

SMD multilayer varistor with AgPt termination

Series/Type: CN2220S14BAUT0E2G2K2

Ordering code: B72542V3140S272

Date: 2010-01-20

Version:

CN2220S14BAUTOE2G2K2

### **Designation system**

CN =  $\underline{\mathbf{c}}$ hip  $\underline{\mathbf{n}}$ ot molded

2220 = dimensions of the device  $\underline{22} \times \underline{20}$  (length x width in 1/100 inch)

S...B =  $\underline{s}$  pecial tolerance  $\underline{B}$  of the varistor voltage

14 = max. RMS operating voltage

AUTO = Suited for <u>AUTO</u>motive application E2 = increased energy handling capability

G2 = taped version, blister tape, 13" reel (3000 pcs. /reel)

K2 = termination material AgPt

#### **Electrical data**

Max. operating voltage

RMS voltage  $V_{RMS} = 14 \text{ V}$ DC voltage  $V_{DC} = 16 \text{ V}$ 

Varistor voltage (@ 1 mA, 25 °C)  $V_v = 22.0...27.0 \text{ V}$ 

Max. clamping voltage (@ 10 A)  $V_c = 40 V$ 

Max. average power dissipation  $P_{max} = 30 \text{ mW}$ 

Max. surge current (8/20  $\mu$ s)  $\hat{l}_{max} = 1 \times 1200 \text{ A}$ 

Max. energy absorption (2 ms)  $E_{max} = 1 \times 5.8 J$ 

Load Dump  $E_{max} = 10 \times 25 \text{ J}$ 

Jump Start 24.5 V, 5 min.

Capacitance (@ 1 kHz, 1 V, 25 °C; typical) C = 15 nF

Response time < 0.5 ns

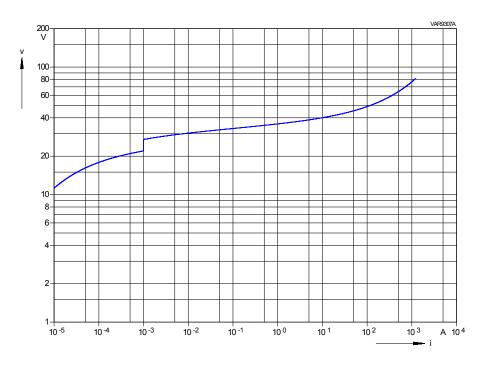
Operating temperature -55 ... +125 °C

Storage temperature (mounted parts) -55 ... +150 °C

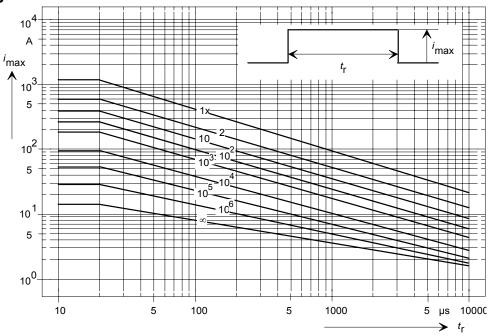


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### v/i-characteristic



# **Derating field**

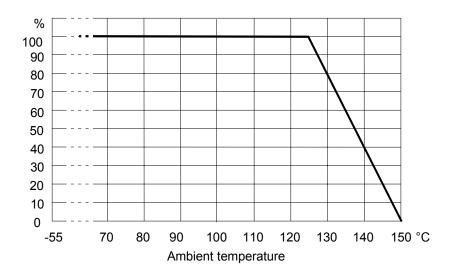




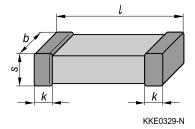
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### **Temperature derating**

Max. current, energy, operating voltage and average power dissipation depending on ambient temperature



