MHS Varistor Series

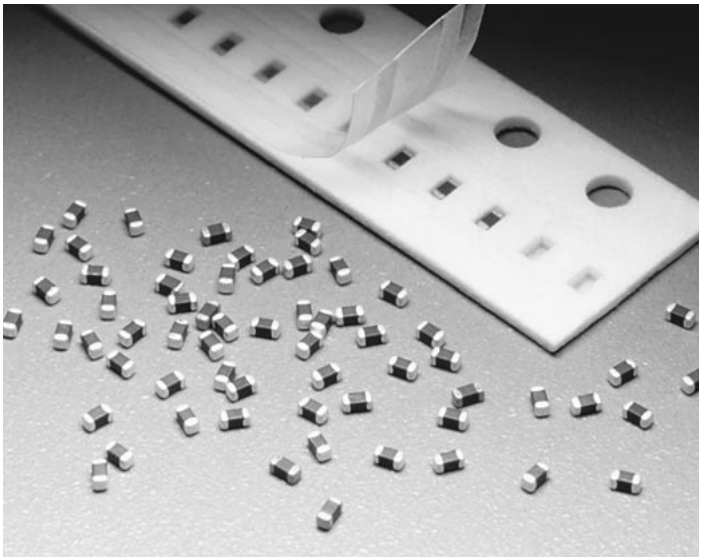
The Multilayer High-Speed MHS Series is a very-low capacitance extension to the Littelfuse ML family of Transient Voltage Surge Suppression devices available in an 0402 and 0603-size surface mount chip.

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

Their small size is ideal for high-density printed circuit boards, being typically applied to protect intergrated circuits and other sensitive components. They are particularly well suited to suppress 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 and is supplied in a leadless, surface mount package. The MHS Series is also 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
- -55°C to +125°C 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
- Computer/DSP Products
- Industrial Instruments Including Medical

Absolute Maximum Ratings For ratings of individual members of a series, see device ratings and specifications table.

	MHS SERIES	UNITS
Continuous:		
Steady State Applied Voltage: DC Voltage Range ($V_{M(DC)}$): V0402/0603MHS03	≤ 42	V
V0402/0603MHS12	≤ 18	V
Operating Ambient Temperature Range (T_A)	-55 to + 125	°C
Storage Temperature Range (T_{STG})	-55 to + 150	°C

MHS Varistor Series

Device Ratings and Specifications

PART NUMBER	MAX RATINGS (125°C)	PERFORMANCE SPECIFICATIONS (25°C)								
	MAXIMUM NON-REPETITIVE SURGE ENERGY (10/1000µS)	MAXIMUM CLAMPING VOLTAGE AT 1A (8X20µs)	MAXIMUM ESD CLAMP VOLTAGE (NOTE 1)		MAXIMUM LEAKAGE CURRENT AT SPECIFIED DC VOLTAGE				TYPICAL CAPACITANCE AT 1MHz (1V p-p)	TYPICAL INDUCTANCE (from Impedance Analysis)
			(Note 2) 8kV CONTACT	(Note 3) 15kV AIR	3.5V	5.5V	9V	15V	(NOTE 4) C	L
	W_{TM}		Clamp	Clamp	P	I_L	I_L	I_L		
	(J)	(Vc)	(V)	(V)	(µA)	(µA)	(µA)	(µA)	(pF)	(nH)
V0402MHS03	0.010	110	300	400	0.1	0.15	0.25	0.50	3	<1.0
V0603MHS03	0.010	110	300	400	0.1	0.15	0.25	0.50	3	<1.0
V0402MHS12	0.025	55	125	160	0.1	0.15	1.00	5.00	12	<1.0
V0603MHS12	0.025	55	125	160	0.1	0.15	1.00	5.00	12	<1.0

NOTES:
1. Tested to IEC-61000-4-2 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.

