)

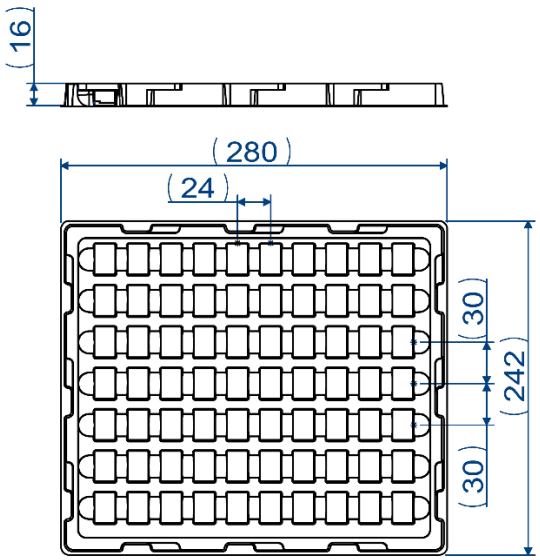
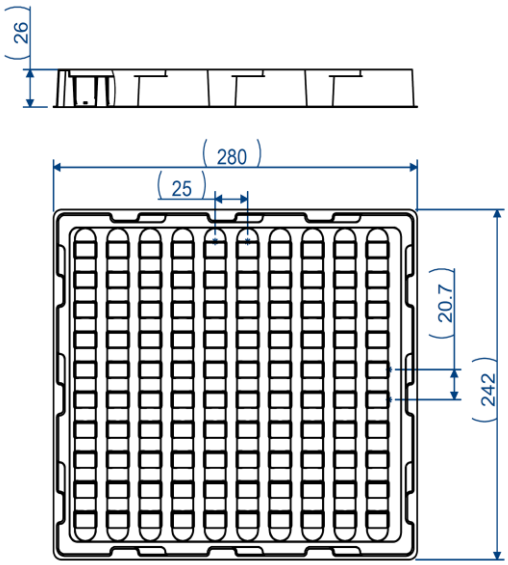
Type	I_{max} (8/20 µs) 1 time A	I_n [1)] (8/20 µs) 15 times A	W_{max} (2 ms) J	P_{max} W	V_v (1 mA) V ±10%	$v_{c,max}$ (i_c=35A) V	C_{typ} (1 kHz) pF
V10K175	6000	3000	80.0	0.60	270	455	670
H10K175	6000	3000	80.0	0.60	270	455	670
V10K210	6000	3000	95.0	0.60	330	545	620
H10K210	6000	3000	95.0	0.60	330	545	620
V10K230	6000	3000	105.0	0.60	360	595	580
H10K230	6000	3000	105.0	0.60	360	595	580
V10K250	6000	3000	115.0	0.60	390	650	550
H10K250	6000	3000	115.0	0.60	390	650	550
V10K275	6000	3000	130.0	0.60	430	710	510
H10K275	6000	3000	130.0	0.60	430	710	510
V10K300	6000	3000	140.0	0.60	470	775	475
H10K300	6000	3000	140.0	0.60	470	775	475
V10K320	6000	3000	150.0	0.60	510	840	425
H10K320	6000	3000	150.0	0.60	510	840	425
V10K350	6000	3000	165.0	0.60	560	910	380
H10K350	6000	3000	165.0	0.60	560	910	380
V10K385	6000	3000	180.0	0.60	620	1025	330
H10K385	6000	3000	180.0	0.60	620	1025	330
V10K420	6000	3000	190.0	0.60	680	1120	280
H10K420	6000	3000	190.0	0.60	680	1120	280
V10K460	6000	3000	200.0	0.60	750	1240	245
H10K460	6000	3000	200.0	0.60	750	1240	245

[1)] **Note:** Nominal discharge current I_n according to UL 1449, 4th edition.

