TMOV™ Varistor

Data Sheet **September 2001**

Thermally Protected Metal Oxide Varistor (TMOV™ Varistor)

Metal Oxide Varistors (*MOVs)* are rated for specific AC line operating voltages. Exceeding these limits through the application of a sustained abnormal over-voltage condition could result in overheating and damage to the MOV. This condition is specifically identified and addressed in the UL 1449 TVSS Standard. It requires that end-product manufacturers include a separate protection element for a standard MOV in many cases.

The Littelfuse TMOV™ - *Thermally Protected MOV* addresses this issue in a single integrated package. The TMOV series is a thermally protected version of the Littelfuse UltraMOV™ series which meets the surge suppressor component recognition requirements of UL1449 for both cord connected and permanently connected TVSS end products. Additionally, the TMOV varistor incorporates a patent-pending integrated thermal protection element within the body of the device which will open-circuit the varistor in case of overheating due to over-voltages.

The TMOV series is designed to meet the Abnormal Over-voltage requirements of UL 1449 (Abnormal Over-voltage Limited Current requirements up to and including the 5A/7hrs requirement.)

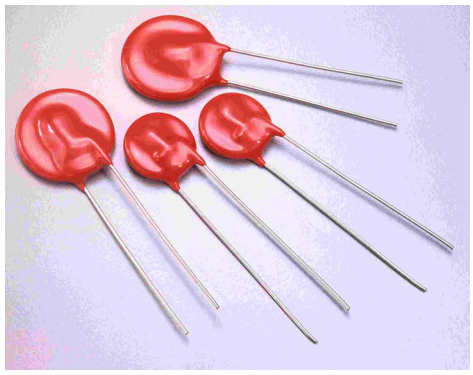
The TMOV varistor can be wave soldered without any need for special or expensive assembly processes.

Features

- Patent Pending Integrated Thermal Protection Device
- Recognized Component under UL 1449 for Cord Connected and Permanently Connected Applications
- Meets UL 1449 Abnormal Over-voltage test (Conforms to limited current testing at 0.125A, 0.5A, 2.5A and 5A.)
- High peak surge current rating up to 10kA
- Standard lead form and spacing option.
- Low Leakage
- -55ºC to +85ºC Operating Temperature Range

Applications

- TVSS products
- AC Line Power Supplies
- AC Power Meters
- AC Panel Protection Modules
- Surge protected strip connectors
- Re-locatable AC power taps



Example of a TMOV™ Varistor Encapsulant Surface Temperature Performance

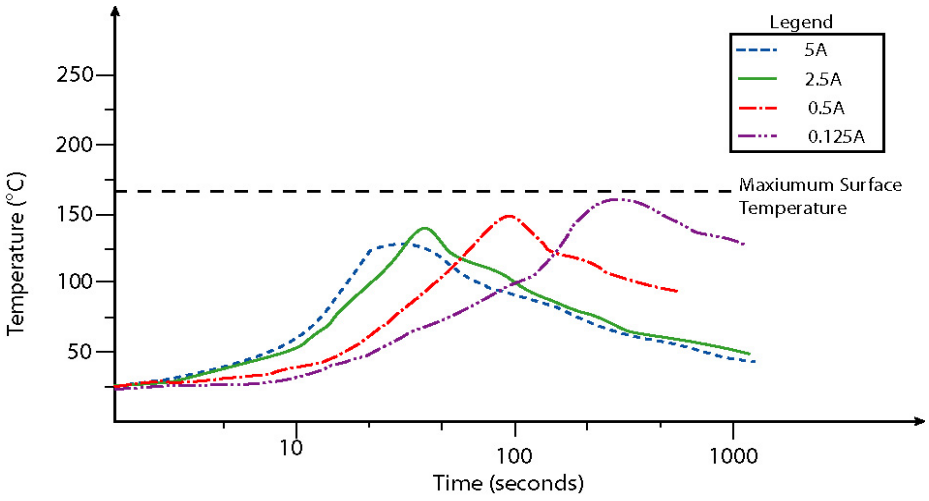


Figure 1: Example of a TMOV Varistor Encapsulant Surface Temperature during UL1449 Abnormal Over-voltage Limited Current Test

Absolute Maximum Ratings.

