

## **SIOV metal oxide varistors**

Leaded varistors, Automotive 42 V series

**Series/Type:** B722\*  
**Date:** January 2018

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### Construction

- Round varistor element, leaded
- Coating: phenolic resin
- Terminals: tinned wire

### Features

- Automotive series for 42 V supply systems
- This series complies with the electrical requirements for the new 42 V board net as specified in draft standard ISO/TC22 WD42V-1E
- Stable protection level, minimum leakage current
- High resistance to cyclic temperature stress: 1000 cycles
- High operating temperature up to 125 °C
- All types are AEC-Q200 qualified

### 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 | 40/125/56    |    |
| Operating temperature |                | −40 ... +125 | °C |
| Storage temperature   |                | −40 ... +150 | °C |


**Leaded varistors**
**B722\***
**Automotive series for 42 V**
**Electrical specifications and ordering codes**
**Maximum ratings ( $T_A = 125\text{ °C}$ )**

| Ordering code              | Type<br>(untaped) | $V_{\text{RMS, op, max}}^{1)}$<br>$V_{\text{DC}}$ | $V_{\text{op, max}}^{2)}$<br>$V_{\text{DC}}$ | $V_{\text{max, dyn}}^{3)}$<br>$V_{\text{DC}}$ | $W_{\text{max}}$<br>(2 ms)<br>J | $P_{\text{max}}$<br>W |
|----------------------------|-------------------|---------------------------------------------------|----------------------------------------------|-----------------------------------------------|---------------------------------|-----------------------|
| <b>42-V supply systems</b> |                   |                                                   |                                              |                                               |                                 |                       |
| B72207S1390K201            | S07V42AUTOS2D1    | 48                                                | 50                                           | 58                                            | 3.0                             | 0.02                  |
| B72210S1390K501            | S10V42AUTOS5D1    | 48                                                | 50                                           | 58                                            | 6.4                             | 0.05                  |
| B72214S1390K501            | S14V42AUTOS5D1    | 48                                                | 50                                           | 58                                            | 13.0                            | 0.10                  |
| B72220S1390K501            | S20V42AUTOS5D1    | 48                                                | 50                                           | 58                                            | 37.0                            | 0.20                  |

1) Root-mean-square value of max. DC operating voltage incl. ripple

2) Peak value of max. DC operating voltage incl. ripple

3) Max. dynamic overvoltage as per ISO/TC22 WD24V-1E,  $t_b \leq 400\text{ ms}$ 
**Characteristics ( $T_A = 25\text{ °C}$ )**

| Ordering code              | Type<br>(untaped) | $V_v$<br>(1 mA)<br>V | $\Delta V_v$<br>(1 mA)<br>% | $V_{c, \text{max}}$<br>( $i_c$ )<br>V | $i_c$<br>A | $C_{\text{typ}}$<br>(1 kHz)<br>nF |
|----------------------------|-------------------|----------------------|-----------------------------|---------------------------------------|------------|-----------------------------------|
| <b>42-V supply systems</b> |                   |                      |                             |                                       |            |                                   |
| B72207S1390K201            | S07V42AUTOS2D1    | 68                   | $\pm 10$                    | 135                                   | 2.5        | 0.90                              |
| B72210S1390K501            | S10V42AUTOS5D1    | 68                   | $\pm 10$                    | 135                                   | 5.0        | 2.10                              |
| B72214S1390K501            | S14V42AUTOS5D1    | 68                   | $\pm 10$                    | 135                                   | 10.0       | 3.55                              |
| B72220S1390K501            | S20V42AUTOS5D1    | 68                   | $\pm 10$                    | 135                                   | 20.0       | 6.75                              |

