PAGE

Varistor Products Overview

The **M**etal **O**xide **V**aristor (MOV) components listed in this section are intended for a comprehensive range of applications and transient voltage suppression products.

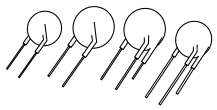
The product series in this section vary in size, form factor, and package style as illustrated in Figure 1 in order to meet specific performance as well as manufacturing needs of the user.

Additionally, Figure 2 forms a selection guide matrix for the designer by illustrating the various device's working voltage transient energy and peak current ratings range.

The data sheets in this section have been grouped by package style and are presented in the following sequence:

- Radial Lead Styles
  - TMOV®, *i*TMOV® and UltraMOV™ Varistors, C-III, LA and ZA Series
- High Energy Industrial Varistors
  - BA/BB, DA/DB, TMOV34S®, HA, HB, HC, HF, HG, and DHB Series
- High Energy Industrial Varistor Discs
  - CA and NA Series
- Other Application Specific Varistors
  - MA, PA and RA Series

TMOV™ Varistor and iTMOV™ Varistors



- Available indicating third leg
- Thermally Protected MOV
- High Energy Capability
- Radial Package
- AC Line Voltage Operation
- UL 1449 Recognized

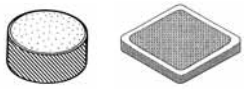
UltraMOV/C-III/LA SERIES

- Radial Package
- AC Line Voltage Operation
- UL/CSA Recognized
- CECC Certified
- VDE Certified

ZA SERIES

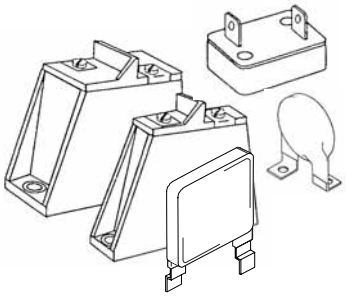
- Radial Package
- Low Voltage Operation
- UL/CSA Recognized
- CECC Certified
- VDE Certified

CA, NA SERIES



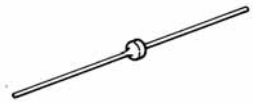
- Industrial Discs
- Solderable Contacts
- Edge Passivation

BB, BA, DA, DB, HA, HB, HC, HF, HG, DHB,TMOV34S SERIES



- High Energy Capability
- Rigid Terminals
- Improved Creep and Strike
- Isolated
- Low Inductance
- UL/CSA Recognized

MA SERIES

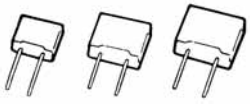


- Axial Package
- Wide Voltage Range
- 3mm Disc

PA SERIES

- Rigid Mountdown
- NEMA Creep and Strike Distance
- Quick Connect Terminal
- UL/CSA Recognized

RA SERIES



- Low Profile
- High Temperature Capability
- In-Line Leads
- Precise Seating Plane
- UL/CSA Recognized

FIGURE 1. VARISTOR PRODUCTS PACKAGE STYLES

Varistor Products Overview

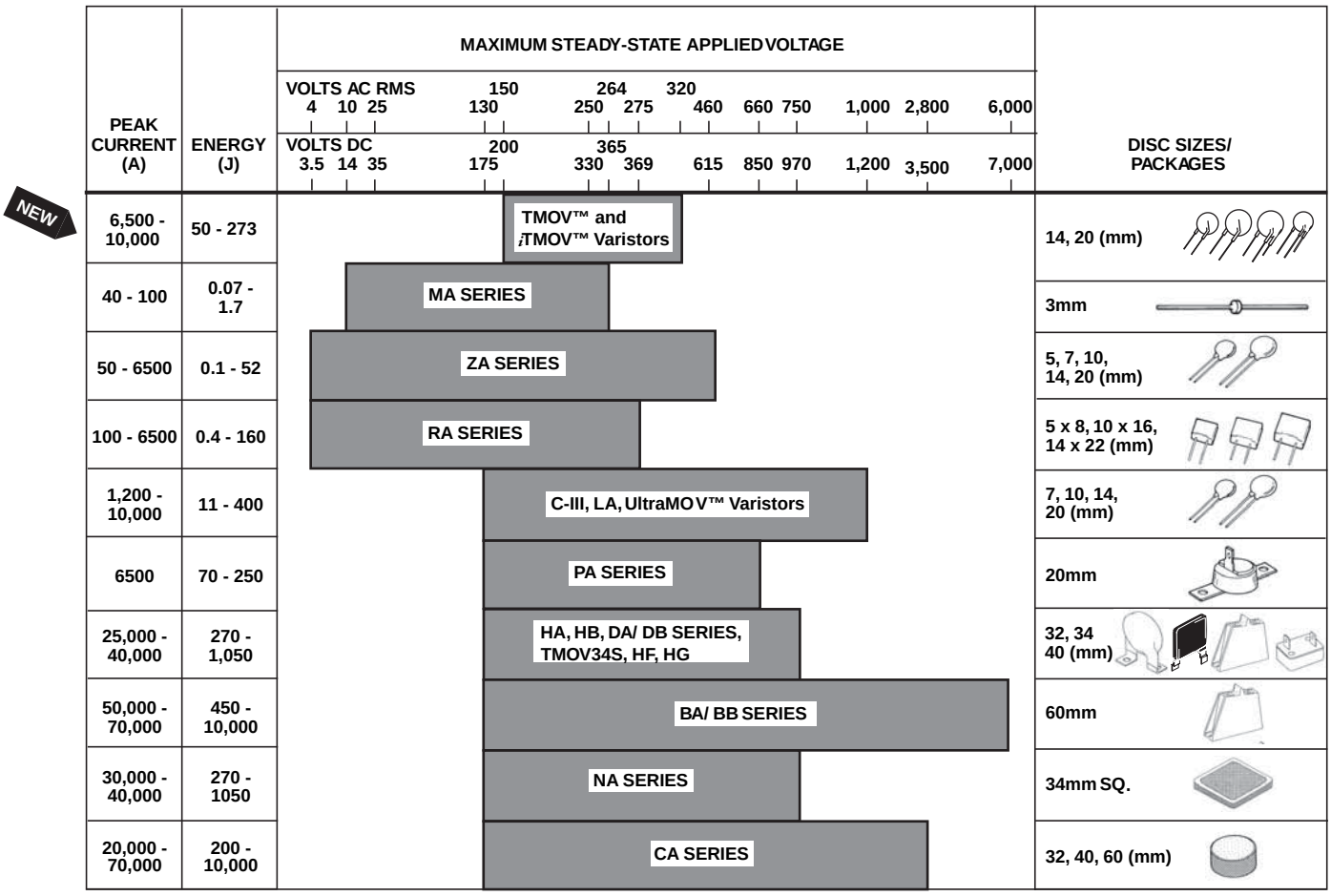


FIGURE 2. VARISTOR PRODUCT FAMILY SELECTION GUIDE

TMOV® and *i*TMOV® Varistor Series

The Littelfuse TMOV and *i*TMOV thermally protected varistors represent a new development in integrated circuit protection (patent pending). 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 over-voltage, limited current, conditions outlined in UL1449.

The *i*TMOV 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 *i*TMOV 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 *i*TMOV varistors are wave solderable, thus simplifying end product assembly by reducing the expense and rework associated with hand soldering operations.

The TMOV and *i*TMOV varistors are both recognized surge suppression components to UL 1449. The TMOV and *i*TMOV 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 *i*TMOV 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
- Three-lead version available for indication purposes.

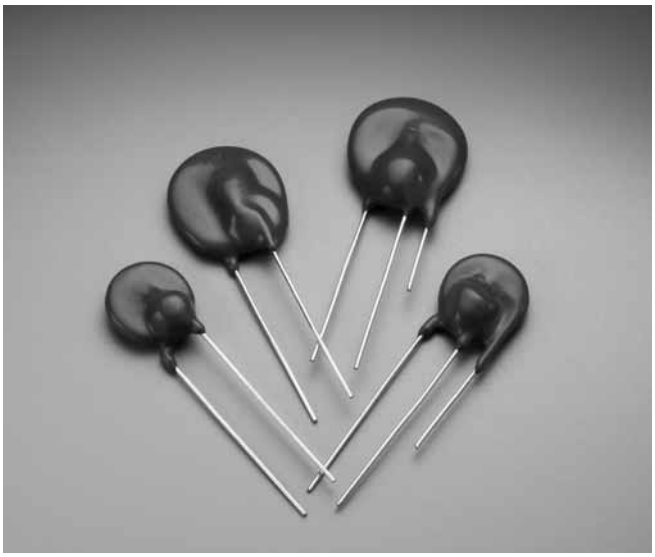
AGENCY APPROVALS:
Documented in UL file E75961. CSA recognized.

20mm Devices-Recognized under the components program of Underwriters Laboratories UL1449 and UL1414. Includes selected tests from UL1020, regarding thermal cutoffs for devices with voltage ratings up to 420VAC.

14mm Devices-Devices are approved as an MOV to UL1449 and UL1414. Approval to selected UL1020 requirements pending. Devices (14mm and 20mm) with ratings greater than 420VAC are not affected by these abnormal voltage conditions.

Accelerated Aging Testing-14 and 20mm devices comply with Acclerated Aging Test requirements per. ANSI/IEEE C62.11 and may be used in secondary surge arrestors without repeating this test.

AGENCY FILE NUMBERS: ULE56529 (UL1414)
ULE75961 (UL1449)
CSA LR91788



Applications

- TVSS Products
- AC Panel Protection Modules
- AC Line Power Supplies
- Surge Protected Strip Connectors
- AC Power Meters
- Relocatable AC Power Taps
- GFCI (Ground Fault Current Interupter)
- UPS (Uninterruptable Power Supply)
- White Goods
- Plug-in TVSS
- Inverters
- AC/DC Power Supplies

TMOV® and *i*TMOV® Varistor Series

TMOV and iTMOV Varistor Series - Absolute Maximum Ratings

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

	TMOV / iTMOV Varistor	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	115 to 750	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8x20µs Current Wave, single pulse	6000 to 10,000	A
Single-Pulse Energy Capability		
For 2ms Current Wave	35 to 480	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
Thermal Protection Isolation Voltage Capability (when operated)	600	V
Insulation Resistance	1,000	MΩ
Indicator Lead Rating (Lead-3 - iTMOV varistor only):		
Continuous RMS current	100	mA
Surge Current, 8/20µs	10,000	A

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 BRAND-ING	DISC DIA-METER	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	SUPPRESSED VOLTAGE RATING	ENERGY 2ms	PEAK SURGE CURRENT 8/20µs						
			$V_{M(AC)RMS}$	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
		(mm)	(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
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
TMOV14R200E	4T200E	14	200	700	75	6000	4500	281	344	530	50	630
TMOV20R200E	20T200E	20	200	700	154	10000	6500	281	344	530	100	1250
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
TMOV14R300E	4T300E	14	300	900	125	6000	4500	423	517	775	50	400
TMOV20R300E	20T300E	20	300	900	250	10000	6500	423	517	775	100	800

NOTE: For 14mm devices with a voltage rating greater than 420V, please contact factory regarding availability.

TMOV® and *i*TMOV® Varistor Series

Device Ratings and Specifications - TMOV Varistor Series continued...

PART NUMBER	DEVICE MODEL NUMBER BRANDING	DISC DIA-METER	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	SUPPRESSED VOLTAGE RATING	ENERGY 2ms	PEAK SURGE CURRENT 8/20μs						
			$V_{M(AC)RMS}$	UL 1449 TABLE 60.1	WTM	I_{TM} 1 x PULSE	I_{TM} 2 x PULSE	$V_{N(DC)}$ MIN	$V_{N(DC)}$ MAX	V_C	I_{PK}	C
		(mm)	(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
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
TMOV20R460E	20T460E	20	460	n/a	360	10000	6500	675	825	1240	100	200
TMOV20R510E	20T510E	20	510	n/a	325	10000	6500	738	902	1355	100	350
TMOV20R550E	20T550E	20	550	n/a	360	10000	6500	819	1001	1500	100	300
TMOV20R575E	20T575E	20	575	n/a	375	10000	6500	856	1047	1568	100	275
TMOV20R625E	20T625E	20	625	n/a	400	10000	6500	900	1100	1650	100	250
TMOV20R750E	20T750E	20	750	n/a	480	10000	6500	1080	1320	1980	100	175

NOTE: For 14mm devices with a voltage rating greater than 420V, please contact factory regarding availability.

Device Ratings and Specifications - *i*TMOV Varistor Series

PART NUMBER	DEVICE MODEL NUMBER BRAND-ING	DISC DIA-METER	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	SUPPRESSED VOLTAGE RATING	ENERGY 2ms	PEAK SURGE CURRENT 8/20μs						
			$V_{M(AC)RMS}$	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
		(mm)	(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
TMOV14R115M	4T115M	14	115	300	35	6000	4500	162	198	300	50	1100
TMOV20R115M	20T115M	20	115	300	52	10000	6500	162	198	300	100	2400
TMOV14R130M	4T130M	14	130	400	50	6000	4500	184	226	340	50	1000
TMOV20R130M	20T130M	20	130	400	100	10000	6500	184	226	340	100	1900
TMOV14R140M	4T140M	14	140	500	55	6000	4500	200	240	360	50	900
TMOV20R140M	20T140M	20	140	400	110	10000	6500	200	240	360	100	1750
TMOV14R150M	4T150M	14	150	500	60	6000	4500	216	264	395	50	800
TMOV20R150M	20T150M	20	150	400	120	10000	6500	216	264	395	100	1600
TMOV14R175M	4T175M	14	175	700	70	6000	4500	243	297	455	50	700
TMOV20R175M	20T175M	20	175	700	135	10000	6500	243	297	455	100	1400
TMOV14R200M	4T200M	14	200	700	75	6000	4500	281	344	530	50	630
TMOV20R200M	20T200M	20	200	700	154	10000	6500	281	344	530	100	1250
TMOV14R230M	4T230M	14	230	700	80	6000	4500	324	396	595	50	550
TMOV20R230M	20T230M	20	230	700	160	10000	6500	324	396	595	100	1100
TMOV14R250M	4T250M	14	250	800	100	6000	4500	351	429	650	50	500
TMOV20R250M	20T250M	20	250	700	170	10000	6500	351	429	650	100	1000
TMOV14R275M	4T275M	14	275	900	110	6000	4500	387	473	710	50	450
TMOV20R275M	20T275M	20	275	700	190	10000	6500	387	473	710	100	900
TMOV14R300M	4T300M	14	300	900	125	6000	4500	423	517	775	50	400
TMOV20R300M	20T300M	20	300	900	250	10000	6500	423	517	775	100	800

NOTE: For 14mm devices with a voltage rating greater than 420V, please contact factory regarding availability.

TMOV® and *i*TMOV® Varistor Series

Device Ratings and Specifications - *i*TMOV Varistor Series continued...

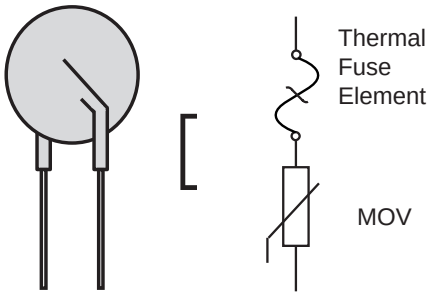
PART NUMBER	DEVICE MODEL NUMBER BRAND-ING	DISC DIA-METER	MAXIMUM RATING (85°C)					SPECIFICATIONS (25°C)				
			CONTINUOUS	TRANSIENT								
			AC VOLTS	SUPPRESSED VOLTAGE RATING	ENERGY 2ms	PEAK SURGE CURRENT 8/20µs		VARISTOR VOLTAGE AT 1mA TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8/20µs		TYPICAL CAPACI-TANCE f = 1MHz
			$V_{M(AC)RMS}$	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
		(mm)	(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
TMOV14R320M	4T320M	14	320	900	136	6000	4500	459	561	840	50	380
TMOV20R320M	20T320M	20	320	900	273	10000	6500	459	561	840	100	750
TMOV14R385M	4T385M	14	385	1200	150	6000	4500	558	682	1025	50	360
TMOV20R385M	20T385M	20	385	1200	300	10000	6500	558	682	1025	100	700
TMOV14R420M	4T420M	14	420	1200	160	6000	4500	612	748	1120	50	300
TMOV20R420M	20T420M	20	420	1200	320	10000	6500	612	748	1120	100	600
TMOV20R460M	20T460M	20	460	n/a	360	10000	6500	675	825	1240	100	200
TMOV20R510M	20T510M	20	510	n/a	325	10000	6500	738	902	1355	100	350
TMOV20R550M	20T550M	20	550	n/a	360	10000	6500	819	1001	1500	100	300
TMOV20R575M	20T575M	20	575	n/a	375	10000	6500	856	1047	1568	100	275
TMOV20R625M	20T625M	20	625	n/a	400	10000	6500	900	1100	1650	100	250
TMOV20R750M	20T750M	20	750	n/a	480	10000	6500	1080	1320	1980	100	175

NOTE: For 14mm devices with a voltage rating greater than 420V, please contact factory regarding availability.

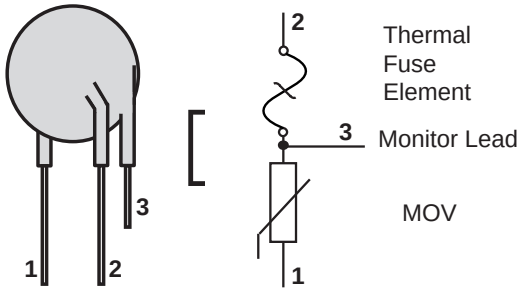
TMOV® and *i*TMOV® Varistor Series

Lead Configurations

TMOV Varistor



*i*TMOV Varistor



Note: MOVs are non-polarized passive elements

*i*TMOV Varistor Application Examples

The application examples below show how the indicator lead on the *i*TMOV 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 *i*TMOV varistor and the indicating or alarm circuitry.

Application Example 3 (Figure 3)

This circuit illustrates the use of the monitoring lead of the *i*TMOV 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 *i*TMOV varistor. In the event of the thermal element being activated, the relay will de-activate, 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.

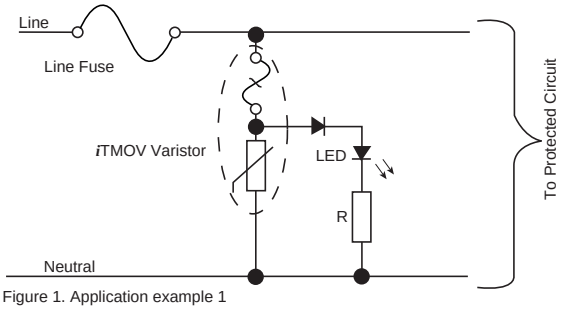


Figure 1. Application example 1

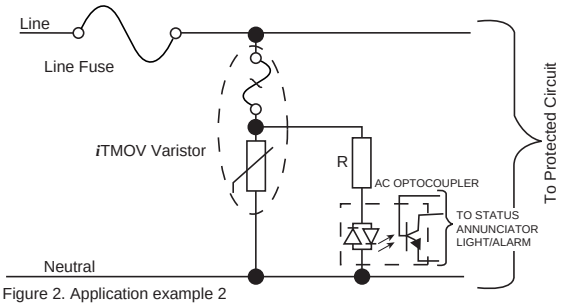


Figure 2. Application example 2

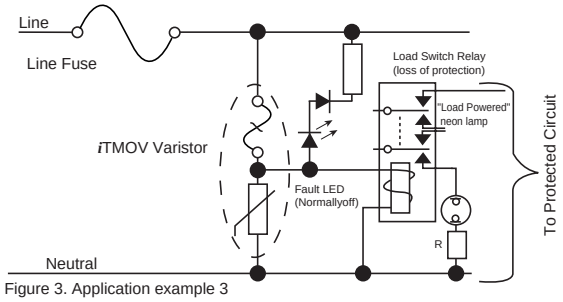
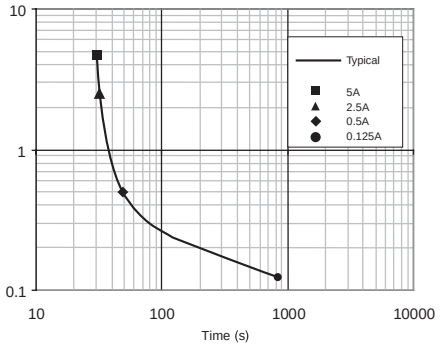


Figure 3. Application example 3

TMOV® and *i*TMOV® Varistor Series

Thermal Characteristics



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

Note : The TMOV and *i*TMOV varistors are intended, in conjunction with appropriate enclosure design, to help facilitate TVSS module compliance to UL 1449, Section 37.4 (abnormal over-voltage limited current requirements). Under these extreme abnormal over-voltage 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.

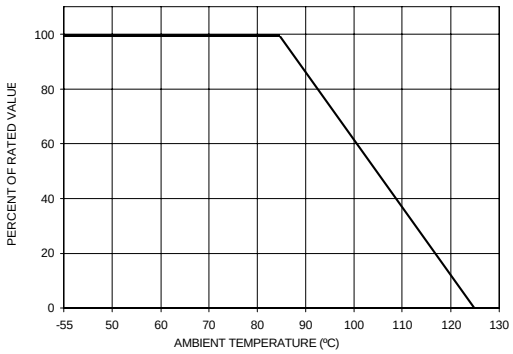


Figure 5: Peak Current & Energy Derating Curve

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

Transient V-I Characteristic Curves

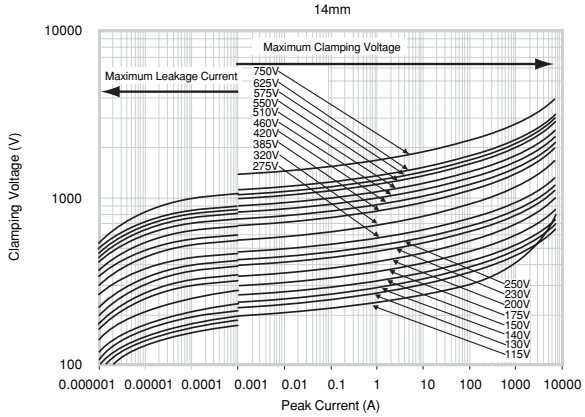


Figure 6: V-I Characteristic Curves for 14mm Types

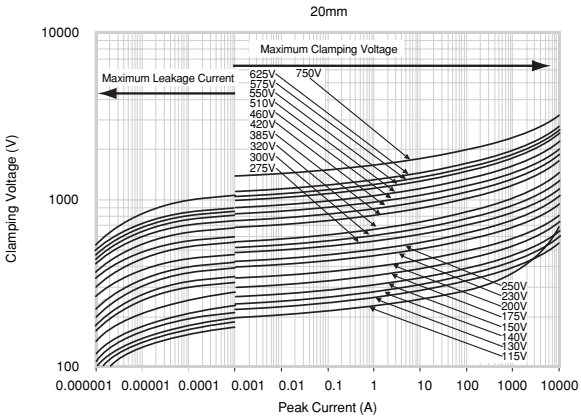


Figure 7: V-I Characteristic Curves for 20mm Types

Pulse Rating Curves

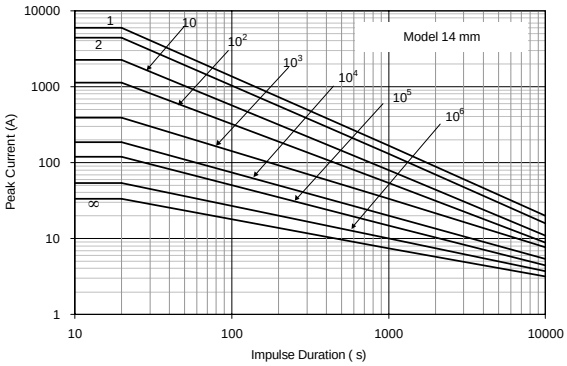


Figure 8: Pulse Rating Curves for 14mm types

NOTE: Average power dissipation of transients should not exceed 0.6W

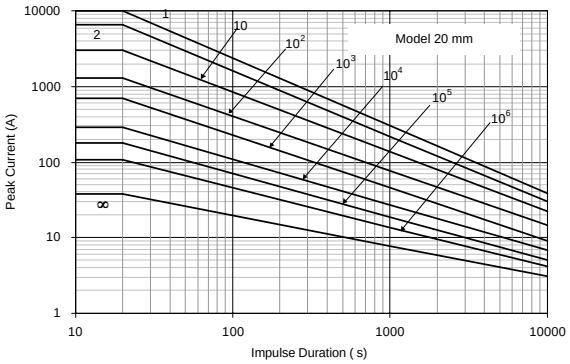


Figure 9: Pulse Rating Curves for 20mm types

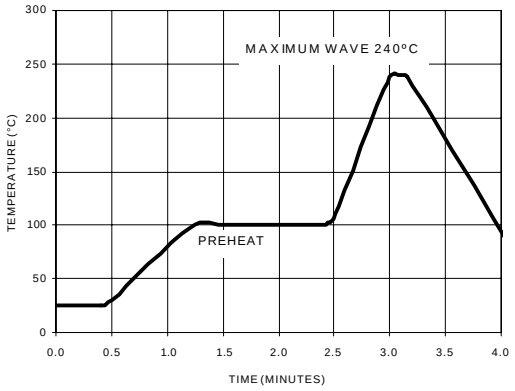
NOTE: Average power dissipation of transients should not exceed 1.0W

TMOV® and *i*TMOV® Varistor Series

Soldering Recommendations

Because the TMOV™ and *i*TMOV 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 heat-sink the leads of the device. Secondly, wave-soldering: It is critically important that all preheat stage and the solder bath temperatures are rigidly controlled. The recommended solder for the TMOV and *i*TMOV 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.