### Dimensional drawing in mm



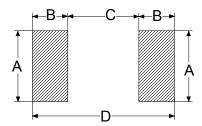
$$I = 5.7 \pm 0.4$$

$$b = 5.0 \pm 0.4$$

$$s = 2.3 \text{ max}.$$

$$k = 0.25 \dots 1.0$$

### Recommended solder pad layout

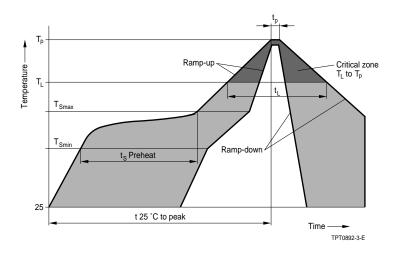


$$A = 5.5 \text{ mm}$$

$$C = 4.2 \text{ mm}$$

### Recommended reflow soldering temperature profile and solder paste

### Reflow soldering temperature profile for Pb-free assembly



Profile feature	Pb-free assembly
Average ramp-up rate $(T_{Smax} \text{ to } T_p)$	3 °C/ second max.
Preheat	
- Temperature min (T <sub>Smin</sub> )	150 °C
- Temperature max (T <sub>Smax</sub> )	200 °C
- Time ( $t_{\text{Smin}}$ to $t_{\text{Smax}}$ )	60 180 seconds
Time maintained above	
- Temperature min (T <sub>L</sub> )	217 °C
- Time (t <sub>L</sub> )	60 150 seconds
Peak classification temperature	240 °C 260 °C
(I <sub>p</sub> )	
Time within 5 °C of actual peak	20 40 seconds
temperature (t <sub>p</sub> )	
Ramp-down rate	6 °C/ second max.
Time 25 °C to peak temperature	8 minutes max.

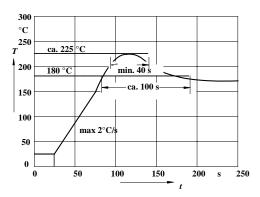
**Notes:** All temperatures refer to topside of the package, measured on the package body surface. Max. number of reflow cycles: 3

### Recommended solder paste for Pb-free assembly

SAC (e.g. Sn95.5Ag3.8Cu0.7)

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#### Reflow soldering temperature profile for Sn-Pb eutectic assembly



This component is only suited for reflow soldering at low temperatures (typ. Tmax = 225°C) when using Sn-Pb solder.

# **Recommended solder paste for Sn-Pb eutectic assembly** Sn62Pb36Ag2

Please note that this component isn't suitable for wave soldering.

### Soldering guidelines

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

The components are suitable for reflow soldering to JEDEC J-STD-020C only.

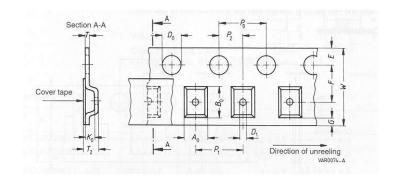
### **Storage condition**

- As far as possible, the components should be employed within 6 months after delivery from EPCOS.
- They should be left in their original packings to avoid soldering problems due to oxidized contacts.
- Storage temperature: 25 up to + 45°C.
- Relative humidity: < 75 % annual average, < 95 % on max. 30 days in a year.</li>

### Taping and packaging

Tape and reel packing according to IEC 60286-3

Tape material: Blister



### Dimensions and tolerances

Definition	Symbol	Dimension	Tolerance
		[mm]	[mm]
Compartment width	A <sub>0</sub>	5.1	±0.2
Compartment length	B <sub>0</sub>	6.0	±0.2
Compartment height	K <sub>0</sub>	2.6	max.
Sprocket hole diameter	D <sub>0</sub>	1.5	+0.1 /-0
Compartment hole diameter	D <sub>1</sub>	1.5	min.
Sprocket hole pitch	P <sub>0</sub>	4.0	±0.1 <sup>1)</sup>
Distance center hole to center compartment	P <sub>2</sub>	2.0	±0.05
Pitch of the component compartments	P <sub>1</sub>	8.0	±0.1
Tape width	W	12.0	±0.3
Distance edge to center of hole	Е	1.75	±0.1
Distance center hole to center compartment	F	5.5	±0.05
Distance compartment to edge	G	0.75	min.
Overall thickness	T <sub>2</sub>	3.5	max.
Thickness tape	Т	0.3	max.

