

## 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:  $\leq 18\text{Vdc}$
- Case Size: 0402, 0603  
0405 2xArray  
0612 4xArray

## FEATURES

- Compact footprint
- High ESD capability (25kV)
- High Inrush Current (8x20 $\mu\text{s}$ )
- 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                            | 0001                                                                                                                   | D                                                                                                                         | P                        |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Style</b>                   | <b>Case Size</b>                                                                                                       | <b>Packaging Code (Reel Size)</b>                                                                                         | <b>Termination</b>       |
| CAN = CAN BUS<br>FLX = FlexRay | 0001 = 0603 Discrete<br>0002 = 0405 2-Element<br>0004 = 0612 4-Element<br>0005 = 0402 Discrete<br>0007 = 0603 Discrete | D = 7" reel (1,000 pcs.)<br>R = 7" reel (4,000 pcs.)<br>T = 13" reel (10,000 pcs.)<br>W = 7" reel (10,000 pcs.) 0402 only | P = Ni/Sn Alloy (Plated) |



## PERFORMANCE CHARACTERISTICS

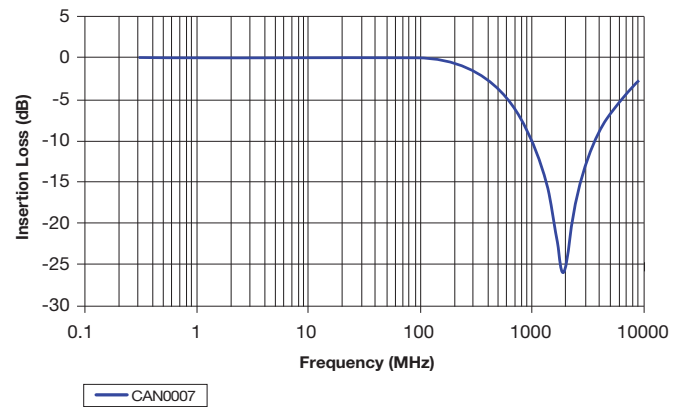
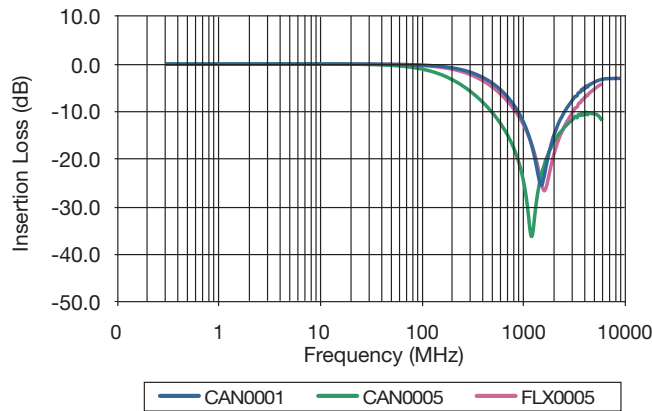
| AVX PN     | V <sub>W</sub> (DC) | V <sub>W</sub> (AC) | V <sub>B</sub> | V <sub>C</sub> | I <sub>VC</sub> | I <sub>L</sub> | E <sub>T</sub> | I <sub>P</sub> | Cap    | Freq | V <sub>Jump</sub> | P <sub>Diss Max</sub> | Case | Elements |
|------------|---------------------|---------------------|----------------|----------------|-----------------|----------------|----------------|----------------|--------|------|-------------------|-----------------------|------|----------|
| CAN0001 __ | $\leq 18$           | $\leq 14$           | 120            | 225            | 1               | 2              | 0.015          | 4              | 22 Max | M    | 27.5              | 0.003                 | 0603 | 1        |
| CAN0002 __ | $\leq 18$           | $\leq 14$           | 70             | 145            | 1               | 2              | 0.015          | 4              | 22 Max | M    | 27.5              | 0.003                 | 0405 | 2        |
| CAN0004 __ | $\leq 18$           | $\leq 14$           | 100            | 180            | 1               | 2              | 0.015          | 4              | 22 Max | M    | 27.5              | 0.003                 | 0612 | 4        |
| CAN0005 __ | $\leq 18$           | $\leq 14$           | 33             | 55             | 1               | 2              | 0.05           | 10             | 37 Max | M    | 27.5              | 0.01                  | 0402 | 1        |
| CAN0007 __ | $\leq 32.0$         | $\leq 25.0$         | 61             | 120            | 1               | 5              | 0.05           | 5              | 15 Max | K    | 27.5              | 0.003                 | 0603 | 1        |
| FLX0005 __ | $\leq 18$           | $\leq 14$           | 26             | 45             | 1               | 5              | 0.02           | 4              | 17 Max | M    | 27.5              | 0.004                 | 0402 | 1        |