Figure 10: Wave Solder Profile



Ordering Information

Standard Parts

TMOV 20 R 150 E

DEVICE FAMILY
Littelfuse Thermally Protected MOV

DISC DIAMETER (mm)
14 or 20mm

CERAMIC SHAPE
R: Round

$V_{M(AC)RMS}$
115V to 420V

Series Designator
E: 2- Leaded TMOV Varistor Series Supplied in Bulk Pack with 7.5mm lead spacing.
M: 3-Leaded *i*TMOV Varistor Series Supplied in Bulk Pack with 7.5mm lead spacing (between leads 1 & 2)
(Available in 20mm only)

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
- Leads not in-line except parts > 420 V. See table on page 34.

Additional Options

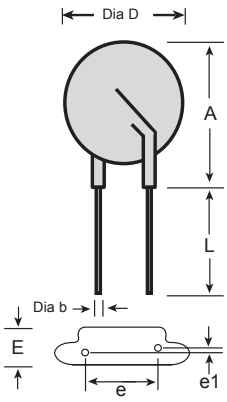
Tape and Reel
- Add suffix L2T7 to the end of standard part number (ex. TMOV20R150EL2T7)
- Tape and Reeled parts have in-line, crimped leads. This excludes the varistor lead on *i*TMOV devices which are not crimped and not in-line. See drawings on page 35.

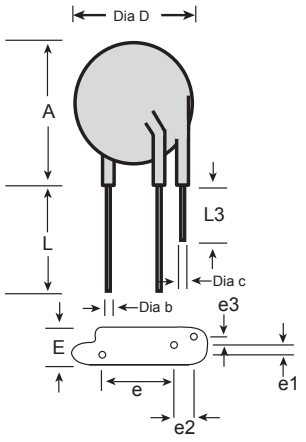
Alternative Leadstyles:
- Contact factory for details

TMOV® and *i*TMOV® Varistor Series

General Dimensions, Bulk Pack Non-Crimped Devices

SYMBOL	Vrms Model Voltage	TMOV Varistor Model Size 14mm MIN mm (in)	TMOV Varistor Model Size 14mm MAX mm (in)	TMOV Varistor Model Size 20mm MIN mm (in)	TMOV Varistor Model Size 20mm MAX mm (in)	iTMOV Varistor Model Size 14mm MIN mm (in)	iTMOV Varistor Model Size 14mm MAX mm (in)	iTMOV Varistor Model Size 20mm MIN mm (in)	iTMOV Varistor Model Size 20mm MAX mm (in)
A	ALL	17.0 (0.669)	22.0 (0.866)	23.0 (0.906)	28.0 (1.10)	17.0 (0.669)	22.0 (0.866)	23.0 (0.906)	28.0 (1.10)
Dia D	ALL	13.5 (0.531)	17.0 (0.669)	19.0 (0.748)	23.0 (0.906)	13.5 (0.531)	17.0 (0.669)	19.0 (0.748)	23.0 (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)	6.5 (0.256)	8.5 (0.335)
e1	115-175	1.5 (0.059)	4.0 (0.157)	1.5 (0.059)	4.0 (0.157)	1.5 (0.059)	4.0 (0.157)	1.5 (0.059)	4.0 (0.157)
	200-420	2.0 (0.079)	6.0 (0.236)	2.0 (0.079)	6.0 (0.236)	2.0 (0.079)	6.0 (0.236)	2.0 (0.079)	6.0 (0.236)
	460-750			0	2.0 (0.079)			0	2.0 (0.079)
e2	ALL					4.0 (0.138)	6.0 (0.236)	4.0 (0.157)	6.0 (0.236)
e3	ALL					0	2.0 (0.079)	0	2.0 (0.079)
E	115-175		9.0 (0.335)		9.0 (0.335)		9.0 (0.335)		9.0 (0.335)
	200-320		9.5 (0.374)		9.5 (0.374)		9.5 (0.374)		9.5 (0.374)
	385-460		11.0 (0.433)		11.0 (0.433)		11.0 (0.433)		11.0 (0.433)
	510-575				12.0 (0.472)				12.0 (0.472)
	625-750				13.0 (0.512)				13.0 (0.512)
L	ALL	25.4 (1.00)		25.4 (1.00)		25.4 (1.00)		25.4 (1.00)	
L3	ALL					6.0 (0.236)		6.0 (0.236)	
Dia b	115-420	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)
	460-750			0.95 (0.037)	1.05 (0.041)			0.95 (0.037)	1.05 (0.041)
Dia c Outside Lead Only	ALL					0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)





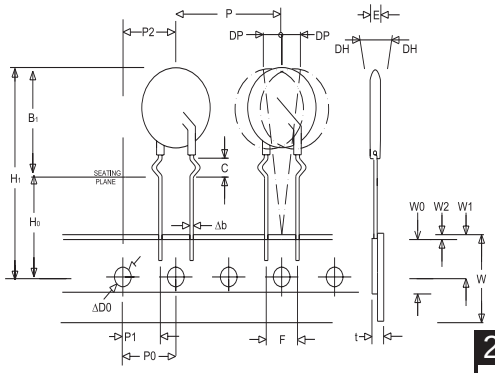
For 14mm ratings above 420 Vrms contact factory for specifications.

TMOV® and *i*TMOV® Varistor Series

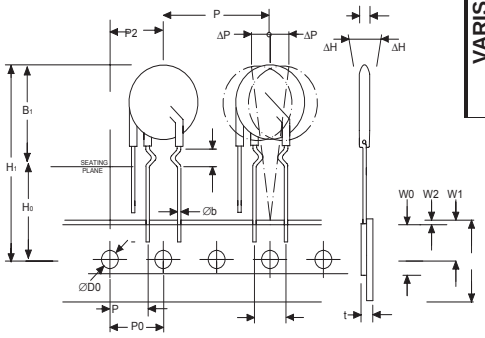
Tape and Reel Specifications - Additional Option L2T7

SYMBOL	PARAMETER	MODEL SIZE	
		14mm	20mm
B_1	Component Top to Seating Plane	22.5 Max	31 Max
P	Pitch of Component	25.4 ± 1.0	25.4 ± .0
P_0	Feed Hole Pitch	12.7 ± 0.2	12.7 ± 0.2
P_1	Feed Hole Center to Pitch	8.95 ± 0.7	8.95 ± 0.7
P_2	Hole Center to Component Center	12.7 ± 0.7	12.7 ± 0.7
F	Lead to Lead Distance	7.5 ± 0.8	7.5 ± 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	12.0 ± 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_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
C	Crimp Length	2.6 typ	2.6 typ
H_O	Seating Plane Height	16.0±0.5	16.0±0.5

Dimensions are in mm.



TMOV varistor with outer crimp



iTMOV varistor with inner crimp

- Reel capacity varies with voltage.
- Leads are crimped and in-line. This excludes the varistor lead on *i*TMOV devices which are not crimped and not in-line.
- To order tape and reel option please add suffix L2T7 to end of standard part number.
- Tape and Reel option is available for rated voltages up to 420volts. Contact factory regarding availability of higher voltages.

Contact Littelfuse for additional details.

Pack Quantities

Rated Voltage	Pack Quantities			
	Bulk Pack		Tape and Reel	
	Model Size		Model Size	
	14mm	20mm	14mm	20mm
115-250	600	400	500	400
275-550	500	300	400	300
575-750	400	200	n/a	n/a

NOTE: Tape and Reel available up to 420V only - please contact factory regarding availability of higher voltage parts.

UltraMOV™ Varistor Series

The UltraMOV Metal Oxide Varistor Series is designed for applications requiring high peak surge current ratings and high energy absorption capability. UltraMOV varistors are primarily intended for use in AC Line Voltage applications such as Transient Voltage Surge Suppressors (TVSS), Uninterruptable Power Supplies (UPS), AC Power Taps, AC Power Meters, or other products that require voltage clamping of high transient surge currents from sources such as lightning, inductive load switching, or capacitor bank switching.

These devices are produced in radial lead package sizes of 7, 10, 14, and 20mm and offered in a variety of lead forms. UltraMOVs are manufactured with recognized epoxy encapsulation and are rated for ambient temperatures up to 85°C with no derating. This Series is LASER-branded and is supplied in bulk, ammo pack (fan-fold), or tape and reel packaging.

Features

- High Peak Surge Current Rating (I_{TM}) Up to 10kA, Single 8 x 20 Pulse, (20mm)
- Standard Operating Voltage Range Compatible with Common AC Line Voltages (130VAC to 625VAC)
- Characterized for Maximum Standby Current (Leakage)
- Custom Voltage Types Available
- Standard Lead Form and Lead Space Options

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA, VDE and CECC.

AGENCY FILE NUMBERS: UL E75961, CSA LR91788, VDE 116895E, CECC 42201-006.

UltraMOV™ Varistor Series

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

	ULTRAMOV VARISTOR	UNITS
Continuous:		
Steady State AC Voltage Range ($V_{M(AC)RMS}$)	130 to 625V	V
Transient:		
Single-Pulse Peak Current (I_{TM}) 8x20µs Wave (See Figure 2)	1,750 to 10,000	A
Single-Pulse Energy Range (W_{TM}) 2ms Square Wave	12.5 to 400	J
Maximum Temporary Overvoltage of $V_{M(AC)}$		
5 Minutes at 25°C	130	%
5 Minutes at 125°C	125	%
Operating Ambient Temperature Range (T_A)	-55 to 85	°C
Storage Temperature Range (T_{STG})	-55 to125	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/°C
Hi-Pot Encapsulation Isolation Voltage Capability, Per MIL-STD-202, Method 301	2500	V

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.

NOTE: 2MS SQ Wave Us. 100x1000 exponential condition for Ultra CIII, LA, TA and FCTC.

Device Ratings and Specifications

MODEL NUMBER	DEVICE MODEL NUMBER BRANDING	MAXIMUM RATING (85°C)					SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT			VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20 µs		TYPICAL CAPACI-TANCE
		RMS VOLTS	DC VOLTS	ENERGY 2ms	PEAK CURRENT 8 x 20µs						
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM} 1 x PULSE	I_{TM} 2 x PULSE	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	f = 1MHz
		(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
V07E130	7V130	130	170	12.5	1750	1200	184	226	340	10	180
V10E130	10V130	130	170	25	3500	2500	184	226	340	25	450
V14E130	14V130	130	170	50	6000	4500	184	226	340	50	1000
V20E130	20V130	130	170	100	10000	6500	184	226	340	100	1900
V07E140	7V140	140	180	13.5	1750	1200	200	240	360	10	160
V10E140	10V140	140	180	27.5	3500	2500	200	240	360	25	400
V14E140	14V140	140	180	55	6000	4500	200	240	360	50	900
V20E140	20V140	140	180	110	10000	6500	200	240	360	100	1750
V07E150	7V150	150	200	15	1750	1200	216	264	395	10	150
V10E150	10V150	150	200	30	3500	2500	216	264	395	25	360
V14E150	14V150	150	200	60	6000	4500	216	264	395	50	800
V20E150	20V150	150	200	120	10000	6500	216	264	395	100	1600
V07E175	7V175	175	225	17	1750	1200	243	297	455	10	130
V10E175	10V175	175	225	35	3500	2500	243	297	455	25	350
V14E175	14V175	175	225	70	6000	4500	243	297	455	50	700
V20E175	20V175	175	225	135	10000	6500	243	297	455	100	1400
V07E230	7V230	230	300	20	1750	1200	324	396	595	10	100
V10E230	10V230	230	300	42	3500	2500	324	396	595	25	250
V14E230	14V230	230	300	80	6000	4500	324	396	595	50	550
V20E230	20V230	230	300	160	10000	6500	324	396	595	100	1100

UltraMOV™ Varistor Series

Device Ratings and Specifications (Continued)

MODEL NUMBER	DEVICE MODEL NUMBER BRANDING	MAXIMUM RATING (85°C)					SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT			VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20 µs		TYPICAL CAPACI-TANCE
		RMS VOLTS	DC VOLTS	ENERGY 2ms	PEAK CURRENT 8 x 20 µs						
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM} 1 x PULSE	I_{TM} 2 x PULSE	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	f = 1MHz
		(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
V07E250	7V250	250	320	25	1750	1200	351	429	650	10	90
V10E250	10V250	250	320	50	3500	2500	351	429	650	25	220
V14E250	14V250	250	320	100	6000	4500	351	429	650	50	500
V20E250	20V250	250	320	170	10000	6500	351	429	650	100	1000
V07E275	7V275	275	350	28	1750	1200	387	473	710	10	80
V10E275	10V275	275	350	55	3500	2500	387	473	710	25	200
V14E275	14V275	275	350	110	6000	4500	387	473	710	50	450
V20E275	20V275	275	350	190	10000	6500	387	473	710	100	900
V07E300	7V300	300	385	30	1750	1200	423	517	775	10	70
V10E300	10V300	300	385	60	3500	2500	423	517	775	25	180
V14E300	14V300	300	385	125	6000	4500	423	517	775	50	400
V20E300	20V300	300	385	250	10000	6500	423	517	775	100	800
V07E320	7V320	320	420	32	1750	1200	459	561	840	10	65
V10E320	10V320	320	420	67	3500	2500	459	561	840	25	170
V14E320	14V320	320	420	136	6000	4500	459	561	840	50	380
V20E320	20V320	320	420	273	10000	6500	459	561	840	100	750
V07E385	7V385	385	505	36	1750	1200	558	682	1025	10	60
V10E385	10V385	385	505	75	3500	2500	558	682	1025	25	160
V14E385	14V385	385	505	150	6000	4500	558	682	1025	50	360
V20E385	20V385	385	505	300	10000	6500	558	682	1025	100	700
V07E420	7V420	420	560	40	1750	1200	612	748	1120	10	55
V10E420	10V420	420	560	80	3500	2500	612	748	1120	25	140
V14E420	14V420	420	560	160	6000	4500	612	748	1120	50	300
V20E420	20V420	420	560	320	10000	6500	612	748	1120	100	600
V07E440	7V440	440	585	44	1750	1200	643	787	1180	10	50
V10E440	10V440	440	585	85	3500	2500	643	787	1180	25	130
V14E440	14V440	440	585	170	6000	4500	643	787	1180	50	260
V20E440	20V440	440	585	340	10000	6500	643	787	1180	100	500
V07E460	7V460	460	615	48	1750	1200	675	825	1240	10	45
V10E460	10V460	460	615	90	3500	2500	675	825	1240	25	120
V14E460	14V460	460	615	180	6000	4500	675	825	1240	50	220
V20E460	20V460	460	615	360	10000	6500	675	825	1240	100	400
V10E510	10V510	510	670	80	3500	2500	738	902	1355	25	110
V14E510	14V510	510	670	165	6000	4500	738	902	1355	50	200
V20E510	20V510	510	670	325	10000	6500	738	902	1355	100	350

UltraMOV™ Varistor Series

Device Ratings and Specifications (Continued)

MODEL NUMBER	DEVICE MODEL NUMBER BRANDING	MAXIMUM RATING (85°C)					SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT			VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20 µs		TYPICAL CAPACI-TANCE
		RMS VOLTS	DC VOLTS	ENERGY 2ms	PEAK CURRENT 8 x 20 µs						
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM} 1 x PULSE	I_{TM} 2 x PULSE	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	f = 1MHz
		(V)	(V)	(J)	(A)	(A)	(V)		(V)	(A)	(pF)
V10E550	10V550	550	745	90	3500	2500	819	1001	1500	25	100
V14E550	14V550	550	745	180	6000	4500	819	1001	1500	50	180
V20E550	20V550	550	745	360	10000	6500	819	1001	1500	100	300
V10E625	10V625	625	825	100	3500	2500	900	1100	1650	25	90
V14E625	14V625	625	825	200	6000	4500	900	1100	1650	50	160
V20E625	20V625	625	825	400	10000	6500	900	1100	1650	100	250

NOTE:

1. Average power dissipation of transients should not exceed 0.25W, 0.4W, 0.6W and 1.0W for 7mm, 10mm, 14mm, and 20mm model sizes, respectively.

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

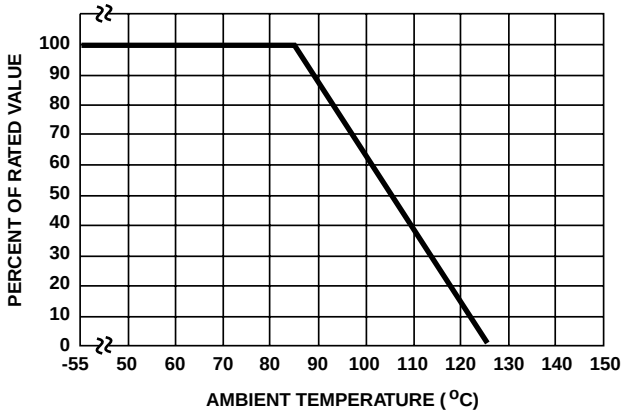
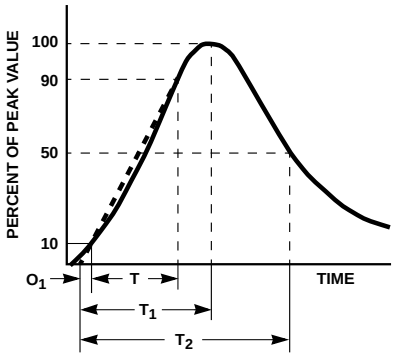


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20µs Current Waveform:
8µs = T_1 = Virtual Front Time
20µs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

UltraMOV™ Varistor Series

Transient V-I Characteristic Curves

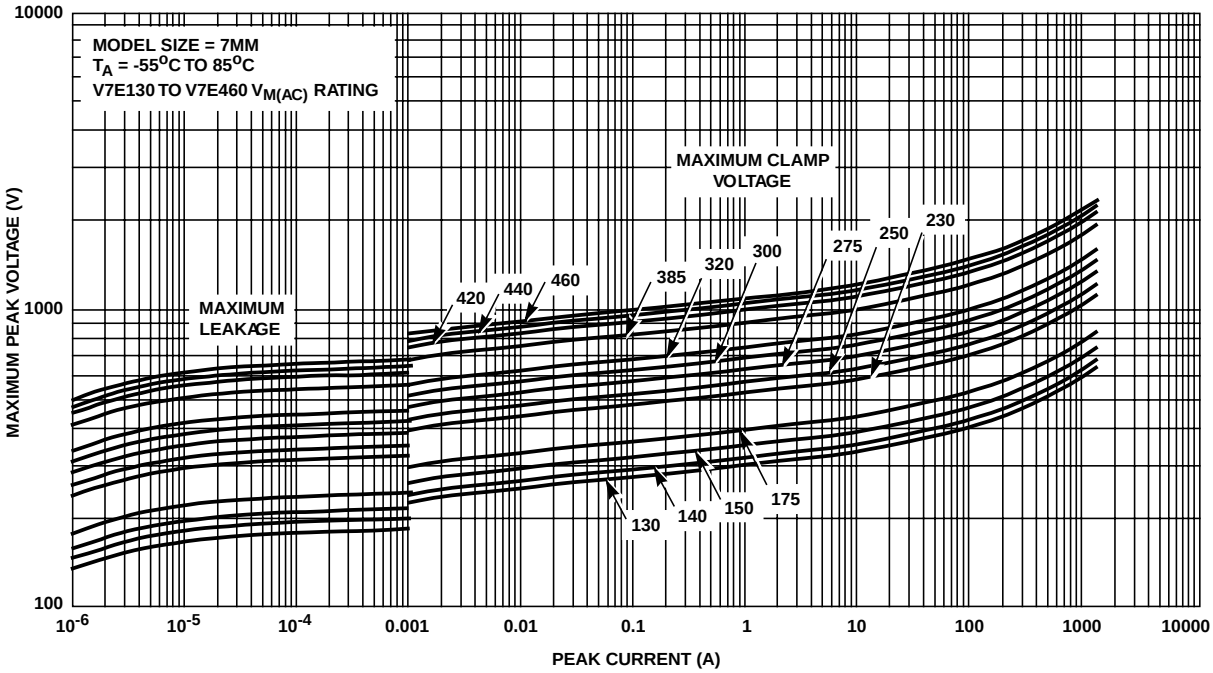


FIGURE 3. Clamping Voltage for V7E130- V7E460

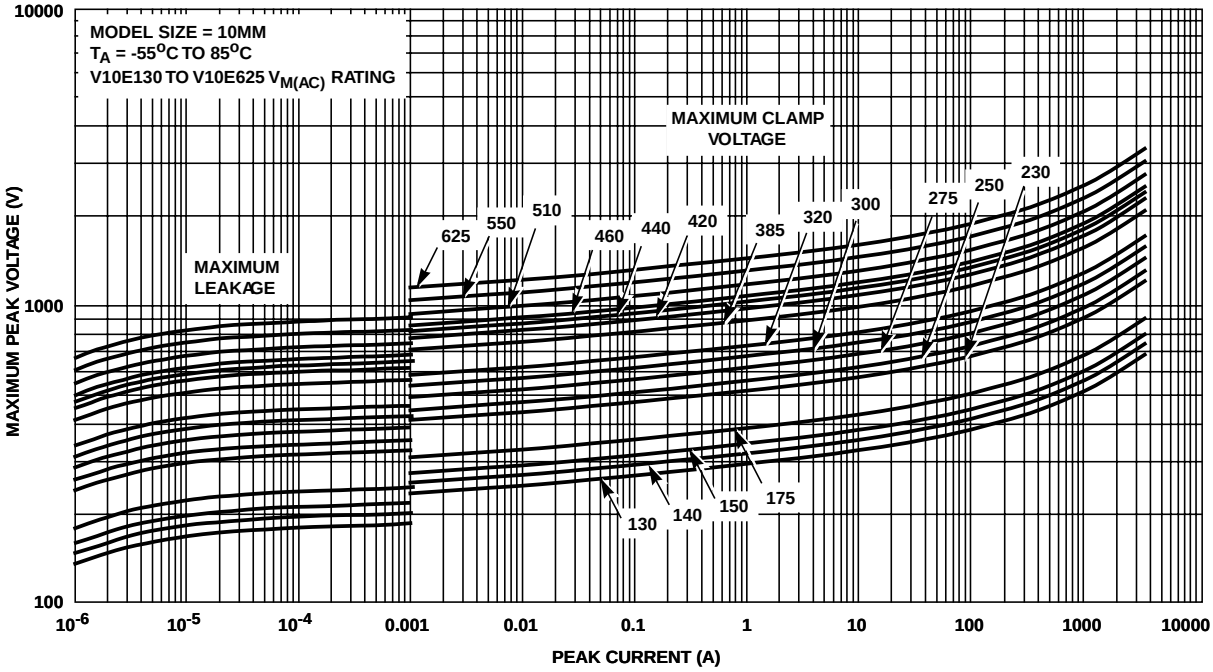


FIGURE 4. Clamping Voltage for VI10E130- V10E625

UltraMOV™ Varistor Series

Transient V-I Characteristic Curves (Continued)