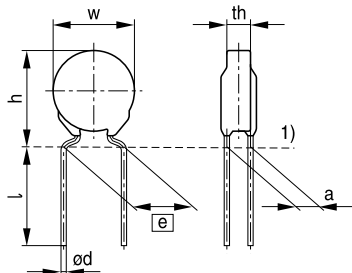


# Leaded varistors

B722\*

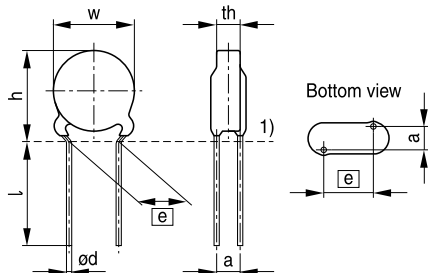
## Automotive series for 42 V

### Dimensional drawings



1) Seating plane to IEC 60717 VAR0553-D-E

**S07V42AUTOS2D1**



1) Seating plane to IEC 60717

VAR0545-M-E

**S10, S14, S20V42AUTOS5D1**

### Dimensions

| Ordering code   | [e] ±1<br>mm | a (typical)<br>mm | w <sub>max</sub><br>mm | th <sub>max</sub><br>mm | h <sub>max</sub><br>mm | l <sub>min</sub><br>mm | d ±0.05<br>mm |
|-----------------|--------------|-------------------|------------------------|-------------------------|------------------------|------------------------|---------------|
| B72207S1390K201 | 5.0          | 1.7               | 9.0                    | 4.1                     | 12.5                   | 25.0                   | 0.6           |
| B72210S1390K501 | 7.5          | 2.0               | 12.0                   | 4.8                     | 16.0                   | 25.0                   | 0.8           |
| B72214S1390K501 | 7.5          | 2.1               | 16.0                   | 4.9                     | 20.0                   | 25.0                   | 0.8           |
| B72220S1390K501 | 10.0         | 2.3               | 22.0                   | 5.5                     | 27.0                   | 25.0                   | 1.0           |

### Weight

| Nominal diameter<br>mm | V <sub>RMS, op, max</sub><br>V | Weight<br>g |
|------------------------|--------------------------------|-------------|
| 7                      | 48                             | 0.5         |
| 10                     | 48                             | 1.0         |
| 14                     | 48                             | 2.5         |
| 20                     | 48                             | 5.0         |


**Leaded varistors**
**B722\***
**Automotive series for 42 V**
**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 <sub>DC</sub> @ 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. DC operating voltage | MIL STD 202F, method 108A, UCT, V <sub>DC</sub> , 1000 h                                                                                         | $ \Delta V/V (1 \text{ mA})  \leq 10\%$<br>No visible damage |
| Fast temperature cycling  | IEC 60068-2-14, test Na, LCT/UCT, dwell time 15 min, 100 cycles for SIOV...AUTO types and dwell time 15 min, 1000 cycles for SIOV...AUTOD1 types | $ \Delta V/V (1 \text{ mA})  \leq 5\%$<br>No visible damage  |
| Damp heat                 | IEC 60068-2-67, test Cy, 85 °C, 85% r. H., V <sub>DC</sub> , 1000 h                                                                              | $ \Delta V/V (1 \text{ mA})  \leq 10\%$<br>No visible damage |

