

SIOV metal oxide varistors

Housed (ThermoFuse) varistors, AdvancedD series

Series/Type: **ETFV25**
Date: April 2011

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Construction

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

Features

- Wide operating voltage range 115 ... 420 V_{RMS}
- Self-protected under abnormal overvoltage conditions
- Very high surge current ratings of 20 kA

Approvals

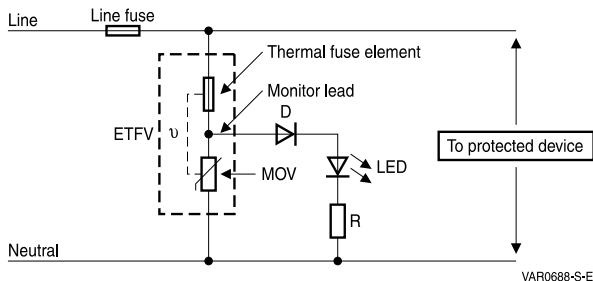
- UL
- IEC
- VDE

Applications

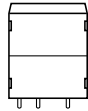
- Air conditioner, refrigerator, TV, etc.
- Power meter, inverter, telecom equipment, etc.
- Transient voltage surge suppressors (TVSS)
- Solar inverter

Delivery mode

- Bulk (standard)

Typical applications

General technical data

| | | | |
|-----------------------|----------------|--------------|-------------------|
| Climatic category | to IEC 60068-1 | 40/85/56 | |
| Operating temperature | to IEC 61051 | -40 ... + 85 | °C |
| Storage temperature | | -40 ... + 85 | °C |
| Electric strength | to IEC 61051 | ≥ 2.5 | kV _{RMS} |
| Insulation resistance | to IEC 61051 | ≥ 100 | MΩ |
| Response time | | < 25 | ns |

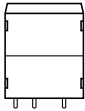

Electrical specifications and ordering codes
Maximum ratings ($T_A = 85\text{ }^\circ\text{C}$)

| Ordering code | Type (untaped) SIOV- | V_{RMS} | V_{DC} | $i_{max}^{1)}$ (8/20 μs) | W_{max} (2 ms) | P_{max} |
|-----------------|----------------------------|-----------|----------|---|---------------------|-----------|
| | | V | V | A | J | W |
| B72225T4111K101 | ETFV25K115E4 | 115 | 150 | 20000 | 170 | 1.0 |
| B72225T4131K101 | ETFV25K130E4 | 130 | 170 | 20000 | 185 | 1.0 |
| B72225T4141K101 | ETFV25K140E4 | 140 | 180 | 20000 | 195 | 1.0 |
| B72225T4151K101 | ETFV25K150E4 | 150 | 200 | 20000 | 215 | 1.0 |
| B72225T4171K101 | ETFV25K175E4 | 175 | 225 | 20000 | 245 | 1.0 |
| B72225T4211K101 | ETFV25K210E4 | 210 | 270 | 20000 | 290 | 1.0 |
| B72225T4231K101 | ETFV25K230E4 | 230 | 300 | 20000 | 315 | 1.0 |
| B72225T4251K101 | ETFV25K250E4 | 250 | 320 | 20000 | 345 | 1.0 |
| B72225T4271K101 | ETFV25K275E4 | 275 | 350 | 20000 | 375 | 1.0 |
| B72225T4301K101 | ETFV25K300E4 | 300 | 385 | 20000 | 410 | 1.0 |
| B72225T4321K101 | ETFV25K320E4 | 320 | 420 | 20000 | 445 | 1.0 |
| B72225T4351K101 | ETFV25K350E4 | 350 | 460 | 20000 | 495 | 1.0 |
| B72225T4381K101 | ETFV25K385E4 | 385 | 505 | 20000 | 600 | 1.0 |
| B72225T4421K101 | ETFV25K420E4 | 420 | 560 | 20000 | 700 | 1.0 |

Characteristics ($T_A = 25\text{ }^\circ\text{C}$)