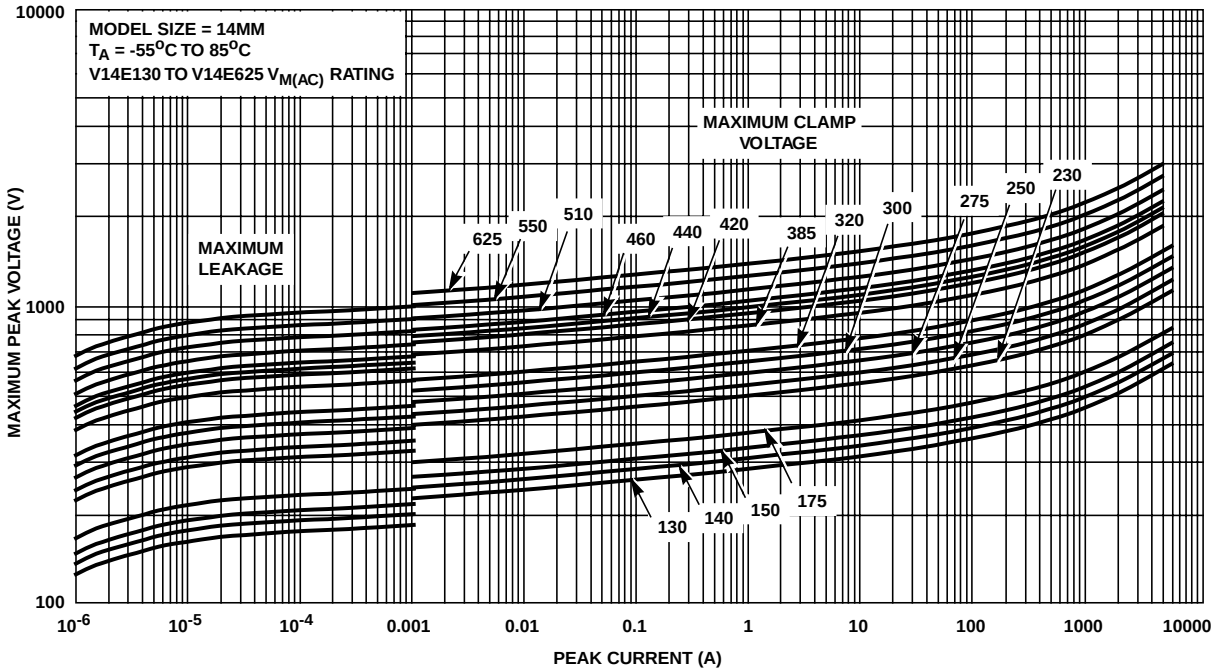


FIGURE 5. Clamping Voltage V14E130 - V14E625

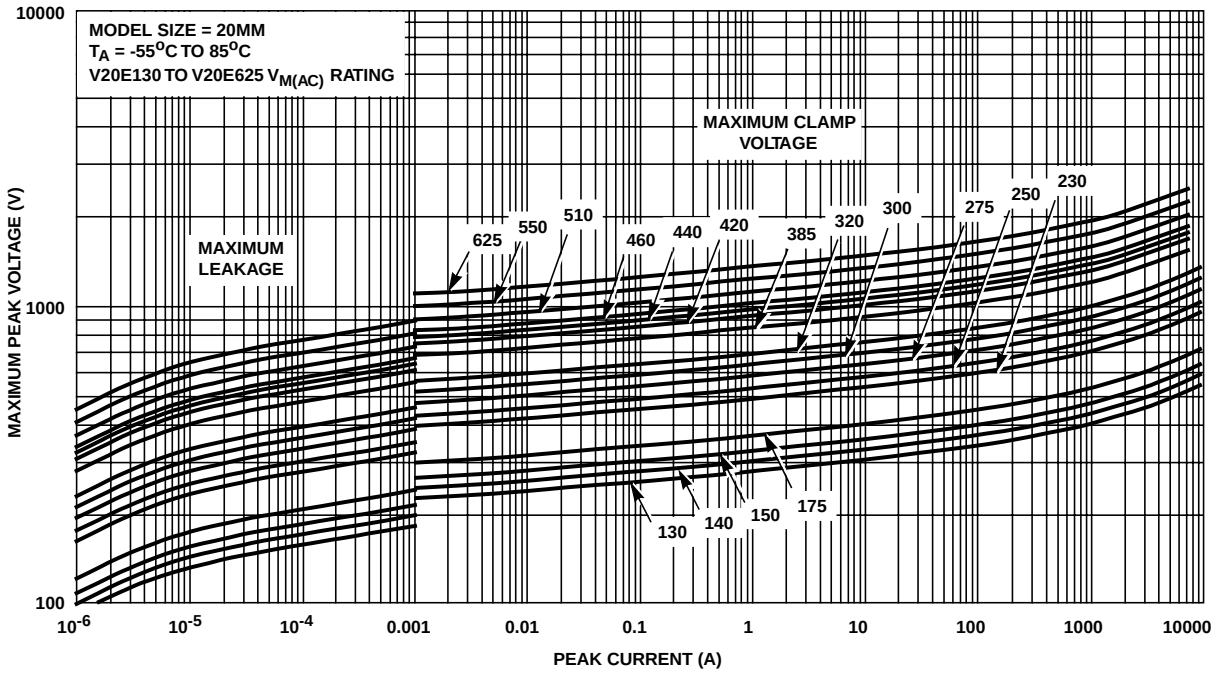


FIGURE 6. Clamping Voltage V20E130 - V20E625

UltraMOV™ Varistor Series

Pulse Rating Curves

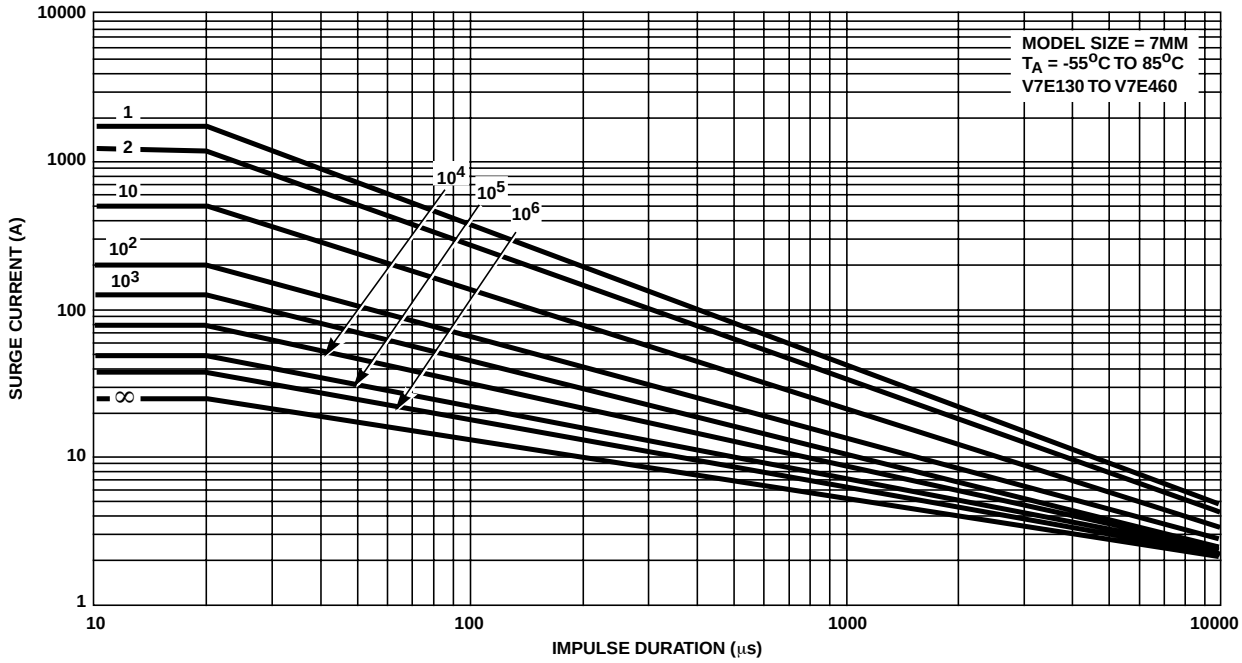


FIGURE 7. Clamping Voltage for V7E130 - V7E460

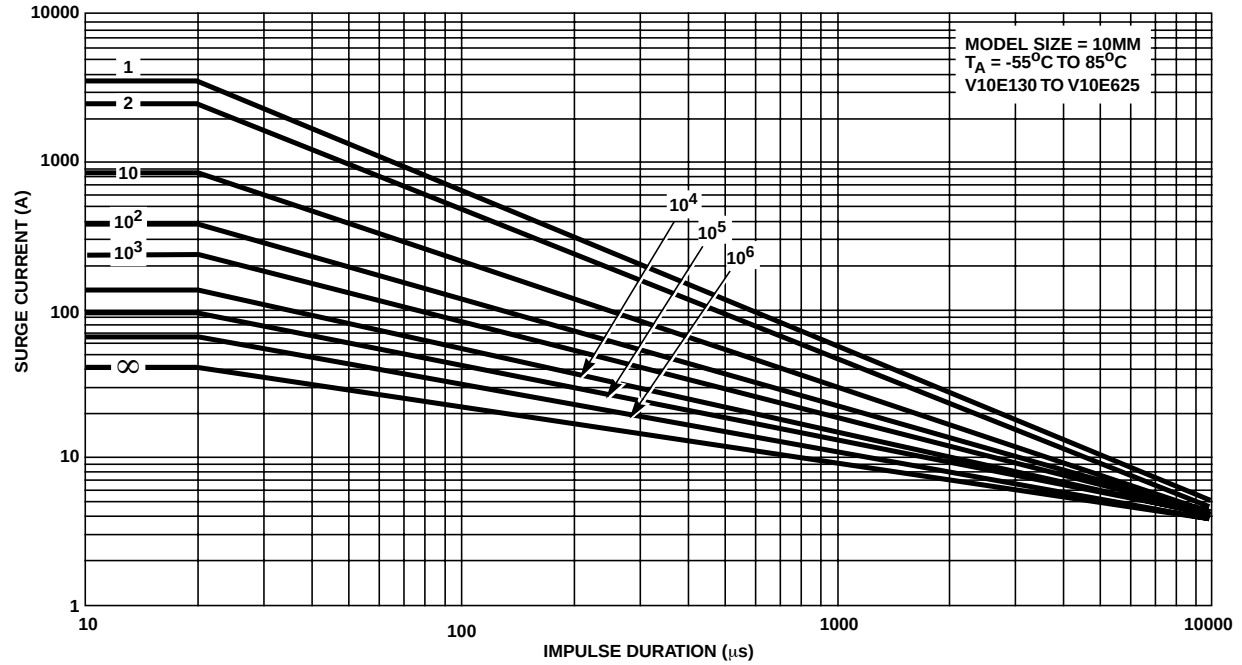


FIGURE 8. Clamping Voltage for V10E130 - VIOE625

UltraMOV™ Varistor Series

Pulse Rating Curves (Continued)

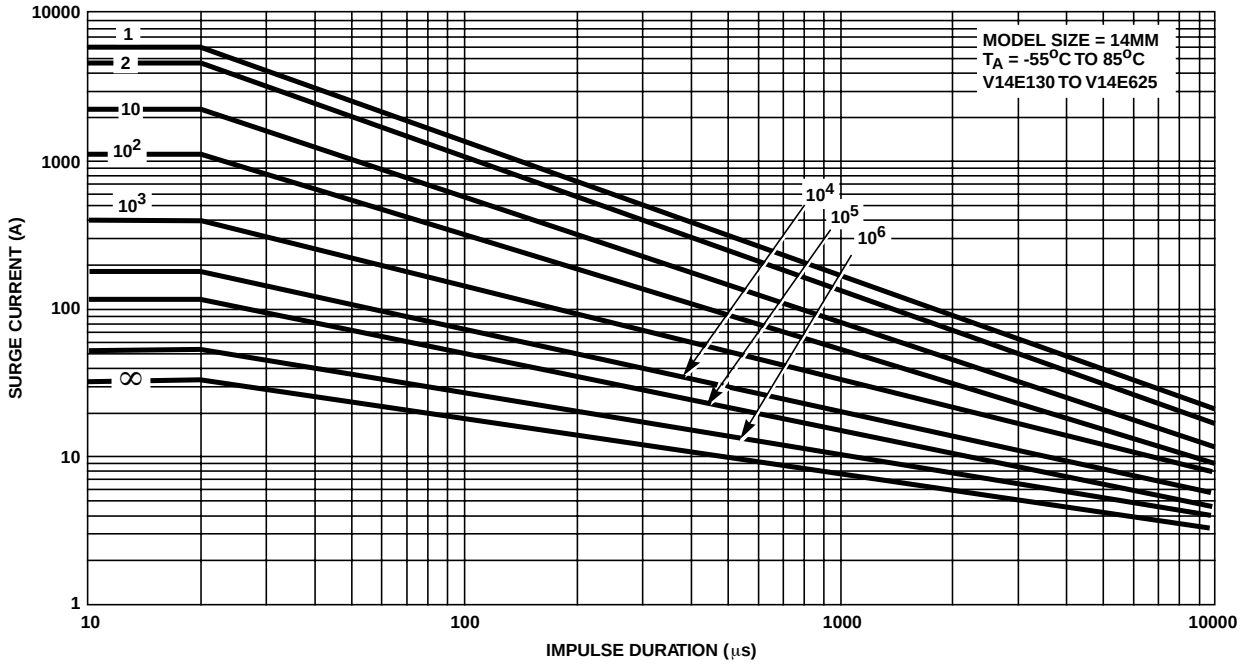


FIGURE 9. Clamping Voltage for V14E130 -Vi4E625

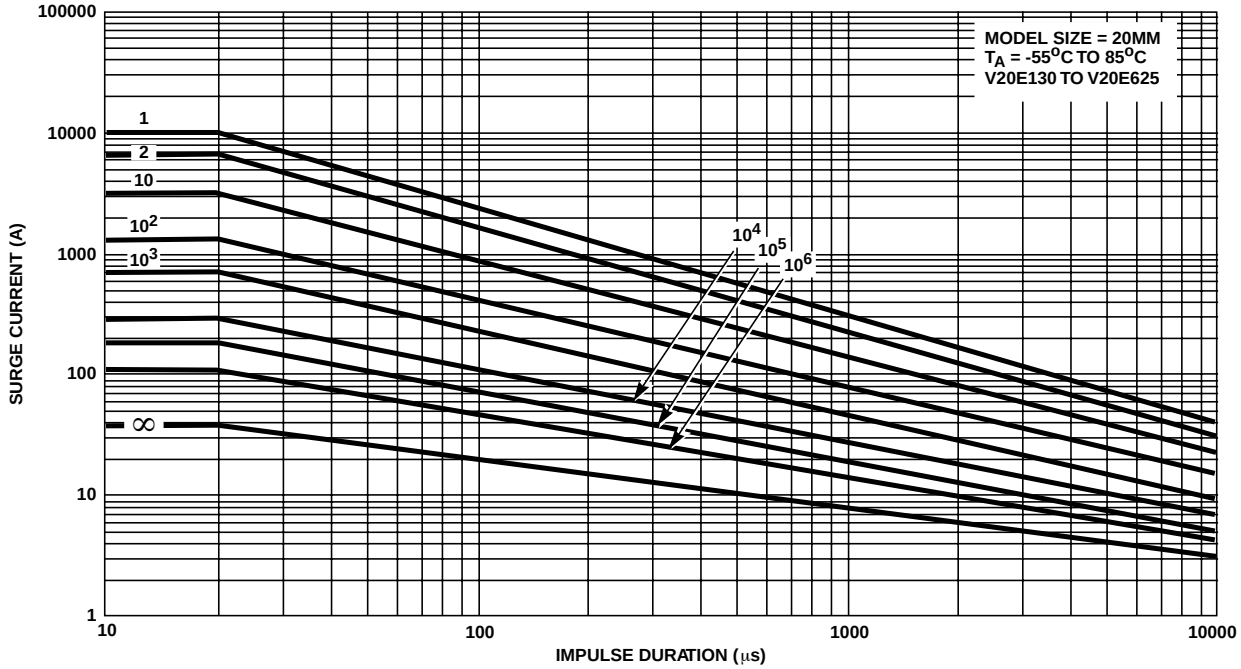
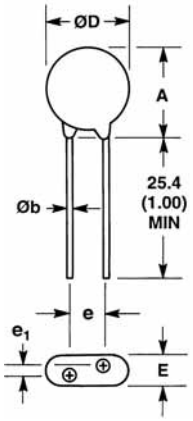


FIGURE 10. Clamping Voltage forV20E130 -V20E625

UltraMOV™ Varistor Series

Package Outline Dimensions *(Lead Form Options L1 and L3)*

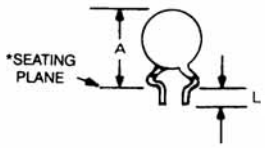


SYMBOL	V_{RMS} VOLTAGE MODEL	VARISTOR MODEL SIZE							
		7mm		10mm		14mm		20mm	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	130-320	-	12 (0.472)	-	16 (0.630)	-	20 (0.787)	-	26.5 (1.043)
	385-625	-	13 (0.512)	-	17 (0.689)	-	20.5 (0.807)	-	28 (1.102)
ØD	All	-	9 (0.354)	-	12.5 (0.492)	-	17 (0.669)	-	23 (0.906)
e (Note 2)	All	4 (0.157)	6 (0.236)	6.5 (0.256)	8.5 (0.335)	6.5 (0.256)	8.5 (0.335)	9 (0.354)	11 (0.433)
e_1 (Note 3)	130-320	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)
	385-625	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)
E	130-320	-	5.6 (0.220)	-	5.6 (0.220)	-	5.6 (0.220)	-	5.6 (0.220)
	385-625	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)
Øb	All	0.585 (0.023)	0.685 (0.027)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030) (Note 2)	0.86 (0.034) (Note 2)

Dimensions in millimeters, inches in parentheses.
NOTES:

2. Standard lead space.
3. For in-line lead option L3, dimension e_1 is “zero”. Straight lead form option L1 shown.

Lead Dimensions *(Lead Form Options L2 and L4)*



*Seating plane interpretation per IEC-717
(Not available on tape or ammo pack)

SYMBOL	VARISTOR MODEL SIZE							
	7mm		10mm		14mm		20mm	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	- -	15 (0.591)	- -	19.5 (0.768)	- -	22.5 (0.886)	- -	29.0 (1.142)
L (L2)	25.4 (1.00)	- -	25.4 (1.00)	- -	25.4 (1.00)	- -	25.4 (1.00)	- -
*L (L4)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)

Dimensions in millimeters, inches in parentheses.

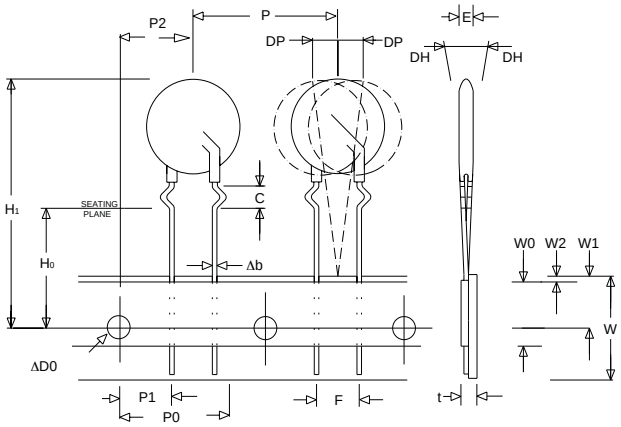
Standard Bulk Pack Quantity

VARISTOR VOLTAGE MODEL	STANDARD BULK PACK QUANTITY			
	VARISTOR MODEL SIZE			
	7mm	10mm	14mm	20mm
130-275	1500	1000	700	500
300-460	1500	700	600	400
510-625	1500	700	500	400

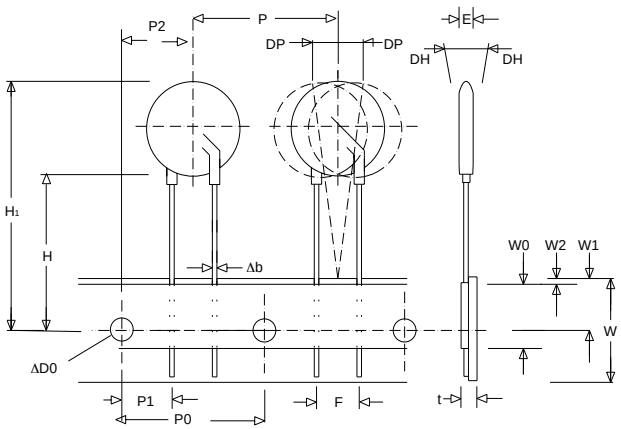
UltraMOV™ Varistor Series

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

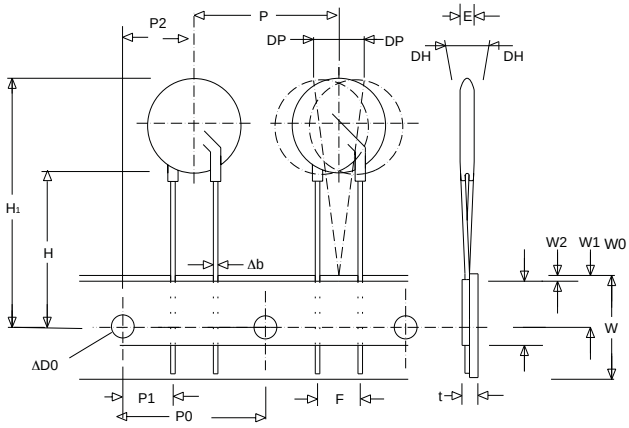
7mm Devices



Crimped Leads "L2"

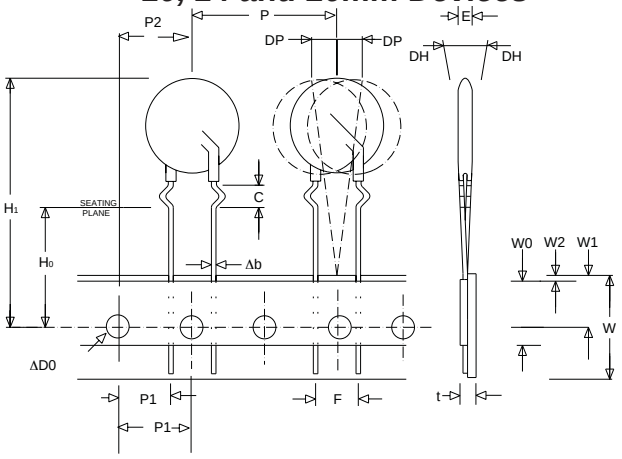


In Line Leads "L3"

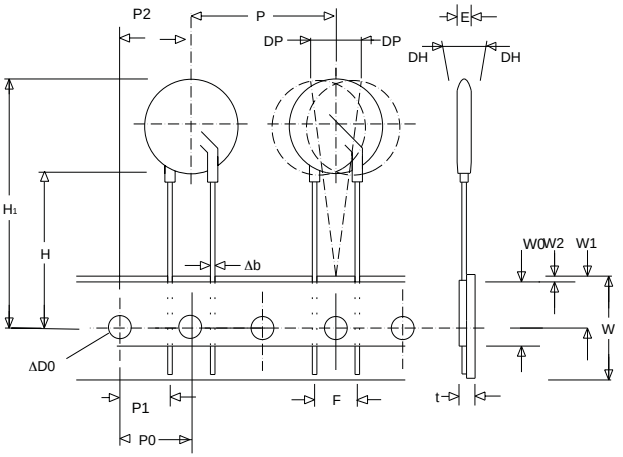


Straight Leads "L1"

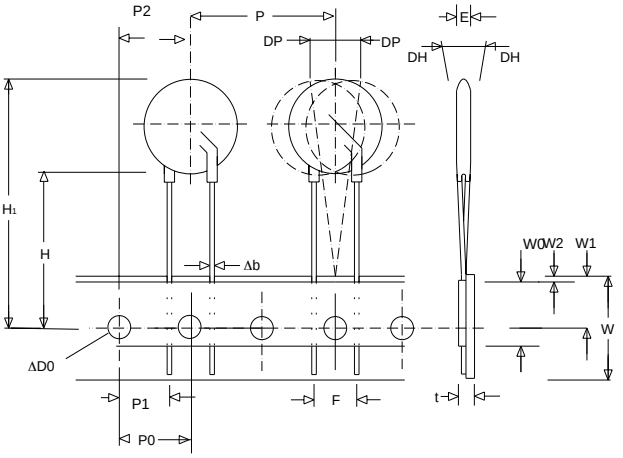
10, 14 and 20mm Devices



Crimped Leads "L2"



In Line Leads "L3"



Straight Leads "L1"

UltraMOV™ Varistor Series

SYMBOL	PARAMETER	MODEL SIZE			
		7mm	10mm	14mm	20mm
B_1	Component Top to Seating Plane	15 Max	19.5 Max	22.5 Max	29 Max
C	Crimp Length	2.4 Typ	2.6 Typ	2.6 Typ	2.6 Typ
P	Pitch of Component	12.7 ± 1.0	25.4 ± 1.0	25.4 ± 1.0	25.4 ± 1.0
P_0	Feed Hole Pitch	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2
P_1	Feed Hole Center to Pitch	3.85 ± 0.7	8.85 ± 0.7	8.85 ± 0.7	7.70 ±0.7
P_2	Hole Center to Component Center	6.35 ± 0.7	12.7± 0.7	12.7± 0.7	12.7 ± 0.7
F	Lead to Lead Distance	5.0 ± 0.8	7.5 ± 0.8	7.5 ± 0.8	10.0 ± 0.8
Δh	Component Alignment	2.0 Max	2.0 Max	2.0 Max	2.0 Max
W	Tape Width	18.0 + 1.0 18.0 - 0.5	18.0 + 1.0 18.0 - 0.52	18.0 + 1.0 18.0 - 0.5	18.0 + 1.0 18.0 - 0.5
W_0	Hold Down Tape Width	12.0± 0.3	12.0± 0.3	12.0± 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	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	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	18.0 + 2.0 18.0 - 0.0	18.0 + 2.0 18.0 - 0.0
H_0	Seating Plane Height	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5
H_1	Component Height	32.0 Max	36.0 Max	40.0 Max	46.5 Max
D_0	Feed Hole Diameter	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2
t	Total Tape Thickness	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2
Δp	Component Alignment	3^o Max, 1.00mm	3^o Max, 1.00mm	3^o Max, 1.00mm	3^o Max

Dimensions are in mm.