**Note:**

UCT = Upper category temperature

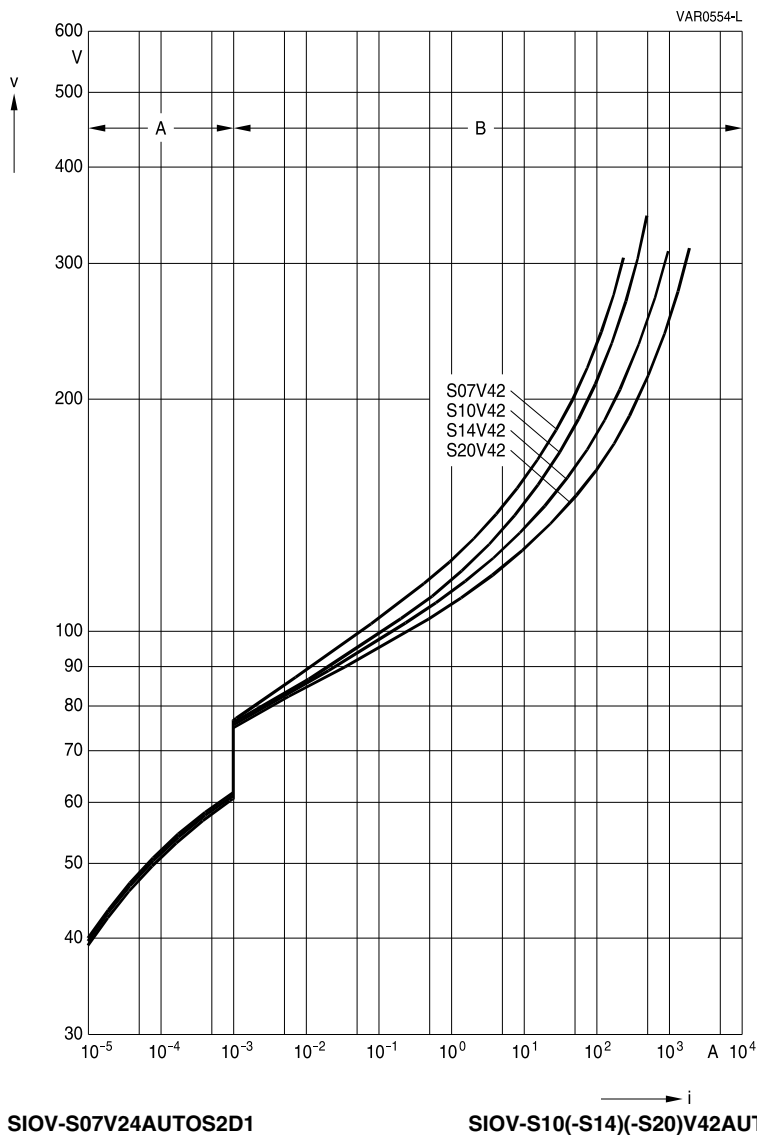
LCT = Lower category temperature



## 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

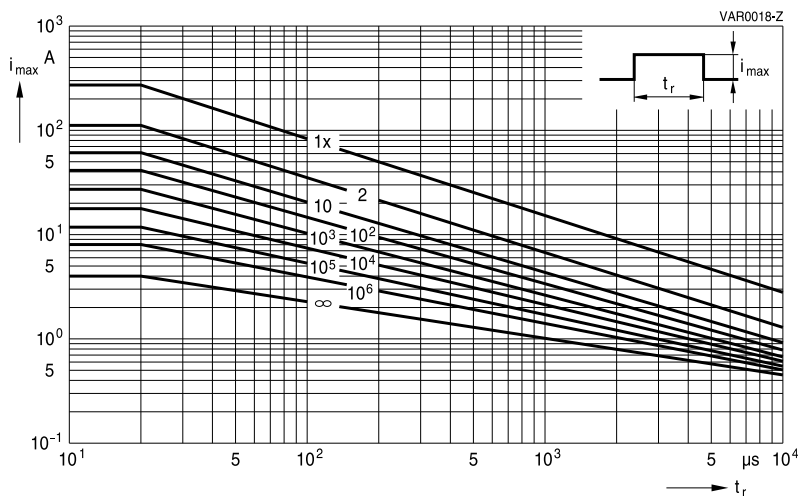




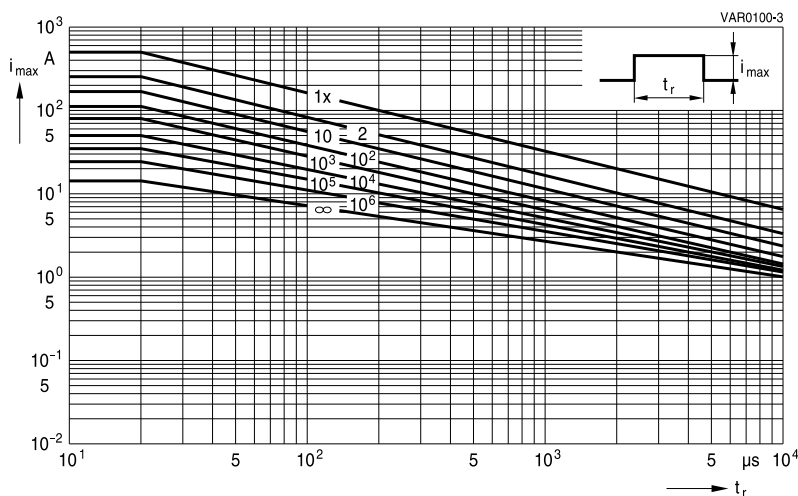
## Derating curves

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

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



