

TMOV™ and iTMOV™ Varistor Series



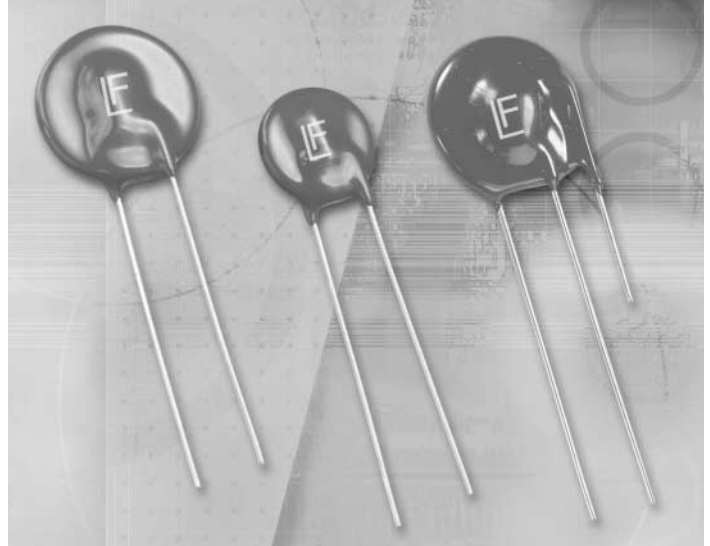
The Littelfuse TMOV and iTMOV thermally protected varistors represent a new development in integrated circuit protection. Both versions are comprised of radial leaded MOVs (Metal Oxide Varistors) with an integrated thermally activated element designed to open in the event of overheating due to the abnormal overvoltage, limited current, conditions outlined in UL1449.

The iTMOV varistor differs from the TMOV varistor by the inclusion of a third lead for the purpose of indicating that the MOV has been disconnected from the circuit. This lead facilitates connection to monitoring circuitry.

The TMOV and iTMOV varistors offer quick thermal response due to the close proximity of the integrated thermal element to the MOV body. The integrated configuration also offers lower inductance than most discrete solutions resulting in improved clamping performance to fast over-voltage transients. Additionally, TMOV and iTMOV varistors are wave solderable, thus simplifying end product assembly by reducing the expense and rework associated with hand soldering operations.

The TMOV and iTMOV varistors are both recognized surge suppression components to UL 1449. The TMOV and iTMOV varistor's integrated thermal element, in conjunction with appropriate enclosure design, helps facilitate TVSS module compliance to UL1449 for both cord connected and permanently connected applications.

TMOV and iTMOV varistors are compatible for use with industry standard wave-soldering processes or recommended hand-soldering methods.



Features

- Patent Pending Integrated Thermal Protection Device
- Designed to facilitate compliance to UL1449 for TVSS product
- High peak surge current rating up to 10kA
- Wave solderable
- Standard lead form and spacing option
- Low Leakage
- -55°C to +85°C Operating Temperature Range
- Third lead for indication purposes.

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories UL1449. Includes selected tests from UL1020, regarding thermal cutoffs.

AGENCY FILE NUMBERS: UL E75961

Applications

- TVSS Products
- AC Panel Protection Modules
- AC Line Power Supplies
- Surge Protected Strip Connectors
- AC Power Meters
- Re-locatable AC Power Taps

TMOV™ and iTMOV™ Varistor Series

TMOV Varistor Series - Absolute Maximum Ratings

Absolute Maximum Ratings For ratings of individual members of a series, see Device Ratings and Specifications chart

| | TMOV Varistor | UNITS |
|--|----------------|------------|
| Continuous: | | |
| Steady State Applied Voltage: | | |
| AC Voltage Range ($V_{M(AC)RMS}$) | 115 to 420 | V |
| Transient: | | |
| Peak Pulse Current (I_{TM}) | | |
| For 8x20 μ s Current Wave, single pulse | 6000 to 10,000 | A |
| Single-Pulse Energy Capability | | |
| For 2ms Current Wave | 35 to 320 | J |
| Operating Ambient Temperature Range (T_A) | -55 to 85 | °C |
| Storage Temperature Range (T_{STG}) | -55 to 125 | °C |
| Temperature Coefficient (α_V) of Clamping Voltage (V_C) at Specified Test Current | <0.01 | %/°C |
| Hi-Pot Encapsulation (Isolation Voltage Capability) | 2500 | V |
| Thermal Protection Isolation Voltage Capability (when operated) | 600 | V |
| Insulation Resistance | 1,000 | M Ω |