	TMOV SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)……	130 to 320	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave, single pulse……..	6000 to 10000	A
Single Pulse Energy Capability		
For 2ms Current Wave……	50 to 273	J
Operating Ambient Temperature range (T_A)……..	-55 to +85	ºC
Storage Temperature (T_{STG})……	-55 to +125	ºC
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/ºC
Hi-Pot Encapsulation (Isolation Voltage Capability)……	2500	V
Thermal Protection Isolation Voltage Capability (when operated)..…….……..	600	V
Insulation Resistance……	1000	MΩ

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications

PART NUMBER	DEVICE MODEL NUMBER BRAND-ING	MAXIMUM RATING (85°C)						SPECIFICATIONS (25°C)				
		CONTINUOUS			TRANSIENT			VARISTOR VOLTAGE AT 1mA TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8/20µs		TYPICAL CAPACI-TANCE f = 1MHz
		AC VOLTS	DC VOLTS	SUPPRESSED VOLTAGE RATING	ENERGY 2ms	PEAK SURGE CURRENT 8/20µs						
		$V_{M(AC)RMS}$	$V_{M(DC)}$	UL 1449 TABLE 60.1	W_{TM}	I_{TM} 2 x PULSE	I_{TM} 1 x PULSE	$V_{N(DC)}$ MIN	$V_{N(DC)}$ MAX	V_C	I_{PK}	C
		(V)	(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
TMOV14R130E	4T130E	130	170	400	50	4500	6000	184	226	340	50	1000
TMOV20R130E	20T130E	130	170	400	100	6500	10000	184	226	340	100	1900
TMOV14R140E	4T140E	140	180	500	55	4500	6000	200	240	360	50	900
TMOV20R140E	20T140E	140	180	400	110	6500	10000	200	240	360	100	1750
TMOV14R150E	4T150E	150	200	500	60	4500	6000	216	264	395	50	800
TMOV20R150E	20T150E	150	200	400	120	6500	10000	216	264	395	100	1600
TMOV14R175E	4T175E	175	225	700	70	4500	6000	243	297	455	50	700
TMOV20R175E	20T175E	175	225	700	135	6500	10000	243	297	455	100	1400
TMOV14R230E	4T230E	230	300	700	80	4500	6000	324	396	595	50	550
TMOV20R230E	20T230E	230	300	700	160	6500	10000	324	396	595	100	1100
TMOV14R250E	4T250E	250	320	800	100	4500	6000	351	429	650	50	500
TMOV20R250E	20T250E	250	320	700	170	6500	10000	351	429	650	100	1000
TMOV14R275E	4T275E	275	350	900	110	4500	6000	387	473	710	50	450
TMOV20R275E	20T275E	275	350	700	190	6500	10000	387	473	710	100	900
TMOV14R320E	4T320E	320	420	900	136	4500	6000	459	561	840	50	380
TMOV20R320E	20T320E	320	420	900	273	6500	10000	459	561	840	100	750

Thermal Characteristics

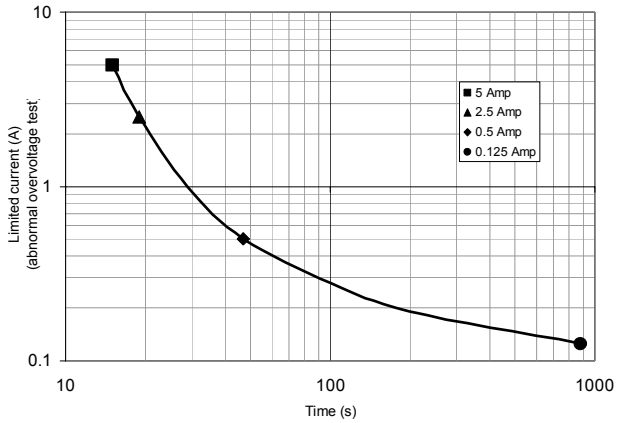


Figure 2: Typical time to open circuit under UL1449 Abnormal Overvoltage Limited Current Test

For applications exceeding 85ºC ambient temperature, the peak surge current and energy ratings must be reduced as shown in Figure 3.