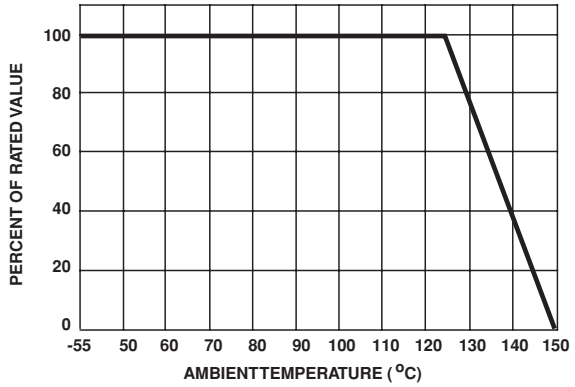


FIGURE 1. PEAK CURRENT AND ENERGY DERATING CURVE

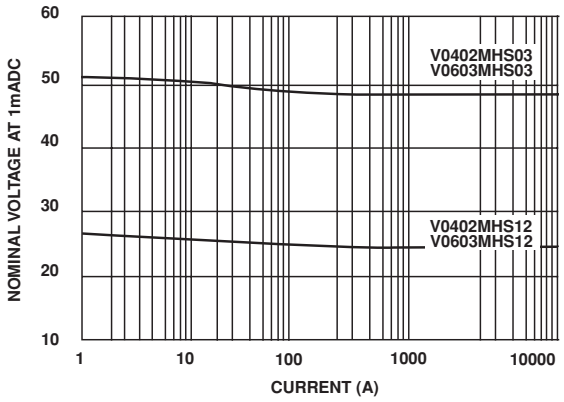


FIGURE 3. NOMINAL VOLTAGE STABILITY TO MULTIPLE ESD IMPULSES (8KV CONTACT DISCHARGES PER IEC 61000-4-2)

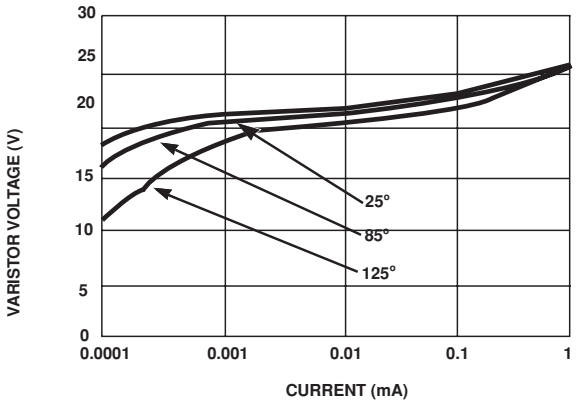


FIGURE 2: STANDBY CURRENT AT NORMALIZED VARISTOR VOLTAGE AND TEMPERATURE

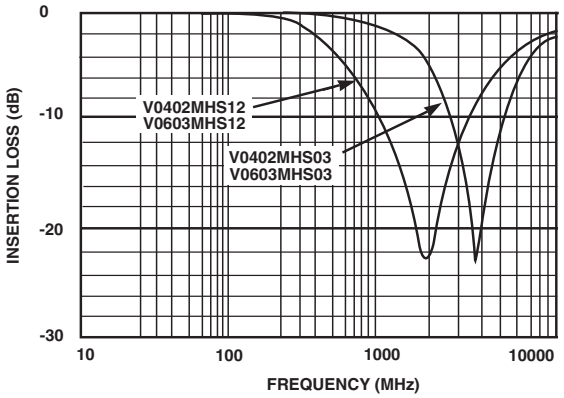


FIGURE 4. INSERTION LOSS (S21) CHARACTERISTICS

MHS Varistor Series

Soldering Recommendations

The principal techniques used for the soldering of components in surface mount technology are infared (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 63/36/2 (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 reflow 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 within 100 degrees of the solder's peak temperature is essentail 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.