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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications - TMOV Varistor Series

| PART NUMBER | DEVICE MODEL NUMBER BRANDING | DISC DIA-METER (mm) | MAXIMUM RATING (85°C) | | | | | | SPECIFICATIONS (25°C) | | | | |
|-------------|------------------------------|---------------------|-----------------------|---------------------------|------------|---------------------------------|--------------------|----------------|--------------------------------------|-------|---------------------------------------|------|------------------------------|
| | | | CONTINUOUS | | TRANSIENT | | | | VARISTOR VOLTAGE AT 1mA TEST CURRENT | | MAXIMUM CLAMPING VOLTAGE 8/20 μ s | | TYPICAL CAPACITANCE f = 1MHz |
| | | | AC VOLTS | SUPPRESSED VOLTAGE RATING | ENERGY 2ms | PEAK SURGE CURRENT 8/20 μ s | | | | | | | |
| | | | $V_{M(AC)RMS}$ | UL 1449 TABLE 60.1 | W_{TM} | I_{TM} 1 x PULSE | I_{TM} 2 x PULSE | $V_{N(DC)MIN}$ | $V_{N(DC)MAX}$ | V_C | I_{PK} | C | |
| TMOV14R115E | 4T115E | 14 | 115 | 300 | 35 | 6000 | 4500 | 162 | 198 | 300 | 50 | 1100 | |
| TMOV20R115E | 20T115E | 20 | 115 | 300 | 52 | 10000 | 6500 | 162 | 198 | 300 | 100 | 2400 | |
| TMOV14R130E | 4T130E | 14 | 130 | 400 | 50 | 6000 | 4500 | 184 | 226 | 340 | 50 | 1000 | |
| TMOV20R130E | 20T130E | 20 | 130 | 400 | 100 | 10000 | 6500 | 184 | 226 | 340 | 100 | 1900 | |
| TMOV14R140E | 4T140E | 14 | 140 | 500 | 55 | 6000 | 4500 | 200 | 240 | 360 | 50 | 900 | |
| TMOV20R140E | 20T140E | 20 | 140 | 400 | 110 | 10000 | 6500 | 200 | 240 | 360 | 100 | 1750 | |
| TMOV14R150E | 4T150E | 14 | 150 | 500 | 60 | 6000 | 4500 | 216 | 264 | 395 | 50 | 800 | |
| TMOV20R150E | 20T150E | 20 | 150 | 400 | 120 | 10000 | 6500 | 216 | 264 | 395 | 100 | 1600 | |
| TMOV14R175E | 4T175E | 14 | 175 | 700 | 70 | 6000 | 4500 | 243 | 297 | 455 | 50 | 700 | |
| TMOV20R175E | 20T175E | 20 | 175 | 700 | 135 | 10000 | 6500 | 243 | 297 | 455 | 100 | 1400 | |
| TMOV14R230E | 4T230E | 14 | 230 | 700 | 80 | 6000 | 4500 | 324 | 396 | 595 | 50 | 550 | |
| TMOV20R230E | 20T230E | 20 | 230 | 700 | 160 | 10000 | 6500 | 324 | 396 | 595 | 100 | 1100 | |
| TMOV14R250E | 4T250E | 14 | 250 | 800 | 100 | 6000 | 4500 | 351 | 429 | 650 | 50 | 500 | |
| TMOV20R250E | 20T250E | 20 | 250 | 700 | 170 | 10000 | 6500 | 351 | 429 | 650 | 100 | 1000 | |
| TMOV14R275E | 4T275E | 14 | 275 | 900 | 110 | 6000 | 4500 | 387 | 473 | 710 | 50 | 450 | |
| TMOV20R275E | 20T275E | 20 | 275 | 700 | 190 | 10000 | 6500 | 387 | 473 | 710 | 100 | 900 | |
| TMOV14R320E | 4T320E | 14 | 320 | 900 | 136 | 6000 | 4500 | 459 | 561 | 840 | 50 | 380 | |
| TMOV20R320E | 20T320E | 20 | 320 | 900 | 273 | 10000 | 6500 | 459 | 561 | 840 | 100 | 750 | |
| TMOV14R385E | 4T385E | 14 | 385 | 1200 | 150 | 6000 | 4500 | 558 | 682 | 1025 | 50 | 360 | |
| TMOV20R385E | 20T385E | 20 | 385 | 1200 | 300 | 10000 | 6500 | 558 | 682 | 1025 | 100 | 700 | |
| TMOV14R420E | 4T420E | 14 | 420 | 1200 | 160 | 6000 | 4500 | 612 | 748 | 1120 | 50 | 300 | |
| TMOV20R420E | 20T420E | 20 | 420 | 1200 | 320 | 10000 | 6500 | 612 | 748 | 1120 | 100 | 600 | |