**SIOV-S07V42AUTOS2D1**



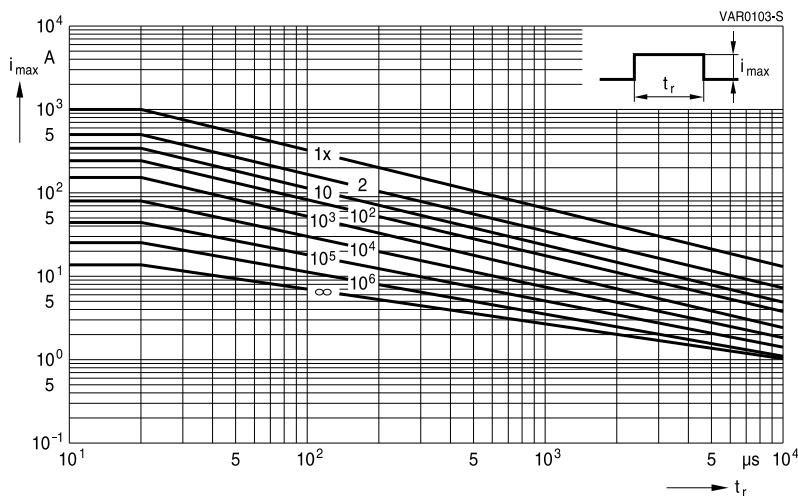
**SIOV-S10V42AUTOS5D1**



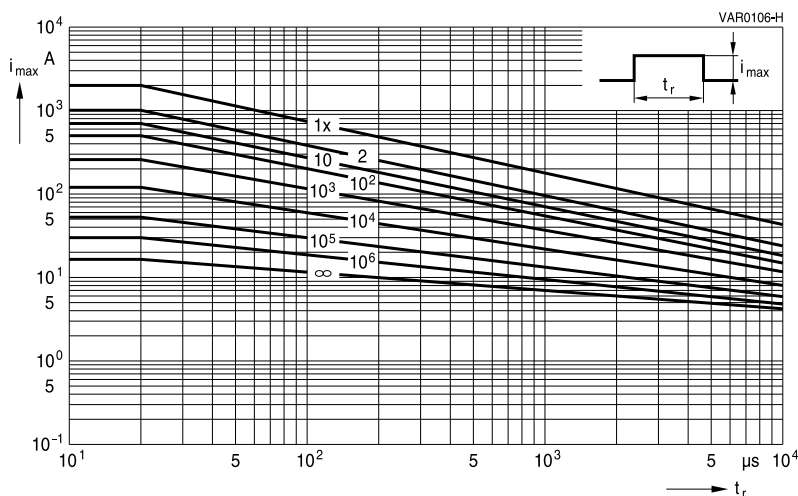
## Derating curves

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

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



**SIOV-S14V42AUTOS5D1**



**SIOV-S20V42AUTOS5D1**



## Leaded varistors

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### Automotive series for 42 V

