Communication BUS Varistor

**GENERAL DESCRIPTION**

The CAN BUS and FlexRay varistor is a zinc oxide (ZnO) based ceramic semiconductor device with non-linear voltage-current characteristics (bi-directional) similar to back-to-back Zener diodes and an EMC capacitor in parallel (see equivalent circuit model). They have the added advantage of greater current and energy handling capabilities as well as EMI/RFI attenuation. Devices are fabricated by a ceramic sintering process that yields a structure of conductive ZnO grains surrounded by electrically insulating barriers, creating varistor like behavior.

AVX Communication Bus Varistors offer the advantages of large in-rush current capability, low capacitance to minimize signal distortion, fast turn on time to conservatively clamp the energy before its maximum and off state EMI filtering through their bulk capacitance. These features coupled with an extremely low FIT rate and excellent process capability make an ideal device for today's automotive or general circuit protection.

**GENERAL CHARACTERISTICS**

- Operating Temperature: -55°C to +125°C
- Working Voltage: ±18Vdc
- Case Size: 0402, 0603
  - 0405 2xArray
  - 0612 4xArray

**FEATURES**

- Compact footprint
- High ESD capability (25kV)
- High Inrush Current (8x20μs)
- EMI/RFI Attenuation
- Low Capacitance/Low Insertion Loss
- Very Fast Response Time
- High Reliability <0.1 FIT
- AEC-Q200 Qualified

**APPLICATIONS**

- Communication Bus: CAN Bus, FlexRay, etc.
- General I/O Protocols
- Keyboard Interfaces
- Datalines
- Sensors
- Capacitance sensitive applications and more

**HOW TO ORDER**

**CAN STYLE**

**0001**

- Style: CAN = CAN BUS
  - FLX = FlexRay
- Case Size: 0001 = 0603 Discrete
  - 0002 = 0405 2-Element
  - 0003 = 0405 2-Element
  - 0004 = 0612 4-Element
  - 0005 = 0402 Discrete
  - 0007 = 0603 Discrete
- Packaging Code: D = 7” reel (1,000 pcs.)
  - R = 7” reel (4,000 pcs.)
  - T = 13” reel (10,000 pcs.)
  - W = 7” reel (10,000 pcs. 0402 only)
- Termination: P = Ni/Sn (Plated)

**PERFORMANCE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>AVX PN</th>
<th>( V_{w}^{(DC)} )</th>
<th>( V_{w}^{(AC)} )</th>
<th>( V_{b} )</th>
<th>( I_{vc} )</th>
<th>( I_{1} )</th>
<th>( E_{1} )</th>
<th>( I_{p} )</th>
<th>Cap</th>
<th>Freq</th>
<th>VJump</th>
<th>PDiss Max</th>
<th>Case</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN0001___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>120</td>
<td>225</td>
<td>1</td>
<td>2</td>
<td>0.015</td>
<td>4</td>
<td>22</td>
<td>Max</td>
<td>0.003</td>
<td>0603</td>
<td>1</td>
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<tr>
<td>CAN0002___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>70</td>
<td>145</td>
<td>1</td>
<td>2</td>
<td>0.015</td>
<td>4</td>
<td>22</td>
<td>Max</td>
<td>0.003</td>
<td>0405</td>
<td>2</td>
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<tr>
<td>CAN0003___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>28.5</td>
<td>50</td>
<td>1</td>
<td>5</td>
<td>0.02</td>
<td>15</td>
<td>50</td>
<td>Max</td>
<td>0.0008</td>
<td>0405</td>
<td>2</td>
</tr>
<tr>
<td>CAN0004___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>100</td>
<td>180</td>
<td>1</td>
<td>2</td>
<td>0.015</td>
<td>4</td>
<td>22</td>
<td>Max</td>
<td>0.003</td>
<td>0612</td>
<td>4</td>
</tr>
<tr>
<td>CAN0005___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>33</td>
<td>55</td>
<td>1</td>
<td>5</td>
<td>0.05</td>
<td>10</td>
<td>37</td>
<td>Max</td>
<td>0.01</td>
<td>0402</td>
<td>1</td>
</tr>
<tr>
<td>CAN0007___</td>
<td>( \leq 32.0 )</td>
<td>( \leq 25.0 )</td>
<td>61</td>
<td>120</td>
<td>1</td>
<td>5</td>
<td>0.05</td>
<td>5</td>
<td>15</td>
<td>Max</td>
<td>0.003</td>
<td>0603</td>
<td>1</td>
</tr>
<tr>
<td>FLX0005___</td>
<td>( \leq 18 )</td>
<td>( \leq 14 )</td>
<td>26</td>
<td>45</td>
<td>1</td>
<td>5</td>
<td>0.02</td>
<td>4</td>
<td>17</td>
<td>Max</td>
<td>0.004</td>
<td>0402</td>
<td>1</td>
</tr>
</tbody>
</table>

**Termination Finish Code**

- D = 7” reel (1,000 pcs.)
- R = 7” reel (4,000 pcs.)
- T = 13” reel (10,000 pcs.)
- W = 7” reel (10,000 pcs. 0402 only)