Varistor Products

Thermally Protected

TMOV™ and iTMOV™ Varistor Series

iTMOV Varistor Series - Absolute Maximum Ratings

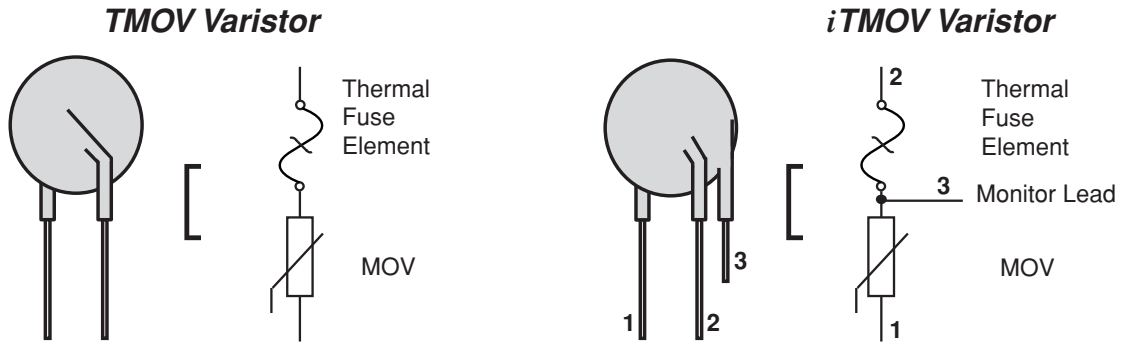
| Absolute Maximum Ratings | iTMOV Varistor | UNITS |
|--|----------------|------------|
| Continuous: | | |
| Steady State Applied Voltage: | | |
| AC Voltage Range ($V_{M(AC)RMS}$) | 115 to 420 | V |
| Transient: | | |
| Pulse Peak Current (I_{TM}) | | |
| For 8/20 μ s Current Wave, Single Pulse | 10,000 | A |
| Single-Pulse Energy Capability | | |
| For 10/1000 μ s Current Wave | 52 to 320 | J |
| Operating Ambient Temperature Range (T_A) | -55 to 85 | °C |
| Storage Temperature Range (T_{STG}) | -55 to 125 | °C |
| Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current | <0.01 | %/°C |
| Hi-Pot Encapsulation (Isolation Voltage Capability) | 2500 | $V_{(AC)}$ |
| Isolation Voltage Capability (When Thermal Element Has Opened) | 600 | $V_{(AC)}$ |
| Insulation Resistance | 1000 | $M\Omega$ |
| Indicator Lead Rating (Lead-3): | | |
| Continuous RMS current | 100 | mA |
| Surge Current, 8/20 μ s | 10,000 | A |