## Taping, packaging and lead configuration

### 1 EPCOS ordering code system

#### For leaded varistors

|                                                                                                                                                                   |    |   |   |     |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|---|-----|---|---|---|---|
| B722 or B723                                                                                                                                                      | 10 | S | 2 | 271 | K | 1 | 0 | 1 |
| Monolithic varistor                                                                                                                                               |    |   |   |     |   |   |   |   |
| Nominal disc diameter                                                                                                                                             |    |   |   |     |   |   |   |   |
| <b>Design:</b><br>F = Fail-safe varistor<br>Q = EnergetiQ<br>S = Leaded varistor<br>T = ThermoFuse<br>U = Disk type, SNF<br>X = Disk type, SNF (AEC-Q200)         |    |   |   |     |   |   |   |   |
| <b>Series:</b><br>0 = Standard<br>1 = Automotive<br>2 = AdvanceD<br>3 = SuperioR<br>4 = SuperioR                                                                  |    |   |   |     |   |   |   |   |
| <b>Max. AC operating voltage:</b><br>$271 = 27 \cdot 10^1 = 275 \text{ VAC}$<br>$140 = 14 \cdot 10^0 = 14 \text{ VAC}$<br>$141 = 14 \cdot 10^1 = 140 \text{ VAC}$ |    |   |   |     |   |   |   |   |
| <b>Tolerance of varistor voltage:</b><br>K = $\pm 10\%$<br>J = $\pm 5\%$<br>S = Special tolerance                                                                 |    |   |   |     |   |   |   |   |
| <b>Lead configuration:</b><br>1 = Straight leads<br>2 thru 9 = Kinked form                                                                                        |    |   |   |     |   |   |   |   |
| <b>Packaging:</b><br>0 = Bulk,<br>1 thru 7 = Taping style                                                                                                         |    |   |   |     |   |   |   |   |
| <b>Internal coding:</b><br>1 = Standard                                                                                                                           |    |   |   |     |   |   |   |   |



**Leaded varistors**

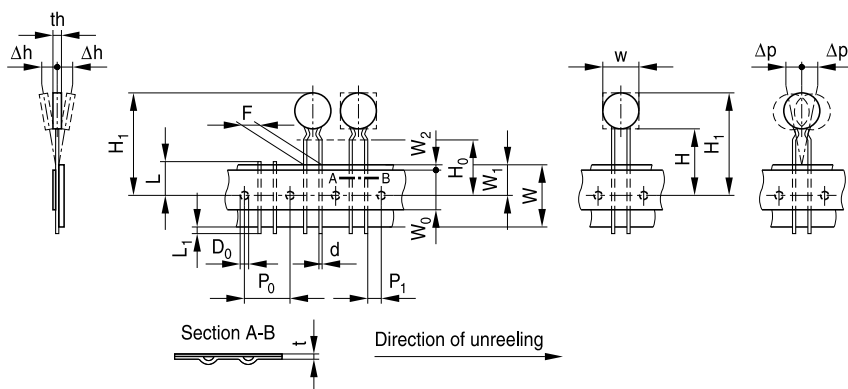
**B722\***

**Automotive series for 42 V**

## 2 Taping and packaging of leaded varistors

Tape packaging for lead spacing  $\boxed{e} = 5$  fully conforms to IEC 60286-2, while for lead spacings  $\boxed{e} = 7.5$  and 10 the taping mode is based on this standard.

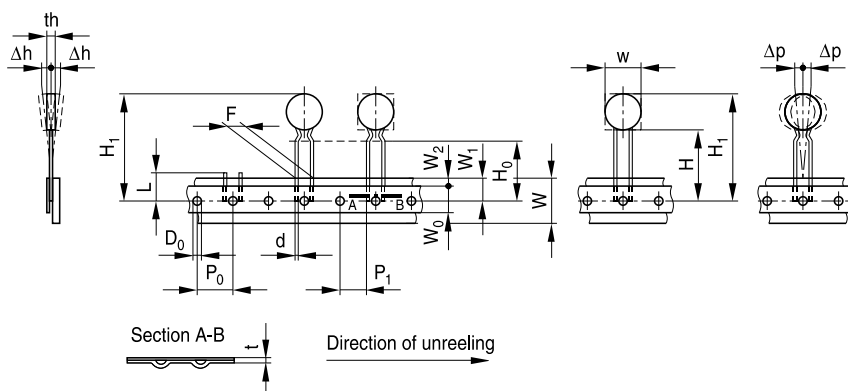
### 2.1 Taping in accordance with IEC 60286-2 for lead spacing 5.0 mm



$F \triangleq \boxed{e} = 5.0 \text{ mm}$

VAR0410-X-E

### 2.2 Taping based on IEC 60286-2 for lead spacing 7.5 and 10 mm



$F \triangleq \boxed{e} = 7.5 \text{ mm}$

$F \triangleq \boxed{e} = 10 \text{ mm}$

VAR0395-J-E



## Leaded varistors

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### Automotive series for 42 V