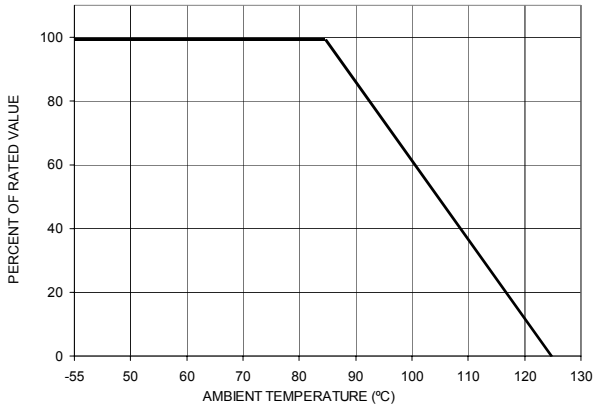


Figure 3: Peak Current & Energy Derating Curve

Transient V-I Characteristic Curves

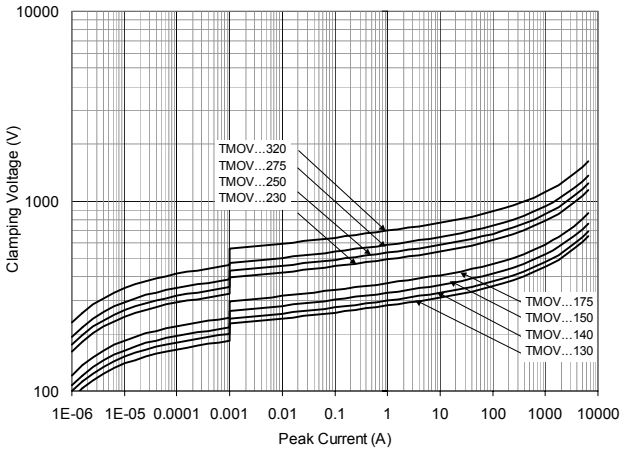


Figure 4: Clamping Voltage for 14mm types

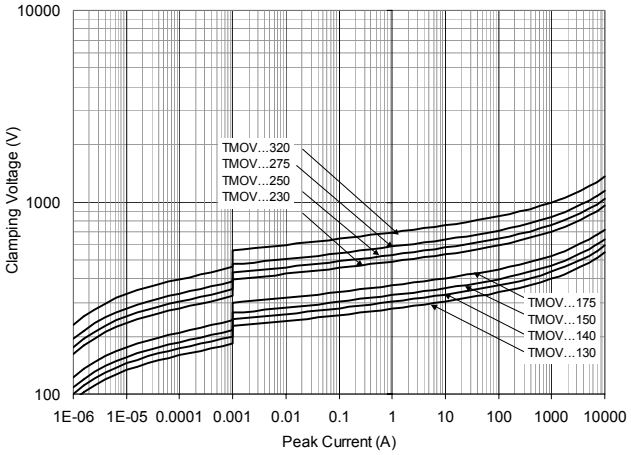


Figure 5: Clamping Voltage for 20mm types

Pulse Rating Curves

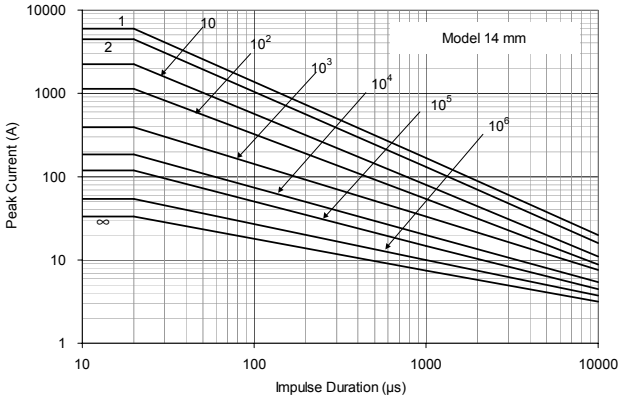


Figure 6: Pulse Rating Curves for 14mm types

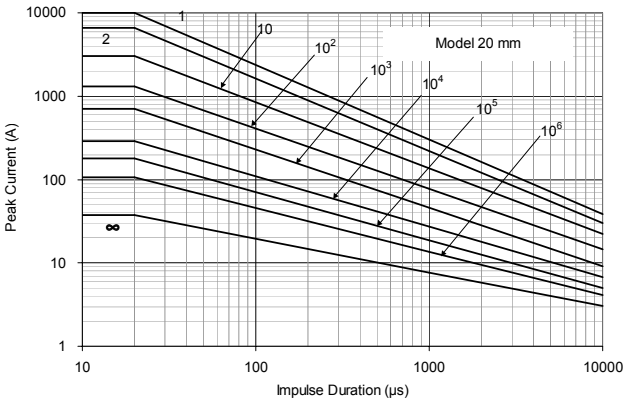


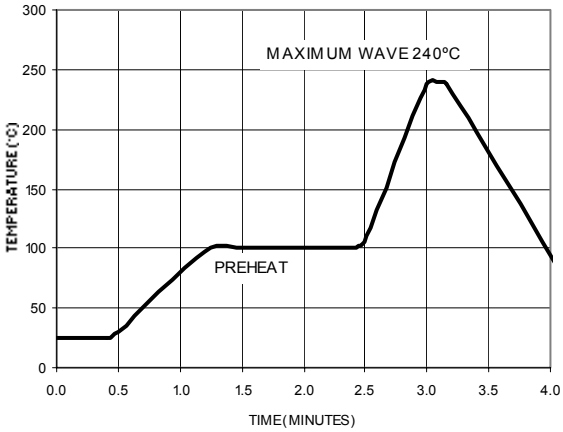
Figure 7: Pulse Rating Curves for 20mm types