Device Ratings and Specifications - iTMOV Varistor Series

| PART NUMBER | DEVICE MODEL NUMBER BRAND-ING | DISC DIA-METER (mm) | MAXIMUM RATING (85°C) | | | | | SPECIFICATIONS (25°C) | | | | |
|-------------|-------------------------------|---------------------|-----------------------|-----------------------------------|--------------|---------------------------------|------------------------|--------------------------------------|---------------------|---------------------------------------|--------------|------------------------------|
| | | | CONTINUOUS | | TRANSIENT | | | VARISTOR VOLTAGE AT 1mA TEST CURRENT | | MAXIMUM CLAMPING VOLTAGE 8/20 μ s | | TYPICAL CAPACITANCE f = 1MHz |
| | | | RMS VOLTS | MINIMUM SUPPRESSED VOLTAGE RATING | ENERGY 2ms | PEAK SURGE CURRENT 8/20 μ s | | | | | | |
| | | | $V_{M(AC)}$ (V) | UL 1449 TABLE 60.1 (V) | W_{TM} (J) | I_{TM} 1 x PULSE (A) | I_{TM} 2 x PULSE (A) | $V_{N(DC)}$ MIN (V) | $V_{N(DC)}$ MAX (V) | V_C (V) | I_{PK} (A) | C (pF) |
| TMOV20R115M | 20T115M | 20 | 115 | 300 | 52 | 10000 | 6500 | 162 | 198 | 300 | 100 | 2400 |
| TMOV20R130M | 20T130M | 20 | 130 | 400 | 100 | 10000 | 6500 | 184 | 226 | 340 | 100 | 1900 |
| TMOV20R140M | 20T140M | 20 | 140 | 400 | 110 | 10000 | 6500 | 200 | 240 | 360 | 100 | 1750 |
| TMOV20R150M | 20T150M | 20 | 150 | 400 | 120 | 10000 | 6500 | 216 | 264 | 395 | 100 | 1600 |
| TMOV20R175M | 20T175M | 20 | 175 | 700 | 135 | 10000 | 6500 | 243 | 297 | 455 | 100 | 1400 |
| TMOV20R230M | 20T230M | 20 | 230 | 700 | 160 | 10000 | 6500 | 324 | 396 | 595 | 100 | 1100 |
| TMOV20R250M | 20T250M | 20 | 250 | 700 | 170 | 10000 | 6500 | 351 | 429 | 650 | 100 | 1000 |
| TMOV20R275M | 20T275M | 20 | 275 | 700 | 190 | 10000 | 6500 | 387 | 473 | 710 | 100 | 900 |
| TMOV20R320M | 20T320M | 20 | 320 | 900 | 273 | 10000 | 6500 | 459 | 561 | 840 | 100 | 750 |
| TMOV20R385M | 20T385M | 20 | 385 | 1200 | 300 | 10000 | 6500 | 558 | 682 | 1025 | 100 | 700 |
| TMOV20R420M | 20T420M | 20 | 420 | 1200 | 320 | 10000 | 6500 | 612 | 748 | 1120 | 100 | 600 |

TMOV™ and iTMOV™ Varistor Series

Lead Configurations



Note: MOVs are non-polarized passive elements

iTMOV Varistor Application Examples

The application examples below show how the indicator lead on the iTMOV can be used to indicate that the thermal element has been opened. This signifies that the circuit is no longer protected from transients by the MOV.

Application Example 1 (Figure 1)

In this case, the LED is normally on, and is off when the thermal element opens.

Application Example 2 (Figure 2)

This circuit utilizes an optocoupler to provide galvanic isolations between the iTMOV varistor and the indicating or alarm circuitry.

Application Example 3 (Figure 3)

This circuit illustrates the use of the monitoring lead of the iTMOV varistor to ensure that equipment is only operated when overvoltage protection present. In normal operation the load switch relay solenoid is powered via the indicator lead of the iTMOV varistor. In the event of the thermal element being activated, the relay will deactivate, cutting power to the protected circuit and the fault LED will illuminate.

Please note: Indicator circuits are provided as a guideline only. Verification of actual indicator circuitry is the responsibility of the end user. Component values selected must be appropriate for the specific AC line voltage service and application.