Tape Specifications for Reel or Ammo Pack

- Conforms to ANSI and EIA specifications.
- Can be supplied to IEC Publication 286-2.
- Radial devices on tape are offered with crimped leads, straight leads, or in-line leads. See Ordering Information.
- For 10mm devices 'P' (component pitch) is 12.2 mm when 'F' (lead space) is 5mm.

REEL CAPACITY 330MM (13IN.)

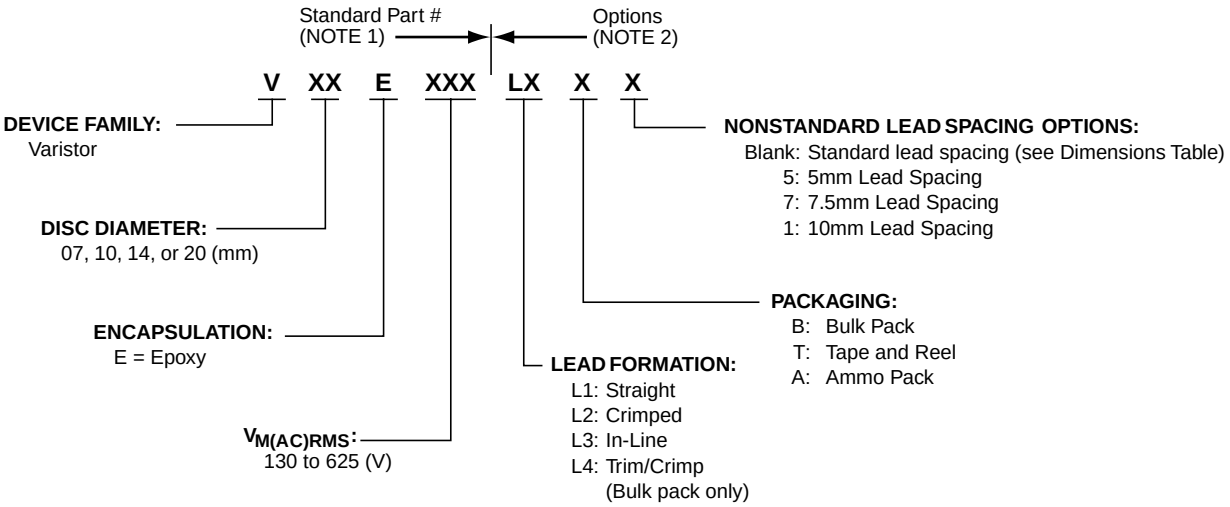
DEVICE SIZE	SHIPPING QUANTITY PER REEL
7	1000
10	500
14	500
20	500

UltraMOV™ Varistor Series

Ultramov series varistors for Hi-Temperature operating conditions:

- Phenolic Coated Ultramov Series devices are available with improved maximum operating maximum temperature 125°C.
- These devices also have improved temperature cycling performance capability.
- Ratings and Specifications are as per standard Ultramov Series except Hi-Pot encapsulation Isolation Voltage Capability = 500V.
- To order: change 'E' in part number to 'P' (e.g. V20P230)
- Marked identifier will contain 'P' to denote Phenolic.
- These devices are not UL, CSA, VDE or CECC certified.
- Contact factory for further details.

Ordering Information



UltraMOV™ is a trademark of Littelfuse, Inc.

NOTE:
1. Standard Parts use base part number only.
2. Parts with additional options append base part number with form, packaging and lead space.
3. Additional optional lead form, packaging or lead spacing requirements are subject to availability and minimum order requirements. Please contact a Littelfuse sales representative for more information.

Standard Part Default Conditions

REEL DIA	PART #	LEAD SPACE	PACKAGING	LEAD SPACE
7	V07E–	5.0±1	Bulk	5
10	V10E–	7.5±1	Bulk	7.5
14	V14E–	7.5±1	Bulk	7.5
20	V20E–	10.0±1	Bulk	10

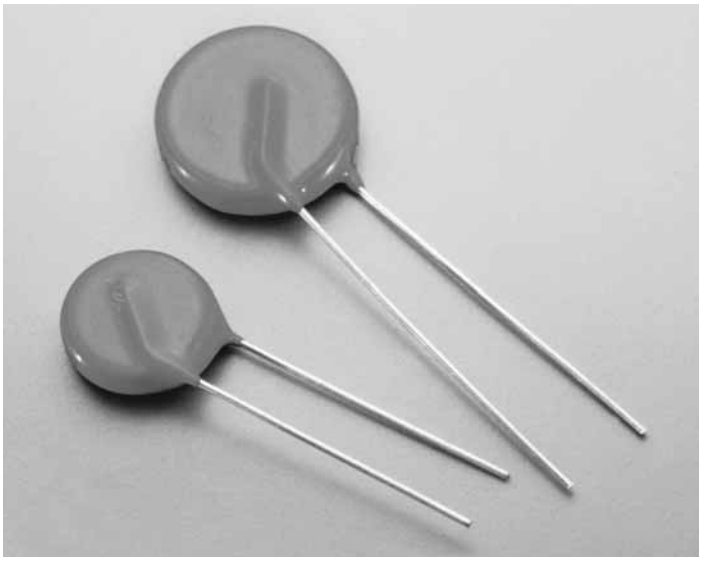
C-III Varistor Series

The C-III Series of metal-oxide varistors are specifically designed for applications requiring high surge energy absorption ratings and superior multiple pulse absorbtion rating. This is achieved through a special dielectric material formulation which also results in higher repetitive surge ratings than other MOV types.

The C-III series is primarily intended for use in AC line Transient Voltage Surge Suppressor (TVSS) product environment and other similar applications requiring high transient energy and peak current capability in a relatively small package size.

The C-III series is supplied in 10mm, 14mm and 20mm disc versions with various lead options.

These types are shipped in bulk or Tape and Reel packaging. Part number and brand information is provided in the Ratings table.



Features

- High Energy Absorption Capability
  W_{TM} . . . . . 40J to 530J (2ms)
- High Pulse Life Rating
- High Peak Pulse Current Capability
  I_{TM} . . . . . .3500A to 9000A (8/20µs)
- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . 130V to 660V
- Available in Tape and Reel for Automatic Insertion; Also Available with Crimped and/or Trimmed Lead Styles
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA, VDE and CECC.

AGENCY FILE NUMBERS: UL E75961, CSA LR91788, VDE 116895E, CECC 42201-006.

ALSO SEE LITTELFUSE ULTRAMOV™ VARISTOR SERIES

C-III Varistor Series

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

	C-III SERIES	UNITS
Continuous:		
Steady State AC Voltage Range ($V_{M(AC)RMS}$)	130 to 660	V
Transients:		
Single-Pulse Peak Current (I_{TM}) 8/20µs Wave (See Figure 2)	3500 to 9000	A
Single-Pulse Energy Range (W_{TM}) 2ms Rectangular Wave	40 to 530	J
Maximum Temporary Overvoltage of $V_{M(AC)}$:		
5 Minutes Duration @ 25°C	130	%
5 Minutes Duration @ 125°C	120	%
Operating Ambient Temperature Range (T_A)	-55 to 85	°C
Storage Temperature Range (T_{STG})	-55 to125	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.0	%/°C

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

C-III Series Ratings

PART NUMBER	BRAND	MAXIMUM RATINGS (85 °C)			
		CONTINUOUS	TRANSIENT		
		MAXIMUM V_{RMS} $V_{M(AC)}$ (V)	WITHSTANDING ENERGY (2ms) W_{TM} (⎍) (J)	PEAK CURRENT (8/20 s)	
				I_{TM1} 1 PULSE (A)	I_{TM2} 2 PULSES (A)
V130LA5C	130L5C	130	40	3500	3000
V130LA10C	130L10C	130	80	6000	5000
V130LA20C	130L20C	130	200	9000	7000
V130LA20CX325	130CX325	130	200	9000	7000
V140LA5C	140L5C	140	45	3500	3000
V140LA10C	140L10C	140	90	6000	5000
V140LA20C	140L20C	140	210	9000	7000
V140LA20CX340	140CX340	140	210	9000	7000
V150LA5C	150L5C	150	50	3500	3000
V150LA10C	150L10C	150	100	6000	5000
V150LA20C	150L20C	150	215	9000	7000
V150LA20CX360	150CX360	150	215	9000	7000
V175LA5C	175L5C	175	55	3500	3000
V175LA10C	175L10C	175	110	6000	5000
V175LA20C	175L20C	175	220	9000	7000
V175LA20CX425	175CX425	175	220	9000	7000
V230LA10C	230L10C	230	60	3500	3000
V230LA20C	230L20C	230	125	6000	5000
V230LA40C	230L40C	230	280	9000	7000
V230LA40CX570	230X570	230	280	9000	7000
V250LA10C	250L10C	250	65	3500	3000
V250LA20C	250L20C	250	135	6000	5000
V250LA40C	250L40C	250	300	9000	7000
V250LA40CX620	250CX620	250	300	9000	7000
V275LA10C	275L10C	275	70	3500	3000
V275LA20C	275L20C	275	145	6000	5000
V275LA40C	275L40C	275	320	9000	7000
V275LA40CX680	275CX680	275	320	9000	7000
V300LA10C	300L10C	300	75	3500	3000
V300LA20C	300L20C	300	155	6000	5000
V300LA40C	300L40C	300	335	9000	7000
V300LA40CX745	300CX745	300	335	9000	7000
V320LA10C	320L10C	320	80	3500	3000
V320LA20C	320L20C	320	165	6000	5000
V320LA40C	320L40C	320	345	9000	7000
V385LA20C	385L20C	385	175	6000	5000
V385LA40C	385L40C	385	370	9000	7000
V420LA20C	420L20C	420	185	6000	5000
V420LA40C	420L40C	420	390	9000	7000
V460LA40C	460L40C	460	430	9000	7000
V480LA80C	480L80C	480	420	9000	7000
V510LA80C	510L80C	510	440	9000	7000
V550LA80C	550L80C	550	450	9000	7000
V575LA80C	575L80C	575	460	9000	7000
V625LA80C	625L80C	625	490	9000	7000
V660LA80C	660L80C	660	510	9000	7000

C-III Varistor Series

C-III Series Specifications

PART NUMBER	MODEL SIZE DISC DIAMETER (mm)	SPECIFICATIONS (25°C)					
		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE (8/20 s)		DUTY CYCLE SURGE RATING	
		V_N MIN (V)	V_N MAX (V)	V_C (V)	I_P (A)	3kA (8/20 s) # PULSES	750A (8/20 s) # PULSES
V130LA5C	10	184	228	340	25	2	100
V130LA10C	14	184	228	340	50	40	600
V130LA20C	20	184	228	340	100	80	1600
V130LA20CX325	20	184	220	325	100	80	1600
V140LA5C	10	198	242	360	25	2	100
V140LA10C	14	198	242	360	50	40	600
V140LA20C	20	198	242	360	100	80	1600
V140LA20CX340	20	198	230	340	100	80	1600
V150LA5C	10	212	268	395	25	2	100
V150LA10C	14	212	268	395	50	40	600
V150LA20C	20	212	268	395	100	80	1600
V150LA20CX360	20	212	243	360	100	80	1600
V175LA5C	10	247	303	455	25	2	100
V175LA10C	14	247	303	455	50	40	600
V175LA20C	20	247	303	455	100	80	1600
V175LA20CX425	20	247	285	425	100	80	1600
V230LA10C	10	324	396	595	25	2	100
V230LA20C	14	324	396	595	50	40	600
V230LA40C	20	324	396	595	100	80	1600
V230LA40CX570	20	324	384	570	100	80	1600
V250LA10C	10	354	429	650	25	2	100
V250LA20C	14	354	429	650	50	40	600
V250LA40C	20	354	429	650	100	80	600
V250LA40CX620	20	354	413	620	100	80	1600
V275LA10C	10	389	473	710	25	2	100
V275LA20C	14	389	473	710	50	40	600
V275LA40C	20	389	473	710	100	80	1600
V275LA40CX680	20	389	453	680	100	80	1600
V300LA10C	10	420	517	775	25	2	100
V300LA20C	14	420	517	775	50	40	600
V300LA40C	20	420	517	775	100	80	1600
V300LA40CX745	20	420	490	745	100	80	1600
V320LA10C	10	462	565	850	25	2	100
V320LA20C	14	462	565	850	50	40	600
V320LA40C	20	462	565	850	100	80	1600
V385LA20C	14	558	682	1025	50	40	600
V385LA40C	20	558	682	1025	100	80	1600
V420LA20C	14	610	748	1120	50	40	600
V420LA40C	20	610	748	1120	100	80	1600
V460LA40C	20	640	790	1190	100	80	1600
V480LA80C	20	670	825	1240	100	80	1600
V510LA80C	20	735	910	1350	100	80	1600
V550LA80C	20	780	970	1435	100	80	1600
V575LA80C	20	805	1000	1500	100	80	1600
V625LA80C	20	900	1100	1725	100	80	1600
V660LA80C	20	940	1210	1820	100	80	1600

NOTE: • Average power dissipation of transients not to exceed 0.6W and 1W for model sizes 14mm and 20mm, respectively.
• 7mm and 12mm parts also available-contact factory for further information
• For additional or intermediary voltage ratings contact factory

C-III Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device.The operating values of a MOV need to be deratedat high temperatures as shown in Figure 1. Because varistors only dissipate a relatively small amount of average power they are not suitable 0for repetitive applications that involve substantial amounts of average power dissipation.

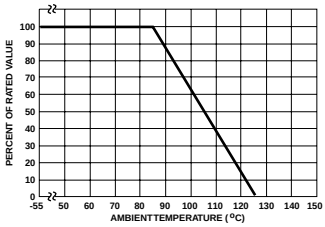
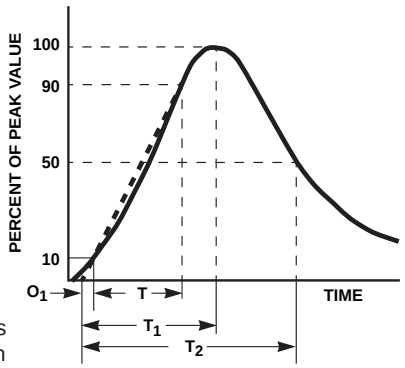


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20 s Current Waveform:
8 s = T_1 = Virtual Front Time
20 s = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

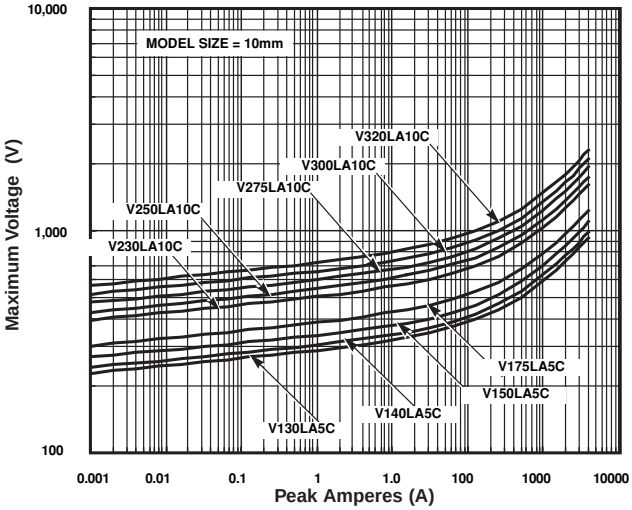


Figure 3. Maximum Clamping Voltage for 10mm Parts (V130LA5C -V320LA10C)

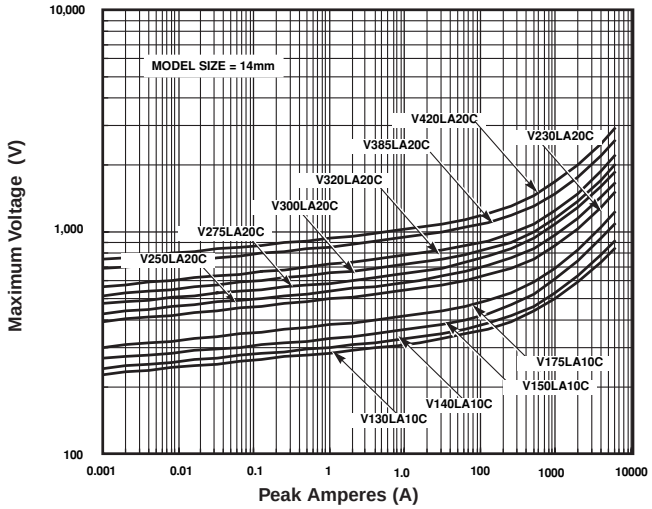


Figure 4. Maximum Clamping Voltage for 14mm Parts (V130LA10C -V420LA20C)

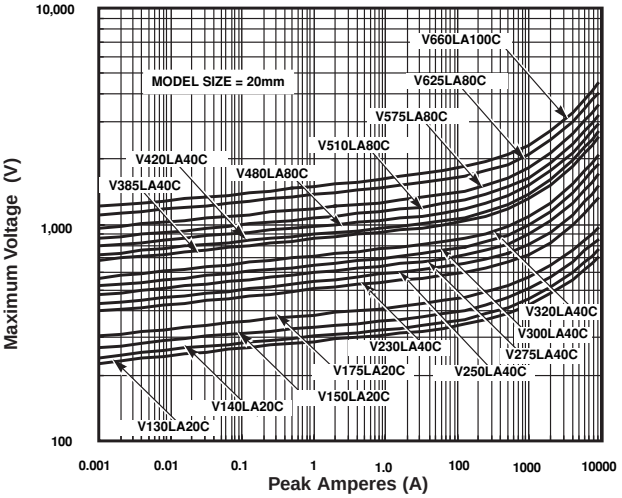


Figure 5. Maximum Clamping Voltage for 20mm Parts (V130LA20C -V660LA100C)

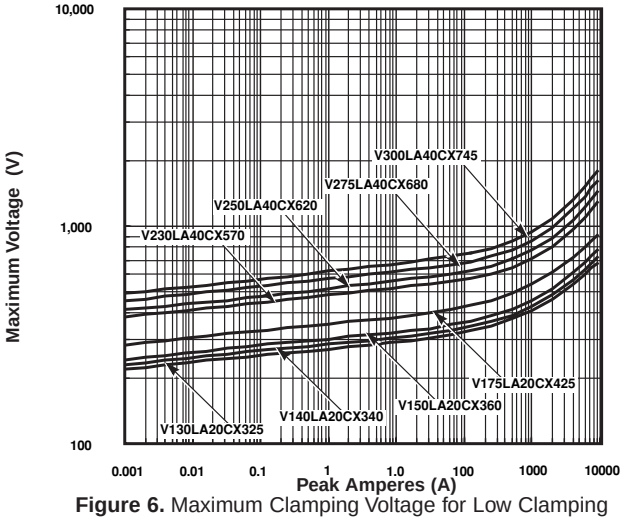


Figure 6. Maximum Clamping Voltage for Low Clamping Voltage Parts (V130LA20CX325 -V300LA40CX245)

C-III Varistor Series

Pulse Rating Curves

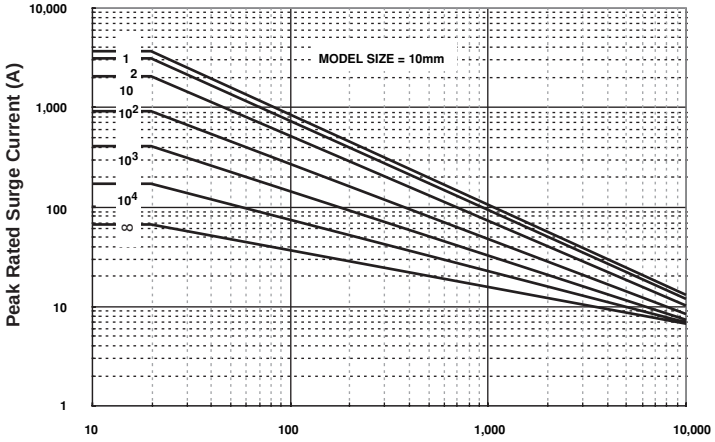


Figure 7. Repetitive Surge Capability for 10mm Parts (V130LA5C-V320LA10C)

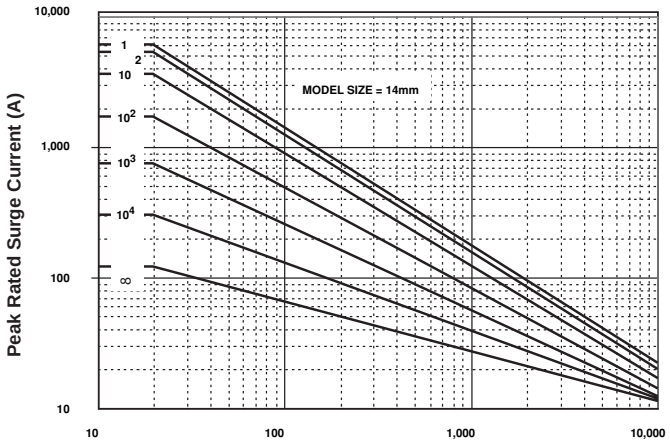


Figure 8. Repetitive Surge Capability for 14mm Parts (V130LA10C-V420LA20C)

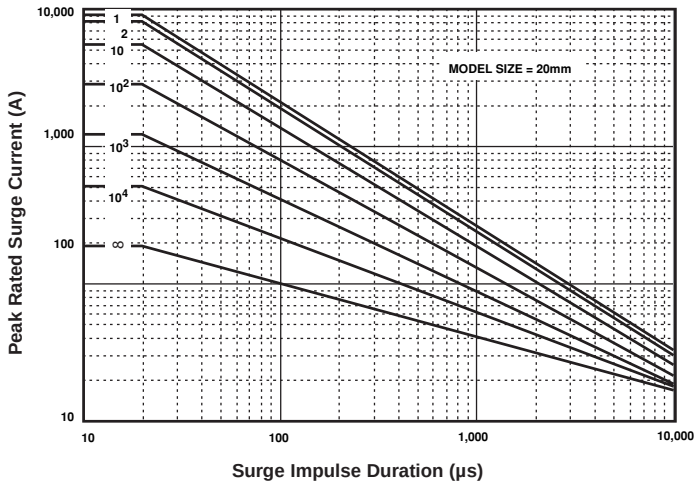


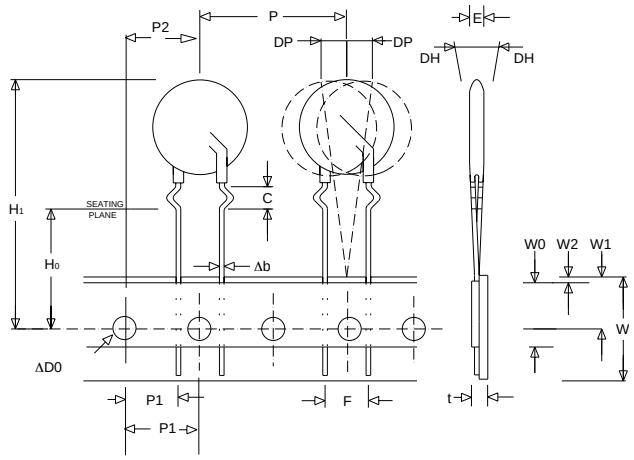
Figure 9. Repetitive Surge Capability for 20mm Parts (V130LA20C-V660LA100C)

CIII series varistors for Hi-Temperature operating conditions:

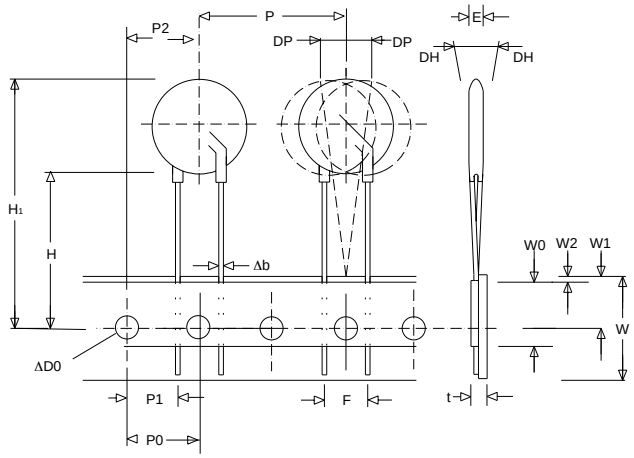
- Phenolic Coated CIII Series devices are available with improved maximum operating maximum temperature 125°C.
- These devices also have improved temperature cycling performance capability.
- Ratings and Specifications are as per standard CIII Series except Hi-Pot encapsulation Isolation Voltage Capability = 500V.
- To order: add X1347 to part number (e.g. V230LA40CX1347)
- Marked identifier will contain 'P' to denote Phenolic.
- These devices are not UL, CSA, VDE or CECC certified.
- Contact factory for further details.