## 2.3 Tape dimensions (in mm)

| Sym-<br>bol    | $\boxed{e} = 5.0$ | Tolerance | $\boxed{e} = 7.5$  | Tolerance  | $\boxed{e} = 10.0$ | Tolerance  | Remarks                                               |
|----------------|-------------------|-----------|--------------------|------------|--------------------|------------|-------------------------------------------------------|
| w              |                   | max.      |                    | max.       |                    | max.       | see tables in<br>each series<br>under<br>"Dimensions" |
| th             |                   | max.      |                    | max.       |                    | max.       |                                                       |
| d              | 0.6               | ±0.05     | 0.8                | ±0.05      | 1.0                | ±0.05      |                                                       |
| P <sub>0</sub> | 12.7              | ±0.3      | 12.7 <sup>1)</sup> | ±0.3       | 12.7               | ±0.3       | ±1 mm/20<br>sprocket holes                            |
| P <sub>1</sub> | 3.85              | ±0.7      | 8.95               | ±0.8       | 7.7                | ±0.8       |                                                       |
| F              | 5.0               | +0.6/−0.1 | 7.5                | ±0.8       | 10.0               | ±0.8       | measured at<br>top of compo-<br>nent body             |
| Δh             | 0                 | ±2.0      | depends on s       |            | depends on s       |            |                                                       |
| Δp             | 0                 | ±1.3      | 0                  | ±2.0       | 0                  | ±2.0       |                                                       |
| W              | 18.0              | ±0.5      | 18.0               | ±0.5       | 18.0               | ±0.5       | Peel-off<br>force ≥ 5 N                               |
| W <sub>0</sub> | 5.5               | min.      | 11.0               | min.       | 11.0               | min.       |                                                       |
| W <sub>1</sub> | 9.0               | ±0.5      | 9.0                | +0.75/−0.5 | 9.0                | +0.75/−0.5 |                                                       |
| W <sub>2</sub> | 3.0               | max.      | 3.0                | max.       | 3.0                | max.       |                                                       |
| H              | 18.0              | +2.0/−0   | 18.0               | +2.0/−0    | 18.0               | +2.0/−0    | <sup>2)</sup><br><sup>3)</sup>                        |
| H <sub>0</sub> | 16.0<br>(18.0)    | ±0.5      | 16.0<br>(18.0)     | ±0.5       | 16.0               | ±0.5       |                                                       |
| H <sub>1</sub> | 32.2              | max.      | 45.0               | max.       | 45.0               | max.       |                                                       |
| D <sub>0</sub> | 4.0               | ±0.2      | 4.0                | ±0.2       | 4.0                | ±0.2       | without lead                                          |
| t              | 0.9               | max.      | 0.9                | max.       | 0.9                | max.       |                                                       |
| L              | 11.0              | max.      | 11.0               | max.       | 11.0               | max.       |                                                       |
| L <sub>1</sub> | 0.5               | max.      |                    |            |                    |            |                                                       |

1) Taping with P<sub>0</sub> = 15.0 mm upon request

2) Applies only to uncrimped types

3) Applies only to crimped types (H<sub>0</sub> = 18 upon request)



## 2.4 Taping mode

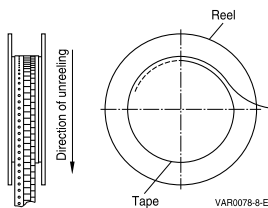
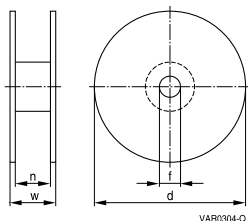
Example: B72210S0271K1 **5** 1  
 Digit 14

| Digit 14 | Taping mode | Reel type | Seating plane height $H_0$<br>for crimped types<br>mm | Seating plane height $H$<br>for uncrimped types<br>mm | Pitch distance<br>$P_0$<br>mm |
|----------|-------------|-----------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------|
| 0        | —           | Bulk      | —                                                     | —                                                     | —                             |
| 1        | G           | I         | 16                                                    | 18                                                    | 12.7                          |
| 2        | G2          | I         | 18                                                    | —                                                     | 12.7                          |
| 3        | G3          | II        | 16                                                    | 18                                                    | 12.7                          |
| 4        | G4          | II        | 18                                                    | —                                                     | 12.7                          |
| 5        | G5          | III       | 16                                                    | 18                                                    | 12.7                          |
| 6        | GA          | Ammo pack | 16                                                    | 18                                                    | 12.7                          |
| 7        | G2A         | Ammo pack | 18                                                    | —                                                     | 12.7                          |

