Multilayer High-Speed - *MHS Series*

Data Sheet **JULY 2001**

Multilayer High-Speed Surface Mount ESD Voltage Suppressor

The **Multilayer High-Speed *MHS Series*** is a very-low capacitance extension to the Littelfuse ML family of Transient Voltage Surge Suppression devices available in an 0402-size surface mount chip.

The MHS series provides protection from ESD and EFT in high-speed data-line and other high frequency applications. The low insertion capacitance of the *high speed* MHS Series permits usage in high-speed analog or digital circuits where it will not attenuate or distort desired signal or data.

Their small size is ideal for high-density printed circuit boards, being typically applied to protect integrated circuits and other sensitive components. They are particularly suited to suppressing ESD events including those specified in IEC 61000-4-2 or other standards used for ElectroMagnetic Compliance (EMC) testing.

The MHS series is manufactured from semiconducting ceramics, is inherently bi-directional and is stable over a wide temperature range and is supplied in leadless, surface mount form compatible with modern reflow and wave soldering processes.

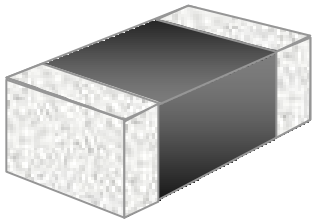
Littelfuse Inc. manufactures other Multilayer Varistor Series products, see the ML, MLE, MLN and AUML series data sheets.

Features

- 3pF & 12pF Capacitance Versions Suitable for High Speed Data-Rate Lines
- ESD Rated to IEC 61000-4-2 (Level 4)
- EFT/B Rated to IEC 61000-4-4 (Level 4)
- Low Leakage Currents
- -55ºC to +125ºC Operating Temperature Range
- Inherently Bi-directional

Applications

- Data, Diagnostic I/O Ports
- Universal Serial Bus (USB)
- Video & Audio Ports
- Portable/Hand-Held Products
- Mobile Communications/Cellular Phones
- Computer/DSP Products
- Industrial Instruments Including Medical



Absolute Maximum Ratings.

		MHS Series	UNITS
Continuous:			
Steady State Applied Voltage: DC Voltage Range ($V_{M(DC)}$):	V0402MHS03	≤ 42	V
	V0402MHS12.....	≤ 18	V
Operating Ambient Temperature range (T_A).....		-55 to +125	ºC
Storage Temperature (T_{STG}).....		-55 to +150	ºC
ESD Rating (per IEC 61000-4-2).....		15kV Air 8kV Contact	

Device Ratings and Specifications

PART NUMBER	MAX RATINGS (125ºC)	PERFORMANCE SPECIFICATIONS (25ºC)							
	MAXIMUM NON-REPETITIVE SURGE ENERGY (10/1000µs)	MAXIMUM ESD CLAMP VOLTAGE (NOTE 1)		MAXIMUM LEAKAGE CURRENT AT SPECIFIED DC VOLTAGE				CAPACITANCE AT 1MHz (1V p-p)	INDUCTANCE (from Impedance Analysis)
	W_{TM}	(NOTE 2) 8kV CONTACT	(NOTE 3) 15kV AIR	3.5V	5.5V	9V	15V	(NOTE 4) C	L
		Clamp	Clamp	I_L					
	(J)	(V)	(V)	(µA)	(µA)	(µA)	(µA)	(pF, Typ)	(nH, Typ)
V0402MHS03	**0.010**	**300**	**400**	**0.1**	**0.15**	**0.25**	**0.5**	**3**	**<1.0**
V0402MHS12	**0.025**	**125**	**160**	**0.1**	**0.15**	**1.0**	**5.0**	**12**	**<1.0**

NOTES:
1.Tested to IEC61000-4-2 Human Body Model (HBM) discharge test circuit.
2. Direct discharge to device terminals (IEC preferred test method).
3. Corona discharge through air (represents actual ESD event)
4. Capacitance may be customized, contact your Littelfuse Sales Representative.

Temperature De-rating

For applications exceeding 125ºC ambient temperature, the peak surge current and energy ratings must be reduced as shown in Figure 1.

