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The ABCs of Littelfuse Multilayer Suppressors

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Introduction

This guide is similar to “The ABCs of MOVs”, offering specific information on Multilayer suppressor device technology and is intended to be a supplement to the Littelfuse Multilayer data sheets.

“A” is for Applications, giving general examples of where these products are used.

“B” is for Basics, describing the fundamental fabrication, operation and functions.

“C” is for Common Questions, addressing frequently asked questions from Production Engineers, and Designers.

There are a number of sources from which literature may be received. To learn more about Multilayer Suppressors:

- Call Littelfuse, Inc. at 1-800-999-9445 in the U.S. (1-847-824-1188 outside the U.S.)
- Visit the Internet at www.littelfuse.com

Applications

As with MOVs, Littelfuse Multilayer Suppressors protect a broad range of applications and circuit components. They are offered in different designs to accommodate different suppression requirements. For an initial determination of which type is suitable, it is desirable to know:

1. The working voltage or maximum system voltage.
2. The type of transient that is to be suppressed and its energy level.
3. What circuit or component requires protection and, therefore, to what level must the transient be suppressed.

Multilayer Suppressors are most often applied to low voltage (<50VDC) systems on power supply, signal, or control lines in order to suppress ESD, EFT, Surge, or other transients at the circuit board level for component protection. Additionally, these devices may be applied to products subjected to immunity testing such as the EN61000 (IEC) standards in order to achieve specific electromagnetic compatibility (EMC) ratings.

The products and circuits to which these Multilayer Suppressors are applicable are diverse and include:

- Computers and their associated peripheral devices including I/O interfaces
- Office equipment such as keypad/controllers for copiers, facsimile and printers
- Automotive electronic modules
- Medical equipment such as electronic diagnostic instruments, monitors and recorders
- Communication devices including MODEMs, wireless LANs, Cellular phones/Cordless phones, Pagers
- Power supplies
- Microprocessor-based controls for machinery and robotics
- Opto isolator
- Sensors
- Portable/hand-held industrial instruments
- LASER diode devices
- Consumer electronics

Basics

Q. What is a Multilayer Suppressor?

A. A Littelfuse Multilayer Suppressor is one of a family of transient voltage suppression devices. They bear similarity to Metal Oxide Varistors in that they are voltage dependent, nonlinear devices that exhibit a bidirectional clamping characteristic and are based on a Zinc Oxide material technology. They are designed to suppress transients at the circuit board level in order to protect components and circuit functions by clamping the transient and dissipating its energy within the suppressor. These devices are ceramic and manufactured in leadless, surface mount form.

Q. What are the Device Families?

A. Since voltage transients have numerous sources and characteristics, Littelfuse Multilayer Suppressors are offered in three separate Series.

The **“ML”** Series (data sheet #2461) supports the broadest range of applications with operating voltages from 3.5 to 120VDC and sizes of “0603”, “0805”, “1206”, and “1210”. This Series offers high peak current (8x20) ratings and is designed for board-level Surge, EFT, ESD and other specific transient events.

The **“AUML”** Series (data sheet #3387) is specifically characterized for Automotive-related parameters and transients. This Series has the single, 18VDC working voltage in sizes of “1210”, “1812”, and “2220”, and affords module protection from secondary Load Dump and other transients found in the auto environment.

The **“MLE”** Series (data sheet #4263) is designed for lower energy transients and is rated for ESD suppression in order to protect sensitive components and, like the “ML”, helps products meet Electromagnetic Compatibility test immunity standards. This Series is also specifically characterized for capacitance and

impedance for combined suppressor/high frequency attenuation applications. MLE devices may be applied to circuits with a working voltage up to 18VDC and are offered in “0603”, “0805”, and “1206” sizes. The MLN device (data sheet #4682) is a four-section Multilayer array in the 1206 leadless chip size and thereby offers the designer reduced part count and space savings on circuit cards. The standard MLN may be operated at any voltage up to 18VDC and is primarily intended for the suppression of ESD or other low-energy transients.

The **“MLN”** device (data sheet #4682) is a four section Multilayer array in the 1206 leadless chip size and thereby offers the designer reduced part count and space savings on circuit cards. The standard MLN may be operated at any voltage up to 10VDC and is primarily intended for the suppression of ESD or other low energy transients.

Q. How Are These Devices Fabricated?

A. Each of the three Series is fabricated by interleaving layers of a specific semiconducting dielectric material and metal electrodes which are alternately screened onto a substrate. The number of layers built and the dielectric material and thickness varies with the device type. This substrate is then divided into the individual devices which are sintered or “fired”, forming a homogenous ceramic device. Metal end terminations are then applied and also fired, completing the basic operation.

Common Questions

Q. Is There Any Difference Between the ML, AUML, MLN and MLE Series?

A. Yes. Generically they are the same, but they can differ from each other in terms of dielectric material formulation, layer count, sizes offered, electrical characterization/parameters, and ratings.

Q. Can Custom Voltage Parts Be Made for My Particular Application?

A. Yes. Littelfuse can tailor the voltage rating of Multilayers by changing the dielectric material and/or thickness during fabrication. Also, by changing layer count, parameters such as Capacitance and Energy ratings can also be modified.

Q. How is the High Peak Surge Current Rating Achieved?

A. The internal, interleaved dielectric/electrode layers form essentially parallel devices so the effective surface area is much larger than the Multilayer size would suggest.

Q. Is There Any Plastic Used to Form the Package?

A. The ceramic construction forms the device itself. There is no encapsulation, plastic or otherwise, used in these devices.

Q. What Standard End Termination Materials are Used?

A. The standard termination is a fired-on Silver/Platinum alloy. An optional Silver/Palladium is also available. To designate either, a character in the model number is added or deleted as shown in the associated data sheet under ordering information.