C-III Varistor Series

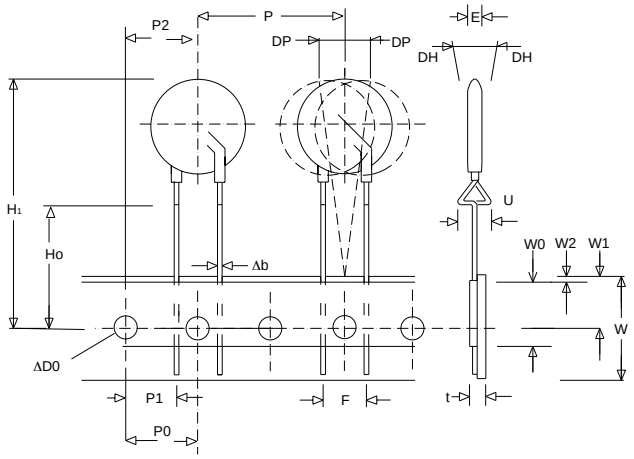
Tape and Reel Specification(available for voltage ratings up to 320V only)



Crimped Leads "LT"



Straight Leads "LS"



Under-crimped Leads "LU"

SYMBOL	DESCRIPTION	MODEL SIZE		
		10mm	14mm	20mm
P	Pitch of Component	25.4 ± 1.0		
P_0	Feed Hole Pitch	12.7 ± 0.2		
P_1	Feed Hole Center to Pitch	8.85 ± 0.8		
P_2	Hole Center to Component Center	12.7 ± 0.7		
F	Lead to Lead Distance	7.50 ± 0.8		
h	Component Alignment	2.00 Max		
W	Tape Width	18.25 ± 0.75		
W_0	Hold Down Tape Width	12.0 ± 0.3		
W_1	Hole Position	9.125 ± 0.625		
W_2	Hold Down Tape Position	0.5 Max		
H	Height From Tape Center To Component Base	19.0 ± 1.0		
H_0	Seating Plane Height	16.0 ± 0.5		
H_1	Component Height	36 Max	40 Max	46.5 Max
D_0	Feed Hole Diameter	4.0 ± 0.2		
t	Total Tape Thickness	0.7 ± 0.2		
p	Component Alignment	3^o Max		
U	Under-crimp Width	8.0 Max		

C-III Varistor Series

Tape and Reel Data

- Conforms to ANSI and EIA Specifications
- Can be supplied to IEC publication 286-2
- Radial devices on tape and reel are supplied with either crimped leads, straight leads, or under-crimped leads
- Available for voltage ratings up to 320V only

Tape and Reel Ordering Information

- Crimped leads are standard on LA types supplied in tape and reel and are denoted by the model letter "T". Also, in tape and reel, model letter "S" denotes straight leads and letter "U" denotes special under-crimped leads.

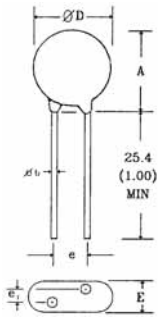
Example:

STANDARD MODEL	CRIMPED LEADS	STRAIGHT LEADS	UNDER CRIMP LEADS
V130LA20C	V130LT20C	V130LS20C	V130LU20C

Shipping Quantity

DEVICE SIZE	QUANTITY PER REEL		
	"T"REEL	"S"REEL	"U"REEL
10mm	500	500	500
14mm	500	500	500
20mm	500	500	500

Mechanical Dimensions



SYMBOL	VRMS VOLTAGE MODEL	VARISTOR MODEL SIZE					
		10mm		14mm		20mm	
		MIN	MAX	MIN	MAX	MIN	MAX
A	ALL	12 (0.472)	16 (0.630)	13.5 (0.531)	20 (0.787)	17.5 (0.689)	26.5 (1.043)
ØD	ALL	10 (0.394)	12.5 (0.492)	13.5 (0.531)	17 (0.669)	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 - 320	2.5 (0.098)	5.5 (0.216)	2.5 (0.098)	5.5 (0.216)	2.5 (0.098)	5.5 (0.216)
	>320			4.5 (0.177)	9.0 (0.354)	4.5 (0.177)	9.0 (0.354)
E	130 - 320	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)
	>320			-	11 (0.433)	-	11 (0.433)
Øb	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)

Dimensions are in millimeters (inches)

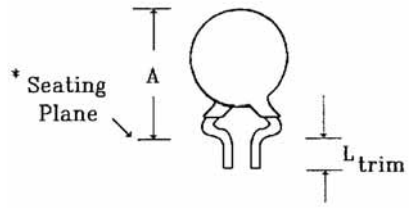
1. 10mm lead spacing also available. See additional lead style options.
2. 7mm and 12mm devices also available upon request. Contact factory for details.

Additional Lead Style Options

Radial lead types can be supplied with combination preformed crimp and trimmed leads. This option is suppliedto the dimensions shown below.
*Seating plane interpretation per IEC-717

SYMBOL	VARISTOR MODEL SIZE					
	10mm		14mm		20mm	
	MIN	MAX	MIN	MAX	MIN	MAX
A	-	19.5 (0.768)	-	23.5 (0.925)	-	30 (1.18)
L_{TRIM}	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)

NOTE: Dimensions are in millimeters (inches).



CRIMPED AND TRIMMED LEAD

- To order this crimped and trimmed lead style, the standard radial type model number "LA" is changed to the model number "LC".This option is supplied in bulk only.

STANDARD MODEL	ORDER AS
V130LA20C	V130LC20C

Example:
- For 10 ± 1mm lead spacing on 20mm units only; append standard model numbers by adding "X10" suffix.

Example:

STANDARD MODEL	ORDER AS
V130LA20C	V130LC20C

- For other lead style variations to the above, please contact Littelfuse.

C-III Varistor Series

AC Bias Reliability

The C-III series of metal oxide varistors was designed for use on the AC line. The varistor is connected across the AC line and is biased with a constant amplitude sinusoidal voltage. It should be noted that the definition of failure is a shift in the nominal varistor voltage (VN) exceeding ±10%. Although this type of varistor is still functioning normally after this magnitude of shift, devices at the lower extremities of VN tolerance will begin to dissipate more power.

Because of this possibility, an extensive series of statistically designed tests were performed to determine the reliability of the C-III type of varistor under AC bias combined with high levels of temperature stress. To date, this test has generated over 50,000 device hours of operation at a temperature of 125°C, although only rated at 85°C. Changes in the nominal varistor voltage, measured at 1mA, of less than 2% have been recorded (Figure 8).

Transient Surge Current/Energy Transient Capability

The transient surge rating serves as an excellent figure of merit for the C-III varistor. This inherent surge handling capability is one of the C-III varistor's best features. The enhanced surge absorption capability results from improved process uniformity and enhanced construction. The homogeneity of the raw material powder and improved control over the sintering and assembly processes are contributing factors to this improvement.

In the low power AC mains environment, industry standards (UL, IEC, NEMA and IEEE) all suggest that the worst case surge occurrence will be 3kA. Such a transient event may occur up to five times over the equipment life time (approximately 10 years). While the occu rences of five 3kA transients is the required capability, the rated, repetitive surge current for the C-III series is 80 pulses for the 20mm units and 40 pulses for the 14mm series.

Additionally, all 20mm C-III devices are listed to the "Permanently Connected" category (10kA) of UL1449, by Underwriter's Laboratories, Inc.

As a measure of the inherent device capability, samples of the 20mm V130LA20C devices were subjected to a worst case repetitive transient surges test. After 100 pulses, each of 3kA, there was negligible change in the device characteristics. Changes in the clamping voltage, measured at 100 amps, of less than 3% were recorded (Figure 9). Samples of the 14mm Series V175LA20C were subjected to repetitive surge occurrences of 750A. Again, there was negligible changes in any of the device characteristics after 2000 pulses (Figure 10). In both cases the inherent device capability is far in excess of the expected worst case scenario.

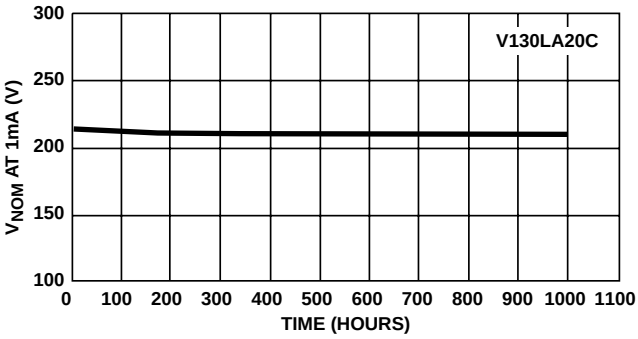


FIGURE 8. HIGH TEMPERATURE OPERATING LIFE 125 °C FOR 1000 HOURS AT RATED BIAS

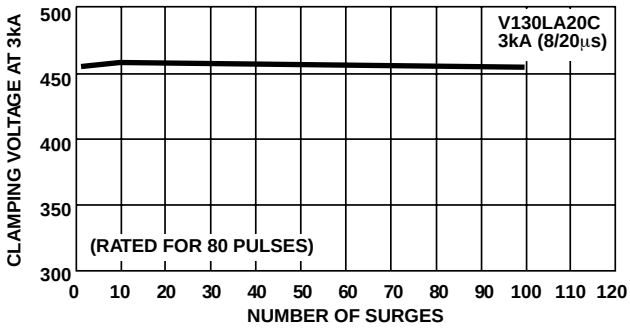


FIGURE 9. TYPICAL REPETITIVE SURGE CURRENT CAPABILITY OF C-III SERIES MOVs

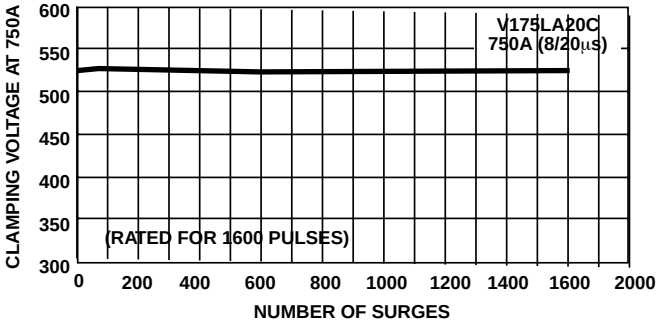


FIGURE 10. TYPICAL REPETITIVE SURGE CURRENT CAPABILITY OF C-III SERIES MOVs

LA Varistor Series

The LA Series of transient voltage surge suppressors are radial-lead varistors (MOVs) that are designed to be operated continuously across AC power lines. These UL recognized varistors require very little mounting space, and are offered in various standard lead form options.

The LA Series varistors are available in four model sizes: 7mm, 10mm, 14mm and 20mm; and have a $V_{M(AC)RMS}$ voltage range from 130V to 1000V, and an energy absorption capability up to 360J. Some LA series model numbers are available with clamping voltage selections, designated by a model number suffix of either A or B. The “A” selection is the standard model; the “B” selection provides a lower clamping voltage.

See LA Series Device Ratings and Specifications table for part number and brand information.

Features

- Energy Absorption Capability (W_{TM}) . . . . . Up to 360J
- Wide Operating Voltage Range $V_{M(AC)RMS}$ . . . . . 130V to 1000V
- No Derating Up to 85°C Ambient
- Available in Tape and Reel or Bulk Pack

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA, VDE and CECC.

AGENCY FILE NUMBERS: UL E75961, E56529, E135010; CSA LR91788; VDE 116895E; CECC 42201-006.

ALSO SEE LITTELFUSE ULTRAMOV™ AND C-III VARISTOR SERIES

LA Varistor Series

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

	LA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	130 to 1000	V
DC Voltage Range ($V_{M(DC)}$)	175 to 1200	V
Transients:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	1200 to 6500	A
Single Pulse Energy Range		
For 10/1000µs Current Wave (W_{TM})	11 to 360	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
(Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)		
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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications

PART NUMBER	MODEL SIZE DISC DIA. (mm)	DEVICE MODEL NUMBER BRAND-ING	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
			CONTINUOUS		TRANSIENT		VARISTOR VOLT-AGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20µs		TYPICAL CAPACI-TANCE f = 1MHz
			V_{RMS}	V_{DC}	ENERGY 10 x 1000µs	PEAK CURRENT 8 x 20µs					
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	C
			(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
V130LA1	7	1301	130	175	11	1200	184	255	390	10	180
V130LA2	7	1302	130	175	11	1200	184	228	340	10	180
V130LA5	10	1305	130	175	20	2500	184	228	340	25	450
V130LA10A	14	130L10	130	175	38	4500	184	228	340	50	1000
V130LA20A	20	130L20	130	175	70	6500	184	228	340	100	1900
V130LA20B	20	130L20B	130	175	70	6500	184	220	325	100	1900
V140LA2	7	1402	140	180	12	1200	198	242	360	10	160
V140LA5	10	1405	140	180	22	2500	198	242	360	25	400
V140LA10A	14	140L10	140	180	42	4500	198	242	360	50	900
V140LA20A	20	140L20	140	180	75	6500	198	242	340	100	1750
V150LA1	7	1501	150	200	13	1200	212	284	430	10	150
V150LA2	7	1502	150	200	13	1200	212	268	395	10	150
V150LA5	10	1505	150	200	25	2500	212	268	395	25	360
V150LA10A	14	150L10	150	200	45	4500	212	268	395	50	800
V150LA20A	20	150L20	150	200	80	6500	212	268	395	100	1600
V150LA20B	20	150L20B	150	200	80	6500	212	243	360	100	1600
V175LA2	7	1752	175	225	15	1200	247	303	455	10	130
V175LA5	10	1755	175	225	30	2500	247	303	455	25	350
V175LA10A	14	175L10	175	225	55	4500	247	303	455	50	700
V175LA20A	20	175L20	175	225	90	6500	247	303	455	100	1400
V230LA4	7	2304	230	300	20	1200	324	396	595	10	100
V230LA10	10	230L	230	300	35	2500	324	396	595	25	250
V230LA20A	14	230L20	230	300	70	4500	324	396	595	50	550
V230LA40A	20	230L40	230	300	122	6500	324	396	595	100	1100

LA Varistor Series

Device Ratings and Specifications (Continued)

PART NUMBER	MODEL SIZE DISC DIA. (mm)	DEVICE MODEL NUMBER BRAND-ING	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20μs		TYPICAL CAPACITANCE f = 1MHz
			V_{RMS}	V_{DC}	ENERGY 10 x 1000μs	PEAK CURRENT 8 x 20μs	V_{NOM} MIN	V_{NOM} MAX			
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}			V_C	I_{PK}	C
			(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
V250LA2	7	2502	250	330	21	1200	354	473	730	10	90
V250LA4	7	2504	250	330	21	1200	354	429	650	10	90
V250LA10	10	250L	250	330	40	2500	354	429	650	25	220
V250LA20A	14	250L20	250	330	72	4500	354	429	650	50	500
V250LA40A	20	250L40	250	330	130	6500	354	429	650	100	1000
V250LA40B	20	250L40B	250	330	130	6500	354	413	620	100	1000
V275LA2	7	2752	275	369	23	1200	389	515	775	10	80
V275LA4	7	2754	275	369	23	1200	389	473	710	10	80
V275LA10	10	275L	275	369	45	2500	389	473	710	25	200
V275LA20A	14	275L20	275	369	75	4500	389	473	710	50	450
V275LA40A	20	275L40	275	369	140	6500	389	473	710	100	900
V275LA40B	20	275L40B	275	369	140	6500	389	453	680	100	900
V300LA2	7	3002	300	405	25	1200	420	565	870	10	70
V300LA4	7	3004	300	405	25	1200	420	517	775	10	70
V300LA10	10	300L	300	405	46	2500	420	517	775	25	180
V300LA20A	14	300L20	300	405	77	4500	420	517	775	50	400
V300LA40A	20	300L40	300	405	165	6500	420	517	775	100	800
V320LA7	7	3207	320	420	25	1200	462	565	850	10	65
V320LA10	10	320L	320	420	48	2500	462	565	850	25	170
V320LA20A	14	320L20	320	420	80	4500	462	565	850	50	380
V320LA40B	20	320L40	320	420	150	6500	462	540	810	100	750
V385LA7	7	3857	385	505	27	1200	558	682	1025	10	60
V385LA10	10	385L	385	505	51	2500	558	682	1025	25	160
V385LA20A	14	385L20	385	505	85	4500	558	682	1025	50	360
V385LA40B	20	385L40	385	505	160	6500	558	682	1025	100	700
V420LA7	7	4207	420	560	30	1200	610	748	1120	10	55
V420LA10	10	420L	420	560	55	2500	610	748	1120	25	140
V420LA20A	14	420L20	420	560	90	4500	610	748	1120	50	300
V420LA40B	20	420L40	420	560	160	6500	610	720	1060	100	600
V460LA7	7	4607	460	615	37	1200	702	858	1130	10	55
V480LA7	7	4807	480	640	35	1200	670	825	1240	10	50
V480LA10	10	480L	480	640	60	2500	670	825	1240	25	120
V480LA40A	14	480L40	480	640	105	4500	670	825	1240	50	270
V480LA80B	20	480L80	480	640	180	6500	670	790	1160	100	550
V510LA10	10	510L	510	675	63	2500	735	910	1350	25	100
V510LA40A	14	510L40	510	675	110	4500	735	910	1350	50	250
V510LA80B	20	510L80	510	675	190	6500	735	860	1280	100	500
V575LA10	10	575L	575	730	65	2500	805	1000	1500	25	90
V575LA40A	14	575L40	575	730	120	4500	805	1000	1500	50	220
V575LA80B	20	575L80	575	730	220	6500	805	960	1410	100	450
V625LA10	10	625L	625	825	67	2500	900	1100	1650	25	80
V625LA40A	14	625L40	625	825	125	4500	900	1100	1650	50	210
V625LA80B	20	625L80	625	825	230	6500	900	1100	1650	100	425

LA Varistor Series

Device Ratings and Specifications (Continued)

PART NUMBER	MODEL SIZE DISC DIA. (mm)	DEVICE MODEL NUMBER BRAND-ING	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20μs		TYPICAL CAPACITANCE f = 1MHz
			V_{RMS}	V_{DC}	ENERGY 10 x 1000μs	PEAK CURRENT 8 x 20μs	V_{NOM} MIN	V_{NOM} MAX			
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}			V_C	I_{PK}	C
			(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
V660LA10	10	660L	660	850	70	2500	940	1210	1820	25	70
V660LA50A	14	660L50	660	850	140	4500	940	1210	1820	50	200
V660LA100B	20	660L100	660	850	250	6500	940	1100	1650	100	400
V1000LA80A	14	1000L80	1000	1200	220	4500	1425	1800	2700	50	130
V1000LA160B	20	1000L160	1000	1200	360	6500	1425	1600	2420	100	250

NOTE: Average power dissipation of transients not to exceed 0.25W, 0.4W, 0.6W or 1W for model sizes 7mm, 10mm, 14mm and 20mm, respectively.

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device.The operating values of a MOV need to be derated at high temperatures as shown in Figure 1. Because varistors only dissipate a relatively small amount of average power they are not suitable for repetitive applications that involve substantial amounts of average power dissipation.