 $<sup>^{1)} \</sup>leq \pm 0.2$  mm over any 10 pitches

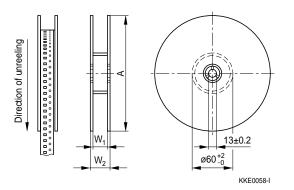
Package: 12-mm tape

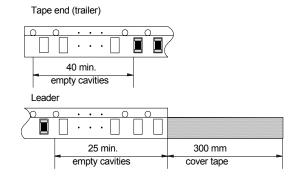
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### Packing

Packing material: Plastic

### Reel dimensions





Dinition	Symbol	Dimension	Tolerance
		[mm]	[mm]
Reel diameter	Α	330	-2
Reel width (inside)	$W_1$	12.4	+1.5 /-0
Reel width (outside)	$W_2$	18.4	max.

Packing unit: 3000 pcs. / reel

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### Qualification tests and comparison with AEC-Q200, Rev. C

Preconditioning: Reflow soldering on PCB

		AEC-Q200, Rev. C		EPCOS OHG	
ITEM	TEST	REFERENCE	ADDITIONAL REQUIREMENTS	REMARKS/ GAP TO AEC-Q200	CRITERIA
01	PRE- AND POST-STRESS ELECTRICAL TEST	Data sheet		All pre- and post-stress electrical measurements are performed at room temperature (25 °C). Electrical measurement includes U <sub>v</sub> @ 1 mA.	
03	HIGH TEMPERATURE EXPOSURE (STORAGE)	MIL-STD-202 Method 108	Unpowered  1000 hrs @ T = 150 °C  Measurement at 24 ±2 hrs after test conclusion.		ΔV/V (1 mA)  ≤ 10 % No visible damage
04	TEMPERATURE CYCLING	JESD22 Method JA-104	1000 Cycles (-40 °C to +125 °C) Electrical test before and after TC. Note: If 85 °C part the 1000 cycles will be at that temperature rating. Measurement at 24 ±2 hrs after test conclusion.	Temperature cycling is performed acc. MIL-STD-202 Method 107 (see test item 16) 300 cycles (-55 °C to +125 °C) Max. transfer time: < 10 s Dwell time: 15 min, Air – Air No warrant will be assumed for the reliability of solder joint.	$ \Delta V/V (1 \text{ mA})  \le 10 \%$ No visible damage
06	MOISTURE RESISTANCE	MIL-STD-202 Method 106	t = 24 hrs/cycle  Note: Steps 7a & 7b not required Unpowered  Measurement at 24 ±2 hrs after test conclusion.		ΔV/V (1 mA)  ≤ 10 % No visible damage
07	BIASED HUMIDITY	MIL-STD-202 Method 103	1000 hrs, 85 °C/85% r.h.  Bias at 85% (+5% / -0%) of rated varistor voltage (1 mA).  Measurement at 24 ±2 hrs after test conclusion.		ΔV/V (1 mA)  ≤ 10 % No visible damage
08	OPERATIONAL LIFE	MIL-STD-202 Method 108	1000 hrs, T <sub>A</sub> = 125 °C.  Note: If 85 °C part 1000 h will be at that temperature.  Bias at 85% (+5% / -0%) of rated varistor voltage (1 mA).  Measurement at 24 ±2 hrs after test conclusion.		ΔV/V (1 mA)  ≤ 10 % No visible damage

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### SMD multilayer varistor with AgPt termination

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		AEC-Q200, Rev. C		EPCOS OHG	
ITEM	TEST	REFERENCE	ADDITIONAL REQUIREMENTS	REMARKS/ GAP TO AEC-Q200	CRITERIA
09	EXTERNAL VISUAL	MIL-STD-883 Method 2009	Inspect device construction, marking and workmanship.  Electrical test not required		
10	PHYSICAL DIMENSIONS	JESD22 Method JB-100	Verify physical dimensions to the applicable device specification. Note: User(s) and Suppliers spec. Electrical Test not required.		Specified values
13	MECHANICAL SCHOCK	MIL-STD-202 Method 213	Figure 1 of Method 213 SMD: Condition F LEADED: Condition C	IEC 60068-2-27, Test E <sub>b</sub> : Pulse: half-sine Max. acceleration = 400 m/s <sup>2</sup> Pulse duration = 6 ms 3 pulses/direction, 6 directions Condition F: Peak value 1500 g's with EPCOS equipment not possible.	ΔV/V (1 mA)  ≤ 5 % No visible damage
14	VIBRATION	MIL-STD-202 Method 204	5 g's for 20 min., 12 cycles each of 3 orientations Note: Use 8"X5" PCB .031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2000 Hz.		$ \Delta V/V $ (1 mA) $ \leq 5$ % No visible damage
15	RESISTANCE TO SOLDERING HEAT	MIL-STD-202 Method 210	Condition B No pre-heat of samples Note: Single Wave Solder – Procedure 2 for SMD Procedure 1 with solder within 1.5 mm of device body for Leaded.	Condition B: dipping	ΔV/V (1 mA)  ≤ 5 %
16	THERMAL SHOCK	MIL-STD-202 Method 107	-55 °C/+125 °C. Note: Number of cycles required-300, Max. transfer time-20 s, Dwell time-15 min. Air-Air.	No warrant will be assumed for the reliability of solder joint.	ΔV/V (1 mA)  ≤ 10 % No visible damage