Q. Why are Different End Terminations Offered?

A. In order to best match specific soldering operations/requirements. Generally, the standard Silver/Platinum finish is used for reflow methods. The optional Silver/Palladium finish is recommended for wave solder methods in order to improve leach resistance.

Q. Does Littelfuse Have a Recommended Solder Procedure?

A. Littelfuse Multilayer devices are compatible with typical industry standard reflow and solder wave methods. Specific solder profile recommendations can be found in the data sheets.

Q. What is the Capacitance of Multilayers?

A. Generally speaking, the range of capacitance for Multilayers is from less than 100 Picofarads to a few thousand Picofarads and inversely proportional to the working voltage. Dielectric type and thickness, number of layers, and device size all contribute in determining the capacitance. Capacitance, therefore, can be tailored by changing these variables.

Q. How Do the Multilayer Series Differ From the Littelfuse CH Series?

A. The CH Series is fabricated from a single layer of MOV material. It is supplied in a single, larger chip size of 5mm x 8mm (3220) and has a higher voltage range up to 369VDC.

Q. Can the Littelfuse ML Series Replace a Zener?

A. Littelfuse Multilayers are often used to replace TVSS Zener diodes. Because the technologies and form factors differ, a direct cross reference is not practical. Contact Littelfuse to help compare parameters and determine if a Multilayer can be used in the application.

Q. Do Multilayers Provide Bidirectional Clamping Like MOVs?

A. Yes. Multilayers provide suppression of transients of either polarity.

Q. Are Multilayer Suppressors 100% Tested?

A. Yes. All Multilayer Suppressors receive a final 100% electrical test for Nominal Voltage and Leakage at the Tape and Reel packaging operation.

Q. What Information is Contained in the ML or MLE Model Number Sequence?

A. Using the V18MLA0805L as an example:

V	The Multilayer maintains the Littelfuse MOV "V" (Varistor) designation for Transient Suppressors.
18	The maximum DC working voltage
ML	The Multilayer Series
A	Performance or application designator
0805	The EIA size for length and width. (80mils x 50mils in this case)
L	Low Capacitance version (reduced layer count version in this case)

Q. Will This Part Number Vary When Placing An Order?

A. Yes. A suffix is added to identify the desired packaging (bulk or reeled) or end termination options. See the Littelfuse data sheet for instructions. Additionally, a custom part will have an X suffix followed by a unique 4 digit designation.

Q. What is the Procedure in Selecting a Multilayer?

A. The basic procedure is to:

1. Determine the working voltage of the circuit in which the ML is to be placed and select an ML with equal or greater $V_{(DC)}$ MAX.
2. Determine what transient needs to be suppressed in terms of its type, peak surge current and energy in order to select the appropriate Series and device size.
3. Determine the maximum acceptable clamping voltage (or sensitivity level) of the components to be protected and review the V-I characteristics curves of the particular ML.
4. Other things to consider are the bidirectional clamping and typical capacitance of the ML.

Q. Are The Multilayers Subject To Listing By Safety Organizations?

A. Since the intended usage is in low voltage applications and not AC line or high voltage circuits, no listings are required. Likewise, since these devices are ceramic and not plastic, flammability ratings are not applicable.

Q. What ESD Level is the MLE Rated For?

A. The MLE is rated to the highest ESD voltage level categories of the IEC-1000-4-2 (human body model) specification. These are the 15kV (air discharge) and the 8kV (direct contact) methods. The IEC specification is a test method used to determine a given level of ESD immunity for EMC (Electromagnetic Compatibility) ratings of end products or systems. The MLE Series is used to suppress this ESD transient, thereby allowing products to meet EMC criteria.

Q. Why is the MLE Characterized for Impedance?

A. While operating in their normal standby mode, the inherent capacitance of all MLs help attenuate unwanted noise signals or harmonic frequencies. The MLE is additionally characterized for impedance since the low voltage circuits to which this Series is intended for use may be particularly sensitive to noise or require filtering of power supply lines, for example.

Q. Is Clamping Performance Derated Over Temperature for Multilayers?

A. No. Clamping voltage, peak current and energy are not derated over the entire temperature range, -55^{o}C to 125^{o}C ambient.

Q. Are These Devices Marked or Branded?

A. No. At the present time part designation is identified on packaging/shipping labels, including bar coding, where applicable.

Q. Where can Multilayers Typically be Placed in Circuits?

A. As a Clamping-Type Suppressor, the Multilayer is usually placed between the circuit point subject to transients and the reference electrical "Ground" or "Common", as close as practical to the transient source. Board level connections include:

- Across Switching Transistors
- Across Inductive Loads such as Relays or Solenoids
- On Local DC Power Supply Lines, Replacing Zener or Zener/Capacitor Combinations
- The Data Lines or Control Lines of ICs to Ground
- Across Remote Sensors
- On High Side or Low Side Drivers
- Bus Transceiver I/O Lines to Ground
- Across Laser Diodes
- Transistor Base or Gate Terminals to Ground
- Op Amp Input or Output Terminals to Ground
- On Interface Terminals or Connectors Subject to Human Contact or Conducted Transients

Q: What is the Leakage of Each Channel of the MLN Array at 5VDC?

A. The Maximum Leakage is less than 6nA for any one channel.

Q. Can Transients be Applied to all Four Inputs of the MLN Simultaneously?

A. The MLN array device exhibits excellent channel isolation and will suppress simultaneous transients at each terminal within its maximum current and energy ratings.

Q. I Have Two Lines to Protect. Can Littelfuse Produce a Dual Version of the MLN Quad Device?

A. Yes. Contact the Sales department with your specific requirements. Additionally, other parameters such as Working Voltage and Capacitance can be custom tailored.