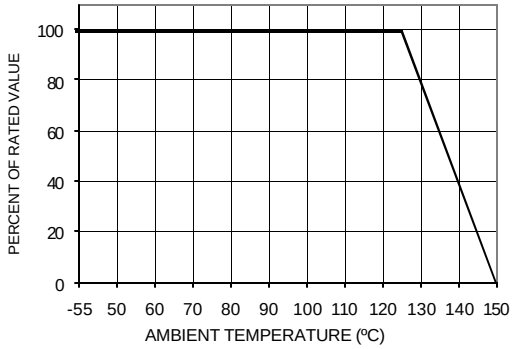


FIGURE 1: PEAK CURRENT AND ENERGY DERATING CURVE

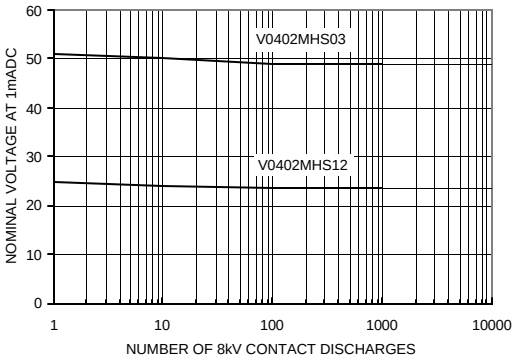


FIGURE 3: NOMINAL VOLTAGE STABILITY TO MULTIPLE ESD IMPULSES (8KV CONTACT DISCHARGES PER IEC 61000-4-2)

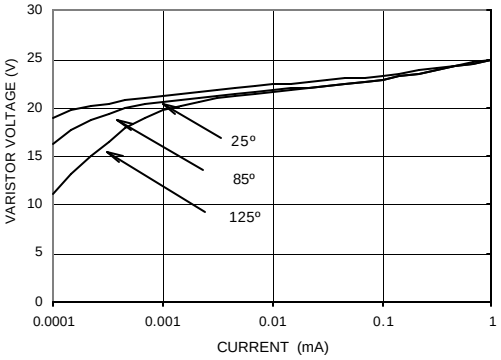


FIGURE 2: STANDBY CURRENT AT NORMALIZED VARISTOR VOLTAGE AND TEMPERATURE

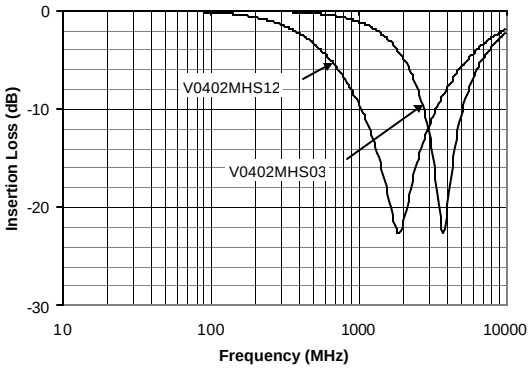


FIGURE 4: INSERTION LOSS (S21) CHARACTERISTICS

Soldering Recommendations

The principal techniques used for the soldering of components in surface mount technology are infrared (IR) re-flow, vapour phase re-flow and wave soldering. Typical profiles are shown in figures 5, 6 and 7. When wave soldering, the MHS suppressor is attached to the circuit board by means of an adhesive. The assembly is then placed on a conveyor and run through the soldering process to contact the wave. With IR and vapour phase re-flow, the device is placed in a solder paste on a substrate. As the solder paste is heated, it re-flows and solders the unit to the board.

The recommended solder for the MHS suppressor is a 62/36/2 (Sn/Pb/Ag), 60/40 (Sn/Pb) or 63/37 (Sn/Pb). Littelfuse also recommends an RMA solder flux.

Wave soldering is the most strenuous of the processes. To avoid the possibility of generating stresses due to thermal shock, a preheat stage in the soldering process is recommended, and the peak temperature of the solder process should be rigidly controlled. For 0402-size devices, IR re-flow is recommended.

When using a re-flow process, care should be taken to ensure that the MHS chip is not subjected to a thermal gradient steeper than 4 degrees per second; the ideal gradient being 2 degrees per second. During the soldering process, preheating to within 100 degrees of the solder's peak temperature is essential to minimize thermal shock. Examples of the soldering conditions for the MHS suppressor are given in the tables below.

Once the soldering process has been completed, it is still necessary to ensure that any further thermal shocks are avoided. One possible cause of thermal shock is hot printed circuit boards being removed from the solder process and subjected to cleaning solvents at room temperature. The boards must be allowed to cool gradually to less than 50ºC before cleaning.