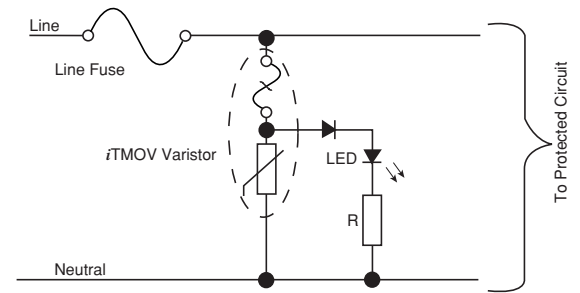


Figure 1. Application example 1

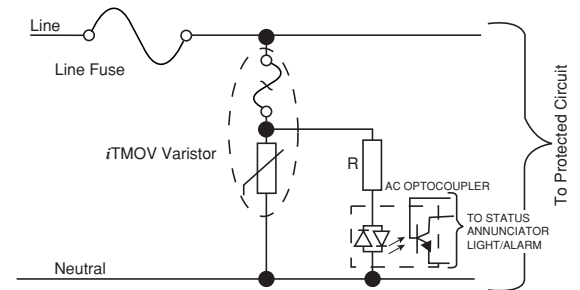


Figure 2. Application example 2

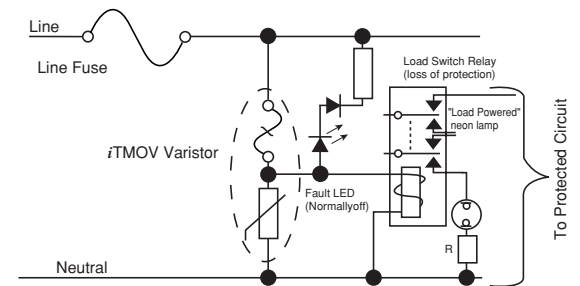
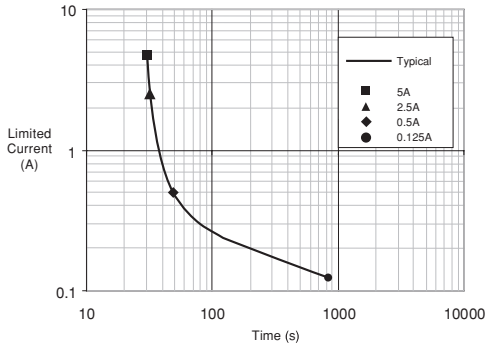


Figure 3. Application example 3

TMOV™ and iTMOV™ Varistor Series

Thermal Characteristics



* Figure 4: Typical time to open circuit under UL1449 Abnormal Overvoltage Limited Current Test

Note : The TMOV and iTMOV varistors are intended, in conjunction with appropriate enclosure design, to help facilitate TVSS module compliance to UL 1449, Section 37.4 (abnormal overvoltage limited current requirements). Under these extreme abnormal overvoltage conditions, the units will exhibit substantial heating and potential venting prior to opening. Modules should be designed to contain this possibility. Application testing is strongly recommended.