General technical data

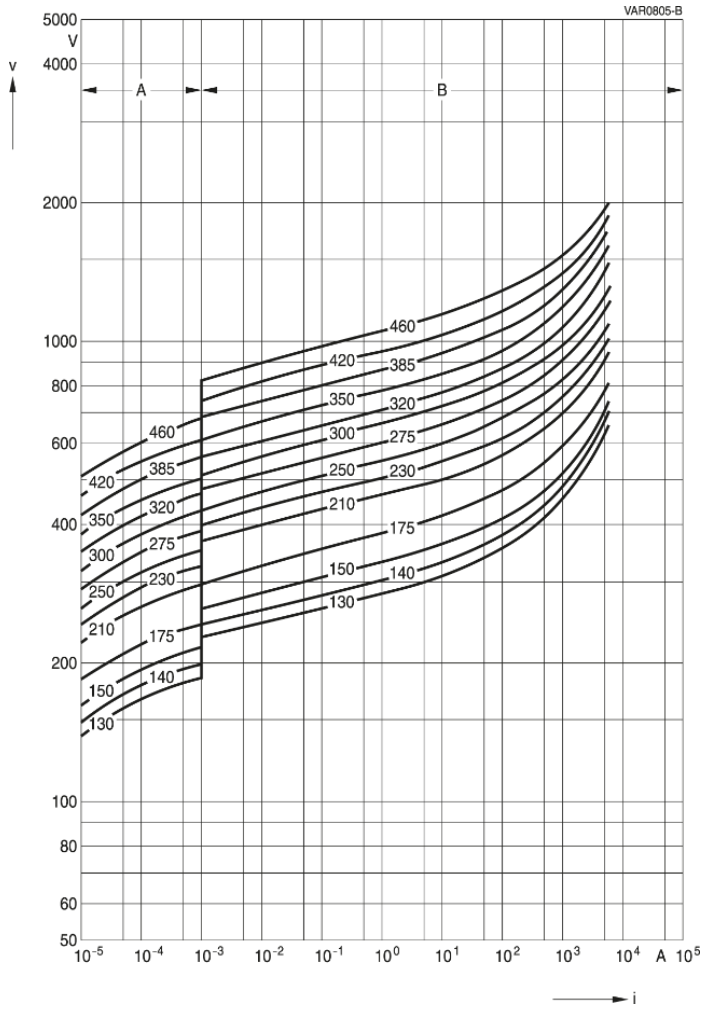
Climatic category	to IEC 60068-1	40/125/56
Operating temperature	to IEC 61051	-40 … +125 °C
Storage temperature		-40 … +150 °C
Electric strength	to IEC 61051	≥ 2.5 kV_{RMS}
Insulation resistance	to IEC 61051	≥ 100 MΩ

Packaging

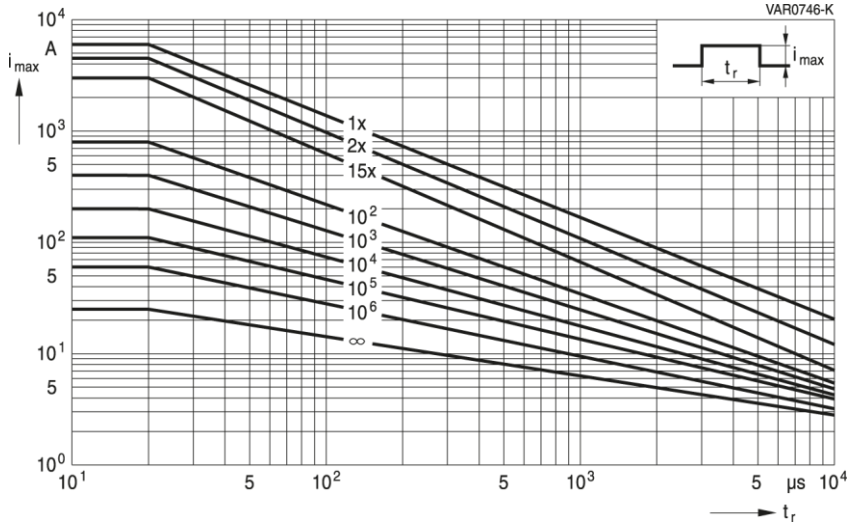
Horizontal version	Vertical version
▪ Standard packaging is in trays ▪ Quantity per tray: 70 pcs ▪ Quantity per box: 210 pcs	▪ Standard packaging is in trays ▪ Quantity per tray: 100 pcs ▪ Quantity per box: 200 pcs
	

() means reference dimensions
Unit: mm

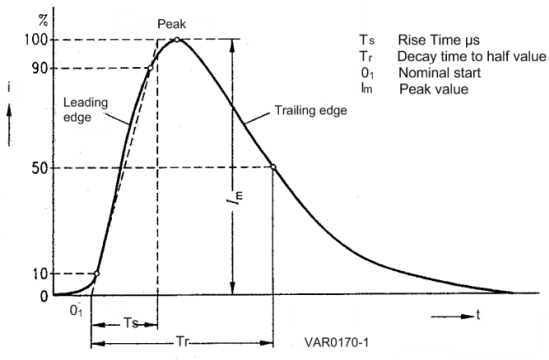
V/I characteristics



Derating curves



Electrical reliability data

Characteristics	Test methods/description	Specifications
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) illustrated below applied. 	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	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 10\%$ (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	10 surge currents (2 ms), unipolar, interval 120 s, amplitude corresponding to derating curve for 10 impulses at 2 ms	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 10\%$ (measured in direction of surge current) No visible damage