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		AEC-Q200, Rev. C		EPCOS OHG	
ITEM	TEST	REFERENCE	ADDITIONAL REQUIREMENTS	REMARKS/ GAP TO AEC-Q200	CRITERIA
17	ESD	AEC-Q200-002			ΔV/V (1 mA)  ≤ 10 % No visible damage
18	SOLDERABILITY	J-STD-002	Electrical Test not required.  Magnification 50 X  Conditions SMD:  a) Method B, 4 hrs @ 155  °C dry heat @ 235 °C.  b) Method B @ 215 °C  category 3.  c) Method D category 3 @ 260 °C.	Reflow solderability using recommended soldering temperature profile and solder paste acc. data sheet	Good solder joint
19	ELECTRICAL CHARACTERI- ZATION	User Spec.	Parametrically test per lot and sample size requirements, summary to show Min, Max, Mean and Standard deviation at room as well as Min and Max operating temperatures.	All electrical measurements are performed at room temperature (25°C) only. Electrical measurement includes U <sub>V</sub> @ 1 mA and U <sub>C</sub> .	Specified values
21	BOARD FLEX	AEC-Q200-005	Appendix 2 Note: 2 mm (min)		$\begin{split}  \Delta V/V \ (1 \ mA)  &\leq 10 \ \% \\  \Delta C/ \ C_0  &\leq 10 \ \% \\ \text{No visible damage} \end{split}$
22	TERMINAL STRENGTH	AEC-Q200-006	Appendix 1 Note: Force of 1.8 kg for 60 s.		ΔV/V (1 mA)  ≤ 10 % No visible damage
30	ELECTRICAL TRANSIENT CONDUCTION	ISO-7637-1	Test pulses 1 to 3	ISO-7637-2	ΔV/V (1 mA)  ≤ 10 % No visible damage



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#### **Cautions and warnings**

#### General

Some parts of this publication contain statements about the suitability of our ceramic transient voltage suppressor (CTVS) components (multilayer varistors (MLVs), CeraDiodes, ESD/EMI filters, SMD disk varistors (CU types), leaded transient voltage/ RFI suppressors (SHCV types)) for certain areas of application, including recommendations about incorporation/design-in of these products into customer applications. The statements are based on our knowledge of typical requirements often made of our CTVS devices in the particular areas. We nevertheless expressly point out that such statements cannot be regarded as binding statements about the suitability of our CTVS components 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 incumbent on the customer to check and decide whether the CTVS devices with the properties described in the product specification are suitable for use in a particular customer application.

- Do not use EPCOS CTVS components for purposes not identified in our specifications, application notes and data books.
- Ensure the suitability of a CTVS in particular by testing it for reliability during design-in. Always evaluate a CTVS component under worst-case conditions.
- Pay special attention to the reliability of CTVS devices intended for use in safety-critical applications (e.g. medical equipment, automotive, spacecraft, nuclear power plant).