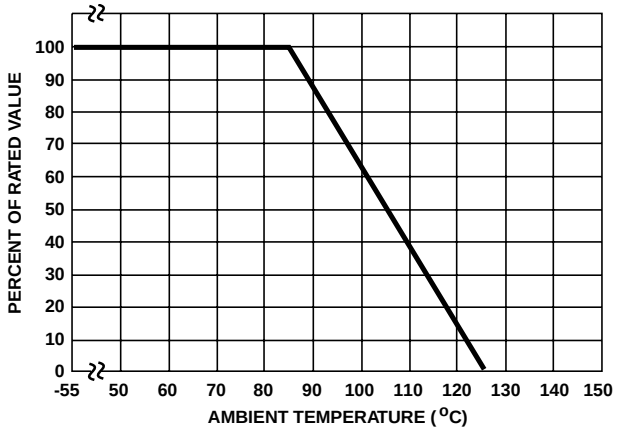
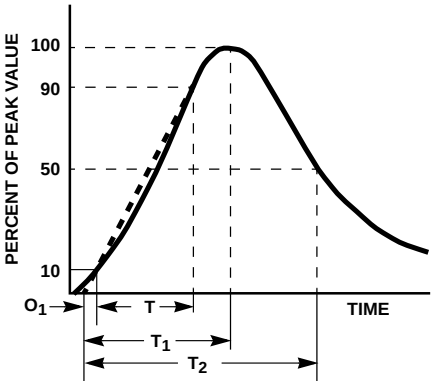


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

LA Varistor Series

Transient V-I Characteristics Curves

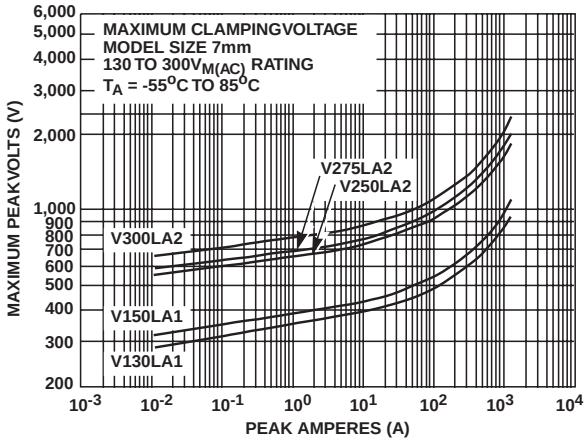


FIGURE 3. CLAMPING VOLTAGE FOR V130LA1 - V300LA2

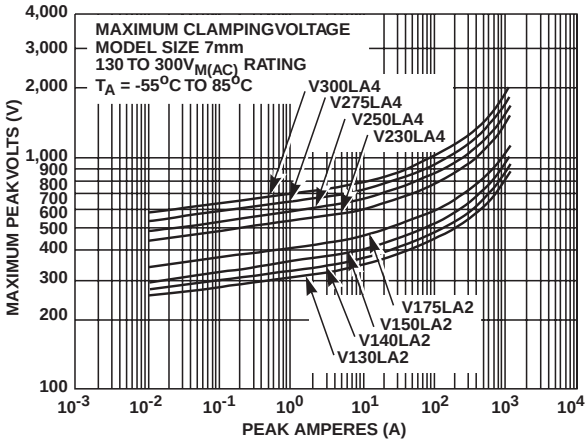


FIGURE 4. CLAMPING VOLTAGE FOR V130LA2 - V300LA4

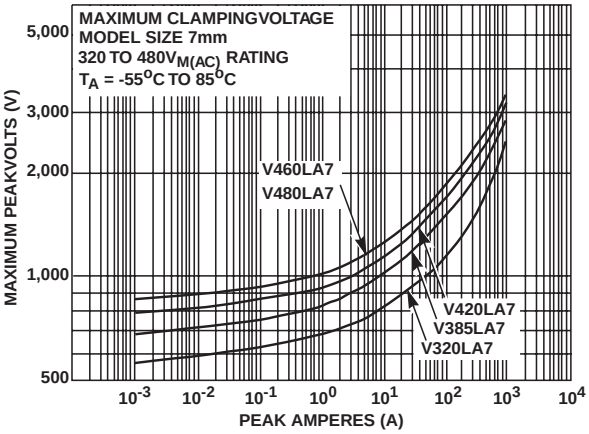


FIGURE 5. CLAMPING VOLTAGE FOR V320LA7 - V480LA7

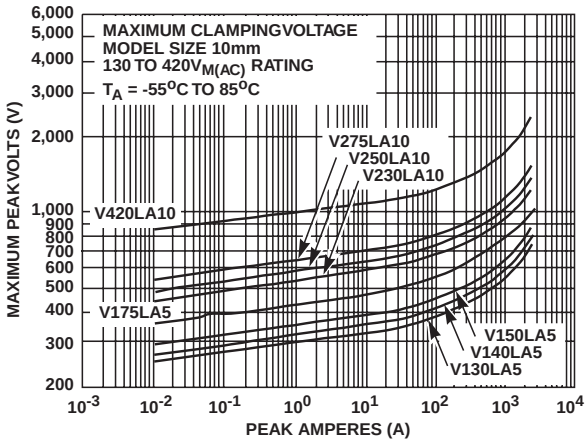


FIGURE 6. CLAMPING VOLTAGE FOR V130LA5 - V420LA10

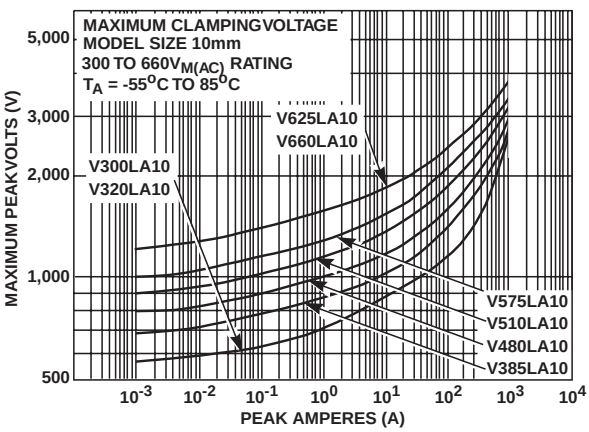


FIGURE 7. CLAMPING VOLTAGE FOR V300LA10 - V660LA10

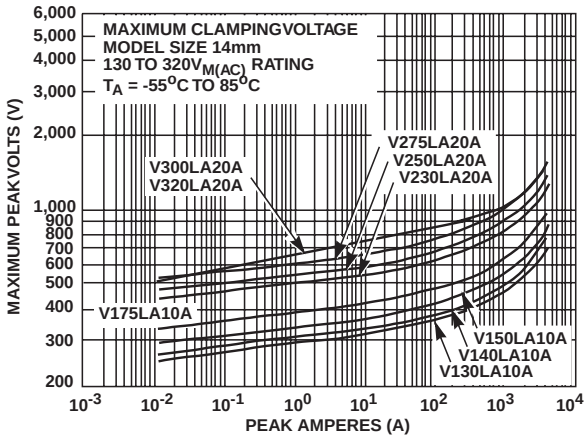


FIGURE 8. CLAMPING VOLTAGE FOR V130LA10A - V320LA20A

LA Varistor Series

Transient V-I Characteristics Curves (Continued)

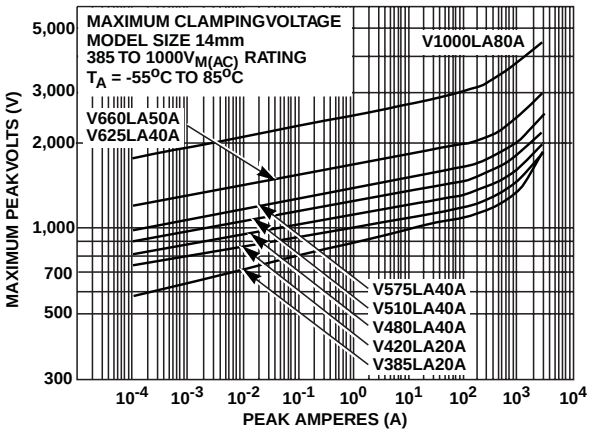


FIGURE 9. CLAMPING VOLTAGE FOR V385LA20A - V1000LA80A

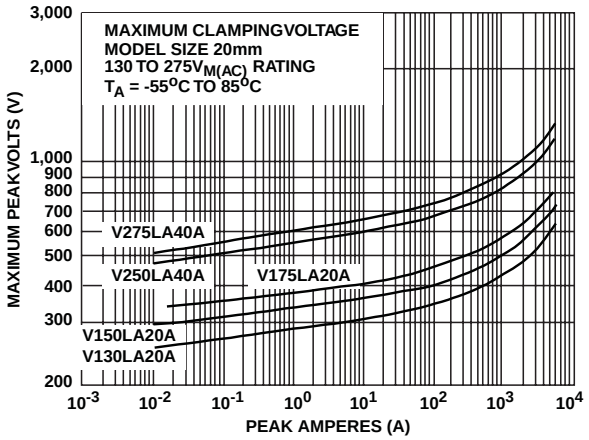


FIGURE 10. CLAMPING VOLTAGE FOR V130LA20A - V275LA40A

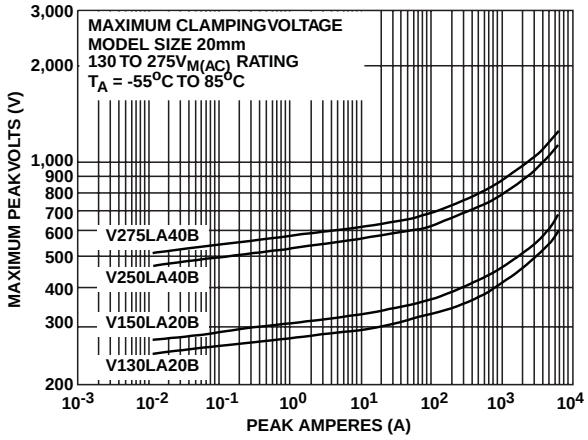
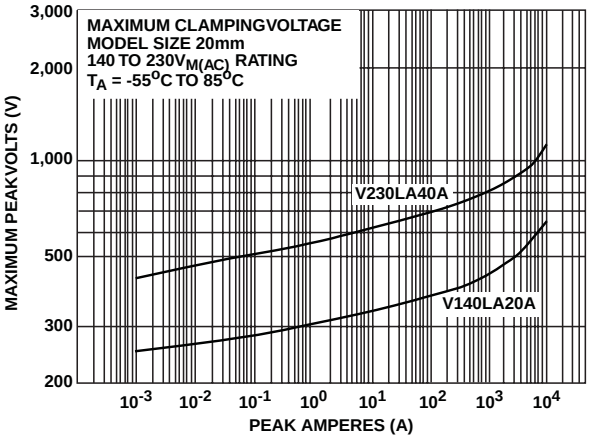


FIGURE 11. CLAMPING VOLTAGE FOR V130LA20B - V275LA40B



FI GURE 12. CLAMPING VOLTAGE FOR V140LA20A - V230LA40A

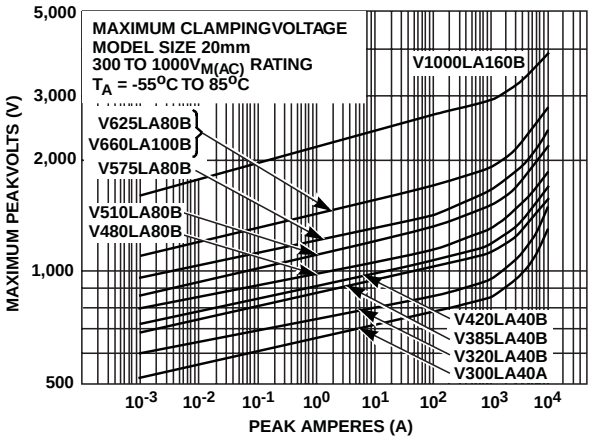


FIGURE 13. CLAMPING VOLTAGE FOR V300LA40A - V1000LA160B

LA Varistor Series

Pulse Rating Curves

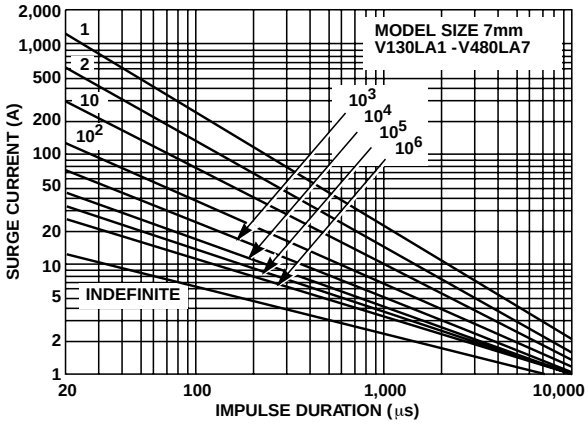


FIGURE 14. SURGE CURRENT RATING CURVES FOR V130LA1 - V480LA7

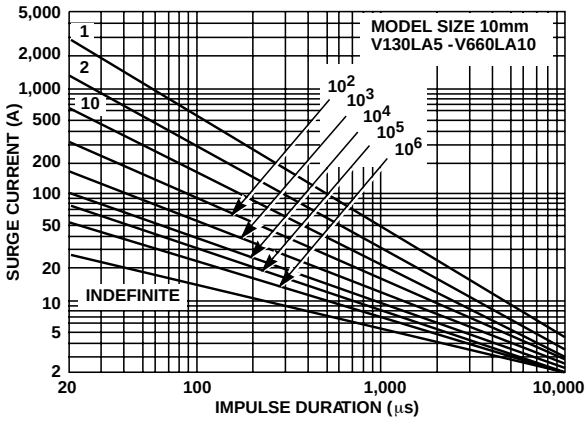


FIGURE 15. SURGE CURRENT RATING CURVES FOR V130LA5 - V660LA10

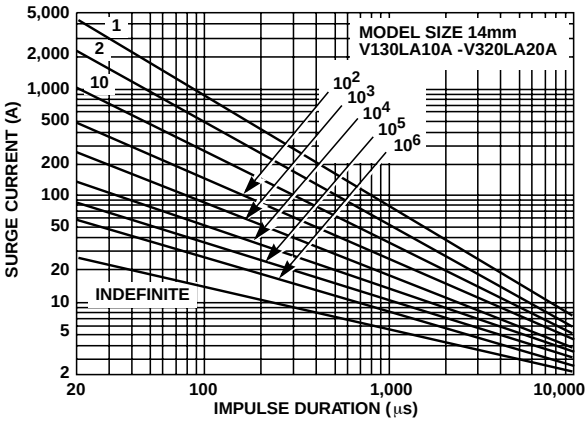


FIGURE 16. SURGE CURRENT RATING CURVES FOR V130LA10A - V320LA20A

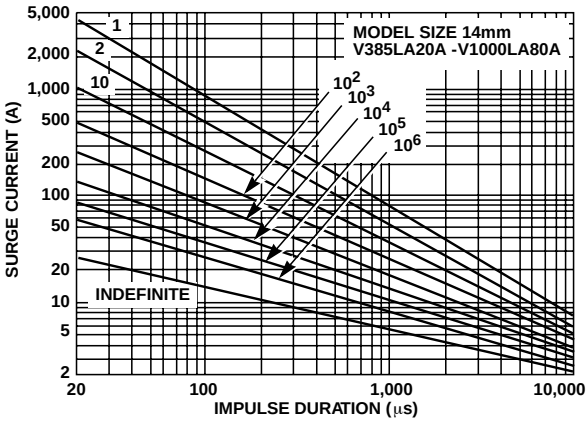


FIGURE 17. SURGE CURRENT RATING CURVES FOR V385LA20A - V1000LA80A

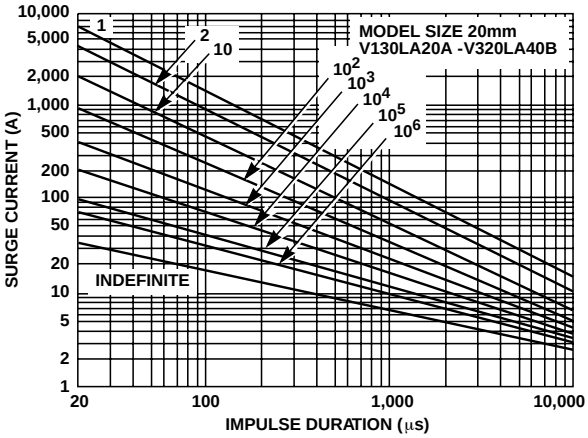


FIGURE 18. SURGE CURRENT RATING CURVES FOR V130LA20A - V320LA40B

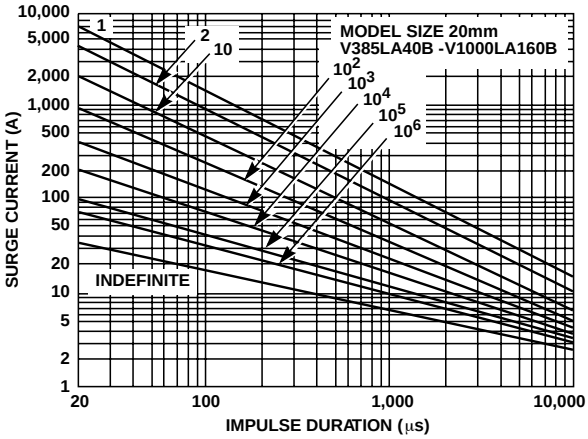


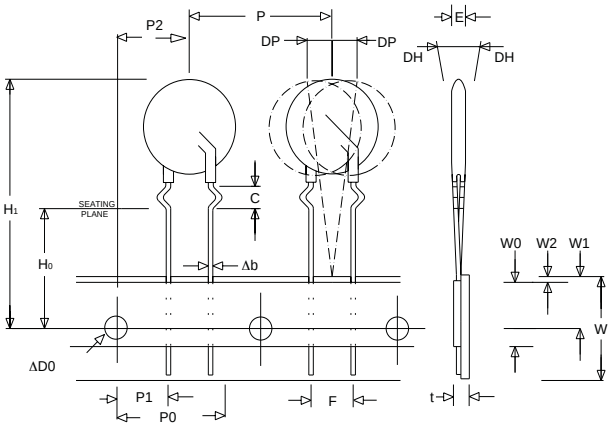
FIGURE 19. SURGE CURRENT RATING CURVES FOR V385LA40B - V1000LA160B

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but does not prevent the device from continuing to function, and to provide ample protection.

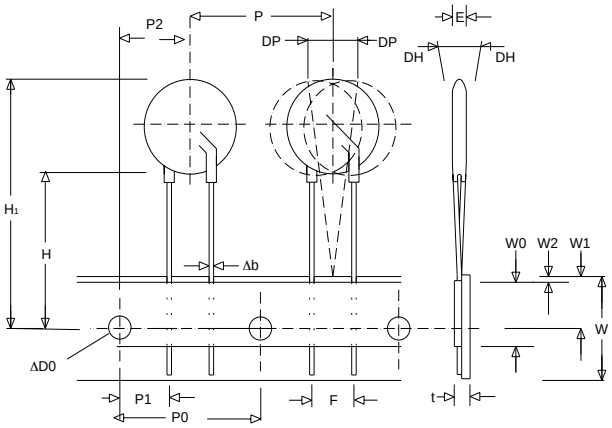
LA Varistor Series

Tape and Reel Specifications

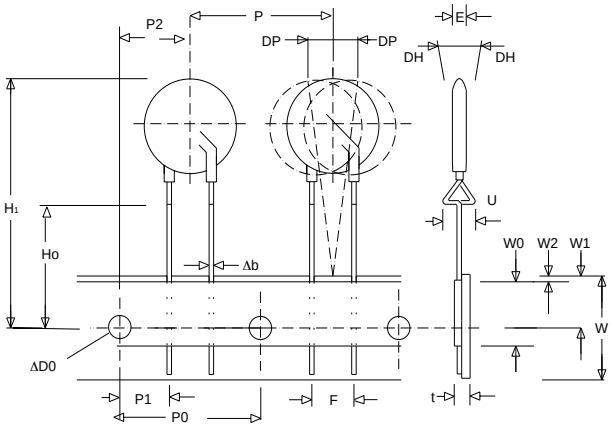
7mm Devices



Crimped Leads "LT"

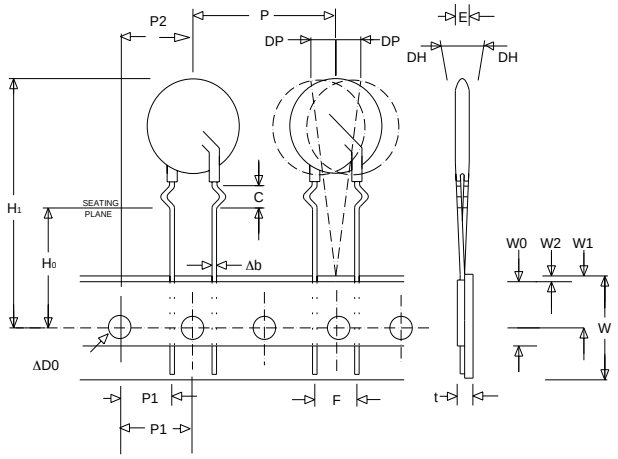


Straight Leads "LS"

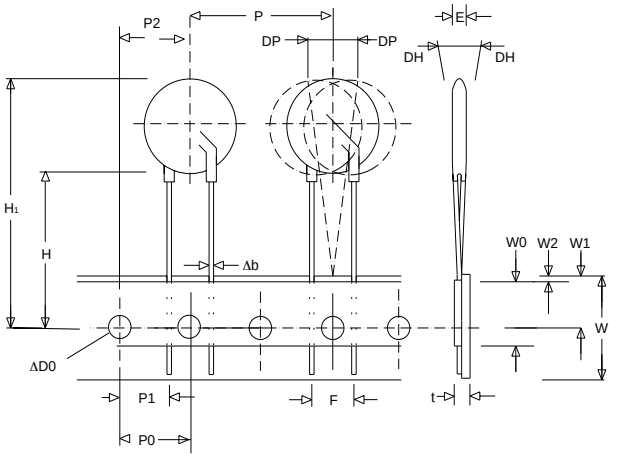


Under-crimped Leads "LU"

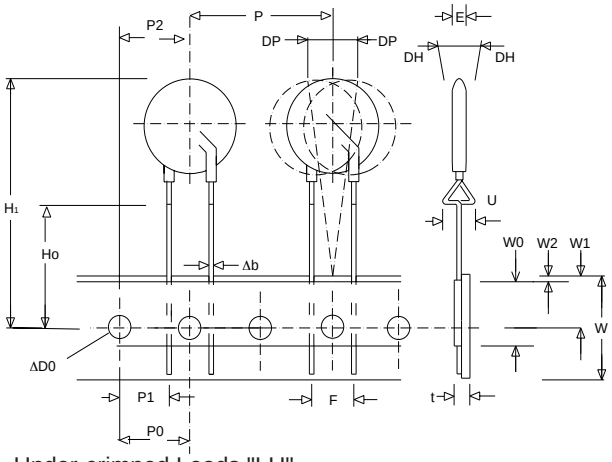
10, 14 and 20mm Devices



Crimped Leads "LT"



Straight Leads "LS"



Under-crimped Leads "LU"

LA Varistor Series

SYMBOL	PARAMETER	MODEL SIZE			
		7mm	10mm	14mm	20mm
P	Pitch of Component	12.7 ± 1.0	25.4 ± 1.0	25.4 ± 1.0	25.4 ± 1.0
P_0	Feed Hole Pitch	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2
P_1	Feed Hole Center to Pitch	3.85 ± 0.7	8.85 ± 0.7	8.85 ± 0.7	8.85 ± 0.7
P_2	Hole Center to Component Center	6.35 ± 0.7	12.7 ± 0.7	12.7 ± 0.7	12.7 ± 0.7
F	Lead to Lead Distance	5.0 ± 0.8	7.5 ± 0.8	7.5 ± 0.8	7.5 ± 0.8
h	Component Alignment	2.0 Max	2.0 Max	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	18.0 + 1.0 18.0 - 0.5	18.0 + 1.0 18.0 - 0.5
W_0	Hold Down Tape Width	12.0 ± 0.3	12.0 ± 0.3	12.0 ± 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	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	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	18.0 + 2.0 18.0 - 0.0	18.0 + 2.0 18.0 - 0.0
H_0	Seating Plane Height	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5
H_1	Component Height	32.0 Max	36.0 Max	40.0 Max	46.5 Max
D_0	Feed Hole Diameter	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2
t	Total Tape Thickness	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2
U	Under-crimp Width	8.0 Max	8.0 Max	8.0 Max	8.0 Max
p	Component Alignment	3^o Max 1.00mm	3^o Max 1.00mm	3^o Max 1.00mm	3^o Max

NOTE: Dimensions are in mm.

Tape and Reel Data

- Conforms to ANSI and EIA specifications
- Can be supplied to IEC Publication 286-2
- Radial devices on tape are supplied with crimped leads, straight leads, or under-crimped leads

LA Varistor Series

Tape and Reel Ordering Information

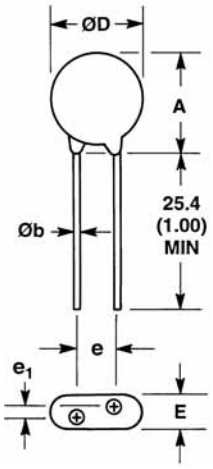
Crimped leads are standard on LA types supplied in tape and reel and are denoted by the model letter "T". Model letter "S" denotes straight leads and letter "U" denotes special under-crimped leads.

Example:

STANDARD MODEL	CRIMPED LEADS	STRAIGHT LEADS	UNDER-CRIMPED LEADS
V130LA2	V130LT2	V130LS2	V130LU2

Standard Bulk Pack Quantity

VARISTOR VOLTAGE MODEL	STANDARD BULK PACK QUANTITY			
	VARISTOR MODEL SIZE			
	7mm	10mm	14mm	20mm
130-275	1500	1000	700	500
300-460	1500	700	600	400
510-625	1500	700	500	400



SYMBOL	VOLTAGE MODEL	VARISTOR MODEL SIZE							
		7mm		10mm		14mm		20mm	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	V130LA-V320LA	- -	12 (0.472)	- -	16 (0.630)	- -	20 (0.787)	- -	26.5 (1.043)
	V385LA-V1000LA	- -	13 (0.0512)	- -	17 (0.689)	- -	20.5 (0.807)	- -	28 (1.102)
ØD	All	- -	9 (0.354)	- -	12.5 (0.492)	- -	17 (0.669)	- -	23 (0.906)
e	All	4 (0.157)	6 (0.236)	6.5 (0.256)	8.5 (0.335)	6.5 (0.256)	8.5 (0.335)	6.5 (0.256) (Note 2)	8.5 (0.335) (Note 2)
e_1	V130LA-V320LA	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)
	V385A-V1000LA	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)	2.5 (0.098)	5.5 (0.217)
E	V130LA-V320LA	- -	5.6 (0.220)	- -	5.6 (0.220)	- -	5.6 (0.220)	- -	5.6 (0.220)
	V385LA-V660LA	- -	7.5 (0.287)	- -	7.5 (0.287)	- -	7.5 (0.287)	- -	7.5 (0.287)
	V1000LA	- -	- -	- -	- -	- -	10.8 (0.425)	- -	10.8 (0.425)
Øb	All (Note 3)	0.585 (0.023)	0.685 (0.027)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030) (Note 2)	0.86 (0.034) (Note 2)

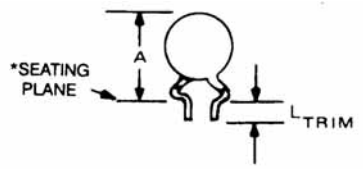
NOTES:

1. Dimensions in millimeters, inches in parentheses.
2. 10mm (9mm min, 11mm Max) ALSO AVAILABLE; See Additional Lead Style Options
3. 1000V parts supplied with lead wire of diameter 1.00 ± 0.05 (0.039 ± 0.002).