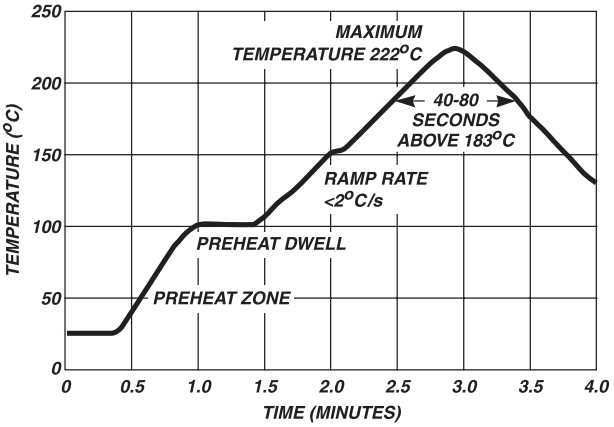


FIGURE 5. REFLOW SOLDER PROFILE

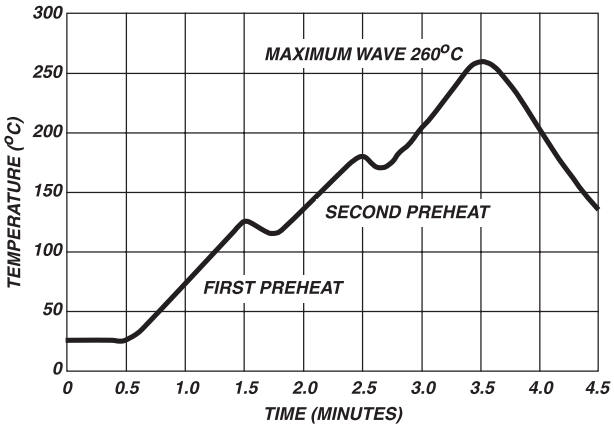


FIGURE 6. WAVE SOLDER PROFILE

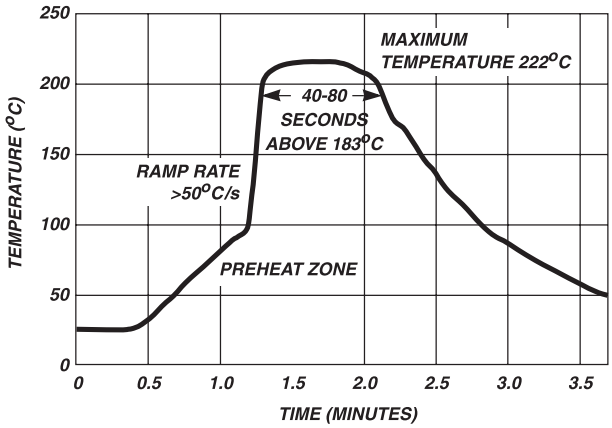


FIGURE 7. VAPOR PHASE SOLDER PROFILE

Recommended Pad Outline

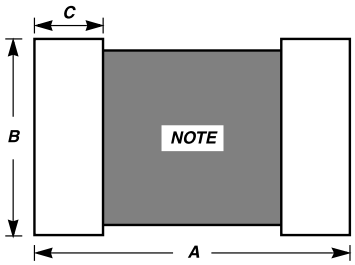


TABLE 1: PAD LAYOUT DIMENSIONS

DIMENSION	A		B		C	
	mm	in	mm	in	mm	in
0402	1.70	0.067	0.510	0.020	0.610	0.024
0603	2.54	0.100	0.760	0.030	0.890	0.035

MHS Varistor Series

Ordering Information

Multilayer High 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)

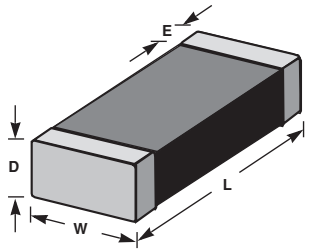
SERIES DESIGNATOR
Multilayer Hi-Speed

CAPACITANCE DESIGNATION
03 = 3PF
12 = 12PF

END TERMINATION OPTION
No Letter: Ag/Pt (Standard)
W: Ag/Pd
N: Nickel Barrier termination subject to availibility.
Please contact a Littelfuse sales representative

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

Mechanical Dimensions



DIMENSION	DEVICE DIMENSIONS			
	0402 SIZE		0603 SIZE	
	INCH	MM	INCH	MM
D Max.	0.024	0.60	0.035	0.9
E	0.10±0.006	0.25±0.15	0.015±0.008	0.4±0.2
L	0.039±0.004	1.00±0.10	0.063±0.006	1.6±1.5
W	0.020±0.004	0.50±0.10	0.032±0.006	0.8±1.5

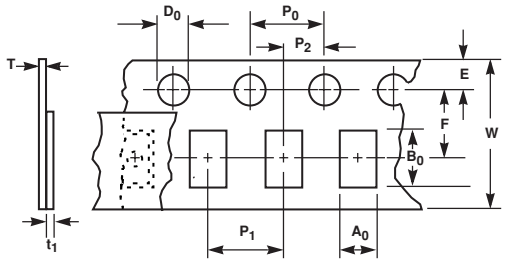
Standard Shipping Quantities

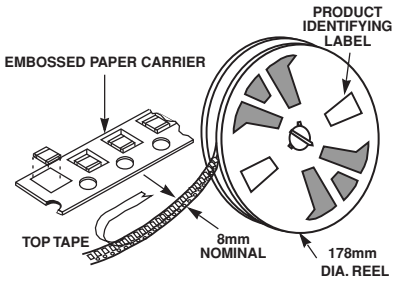
SIZE	7 INCH REEL ("H" OPTION)	13 IN REEL "T" OPTION
0402	10,000	—
0603	2,500	10,000

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	Dependant on chip size to minimize rotation
B_0	Length of Cavity	Dependant on chip size to minimize rotation
K_0	Depth of Cavity	Dependant on chip size to minimize rotation
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 & Cavity Hole 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
D_1	Nominal Paper Thickness	0.61
T_1	Top & Bottom Tape Thickness	0.10 Max





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