Termination Finish Code  
Packaging Code

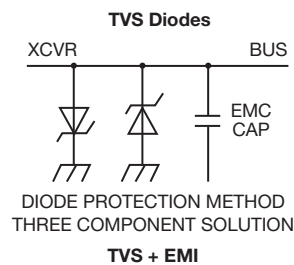
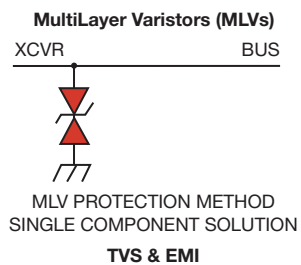
|                     |                                                          |
|---------------------|----------------------------------------------------------|
| V <sub>W</sub> (DC) | DC Working Voltage (V)                                   |
| V <sub>W</sub> (AC) | AC Working Voltage (V)                                   |
| V <sub>B</sub>      | Typical Breakdown Voltage (V @ 1mA <sub>DC</sub> )       |
| V <sub>C</sub>      | Clamping Voltage (V @ I <sub>VC</sub> )                  |
| I <sub>VC</sub>     | Test Current for V <sub>C</sub> (A, 8x20 $\mu\text{s}$ ) |

|                |                                                                  |
|----------------|------------------------------------------------------------------|
| I <sub>L</sub> | Maximum Leakage Current at the Working Voltage ( $\mu\text{A}$ ) |
| E <sub>T</sub> | Transient Energy Rating (J, 10x1000 $\mu\text{s}$ )              |
| I <sub>P</sub> | Peak Current Rating (A, 8x20 $\mu\text{s}$ )                     |
| Cap            | Maximum Capacitance (pF) @ 1 MHz and 0.5Vrms                     |
| Temp Range     | -55°C to +125°C                                                  |