Soldering Recommendations

Because the TMOV™ series contains a thermal protection device, care must be taken when soldering the device into place. Two soldering methods are possible. Firstly, hand soldering: We recommend the use of pliers to heat-sink the leads of the device. Secondly, wave-soldering: This is a strenuous process requiring pre-heat stages to reduce the stresses on surface–mounted devices. It is critically important that all preheat stage and the solder bath temperatures are rigidly controlled.

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

FIGURE 8: WAVE SOLDER PROFILE



Ordering Information

TMOV

TMOV 14 R 150 E

DEVICE FAMILY
Littelfuse UL1449 TVSS Device

DISC DIAMETER (mm)

CERAMIC SHAPE
R: Round

ENCAPSULATION
E: Epoxy

$V_{M(AC)RMS}$
130V to 320V

Explanation of Terms

Rated AC Voltage ($V_{M(AC)RMS}$)
This is the maximum continuous sinusoidal rms voltage that may be applied. This voltage may be applied at any temperature up to the maximum operating temperature of the device.

Maximum Non-Repetitive Surge Current (I_{TM})
This is the maximum peak current which may be applied for a single 8/20µs impulse, with rated line voltage also applied, without causing device failure. The pulse can be applied to the device in either polarity with the same confidence factor.

Suppressed Voltage Rating (SVR)
A rating (or ratings) selected by the manufacturer from UL1449 Table 60.1 and based on the measured limiting voltage determined during the transient-voltage surge suppression test.

UL 1449
An Underwriters Laboratory standard covering the safety requirements for Transient Voltage Surge Suppressors (TVSS) intended for permanently connected, cord-connected and direct plug-in applications.

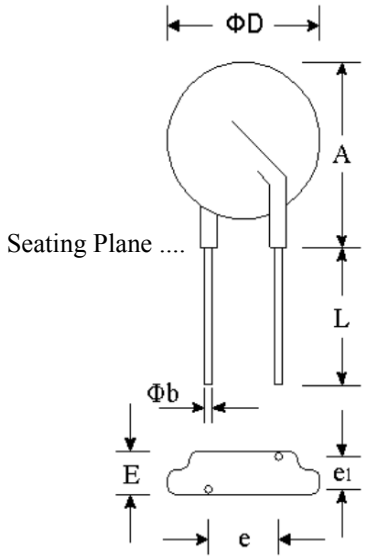
Limited Current Abnormal Over-voltage Test
An AC over-voltage condition applied to a TVSS according to UL1449 Table 37.1. The short circuit current is limited by series connected resistors to 5A, 2.5A, 0.5A and 0.125A respectively for four test samples. The condition is maintained for 7 hours or until the TVSS is removed from the ac supply by a thermal or over-current protection device.

Maximum Non-Repetitive Surge Energy (W_{TM})
This is the maximum rated transient energy which may be dissipated for a single current pulse at a specified impulse duration, with the rated DC or RMS voltage applied, without causing device failure.

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

Package Outline Dimensions

SYMBOL	V_{RMS} MODEL VOLTAGE	VARISTOR MODEL SIZE			
		14 mm (Inch)		20 mm (Inch)	
		MIN	MAX	MIN	MAX
A	ALL	13.5	20.5	17.5	28.0
		(0.531)	(0.787)	(0.689)	(1.043)
ΦD	ALL	13.5	17	17.5	23
		(0.531)	(0.669)	(0.689)	(0.906)
e	All	6.5	8.5	6.5	8.5
		(0.256)	(0.335)	(0.256)	(0.335)
e_1	ALL	2.5	5.5	2.5	5.5
		(0.098)	(0.216)	(0.098)	(0.216)
E	Up to 230V	-	8.8	-	8.8
			(0.327)		(0.327)
E	275V, 320V	-	9.8	-	9.8
			(0.354)		(0.354)
L	ALL	25.4		25.4	
		(1.00)		(1.00)	
Φb	ALL	0.76	0.86	0.76	0.86
		(0.030)	(0.034)	(0.030)	(0.034)



Standard Bulk Pack Quantities

VARISTOR VOLTAGE MODEL	STANDARD BULK PACK QUANTITY	
	VARISTOR MODEL SIZE	
	14 mm	20 mm
Up to 230V	500	400
275V, 320V	400	300