| Ordering code | Type (untaped) SIOV- | V_v | ΔV_v | $V_{c,max}$ | i_c | C_{typ} |
|-----------------|----------------------------|-------------|--------------|----------------|-------|---------------|
| | | (1 mA) V | (1 mA) % | (i_c) V | A | (1 kHz) pF |
| B72225T4111K101 | ETFV25K115E4 | 180 | ± 10 | 300 | 150 | 2280 |
| B72225T4131K101 | ETFV25K130E4 | 205 | ± 10 | 340 | 150 | 2010 |
| B72225T4141K101 | ETFV25K140E4 | 220 | ± 10 | 360 | 150 | 1860 |
| B72225T4151K101 | ETFV25K150E4 | 240 | ± 10 | 395 | 150 | 1740 |
| B72225T4171K101 | ETFV25K175E4 | 270 | ± 10 | 455 | 150 | 1500 |
| B72225T4211K101 | ETFV25K210E4 | 330 | ± 10 | 545 | 150 | 1245 |
| B72225T4231K101 | ETFV25K230E4 | 360 | ± 10 | 595 | 150 | 1140 |
| B72225T4251K101 | ETFV25K250E4 | 390 | ± 10 | 650 | 150 | 1050 |
| B72225T4271K101 | ETFV25K275E4 | 430 | ± 10 | 710 | 150 | 945 |
| B72225T4301K101 | ETFV25K300E4 | 470 | ± 10 | 775 | 150 | 870 |
| B72225T4321K101 | ETFV25K320E4 | 510 | ± 10 | 840 | 150 | 810 |
| B72225T4351K101 | ETFV25K350E4 | 560 | ± 10 | 910 | 150 | 750 |
| B72225T4381K101 | ETFV25K385E4 | 620 | ± 10 | 1025 | 150 | 675 |
| B72225T4421K101 | ETFV25K420E4 | 680 | ± 10 | 1120 | 150 | 630 |

 1) Note: Thermal fuse may form open circuit after 1 impulse @ 20 kA, 8/20 μs test.

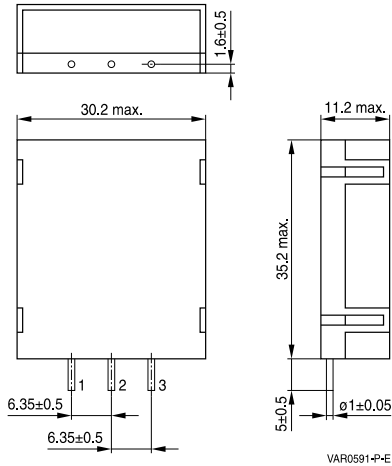


Housed varistors

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ThermoFuse varistors, ETFV25 series

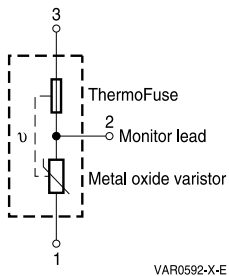
Dimensional drawings

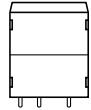


Weight

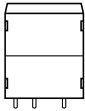
| Nominal diameter mm | V _{RMS} V | Weight g |
|------------------------|-----------------------|--------------|
| 25 | 115 ... 420 | 9.9 ... 18.6 |

Lead configuration

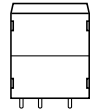



Reliability data

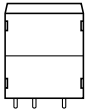
| Test | Test methods/conditions | Requirement |
|---|--|---|
| Varistor voltage | The voltage between two terminals with the specified measuring current applied is called V_V (1 mA _{DC} @ 0.2 ... 2 s). | To meet the specified value |
| Clamping voltage | The maximum voltage between two terminals with the specified standard impulse current (8/20 μ s) applied. | To meet the specified value |
| Endurance at upper category temperature | 1000 h at UCT After having continuously applied the maximum allowable AC 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. | $ \Delta V/V$ (1 mA) $\leq 10\%$ |
| Surge current derating, 8/20 μ s | 10 surge currents (8/20 μ s), unipolar, interval 30 s, amplitude corresponding to derating curve for 10 impulses at 20 μ s | $ \Delta V/V$ (1 mA) $\leq 10\%$ (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 | $ \Delta V/V$ (1 mA) $\leq 10\%$ (measured in direction of surge current) No visible damage |
| Electric strength | IEC 61051-1, test 4.9.2 Metal balls method, 2500 V _{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 |


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ThermoFuse varistors, ETFV25 series

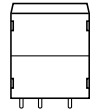
| Test | Test methods/conditions | Requirement |
|-----------------------------|--|---|
| Climatic sequence | <p>The specimen shall be subjected to:</p> <p>a) dry heat at UCT, 16 h, IEC 60068-2-2, test Ba</p> <p>b) damp heat, 1st cycle: 55 °C, 93% r. H., 24 h, IEC 60068-2-30, test Db</p> <p>c) cold, LCT, 2 h, IEC 60068-2-1, test Aa</p> <p>d) damp heat, additional 5 cycles: 55 °C/25 °C, 93% r. H., 24 h/cycle, IEC 60068-2-30, test Db.</p> <p>Then the specimen shall be stored at room temperature and normal humidity for 1 to 2 h.</p> <p>Thereafter, the change of V_V shall be measured. Thereafter, insulation resistance R_{ins} shall be measured at $V = 500$ V.</p> | $ \Delta V/V (1 \text{ mA}) \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$ |
| Rapid change of temperature | IEC 60068-2-14, test Na, LCT/UCT, dwell time 30 min, 5 cycles | $ \Delta V/V (1 \text{ mA}) \leq 5\%$ No visible damage |
| Damp heat, steady state | IEC 60068-2-78, test Ca 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 at $V = 500$ V (insulated varistors only). | $ \Delta V/V (1 \text{ mA}) \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$ |