**Packaging Code**

- P = Ni/Sn (Plated)

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- P = Ni/Sn (Plated)

**Specifications**

- DC Working Voltage (V)
- AC Working Voltage (V)
- Typical Breakdown Voltage (V @ 1mADC)
- Clamping Voltage (V @ IVC)
- Test Current for VC (A, 8x20μs)
- Maximum Leakage Current at the Working Voltage (μA)
- Transient Energy Rating (J, 10x1000μs)
- Peak Current Rating (A, 8x20μs)
- Maximum Capacitance (pF) @ 1 MHz and 0.5Vrms
- Temp Range -55°C to +125°C
**S21 CHARACTERISTICS**

![S21 Characteristic Graphs]

**Typical MLV Implementation**

- **MultiLayer Varistors (MLVs)**
  - XCVR
  - BUS
  - MLV PROTECTION METHOD
  - SINGLE COMPONENT SOLUTION
  - TVS & EMI

- **TVS Diodes**
  - XCVR
  - BUS
  - EMI
  - TVS + EMI
  - DIODE PROTECTION METHOD
  - THREE COMPONENT SOLUTION

**Equivalent Circuit Model**

- **Discrete MLV Model**
  - PCB Trace
  - To Device Requiring Protection
  - Solder Pad
  - $R_v$ = Voltage Variable resistance (per VI curve)
  - $R_p \geq 1012 \, \Omega$
  - $C$ = defined by voltage rating and energy level
  - $R_{on}$ = turn on resistance
  - $L_p$ = parallel body inductance

**Typical Pulse Rating Curve**

![Typical Pulse Rating Curve Graph]
Communication BUS Varistor

**TYPICAL CAN BUS IMPLEMENTATION SCHEME**

![TYPICAL CAN BUS IMPLEMENTATION SCHEME Diagram]

**PHYSICAL DIMENSIONS**

<table>
<thead>
<tr>
<th></th>
<th>0402 Discrete</th>
<th>0603 Discrete</th>
<th>0405 Array</th>
<th>0612 Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>1.00 ±0.10 (0.040 ±0.004)</td>
<td>1.60 ±0.15 (0.063 ±0.006)</td>
<td>1.00 ±0.15 (0.039 ±0.006)</td>
<td>1.60 ±0.20 (0.063 ±0.008)</td>
</tr>
<tr>
<td>Width</td>
<td>0.50 ±0.10 (0.020 ±0.004)</td>
<td>0.80 ±0.15 (0.032 ±0.006)</td>
<td>1.37 ±0.15 (0.054 ±0.006)</td>
<td>3.20 ±0.20 (0.126 ±0.008)</td>
</tr>
<tr>
<td>Thickness</td>
<td>0.60 Max. (0.024 Max.)</td>
<td>0.90 Max. (0.035 Max.)</td>
<td>0.66 Max. (0.026 Max.)</td>
<td>1.22 Max. (0.048 Max.)</td>
</tr>
<tr>
<td>Term Band Width</td>
<td>0.25 ±0.15 (0.010 ±0.006)</td>
<td>0.35 ±0.15 (0.014 ±0.006)</td>
<td>0.36 ±0.10 (0.014 ±0.004)</td>
<td>0.41 ±0.10 (0.016 ±0.010)</td>
</tr>
</tbody>
</table>

**SOLDER PAD DIMENSIONS**

<table>
<thead>
<tr>
<th></th>
<th>0402/0603 Discrete</th>
<th>0405 Array</th>
<th>0612 Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.61 (0.024)</td>
<td>0.46 (0.018)</td>
<td>0.89 (0.035)</td>
</tr>
<tr>
<td>B</td>
<td>0.51 (0.020)</td>
<td>0.74 (0.029)</td>
<td>1.65 (0.065)</td>
</tr>
<tr>
<td>C</td>
<td>1.70 (0.067)</td>
<td>0.12 (0.0047)</td>
<td>2.54 (0.100)</td>
</tr>
<tr>
<td>D</td>
<td>–</td>
<td>0.38 (0.015)</td>
<td>0.46 (0.018)</td>
</tr>
<tr>
<td>E</td>
<td>–</td>
<td>0.64 (0.025)</td>
<td>0.76 (0.030)</td>
</tr>
</tbody>
</table>

The important information/disclaimer is incorporated in these specifications by reference and should be reviewed in full before placing any order.
Communication BUS Varistor

APPLICATION
AVX CAN BUS and FlexRay varistors offer significant advantages in general areas of a typical CAN or FlexRay network as shown on the right. Some of the advantages over diodes include:

- space savings
- higher ESD capability @ 25kV contact
- higher in rush current (4A) 8 x 20μS
- FIT rate ≤0.1 failures (per billion hours)

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**Kyocera AVX:**
- CAN0002DP  CAN0001DP  CAN0005WP  FLX0005DP  FLX0005RP  FLX0005WP  CAN0004DP  CAN0002TP
- CAN0004RP  CAN0001RP  CAN0004TP  CAN0002RP  CAN0001TP