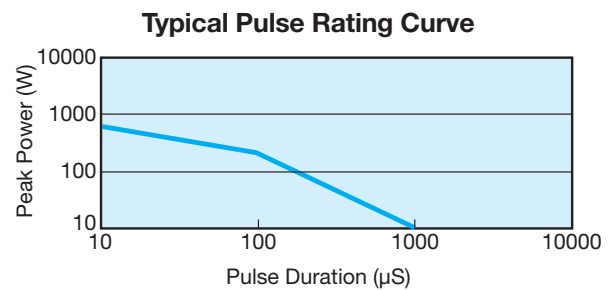
## S21 CHARACTERISTICS



## TYPICAL MLV IMPLEMENTATION

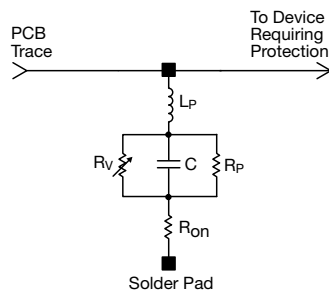


## TYPICAL PULSE RATING CURVE



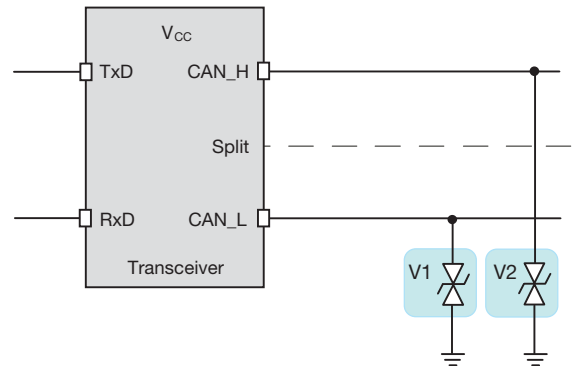
## EQUIVALENT CIRCUIT MODEL

### Discrete MLV Model

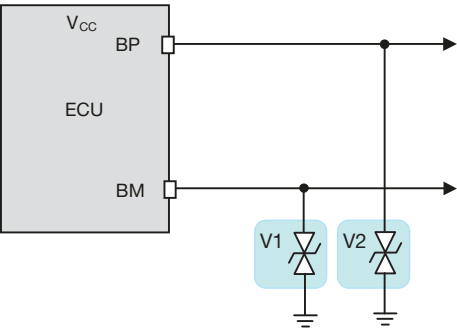


Where:  $R_v$  = Voltage Variable resistance (per VI curve)  
 $R_p \geq 10^{12} \Omega$   
 $C$  = defined by voltage rating and energy level  
 $R_{on}$  = turn on resistance  
 $L_p$  = parallel body inductance

## TYPICAL CAN BUS IMPLEMENTATION SCHEME



## TYPICAL FLEX RAY IMPLEMENTATION SCHEME



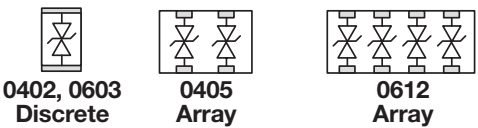
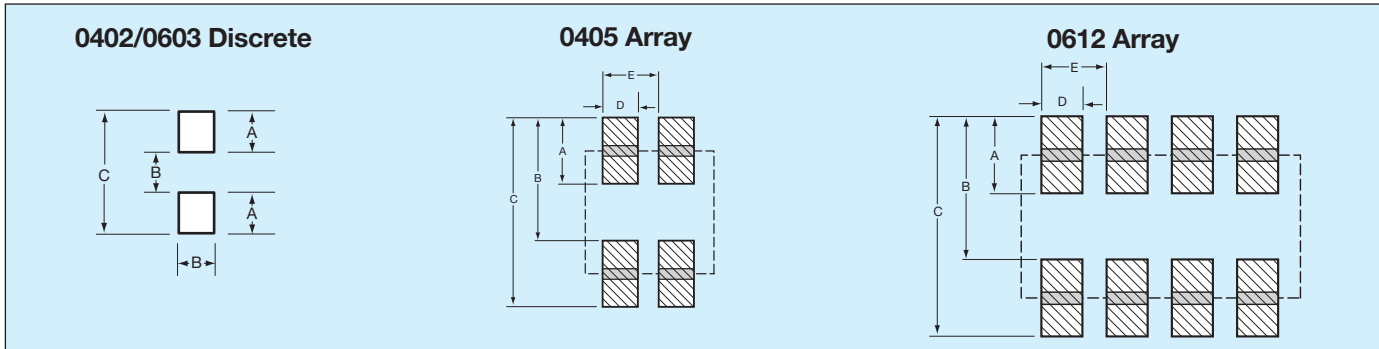
## PHYSICAL DIMENSIONS

mm (inches)

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

## SOLDER PAD DIMENSIONS

mm (inches)



|               | A               | B               | C                | D               | E               |
|---------------|-----------------|-----------------|------------------|-----------------|-----------------|
| 0402 Discrete | 0.61<br>(0.024) | 0.51<br>(0.020) | 1.70<br>(0.067)  | -               | -               |
| 0603 Discrete | 0.89<br>(0.035) | 0.76<br>(0.030) | 2.54<br>(0.100)  | -               | -               |
| 0405 Array    | 0.46<br>(0.018) | 0.74<br>(0.029) | 0.12<br>(0.0047) | 0.38<br>(0.015) | 0.64<br>(0.025) |
| 0612 Array    | 0.89<br>(0.035) | 1.65<br>(0.065) | 2.54<br>(0.100)  | 0.46<br>(0.018) | 0.76<br>(0.030) |

## 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)