| Test | Test methods/conditions | Requirement |
|------------------------------|--|--|
| Solderability | <p>IEC 60068-2-20, test Ta, method 1 with modified conditions for lead-free solder alloys: 245 °C, 3 s:</p> <p>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.</p> | <p>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.</p> |
| Resistance to soldering heat | <p>IEC 60068-2-20, test Tb, method 1A, 260 °C, 10 s:</p> <p>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.</p> <p>The change of V_V shall be measured and the specimen shall be visually examined.</p> | <p>$\Delta V/V (1 \text{ mA}) \leq 5\%$</p> <p>No visible damage</p> |
| Tensile strength | <p>IEC 60068-2-21, test Ua1</p> <p>After gradually applying the force specified below and keeping the unit fixed for 10 s, the terminal shall be visually examined for any damage.</p> <p>Force for wire diameter:</p> <p>0.6 mm = 10 N 0.8 mm = 10 N 1.0 mm = 20 N</p> | <p>$\Delta V/V (1 \text{ mA}) \leq 5\%$</p> <p>No break of solder joint, no wire break</p> |


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| Test | Test methods/conditions | Requirement |
|-------------|---|---|
| Vibration | IEC 60068-2-6, test Fc, method B4 Frequency range: 10 ... 55 Hz Amplitude: 0.75 mm or 98 m/s ² 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. | $ \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 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. |



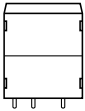
| Test | Test methods/conditions | Requirement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------|---|--|-----------------|-----------------|----------------|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|--------------|-----|-----|
| Abnormal overvoltage test | The device is designed to meet the limited current abnormal overvoltage condition, outlined in section 39.4 of UL 1449, 3 rd edition. Detailed test voltage applied onto the device for different types as in the following table: | Any of these phenomena shall not be observed, or this specimen will be judged as failed part: <ol style="list-style-type: none"> 1. Emission of flame, molten metal, glowing or flaming particles through any openings (pre-existed or created as a result of the test) in the product. 2. Charring, glowing, or flaming of the supporting surface, tissue paper, or cheesecloth. 3. Ignition of the enclosure. 4. Creation of any openings in the enclosure that result in accessibility of live parts, when evaluated in accordance with accessibility of live parts test in section 58.2 of UL1449, 3rd edition. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Type</th> <th>Device rating V</th> <th>Test voltage V</th> </tr> </thead> <tbody> <tr><td>ETFV25K115E4</td><td>115</td><td>240</td></tr> <tr><td>ETFV25K130E4</td><td>130</td><td>260</td></tr> <tr><td>ETFV25K140E4</td><td>140</td><td>280</td></tr> <tr><td>ETFV25K150E4</td><td>150</td><td>300</td></tr> <tr><td>ETFV25K175E4</td><td>175</td><td>350</td></tr> <tr><td>ETFV25K210E4</td><td>210</td><td>420</td></tr> <tr><td>ETFV25K230E4</td><td>230</td><td>415</td></tr> <tr><td>ETFV25K250E4</td><td>250</td><td>500</td></tr> <tr><td>ETFV25K275E4</td><td>275</td><td>480</td></tr> <tr><td>ETFV25K300E4</td><td>300</td><td>600</td></tr> <tr><td>ETFV25K320E4</td><td>320</td><td>600</td></tr> <tr><td>ETFV25K350E4</td><td>350</td><td>600</td></tr> <tr><td>ETFV25K385E4</td><td>385</td><td>600</td></tr> <tr><td>ETFV25K420E4</td><td>420</td><td>600</td></tr> </tbody> </table> | | Type | Device rating V | Test voltage V | ETFV25K115E4 | 115 | 240 | ETFV25K130E4 | 130 | 260 | ETFV25K140E4 | 140 | 280 | ETFV25K150E4 | 150 | 300 | ETFV25K175E4 | 175 | 350 | ETFV25K210E4 | 210 | 420 | ETFV25K230E4 | 230 | 415 | ETFV25K250E4 | 250 | 500 | ETFV25K275E4 | 275 | 480 | ETFV25K300E4 | 300 | 600 | ETFV25K320E4 | 320 | 600 | ETFV25K350E4 | 350 | 600 | ETFV25K385E4 | 385 | 600 | ETFV25K420E4 | 420 | 600 |
| | Type | | Device rating V | Test voltage V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K115E4 | | 115 | 240 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K130E4 | | 130 | 260 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K140E4 | | 140 | 280 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K150E4 | | 150 | 300 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K175E4 | | 175 | 350 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K210E4 | | 210 | 420 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K230E4 | | 230 | 415 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K250E4 | | 250 | 500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K275E4 | | 275 | 480 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K300E4 | | 300 | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ETFV25K320E4 | | 320 | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETFV25K350E4 | 350 | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETFV25K385E4 | 385 | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETFV25K420E4 | 420 | 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Note:

UCT = Upper category temperature

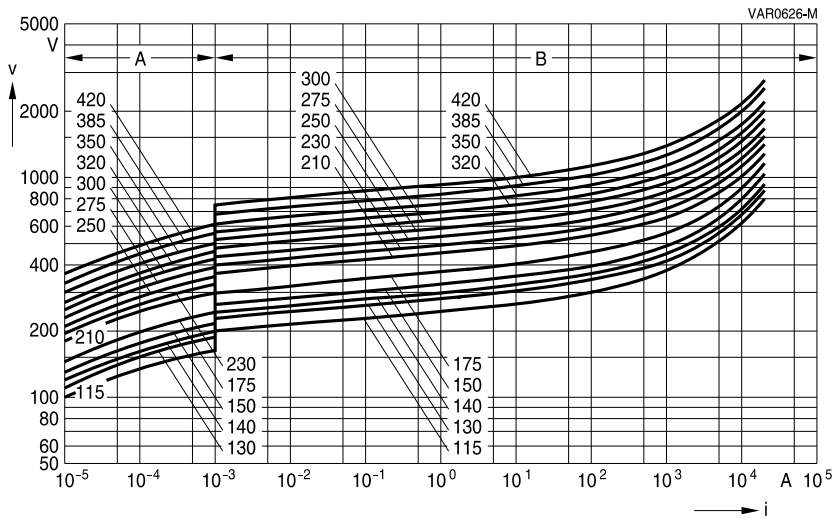
LCT = Lower category temperature

 R_{ins} = Insulation resistance

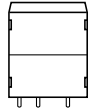


v/i characteristics

$v = f(i)$ for explanation of the characteristics refer to "General technical information", chapter 1.6.3
 A = Leakage current, B = Protection level } for worst-case varistor tolerances



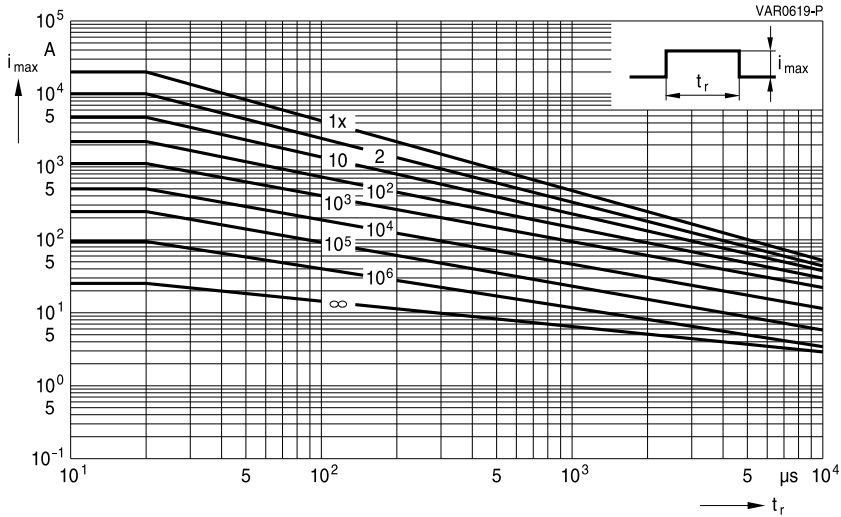
SIOV-ETFV25 ... E4



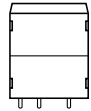
Derating curves

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-ETFV25 ... E4

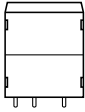


Mounting

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.


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 to IEC 61643-1 |
| I_{nom} | Nominal discharge current to IEC 61643-1 |
| 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 |
| ΔV_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, 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.
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