Internal coding for special taping

|      |           |    |    |      |
|------|-----------|----|----|------|
| G6   | III       | 18 | —  | 12.7 |
| G10  | II        | 16 | 18 | 15.0 |
| G11  | II        | 18 | —  | 15.0 |
| G10A | Ammo pack | 16 | 18 | 15.0 |
| G11A | Ammo pack | 18 | —  | 15.0 |

## 2.5 Reel dimension



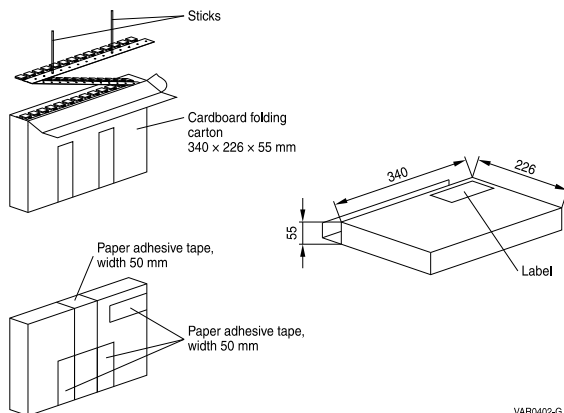
### Dimensions (in mm)

| Reel type | d        | f     | n          | w       |
|-----------|----------|-------|------------|---------|
| I         | 360 max. | 31 ±1 | approx. 45 | 54 max. |
| II        | 360 max. | 31 ±1 | approx. 55 | 64 max. |
| III       | 500 max. | 23 ±1 | approx. 59 | 72 max. |

If reel type III is not compatible with insertion equipment because of its large diameter, nominal disk diameter 10 mm and 14 mm can be supplied on reel II upon request (taping mode G3).



## 2.6 Ammo pack dimensions



## 3 Lead configuration

Straight leads are standard for disk varistors. Other lead configurations as crimp style or customer-specific lead wire length according to 3.1, 3.2, 3.3 and 3.4 are optional. Crimped leads (non-standard) are differently crimped for technical reasons; the individual crimp styles are denoted by consecutive numbers (S, S2 through S5) as shown in the dimensional drawings below.

The crimp styles of the individual types can be seen from the type designation in the ordering tables.

### 3.1 Crimp style mode

Example: B72210S0271K **5** 01

Digit 13

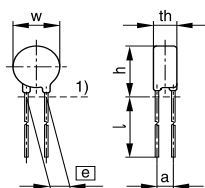
| Digit 13 of ordering code | Crimp style              | Figure |
|---------------------------|--------------------------|--------|
| 1                         | Standard, straight leads | 1      |
| 2                         | S2                       | 2      |
| 3                         | S3                       | 3      |
| 5                         | S5                       | 4      |
| Available upon request    |                          |        |
| Internal coding           | —                        | 5      |



### 3.2 Standard leads and non-standard crimp styles

The basic dimensions in figure 1 to 5 are valid for types with either round or square (EnergetiQ series) component head.

