

# Multilayer Varistor Application Notes

Multilayer Varistors (MLVs) are specifically designed for suppressing electrostatic discharge (ESD).

A varistor is a voltage variable resistor that:

- At low voltages has an extremely high resistance
- At high voltages has a very low resistance

MLVs are made using multiple, fine grain ceramic layers of a specific formulation. To better understand the characteristics and uses of MLVs, it helps to understand the characteristics of the Metal Oxide Varistor (MOV).

## Metal Oxide Varistors

MOVs are made of oxidized zinc grains and small amounts of other metal oxides between two metal electrode plates (see Figure 1). These large adjacent grains form diode junctions that allow current to flow in only one direction. These “diode junctions” arrange themselves in such a way that they perform like opposing diodes in series.

When a large voltage is applied, the grain boundaries that form the diode junctions breakdown due to electron tunneling and become conductive. This allows current and voltage through the varistor shunting the surge to ground. This action protects downstream circuits and board level components from damage.

MOVs alone have generally high capacitances and lower peak current capabilities.

## Multilayer Varistors

MLVs are made of fine grain ceramic layers similar to those of the MOV. These layers are stacked with alternating connections between the two electrodes. Every other layer connects to the same electrode (see Figure 2). This configuration allows for higher resistances at lower voltages with faster response times than MOVs.

### Applications

The MLV has many applications in electronics. Probably the most important is protecting ICs and board level components from ESD damage. Cooper Bussmann has two series of MLVs that can be applied in numerous places:

- The MLVA Series is ideal for low frequency and signal line applications.
- The MLVB Series is optimal for higher frequency applications (up to 480Mbps) or the speed commonly used in USB2.0 ports.

Both series are also excellent for computers and peripherals, DVD players, cell phones, digital still cameras, PDAs, MP3 players, external storage and much more.



MLV Series are available in 0201, 0402 and 0603 SMD packages.

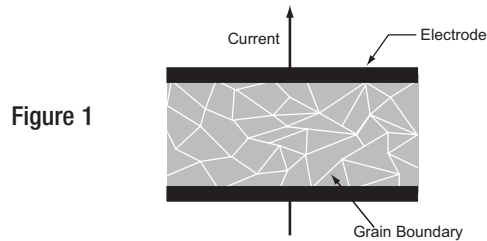


Figure 1

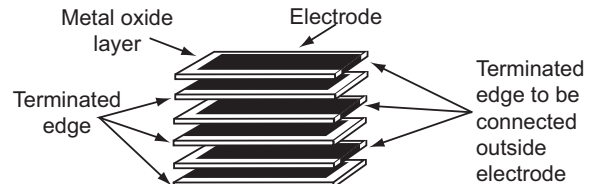
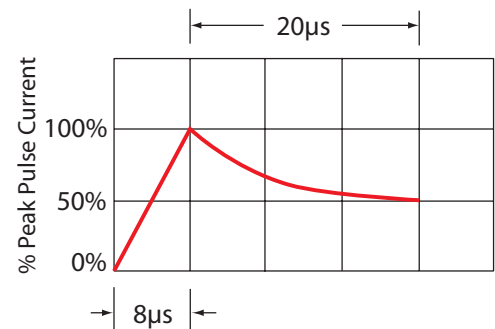


Figure 2



Figure 3



## Features

- RoHS Compliant, lead free\* and halogen free constructions
- IEC 61000-4-2 level 4 test for ESD protection, IEC 61000-4-4 and IEC 61000-4-5\*\*
- 0201, 0402, and 0603 SMD sizes
- Low and stable leakage currents to reduce power consumption
- Low clamping voltages for increased circuit protection

## MLVA & MLVB Specifications\*\*\*

### Catalog Symbols:

- MLVA Series MLVA02V--C--- (0201 size)
- MLVA04V--C--- (0402 size)
- MLVA06V--C--- (0603 size)
- MLVB Series MLVB04V--C--- (0402 size)
- MLVB06V--C--- (0603 size)

### Technology: Multilayer Varistor

Electrical Characteristics:	MLVA	MLVB
• Working Voltage:	5.5-26Vdc	9-18Vdc
• Clamp Voltage:	20-58V	35-250V
• Capacitance:	33-270pF	0.5-5pF

### ESD Capability:

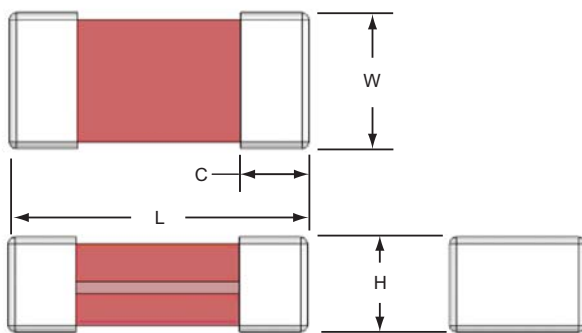
- IEC61000-4-2 Direct Discharge: 8kV
- IEC61000-4-2 Air Discharge: 15kV

\* MLVA Series only.

\*\* 0402 and 0603 MLVA Series only

\*\*\* For more details, see Data Sheets 4070 (MLVA) and 4071 (MLVB) online at [www.cooperbussmann.com/elx](http://www.cooperbussmann.com/elx)

## Product Dimensions - mm:



Size	L	W	H	C
0201**	0.60±0.05	0.30±0.05	0.30±0.05	0.20±0.10
0402	1.00±0.15	0.50±0.10	0.50±0.10	0.25±0.15
0603	1.60±0.20	0.80±0.20	0.80±0.20	0.30±0.20

Order samples online - [www.cooperbussmann.com](http://www.cooperbussmann.com)

## Design Considerations

The location in the circuit for the MLVA and MLVB Series has to be carefully determined. For better performance, the device should be placed as close to the signal input as possible and ahead of any other component. Due to the high current associated with an ESD event, it is recommended to use a "0-stub" pad design (pad directly on the signal/data line and second pad directly on common ground).

In order to specify the optimum Cooper Bussmann MLV Series ESD suppressor, the following need to be taken into consideration:

- The clamping voltage rating on the MLV must be below the voltage the circuit can withstand without suffering damage.
- The clamping voltage is the peak voltage across the MLV Series ESD suppressor at the peak current of an 8/20µs waveform with 1A pulse current (see Figure 3).
- It is also extremely important to know the data speed of the protected circuit and/or the highest capacitance the circuit can handle without distorting the data. (The lower the capacitance rating on the MLV Series ESD suppressor, the less it will distort the data signal propagating through the circuit. Therefore the faster the data speed the lower the capacitance.)
- The working voltage rating of the MLV Series ESD suppressor should be rated greater than the normal operating voltage of the circuit and not exceed 10µA leakage current.