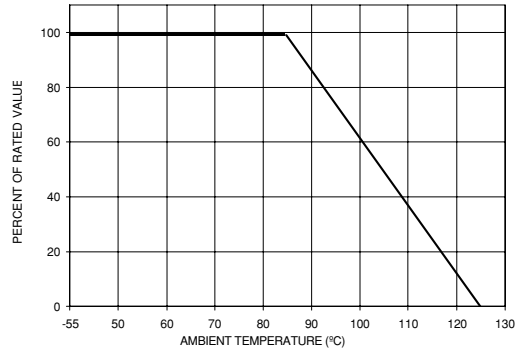


Figure 5: Peak Current & Energy Derating Curve

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

Transient V-I Characteristic Curves

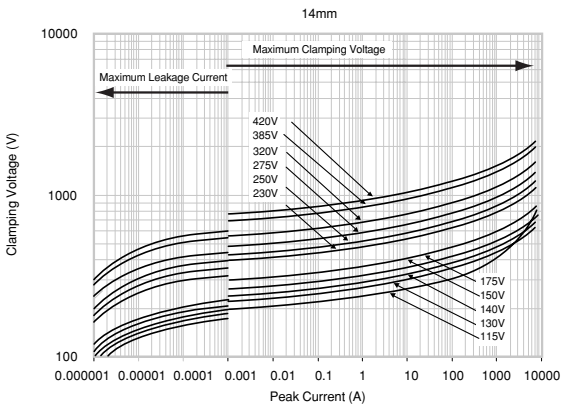


Figure 6: V-I Characteristic Curves for 14mm Types

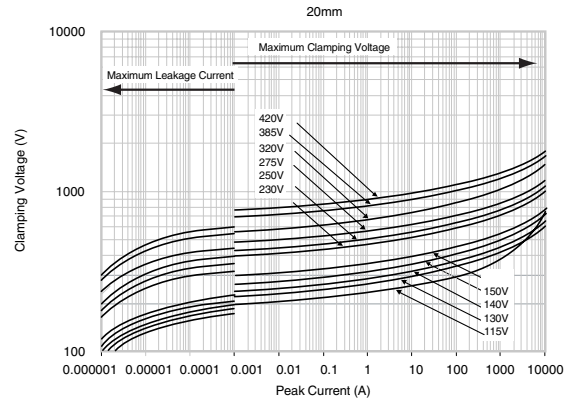


Figure 7: V-I Characteristic Curves for 20mm Types

Pulse Rating Curves

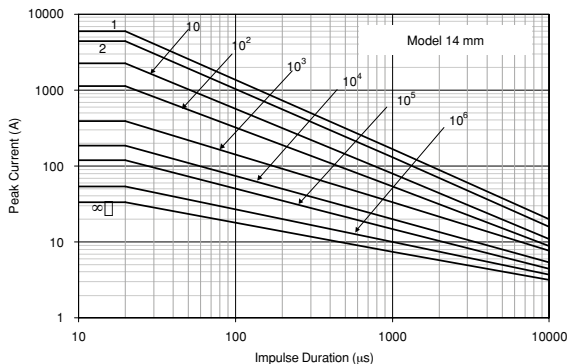


Figure 8: Pulse Rating Curves for 14mm types

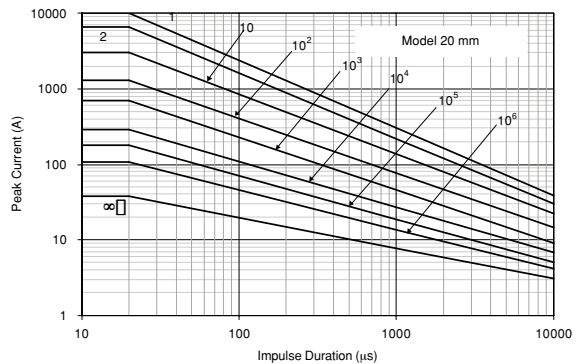


Figure 9: Pulse Rating Curves for 20mm types

TMOV™ and iTMOV™ Varistor Series

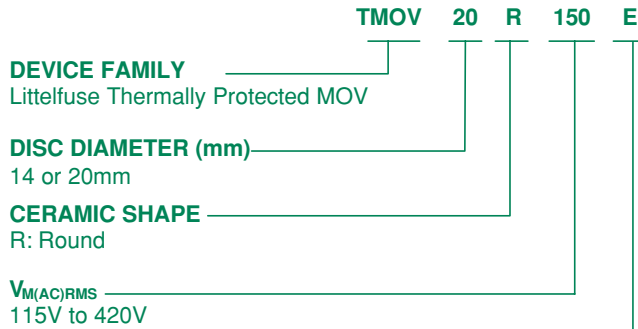
Soldering Recommendations

Because the TMOV™ and iTMOV varistors contain a thermal protection device, care must be taken when soldering the devices into place. Two soldering methods are possible. Firstly, hand soldering: It is recommended to use 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 and iTMOV varistors is a 62/36/2 (Sn/Pb/Ag), 60/40 (Sn/Pb) or 63/37 (Sn/Pb). Littelfuse also recommends an RMA solder flux.