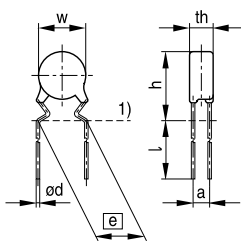
#### Standard, straight leads



1) Seating plane to IEC 717  
VAR0586-W-E

**Figure 1**

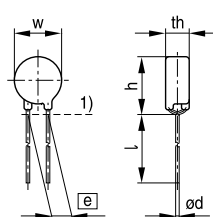
#### Non-standard, crimp style S2



1) Seating plane to IEC 60717  
VAR0411-F-E

**Figure 2**

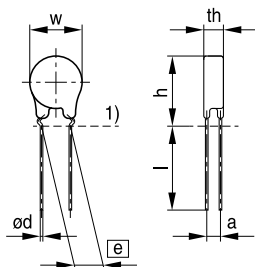
#### Non-standard, crimp style S3



1) Seating plane to IEC 60717  
VAR0396-R-E

**Figure 3**

#### Non-standard, crimp style S5



1) Seating plane to IEC 60717  
VAR0726-M-E

**Figure 4**



### 3.3 Trimmed leads (non-standard)

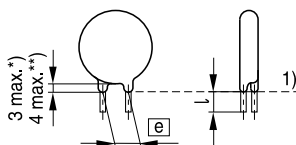
Varistors with cut leads available upon request.

Lead length tolerances:

Straight leads  $\pm 0.8$  mm

Crimped leads  $\pm 0.5$  mm

Minimum lead length 3.0 mm



1) Seating plane to IEC 60717

\*) For round component head

\*\*) For EnergetiQ series, square component head

VAR0642-U-E

**Figure 5**



## Cautions and warnings

### General

1. EPCOS metal oxide varistors 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 prior to processing.
2. Recommended storage conditions in original packaging:  
Storage temperature:  $-25\text{ }^{\circ}\text{C} \dots +45\text{ }^{\circ}\text{C}$ ,  
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 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 EPCOS 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 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.
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 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 deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas etc), corrosive agents, humid or salty conditions. Contact with any liquids and solvents should be prevented.

## Display of ordering codes for EPCOS products

The ordering code for one and the same EPCOS product can be represented differently in data sheets, data books, other publications, on the EPCOS website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.** Detailed information can be found on the Internet under [www.epcos.com/orderingcodes](http://www.epcos.com/orderingcodes)


**Symbols and terms**

| Symbol             | Term                                                                     |
|--------------------|--------------------------------------------------------------------------|
| $C$                | Capacitance                                                              |
| $C_{typ}$          | Typical capacitance                                                      |
| $i$                | Current                                                                  |
| $i_c$              | Current at which $V_{c, max}$ is measured                                |
| $I_{leak}$         | Leakage current                                                          |
| $i_{max}$          | Maximum surge current (also termed peak current)                         |
| $I_{max}$          | Maximum discharge current                                                |
| $I_n$              | Nominal discharge current to UL 1449                                     |
| LCT                | Lower category temperature                                               |
| $L_{typ}$          | Typical inductance                                                       |
| $P_{max}$          | Maximum average power dissipation                                        |
| $R_{ins}$          | Insulation resistance                                                    |
| $R_{min}$          | Minimum resistance                                                       |
| $T_A$              | Ambient temperature                                                      |
| $t_r$              | Duration of equivalent rectangular wave                                  |
| UCT                | Upper category temperature                                               |
| $v$                | Voltage                                                                  |
| $V_{clamp}$        | Clamping voltage                                                         |
| $V_{c, max}$       | Maximum clamping voltage at specified current $i_c$                      |
| $V_{DC}$           | DC operating voltage                                                     |
| $V_{jump}$         | Maximum jump start voltage                                               |
| $V_{max}$          | Maximum voltage                                                          |
| $V_{op}$           | Operating voltage                                                        |
| $V_{RMS}$          | AC operating voltage, root-mean-square value                             |
| $V_{RMS, op, max}$ | Root-mean-square value of max. DC operating voltage incl. ripple current |
| $V_{surge}$        | Super imposed surge voltage                                              |
| $V_V$              | Varistor voltage                                                         |
| $\Delta V_V$       | Tolerance of varistor voltage                                            |
| $W_{LD}$           | Maximum load dump                                                        |
| $W_{max}$          | Maximum energy absorption                                                |
| $e$                | Lead spacing                                                             |

All dimensions are given in mm.

The commas used in numerical values denote decimal points.

## 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 we are 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 a 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 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 an 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 an electronic component.
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## Important notes

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