Mechanical reliability data

Characteristics	Test methods/description	Specifications
Vibration	AEC-Q200-Rev E MIL-STD-202 method 204 5 *g* for 20 min., 12 cycles each of 3 orientations Test from 10 to 2000 Hz	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Mechanical shock	AEC-Q200-Rev E MIL-STD-202 Method 213 Figure 1 of Method 213 Condition C	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Solderability	IEC 60068-2-58, test Td1, method 1 Solder bath, Sn96.5Ag3Cu0.5 T = 245 ±3 °C t = 2 s	The terminations shall be uniformly tinned for soldering test.
Resistance to soldering heat	IEC60068-2-58, test Td2, method 1 Solder bath, Sn96.5Ag3Cu0.5 T = 260 ±5 °C D = 10 ±1 s	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Board flex	AEC-Q200-Rev E 005 60 seconds minimum holding time	$\lvert\Delta V / V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Electric strength	IEC 61051-1, test 4.9.2 Metal balls method, 2500 VRMS, 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

Environmental reliability data

Characteristics	Test methods/description	Specifications
Max. DC operating voltage	MIL-STD-202F, method 108A, UCT, V_{DC}, 1000 h	$\|\Delta V / V (1\ mA)\| \leq 10\%$ No visible damage
Damp heat, steady state	IEC 60068-2-67, test Cy, 85 °C, 85% RH, 0.85 * V_v (1 mA), 1000 h	$\|\Delta V / V (1\ mA)\| \leq 10\%$ No visible damage
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% RH, 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% RH, 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 V.	$\|\Delta V / V (1\ mA)\| \leq 10\%$ $R_{ins} \geq 100\ M\Omega$
Rapid change of temperature	IEC 60068-2-14, test Na, LCT/UCT, dwell time 10 min., 1000 cycles	$\|\Delta V / V (1\ mA)\| \leq 5\%$ No visible damage

Note:

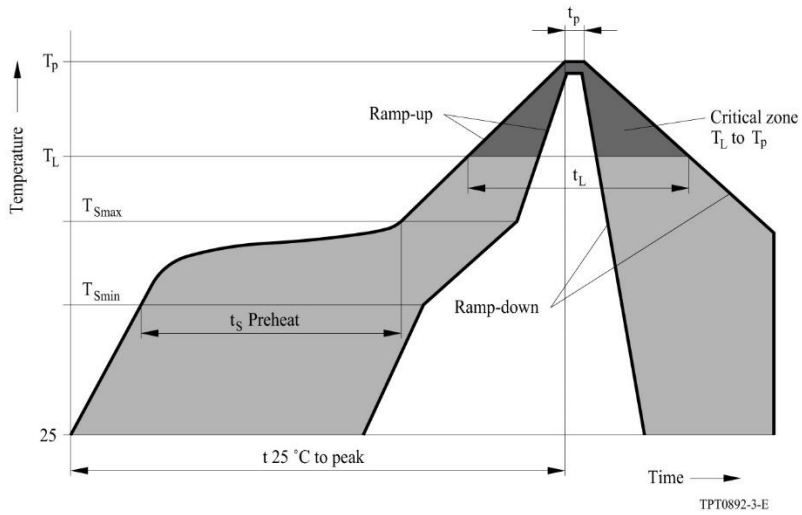
UCT = Upper category temperature

LCT = Lower category temperature

R_{ins} = Insulation resistance

Recommended soldering temperature profiles

Reflow soldering temperature profile



Profile feature	Sn-Pb eutectic assembly	Pb-free assembly
Average ramp-up rate (T_{smax} to T_P)	3 K/s max	3 K/s max
Preheat ▪ Minimum temperature (T_{smin}) ▪ Maximum temperature (T_{smax}) ▪ Time (t_{smin} to t_{smax})	100 °C 150 °C 60 … 120 s	150 °C 200 °C 60…180 s
Time maintained above ▪ Minimum temperature (T_L) ▪ Time (t_L)	183 °C 60 … 150 s	217 °C 60 … 150 s
Peak classification temperature (T_P)	220 °C … 240 °C	240 °C … 260 °C
Time within 5 °C of actual peak temperature (t_p)	10 … 30 s	20 … 40 s
Ramp-down rate	6 K/s max	6 K/s max
Time 25 °C to peak temperature	6 min. max	8 min. max

Note: All temperatures refer to the topside of the package, measured on the package body surface.
Maximum number of reflow cycles: 3

Soldering guidelines

The usage of mild, non-activated fluxes for soldering is recommended, as well as proper cleaning of the PCB.

Cautions and warnings

General

1. TDK Electronics' 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 TDK Electronics 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 restrictions exist or additional safety measures are required.

Storage

1. Store SIOVs only in original packaging. Do not open the package prior to processing.
2. Recommended 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 the SIOVs 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 after shipment from TDK Electronics within the time specified:
   - SIOV-S, -Q, -LS, -B, -SNF: 24 months
   - ETFV/ T series, -CU: 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 the SIOV's 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.
5. Temperatures of all preheat stages and the solder bath must be strictly controlled especially for T series (T14 and T20).

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.

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Release 2024-02