Ordering Information

Standard Parts

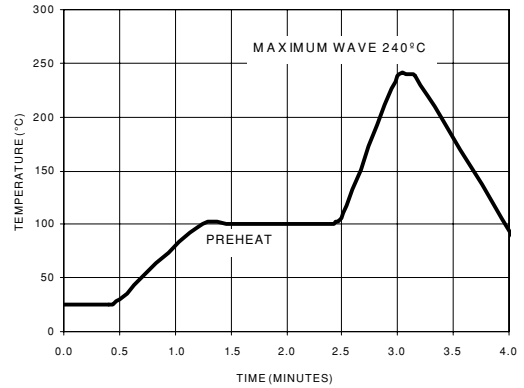


NOTE: By ordering the standard part number, i.e. TMOV20R150E, standard lead styles, packing and lead spacing will be supplied. These specifications are as follows:

- Straight Leads
- Bulk Packed
- 7.5mm Lead Spacing

To change any of the ordering information use the additional option nomenclature.

Figure 10: Wave Solder Profile



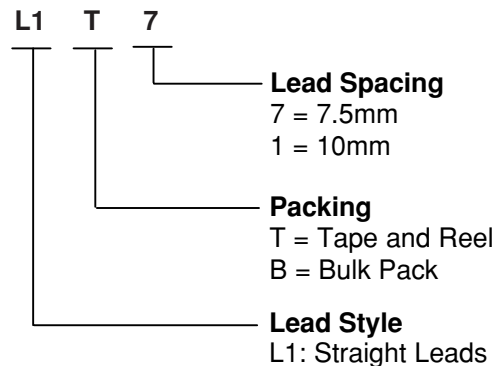
Series Designator

E: 2-Leaded TMOV Varistor Series
Supplied in Bulk Pack with 7.5mm lead spacing.

M: 3-Leaded iTMOV Varistor Series
Supplied in Bulk Pack with 7.5mm lead spacing (between leads 1 & 2)
(Available in 20mm only)

Additional Options

Standard Part



NOTE: For additional options, all 3 additional fields must be added to the standard part number, i.e. TMOV20R275E L1 T 1,

- Don't use additional option fields for standard parts.

NOTE: Lead spacing is for MOV leads only. The indicator lead space (iTMOV Varistor) is only available at 5mm.

TMOV™ and iTMOV™ Varistor Series

| SYMBOL | V _{RMS} MODEL VOLTAGE | TMOV Varistor | | | | iTMOV Varistor | |
|----------------|--------------------------------------|---------------------|------------------|------------------|------------------|------------------|------------------|
| | | VARISTOR MODEL SIZE | | | | | |
| | | 14mm | | 20mm | | 20mm | |
| | | MIN mm (inch) | MAX mm (inch) | MIN mm (inch) | MAX mm (inch) | MIN mm (inch) | MAX mm (inch) |
| A | ALL | 13.5 (0.531) | 20 (0.787) | 17.5 (0.689) | 28 (1.102) | 17.5 (0.689) | 28 (1.102) |
| Φ _D | ALL | 13.5 (0.531) | 17 (0.669) | 17.5 (0.689) | 23 (0.906) | 17.5 (0.689) | 23 (0.906) |
| e | ALL | 6.5 (0.256) | 8.5 (0.335) | 6.5 (0.256) | 8.5 (0.335) | 6.5 (0.256) | 8.5 (0.335) |
| e1 | 130-250 | 2.5 (0.098) | 5.5 (0.216) | 2.5 (0.098) | 5.5 (0.216) | 2.5 (0.098) | 5.5 (0.216) |
| | 275-420 | 2.5 (0.098) | 5.5 (0.216) | 2.5 (0.098) | 5.5 (0.216) | 2.5 (0.098) | 5.5 (0.216) |
| e2 | ALL | | | | | 4.0 (0.157) | 6.0 (0.236) |
| e3 | ALL | | | | | - | 1.3 (0.051) |
| E | 130-250 | - | 8.3 (0.327) | - | 8.3 (0.327) | - | 8.3 (0.327) |
| | 275-420 | - | 11 (0.433) | - | 11 (0.433) | - | 11 (0.433) |
| L | ALL | 25.4 (1.00) | | 25.4 (1.00) | | 25.4 (1.00) | - |
| L3 | ALL | | | | | 10.0 (0.394) | - |
| Φ _B | ALL | 0.76 (0.030) | 0.86 (0.034) | 0.76 (0.030) | 0.86 (0.034) | 0.76 (0.030) | 0.86 (0.034) |