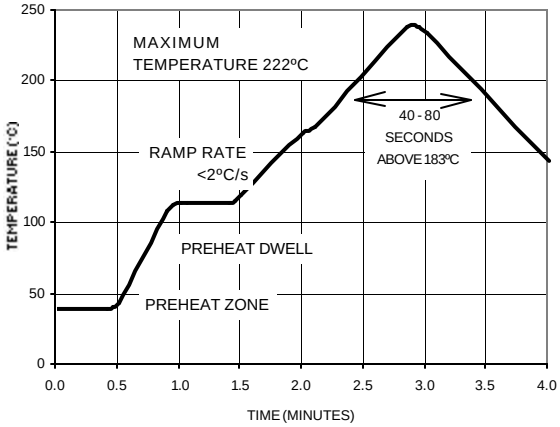


FIGURE 5: REFLOW SOLDER PROFILE

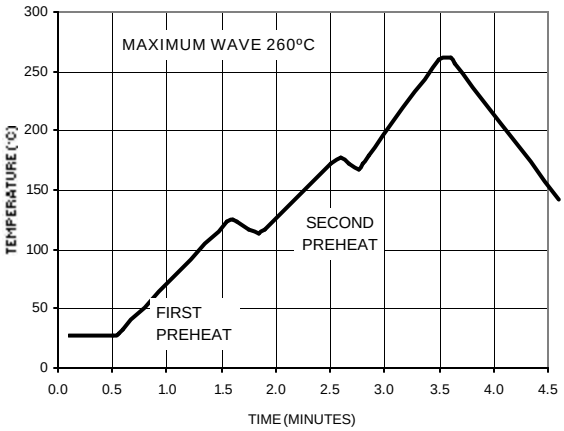


FIGURE 6: W AVE SOLDER PROFILE

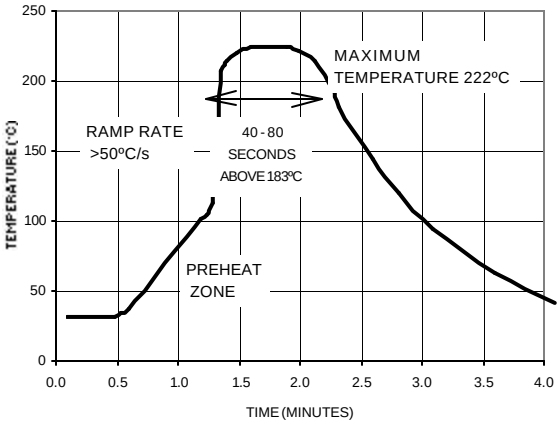


FIGURE 7: VAPOR PHASE SOLDER PROFILE

Recommended Pad Outline

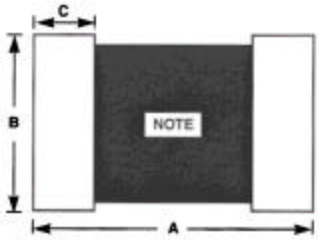


TABLE 1: PAD LAYOUT DIMENSIONS

DIMENSION	A	B	C
millImeters	2.54	1.22	0.76
Inches	0.100	0.048	0.030

Ordering Information

Multilayer Hi-Speed - *MHS Series*

V 0402 MHS 03 W H

DEVICE FAMILY
Littelfuse TVSS Device

DEVICE SIZE
i.e. 40Mil x 20Mil
(1.0mm X 0.5mm)

SERIES DESIGNATOR
Multilayer Hi-Speed

PACKING OPTIONS
H: 7in (178mm) Diameter Reel

END TERMINATION
W: Ag/Pd (Standard)

CAPACITANCE DESIGNATION
03 = 3pF
12 = 12pF

Explanation of Terms

Rated DC Voltage ($V_{M(DC)}$)
This is the maximum continuous DC voltage which may be applied up to the maximum operating temperature of the device. The rated DC operating voltage (working voltage) is also used as the reference point for leakage current. This voltage is always less than the breakdown voltage of the device.

Leakage (I_L) at Specified Voltage
In the non-conducting mode, the device is at a very high impedance ($>10^6\Omega$) and appears essentially as an open circuit in the system. The leakage current drawn at this level is very low. See device ratings.

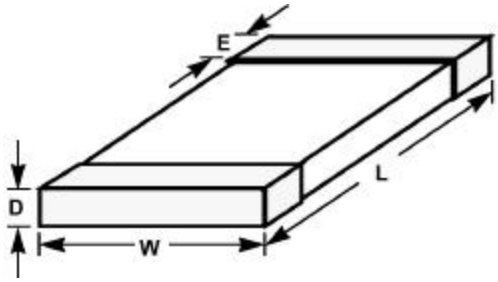
Nominal Voltage ($V_{N(DC)}$)
This is the voltage at which the device changes from the off state to the on state and enters its conduction mode of operation. The voltage is usually characterized at the 1mA point and has a specified minimum and maximum voltage listed.