LA Varistor Series

Additional Lead Style Options

Radial lead types can be supplied with combination preformed crimp and trimmed leads. This option is supplied to the dimensions shown.



*Seating plane interpretation per IEC-717

CRIMPED AND TRIMMED LEAD

SYMBOL	VARISTOR MODEL SIZE							
	7mm		10mm		14mm		20mm	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	- -	15 (0.591)	- -	19.5 (0.768)	- -	22.5 (0.886)	- -	29.0 (1.142)
L_{TRIM}	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)

NOTE: Dimensions in millimeters, inches in parentheses.

- To order this crimped and trimmed lead style, standard radial type model numbers are changed by replacing the model letter “A” with “C”.

Example:

STANDARD CATALOG MODEL	ORDER AS:
V130LA2	V130LC2

For crimped leads without trimming and any variations to the above, contact Littelfuse.

- For 10/±1mm lead spacing on 20mm diameter models only; append standard model numbers by adding “X10”.

Example:

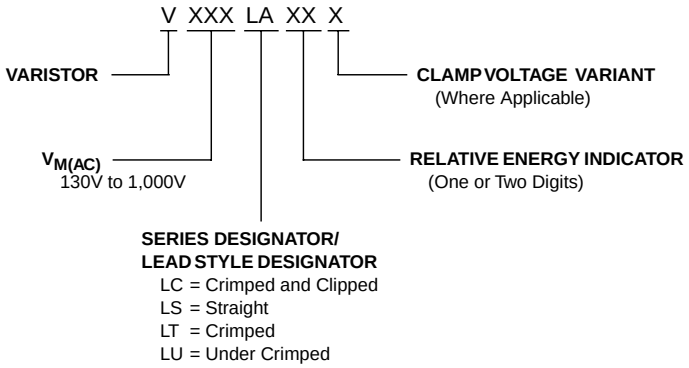
STANDARD CATALOG MODEL	ORDER AS:
V130LA20A	V130LA20AX10

LA series varistors for Hi-Temperature operating conditions:

- Phenolic Coated LA Series devices are available with improved maximum operating maximum temperature 125°C.
- These devices also have improved temperature cycling performance capability.
- Ratings and Specifications are as per standard LA Series except Hi-Pot encapsulation Isolation Voltage Capability = 500V.
- To order: add X1347 to part number (e.g. V230LA20AX1347)
- Marked identifier will contain 'P' to denote Phenolic.
- These devices are not UL, CSA, VDE or CECC certified.
- Contact factory for further details.

Ordering Information

LA series Varistors are shipped standard in bulk pack with straight leads and lead spacing outlined in the package dimensions on page 4-13. Contact your Littelfuse sales representative to discuss the non-standard options outlined below.

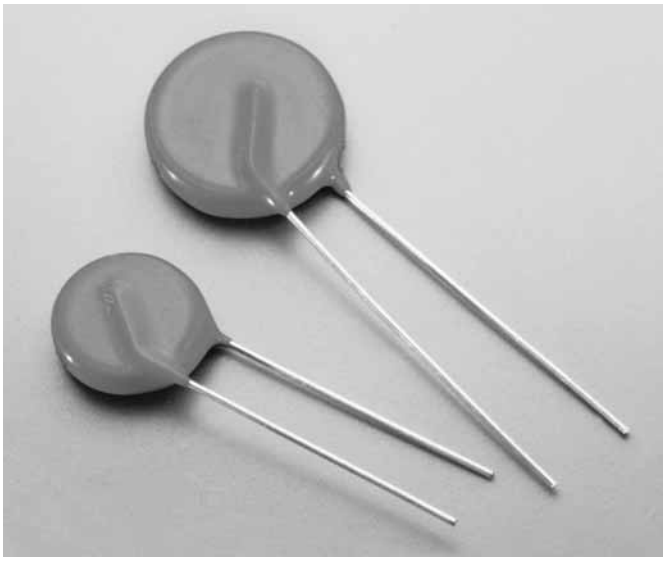


ZA Varistor Series

The ZA Series of transient voltage surge suppressors are radial-lead varistors (MOVs) designed for use in the protection of low and medium-voltage circuits and systems. Typical applications include motor control, telecom, automotive systems, solenoid, and power supply circuits to protect circuit board components and maintain data integrity.

These devices are available in five model sizes: 5mm, 7mm, 10mm, 14mm and 20mm, and feature a wide V_{DC} voltage range of 5.5V to 615V.

See ZA Series Device Ratings and Specifications table for part number and brand information.



Features

- Wide Operating Voltage Range $V_{M(AC)RMS}$ . . . . . .4V to 460V
- DC Voltage Ratings . . . . . .5.5V to 615V
- No Derating Up to 85°C Ambient
- 5 Model Sizes Available . . . . . 5, 7, 10, 14, and 20mm
- Radial-Lead Package for Hard-Wired or Printed Circuit Board Designs
- Available in Tape and Reel or Bulk Pack
- Standard Lead Form Options

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. VDE certified.

AGENCY FILE NUMBERS: UL E135010, VDE 116895E.

ZA Varistor Series

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

	ZA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	4 to 460	V
DC Voltage Range ($V_{M(DC)}$)	5.5 to 615	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	50 to 6500	A
Single Pulse Energy Range (Note 1)		
For 10/1000µs Current Wave (W_{TM})	0.1 to 52	J
Operating Ambient Temperature Range (T_A)	-55 to85	°C
Storage Temperature Range (T_{STG})	-55 to125	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/°C
Hi-Pot Encapsulation (Isolation Voltage Capability)	2500	V
(Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)		
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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications (Note 1)

PART NUMBER	MODEL SIZE DISC DIA. (mm)	BRAND	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20µs		TYPICAL CAPACITANCE f = 1MHz
			V_{RMS}	V_{DC}	ENERGY 10 x 1000µs	PEAK CURRENT 8 x 20µs					
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	C
			(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
V8ZA05	5	Z08	4	5.5	0.1	50	6	11	30	1	1400
V8ZA1	7	08Z1	4	5.5	0.4	100	6	11	22	2.5	3000
V8ZA2	10	08Z2	4	5.5	0.8	250	6	11	20	5	7500
V12ZA05	5	Z12	6	8	0.14	50	9	16	37	1	1200
V12ZA1	7	12Z1	6	8	0.6	100	9	16	34	2.5	2500
V12ZA2	10	12Z2	6	8	1.2	250	9	16	30	5	6000
V18ZA05	5	Z18	10	14	0.17	100	14.4	21.6	36	1	1000
V18ZA1	7	18Z1	10	14	0.8	250	14.4	21.6	36	2.5	2000
V18ZA2	10	18Z2	10	14	1.5	500	14.4	21.6	36	5	5000
V18ZA3	14	18Z3	10	14	3.5	1000	14.4	21.6	36	10	11000
V18ZA40	20	18Z40	10	14	80 (Note 2)	2000	14.4 (Note 3)	21.6	37	20	22000
V22ZA05	5	Z22	14	18	0.2	100	18.7	26	43	1	800
V22ZA1	7	22Z1	14	18	0.9	250	18.7	26	43	2.5	1600
V22ZA2	10	22Z2	14	18	2	500	18.7	26	43	5	4000
V22ZA3	14	22Z3	14	18	4	1000	18.7	26	43	10	9000
V24ZA50	20	24Z50	14	18 (Note 4)	100 (Note 2)	2000	19.2 (Note 3)	26	43	20	18000
V27ZA05	5	Z27	17	22	0.25	100	23	31.1	53	1	600
V27ZA1	7	27Z1	17	22	1	250	23	31.1	53	2.5	1300
V27ZA2	10	27Z2	17	22	2.5	500	23	31.1	53	5	3000
V27ZA4	14	27Z4	17	22	5	1000	23	31.1	53	10	7000
V27ZA60	20	27Z60	17	22	120 (Note 2)	2000	23 (Note 3)	31.1	50	20	13000

ZA Varistor Series

Device Ratings and Specifications (Note 1) (Continued)

PART NUMBER	MODEL SIZE DISC DIA. (mm)	BRAND	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20μs		TYPICAL CAPACITANCE f = 1MHz
			V_{RMS}	V_{DC}	ENERGY 10 x 1000μs	PEAK CURRENT 8 x 20μs					
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	C
			(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
V33ZA05	5	Z33	20	26	0.3	100	29.5	38	65	1	500
V33ZA1	7	33Z1	20	26	1.2	250	29.5	36.5	65	2.5	1100
V33ZA2	10	33Z2	20	26	3	500	29.5	36.5	65	5	2700
V33ZA5	14	33Z5	20	26	6	1000	29.5	36.5	65	10	6000
V33ZA70	20	33Z70	21	27	150 (Note 2)	2000	29.5 (Note 3)	36.5	58	20	13000
V36ZA80	20	36Z80	23	31	160 (Note 2)	2000	32 (Note 3)	40	63	20	12000
V39ZA05	5	Z39	25	31	0.3	100	35	46	79	1	500
V39ZA1	7	39Z1	25	31	1.2	250	35	43	79	2.5	1100
V39ZA3	10	39Z3	25	31	3	500	35	43	76	5	2700
V39ZA6	14	39Z6	25	31	6	1000	35	43	76	10	6000
V39ZA20	20	39Z20	25	31	20	2000	35	43	76	20	12000
V47ZA05	5	Z47	30	38	0.4	100	42	55	93	1	400
V47ZA1	7	47Z1	30	38	1.8	250	42	52	93	2.5	800
V47ZA3	10	47Z3	30	38	4.5	500	42	52	93	5	2000
V47ZA7	14	47Z7	30	38	8.8	1000	42	52	93	10	4500
V47ZA20	20	47Z20	30	38	23	2000	42	52	93	20	11000
V56ZA05	5	Z56	35	45	0.5	100	50	66	110	1	360
V56ZA2	7	56Z2	35	45	2.3	250	50	62	110	2.5	700
V56ZA3	10	56Z3	35	45	5.5	500	50	62	110	5	1800
V56ZA8	14	56Z8	35	45	10	1000	50	62	110	10	3900
V56ZA20	20	56Z20	35	45	30	2000	50	62	110	20	10000
V68ZA05	5	Z68	40	56	0.6	100	61	80	135	1	300
V68ZA2	7	68Z2	40	56	3	250	61	75	135	2.5	600
V68ZA3	10	68Z3	40	56	6.5	500	61	75	135	5	1500
V68ZA10	14	68Z10	40	56	13	1000	61	75	135	10	3300
V68ZA20	20	68Z20	40	56	33	2000	61	75	135	20	10000
V82ZA05	5	Z82	50	68	2	400	73	97	135	5	240
V82ZA2	7	82Z2	50	68	4	1200	73	91	135	10	500
V82ZA4	10	82Z4	50	68	8	2500	73	91	135	25	1100
V82ZA12	14	82Z12	50	68	15	4500	73	91	145	50	2500
V100ZA05	5	Z100	60	81	2.5	400	90	117	165	5	180
V100ZA3	7	100Z	60	81	5	1200	90	110	165	10	400
V100ZA4	10	100Z4	60	81	10	2500	90	110	165	25	900
V100ZA15	14	100Z15	60	81	20	4500	90	110	175	50	2000

ZA Varistor Series

Device Ratings and Specifications (Note1) (Continued)

	PART NUMBER	MODEL SIZE DISC DIA. (mm)	BRAND	MAXIMUM RATING (85°C)				SPECIFICATIONS (25°C)				
				CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8 x 20µs		TYPICAL CAPACITANCE f = 1MHz
				V_{RMS}	V_{DC}	ENERGY 10 x 1000µs	PEAK CURRENT 8 x 20µs					
				$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	V_{NOM} MIN	V_{NOM} MAX	V_C	I_{PK}	C
				(V)	(V)	(J)	(A)	(V)		(V)	(A)	(pF)
	V120ZA05	5	Z120	75	102	3	400	108	138	205	5	140
	V120ZA1	7	120Z	75	102	6	1200	108	132	205	10	300
	V120ZA4	10	120Z4	75	102	12	2500	108	132	200	25	750
	V120ZA6	14	120Z6	75	102	22	4500	108	132	210	50	1700
	V120ZA20	20	120Z20	75	102	33	6500	108	132	210	100	1500
	V150ZA05	5	Z150	92	127	4	400	135	173	250	5	120
	V150ZA1	7	Z051	95	127	8	1200	135	165	250	10	250
	V150ZA4	10	150Z4	95	127	15	2500	135	165	250	25	600
†	V150ZA8	14	150Z8	95	127	20	4500	135	165	250	50	1400
	V150ZA20	20	150Z20	95	127	45	6500	135	165	250	100	1000
	V180ZA05	5	Z180	110	153	5	400	162	207	295	5	100
	V180ZA1	7	180Z	115	153	10	1200	162	198	300	10	200
	V180ZA5	10	180Z5	115	153	18	2500	162	198	300	25	500
	V180ZA10	14	180Z10	115	153	35	4500	162	198	300	50	1100
	V180ZA20	20	180Z20	115	153	52	6500	162	198	300	100	2400
	V205ZA05	5	Z205	130	170	5.5	400	184	226	340	5	100
†	V220ZA05	5	Z220	140	180	6	400	198	253	360	5	90
†	V240ZA05	5	Z240	150	200	7	400	216	264	395	5	80
†	V270ZA05	5	Z270	175	225	7.5	400	243	311	455	5	70
†	V330ZA05	5	Z330	210	275	9	400	297	380	540	5	60
†	V360ZA05	5	Z360	230	300	9.5	400	324	396	595	5	55
†	V390ZA05	5	Z390	250	330	10	400	351	449	650	5	50
†	V430ZA05	5	Z430	275	369	11	400	387	495	710	5	45
†	V470ZA05	5	Z470	300	385	12	400	420	517	775	5	35
†	V620ZA05	5	Z620	385	505	13	400	558	682	1025	5	33
†	V680ZA05	5	Z680	420	560	14	400	610	748	1120	5	32
	V715ZA05	5	Z715	440	585	15.5	400	643	787	1180	5	31
	V750ZA05	5	Z750	460	615	17	400	675	825	1240	5	30

NOTES:

1. Average power dissipation of transients not to exceed 0.2W, 0.25W, 0.4W, 0.6W or 1W for model sizes 5mm, 7mm, 10mm, 14mm and 20mm, respectively.
2. Energy rating for impulse duration of 30ms minimum to one half of peak current (auto load dump).
3. 10mA DC test current.
4. Also rated to withstand 24V for 5 minutes.
5. Higher voltages available, contact Littelfuse.

† Also recognized to UL1449, “Transient Voltage Surge Suppressors” File #E75961.

ZA Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

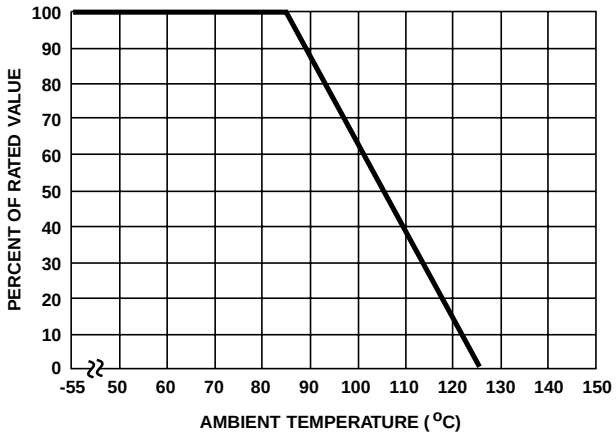
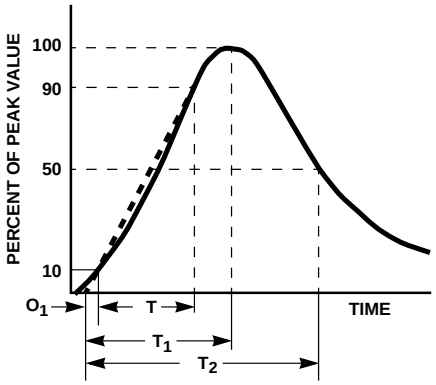


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

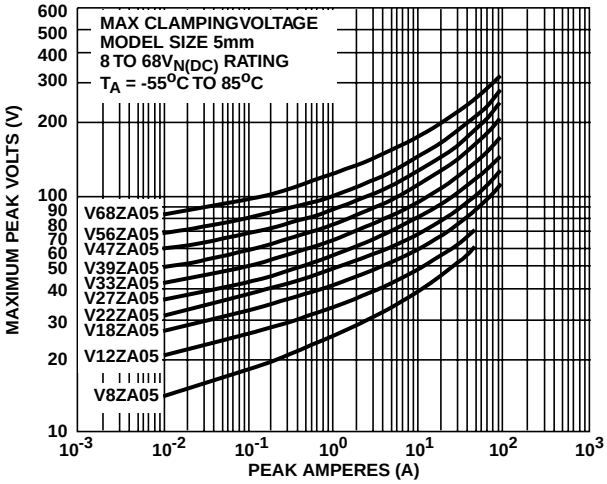


FIGURE 3. CLAMPING VOLTAGE FOR V8ZA05 - V68ZA05

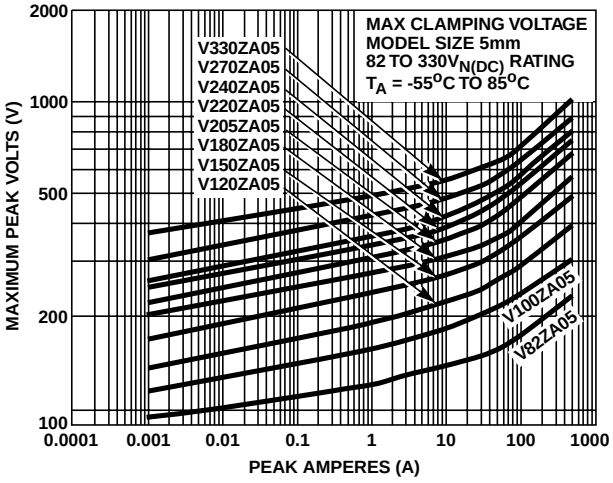


FIGURE 4. CLAMPING VOLTAGE FOR V82ZA05 - V330ZA05

ZA Varistor Series

Transient V-I Characteristics Curves (Continued)

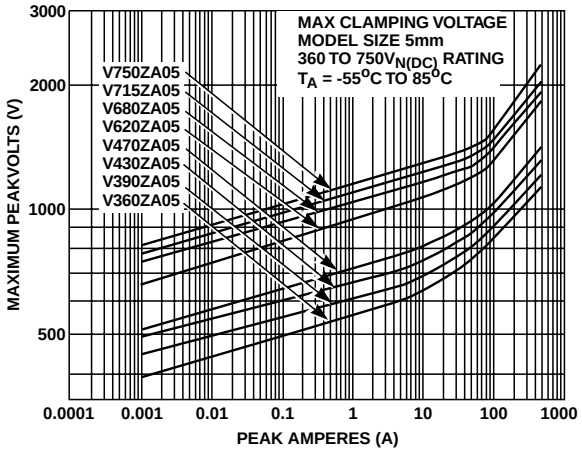


FIGURE 5. CLAMPING VOLTAGE FOR V360ZA05 - V750ZA05

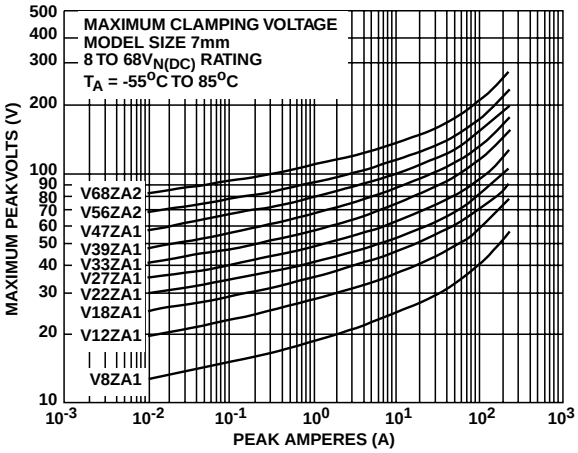


FIGURE 6. CLAMPING VOLTAGE FOR V8ZA1 - V68ZA2

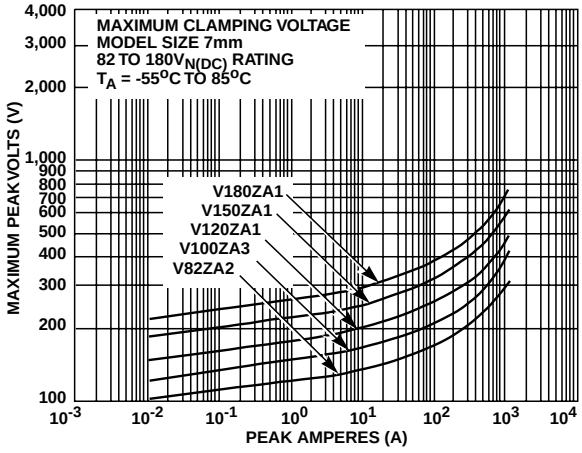


FIGURE 7. CLAMPING VOLTAGE FOR V82ZA2 - V180ZA1

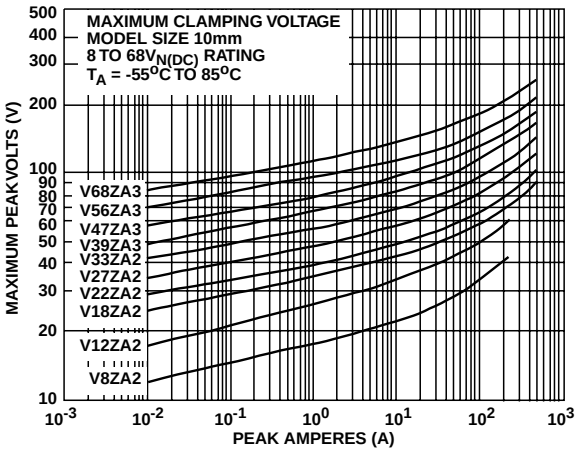


FIGURE 8. CLAMPING VOLTAGE FOR V8ZA2 - V68ZA3

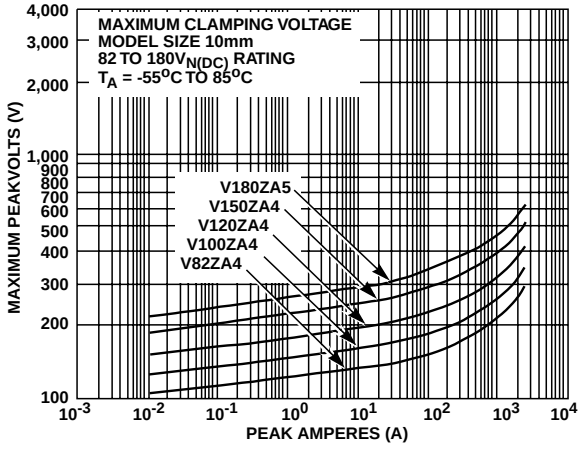


FIGURE 9. CLAMPING VOLTAGE FOR V82ZA4 - V180ZA5

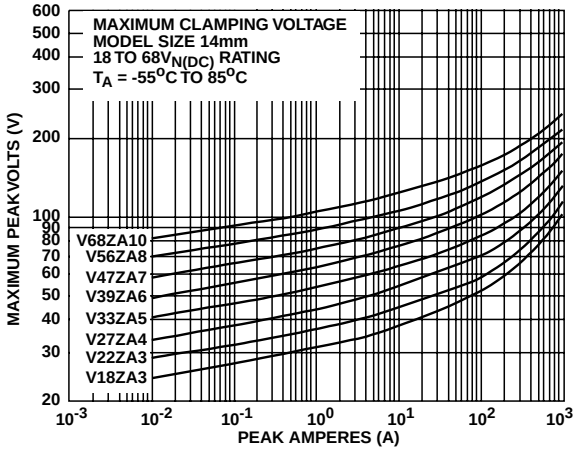


FIGURE 10. CLAMPING VOLTAGE FOR V18ZA3 - V68ZA10

ZA Varistor Series

Transient V-I Characteristics Curves (Continued)