#### **Design notes**

- Always connect a CTVS in parallel with the electronic circuit to be protected.
- Consider maximum rated power dissipation if a CTVS has insufficient time to cool down between a number of pulses occurring within a specified isolated time period. Ensure that electrical characteristics do not degrade.
- Consider derating at higher operating temperatures. Choose the highest voltage class compatible with derating at higher temperatures.
- Surge currents beyond specified values will puncture a CTVS. In extreme cases a CTVS will burst.
- If steep surge current edges are to be expected, make sure your design is as low-inductance as possible.
- In some cases the malfunctioning of passive electronic components or failure before the end of their service life cannot be completely ruled out in the current state of the art, even if they are operated as specified. In applications requiring a very high level of operational safety and especially when the malfunction or failure of a passive electronic component could endanger human life or health (e.g. in accident prevention, life-saving systems, or automotive battery line applications such as clamp 30), ensure by suitable design of the application or other measures (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of such a malfunction or failure. Only use CTVS components from the AUTO series in safety-relevant applications.

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#### SMD multilayer varistor with AgPt termination

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 Specified values only apply to CTVS components that have not been subject to prior electrical, mechanical or thermal damage. The use of CTVS devices in line-to-ground applications is therefore not advisable, and it is only allowed together with safety countermeasures like thermal fuses.

#### Storage

- Only store CTVS in their original packaging. Do not open the package before storage.
- Storage conditions in original packaging: temperature −25 to +45°C, relative humidity ≤75% annual average, maximum 95%, dew precipitation is inadmissible.
- Do not store CTVS devices where they are exposed to heat or direct sunlight. Otherwise the
  packaging material may be deformed or CTVS may stick together, causing problems during
  mounting.
- Avoid contamination of the CTVS surface during storage, handling and processing.
- Avoid storing CTVS devices in harmful environments where they are exposed to corrosive gases for example (SO<sub>x</sub>, CI).
- Use CTVS as soon as possible after opening factory seals such as polyvinyl-sealed packages.
- Solder CTVS components after shipment from EPCOS within the time specified:
  - o CTVS with Ni barrier termination, 12 months
  - o CTVS with AgPd/AgPt termination, 6 months
  - o SHCV and CU series, 24 months

#### Handling

- Do not drop CTVS components and allow them to be chipped.
- Do not touch CTVS with your bare hands gloves are recommended.
- Avoid contamination of the CTVS surface during handling.

#### Mounting

- When CTVS devices are encapsulated with sealing material or overmolded with plastic material, be sure to observe the precautions in "Mounting instructions", "Sealing, potting and overmolding".
- Make sure an electrode is not scratched before, during or after the mounting process.
- Make sure contacts and housings used for assembly with CTVS components are clean before mounting.

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#### SMD multilayer varistor with AgPt termination

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- The surface temperature of an operating CTVS can be higher. Ensure that adjacent components are placed at a sufficient distance from a CTVS to allow proper cooling.
- Avoid contamination of the CTVS surface during processing.
- Multilayer varistors (MLVs) with AgPd termination are not approved for lead-free soldering.

#### Soldering

- Complete removal of flux is recommended to avoid surface contamination that can result in an instable and/or high leakage current.
- Use resin-type or non-activated flux.
- Bear in mind that insufficient preheating may cause ceramic cracks.
- Rapid cooling by dipping in solvent is not recommended, otherwise a component may crack.

#### Conductive adhesive gluing

 Only multilayer varistors (MLVs) with an AgPd termination are approved for conductive adhesive gluing.

#### Operation

- Use CTVS only within the specified operating temperature range.
- Use CTVS only within specified voltage and current ranges.
- Environmental conditions must not harm a CTVS. Only use them in normal atmospheric conditions. Reducing the atmosphere (e.g. hydrogen or nitrogen atmosphere) is prohibited.
- Prevent a CTVS from contacting liquids and solvents. Make sure that no water enters a CTVS (e.g. through plug terminals).
- Avoid dewing and condensation.
- EPCOS CTVS components are mainly designed for encased applications. Under all circumstances avoid exposure to:
  - o direct sunlight
  - rain or condensation
  - steam, saline spray
  - corrosive gases
  - atmosphere with reduced oxygen content



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- EPCOS CTVS devices are not suitable for switching applications or voltage stabilization where static power dissipation is required.
- Multilayer varistors (MLVs) are designed for ESD protection and transient suppression.
   CeraDiodes are designed for ESD protection only, ESD/EMI filters are designed for ESD and EMI protection only.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.



#### 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 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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