Clamping Voltage (V_C)
This is the voltage appearing across the suppressor when measured at conditions of specified pulse current and specified waveform. See Device Ratings.

Capacitance (C)
This is the capacitance of the device at the specified frequency (1MHz) and bias (1Vp-p). See Device Ratings.

IEC 61000-4-2
The electrostatic discharge requirements portion of the electromagnetic compatibility (EMC) standard written by the International Electrotechnical Commission. The specification describes a specific human body model test conditions and methods.

Mechanical Dimensions



DIMENSION	DEVICE DIMENSIONS 0402 SIZE	
	Inch	mm
D Max	0.024	0.6
E	0.010 ± 0.006	0.25 ± 0.15
L	0.039 ± 0.004	1.0 ± 0.1
W	0.020 ± 0.004	0.5 ± 0.1

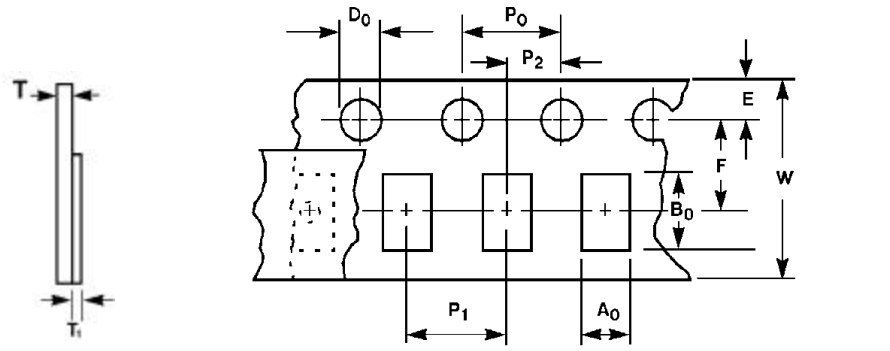
Standard Shipping Quantities

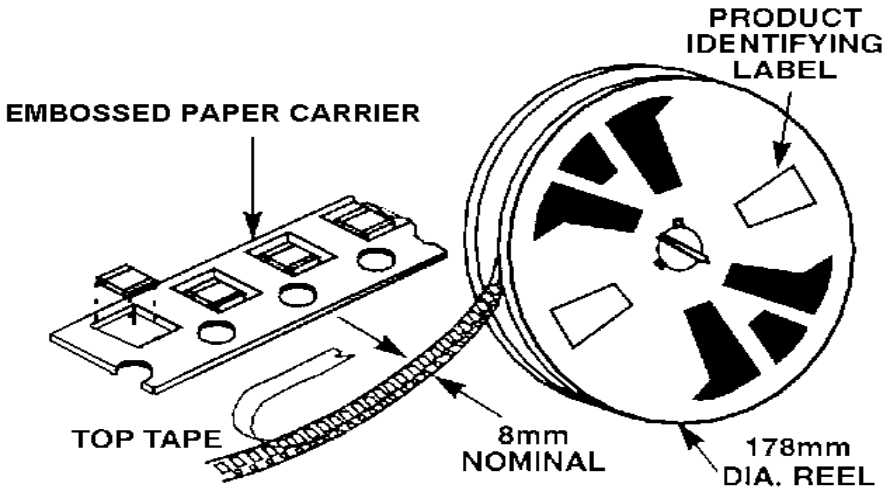
7 INCH REEL ("H" OPTION)
10,000

Tape and Reel Specifications

- Conforms to EIA–481-1, Revision A
- Can be supplied to IEC publication 286-3

SYMBOL	DESCRIPTION	DIMENSIONS IN MILLIMETERS
A_0	Width Of Cavity	0.62 ± 0.03
B_0	Length Of Cavity	1.12 ± 0.03
K_0	Depth Of Cavity	0.50 ±0.03
W	Width Of Tape	8 ± 0.2
F	Distance Between Drive Hole Centers And Cavity Centers	3.5 ± 0.05
E_1	Distance Between Drive Hole Centers And Tape Edge	1.75 ± 0.1
P_1	Distance Between Cavity Center	2 ± 0.05
P_2	Axial Drive Distance Between Drive Hole Centers And Cavity Centers	2 ± 0.1
P_0	Axial Drive Distance Between Drive Hole Centers	4 ± 0.1
D_0	Drive Hole Diameter	1.55 ± 0.05
T	Nominal Paper Thickness	0.61
T_1	Top & Bottom Tape Thickness	0.10 Max.





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