Diagram of TMOV Varistor showing dimensions: Φ_D, A, L, e, E, e1

Diagram of iTMOV Varistor showing dimensions: Φ_D, A, L, L3, e, E, e1, e2, e3

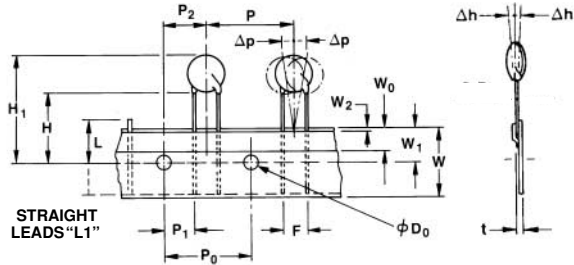
For other lead spacing contact your Littelfuse Sales Representative.

Standard Bulk Pack Quantities

| VOLTAGE MODEL | STANDARD BULK PACK QUANTITY | | TAPE AND REEL |
|---------------|-----------------------------|------|---|
| | VARISTOR MODEL SIZE | | |
| | 14mm | 20mm | |
| 130 - 250 | 500 | 400 | Contact a Littelfuse Sales Representative |
| 275 or Higher | 400 | 300 | |

TMOV™ and iTMOV™ Varistor Series

Tape Specifications for Reel or Ammo Pack (Fan-Fold)



- Conforms to ANSI and EIA specifications.
- Can be supplied to IEC Publication 286-2
- Reel capacity varies with voltage.

Contact Littelfuse for details.

| SYMBOL | PARAMETER | MODEL SIZE | |
|----------------|---|--------------------------|--------------------------|
| | | 14mm | 20mm |
| B ₁ | Component Top to Seating Plane | 21.50 ±0.50 | 28.00 ±0.50 |
| P | Pitch of Component | 25.4 ± 1.0 | 25.4 ± 1.0 |
| P ₀ | Feed Hole Pitch | 12.7 ± 0.2 | 12.7 ± 0.2 |
| P ₁ | Feed Hole Center to Pitch | 2.6 ± 0.7 | 2.6 ± 0.7 |
| P ₂ | Hole Center to Component Center | 6.35 ± 0.7 | 6.35 ± 0.7 |
| F | Lead to Lead Distance | 7.5 ± 0.8 | 10.0 ± 0.8 |
| Δh | Component Alignment | 2.0 Max | 2.0 Max |
| W | Tape Width | 18.0 + 1.0 18.0 - 0.5 | 18.0 + 1.0 18.0 - 0.5 |
| W ₀ | Hold Down Tape Width | 6.0 ± 0.3 | 12.0 ± 0.3 |
| W ₁ | Hole Position | 9.0 + 0.75 9.0 - 0.50 | 9.0 + 0.75 9.0 - 0.50 |
| W ₂ | Hold Down Tape Position | 0.5 Max | 0.5 Max |
| H | Height from Tape Center to Component Base | 18.0 + 2.0 18.0 - 0.0 | 18.0 + 2.0 18.0 - 0.0 |
| H ₁ | Component Height | 40.0 Max | 46.5 Max |
| D ₀ | Feed Hole Diameter | 4.0 ± 0.2 | 4.0 ± 0.2 |
| t | Total Tape Thickness | 0.7 ± 0.2 | 0.7 ± 0.2 |
| L | Length of Clipped Lead | 11.0 Max | 11.0 Max |
| Δp | Component Alignment | 3° Max, 1.00mm | 3° Max |

Dimensions are in mm.