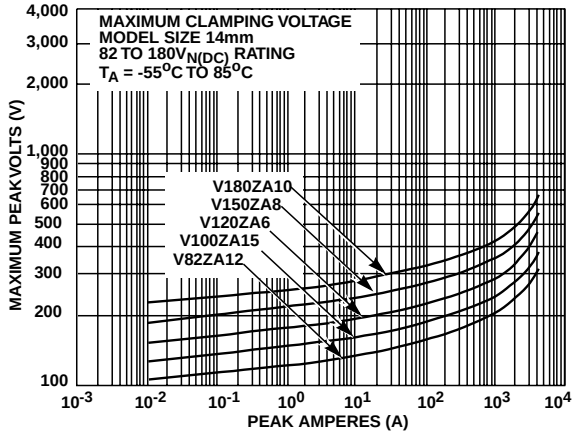


FIGURE 11. CLAMPING VOLTAGE FOR V82ZA12 - V180ZA10

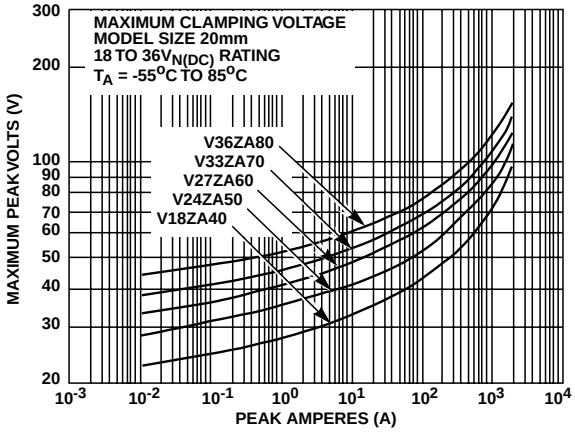


FIGURE 12. CLAMPING VOLTAGE FOR V18ZA40 - V36ZA80

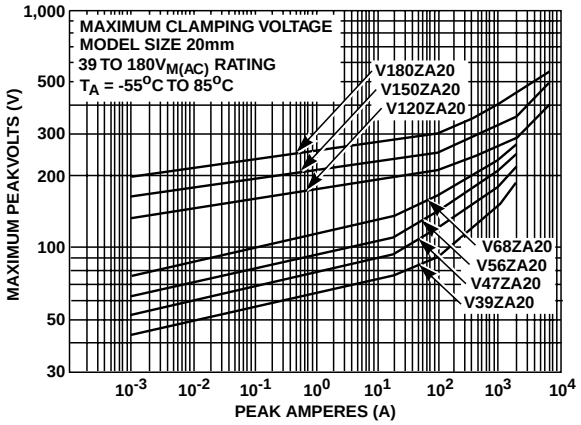


FIGURE 13. CLAMPING VOLTAGE FOR V39ZA20 - V180ZA20

Pulse Rating Curves

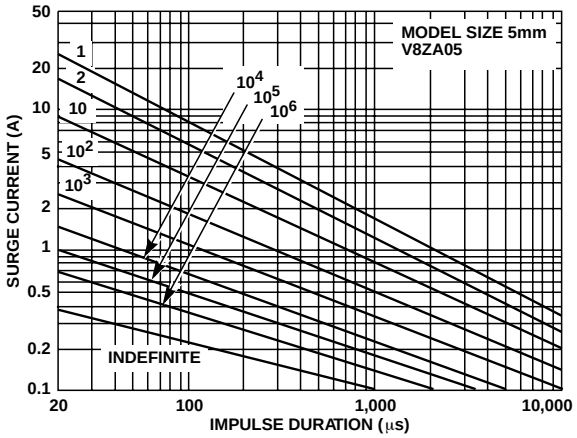


FIGURE 14. SURGE CURRENT RATING CURVES FOR V8ZA05

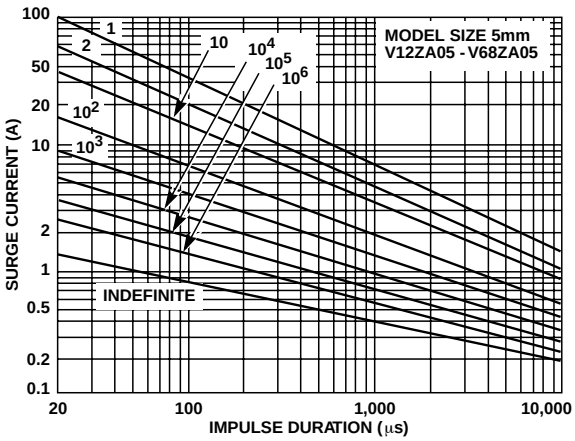


FIGURE 15. SURGE CURRENT RATING CURVES FOR V12ZA05 - V68ZA05

ZA Varistor Series

Pulse Rating Curves (Continued)

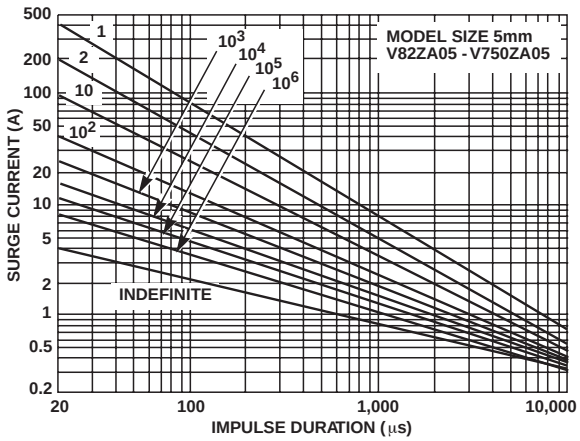


FIGURE 16. SURGE CURRENT RATING CURVES FOR V82ZA05 - V750ZA05

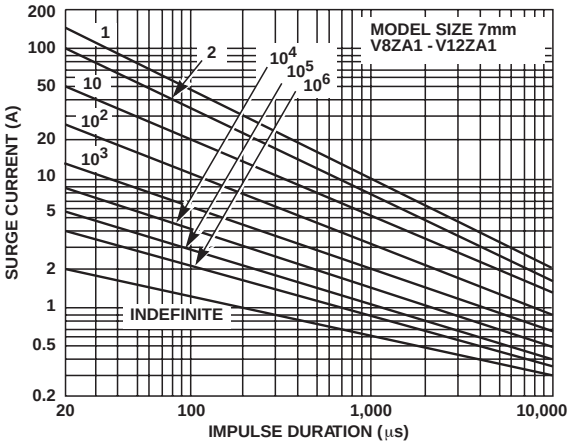


FIGURE 17. SURGE CURRENT RATING CURVES FOR V8ZA1 - V12ZA1

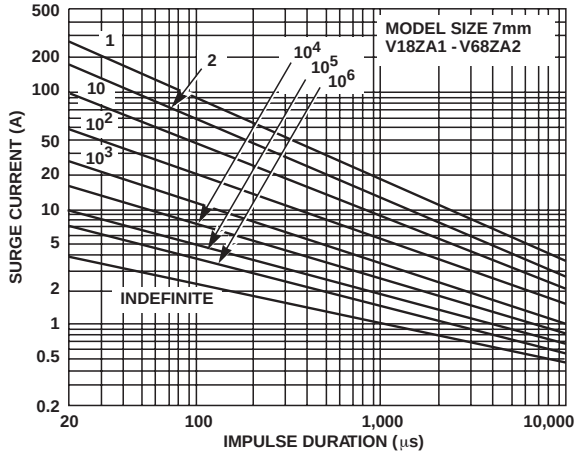


FIGURE 18. SURGE CURRENT RATING CURVES FOR V18ZA1 - V68ZA2

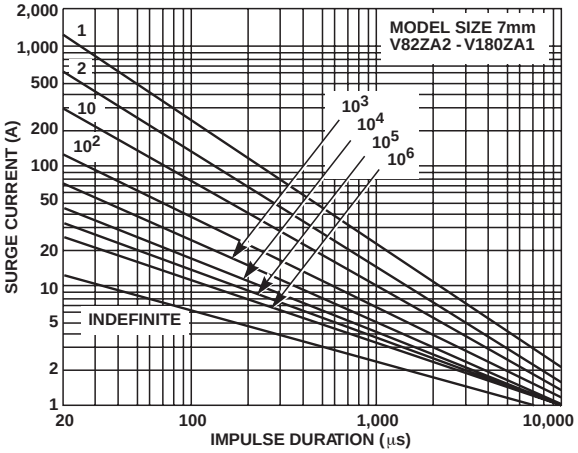


FIGURE 19. SURGE CURRENT RATING CURVES FOR V82ZA2 - V180ZA1

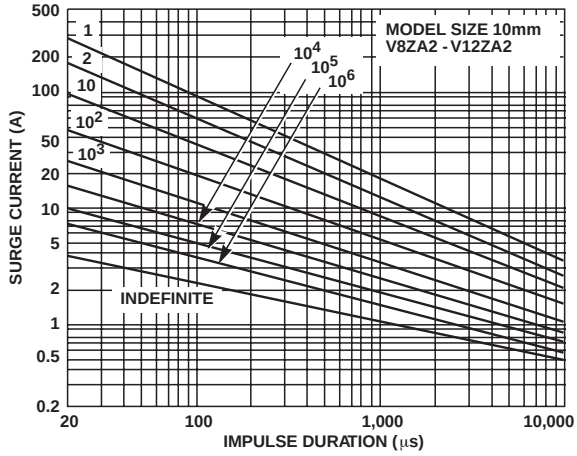


FIGURE 20. SURGE CURRENT RATING CURVES FOR V8ZA2 - V127ZA2

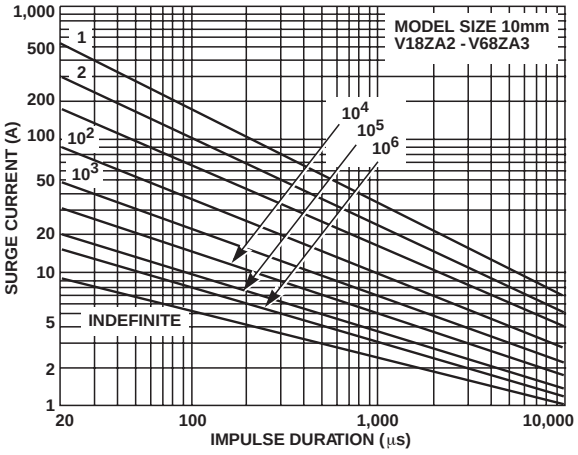


FIGURE 21. SURGE CURRENT RATING CURVES FOR V18ZA2 - V68ZA3

ZA Varistor Series

Pulse Rating Curves (Continued)

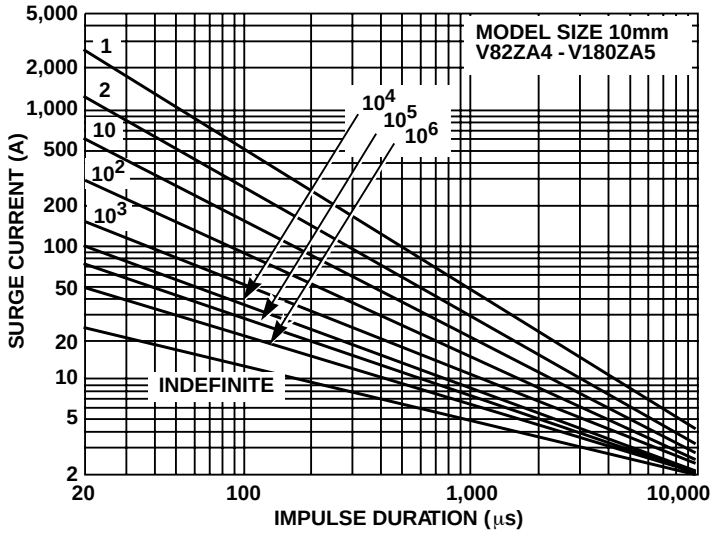


FIGURE 22. SURGE CURRENT RATING CURVES FOR V82ZA4 - V180ZA5

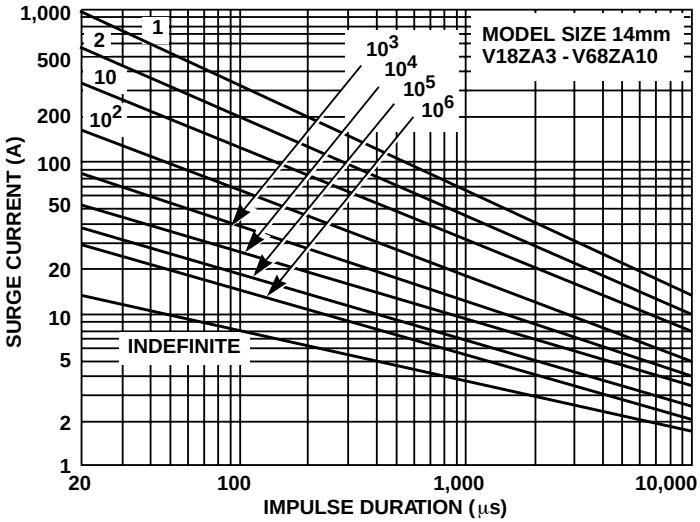


FIGURE 23. SURGE CURRENT RATING CURVES FOR V18ZA3 - V68ZA10

ZA Varistor Series

Pulse Rating Curves (Continued)

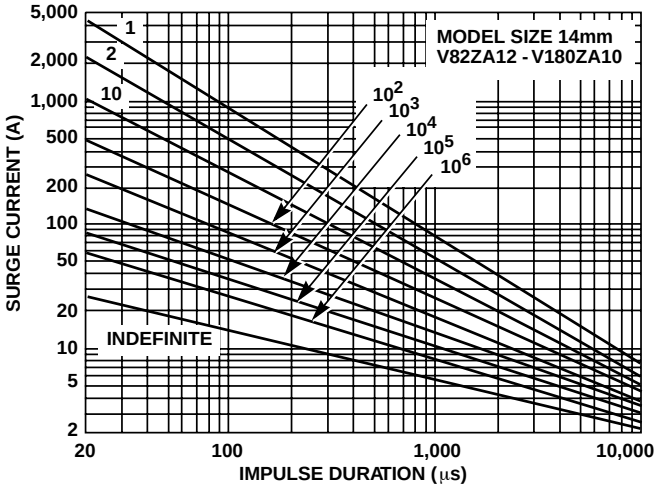


FIGURE 24. SURGE CURRENT RATING CURVES FOR V82ZA12 - V180ZA10

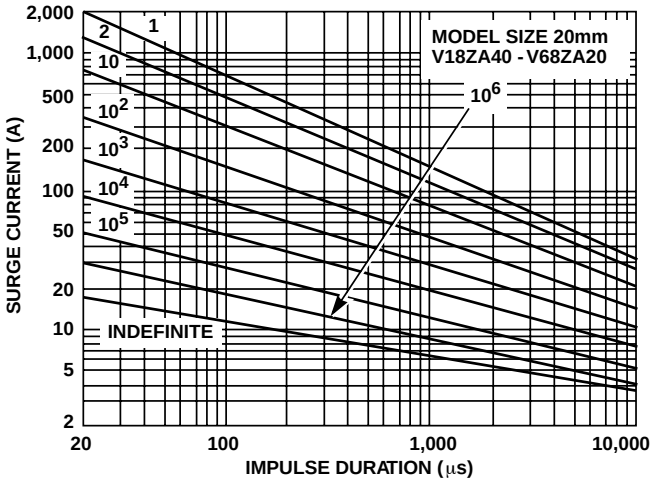


FIGURE 25. SURGE CURRENT RATING CURRENT FOR V18ZA40 - V68ZA20

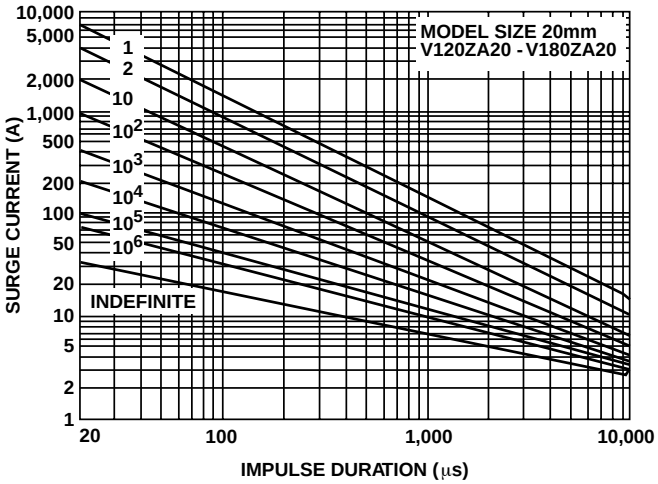


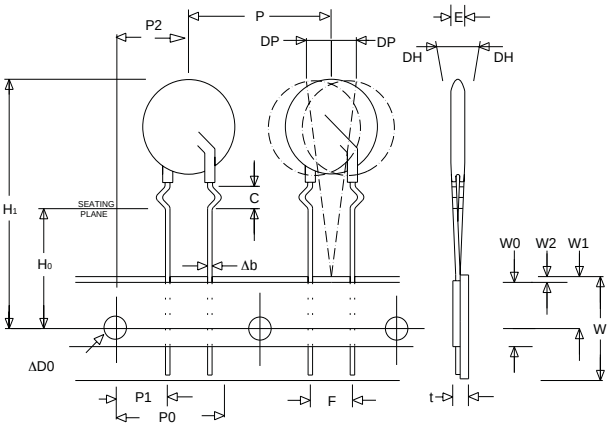
FIGURE 26. SURGE CURRENT RATING CURVES FOR V120ZA20 - V180ZA20

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$(at specified current) of more then ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but does not prevent the device from continuing to function, and to provide ample protection.

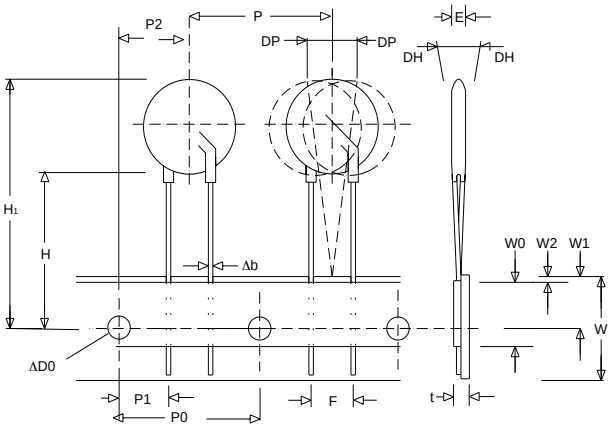
ZA Varistor Series

Tape and Reel Specifications

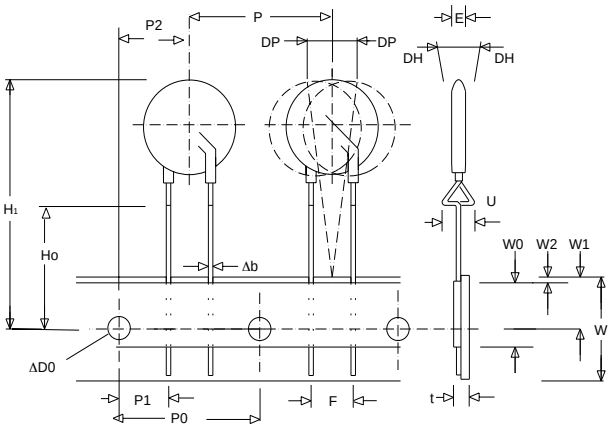
5 and 7mm Devices



Crimped Leads "LT"

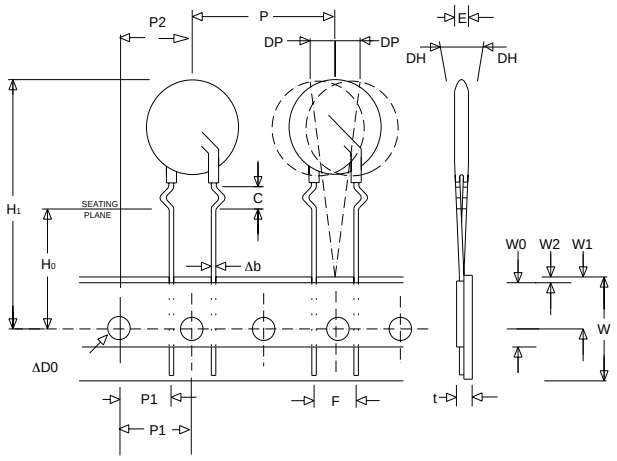


Straight Leads "LS"

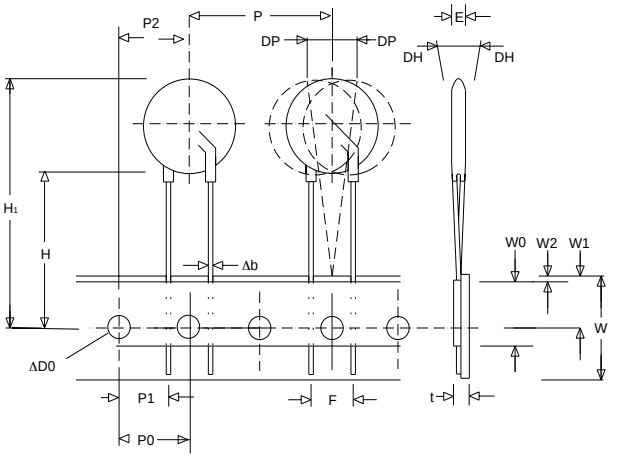


Under-crimped Leads "LU"

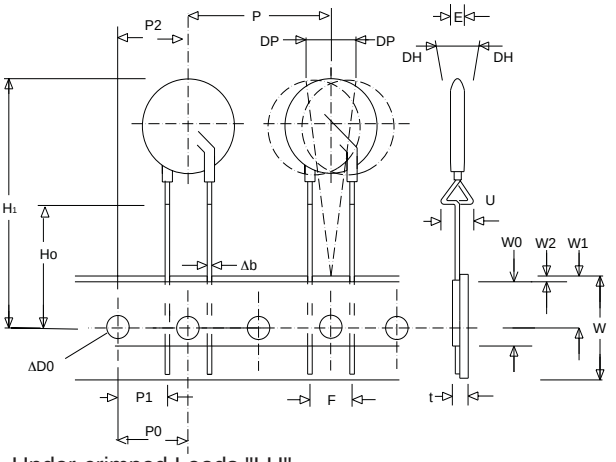
10, 14 and 20mm Devices



Crimped Leads "LT"



Straight Leads "LS"



Under-crimped Leads "LU"

ZA Varistor Series

SYMBOL	PARAMETER	MODEL SIZE				
		5mm	7mm	10mm	14mm	20mm
P	Pitch of Component	12.7 ± 1.0	12.7 ± 1.0	25.4 ± 1.0	25.4 ± 1.0	25.4 ± 1.0
P_0	Feed Hole Pitch	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2	12.7 ± 0.2
P_1	Feed Hole Center to Pitch	3.85 ± 0.7	3.85 ± 0.7	8.85 ± 0.7	8.85 ± 0.7	8.85 ± 0.7
P_2	Hole Center to Component Center	6.35 ± 1.0	6.35 ± 1.0	12.7 ± 0.7	12.7 ± 0.7	12.7 ± 0.7
F	Lead to Lead Distance	5.0 ± 1.0	5.0 ± 1.0	7.5 ± 1.0	7.5 ± 1.0	7.5 ± 1.0
h	Component Alignment	2.0 Max	2.0 Max	2.0 Max	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	18.0 + 1.0 18.0 - 0.5	18.0 + 1.0 18.0 - 0.5	18.0 + 1.0 18.0 - 0.5
W_0	Hold Down Tape Width	12.0 ± 0.3	12.0 ± 0.3	12.0 ± 0.3	12.0 ± 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	9.0 + 0.75 9.0 - 0.50	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	0.5 Max	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	18.0 + 2.0 18.0 - 0.0	18.0 + 2.0 18.0 - 0.0	18.0 + 2.0 18.0 - 0.0
H_0	Seating Plane Height	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5
H_1	Component Height	29.0 Max	32.0 Max	36.0 Max	40.0 Max	46.5 Max
D_0	Feed Hole Diameter	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2
t	Total Tape Thickness	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2	0.7 ± 0.2
U	Under-crimp Width	8.0 Max	8.0 Max	8.0 Max	8.0 Max	8.0 Max
p	Component Alignment	3^o Max	3^o Max	3^o Max	3^o Max	3^o Max

NOTE: Dimensions are in mm.

Tape and Reel Data

- Conforms to ANSI and EIA specifications
- Can be supplied to IEC Publication 286-2
- Radial devices on tape are supplied with crimped leads, straight leads, or under-crimped leads

NOTE: Leads are offset by Dim e1

ZA Varistor Series

Tape and Reel Ordering Information

Crimped leads are standard on ZA types supplied in tape and reel and are denoted by the model letter "T". Model letter "S" denotes straight leads and letter "U" denotes special under-crimped leads.

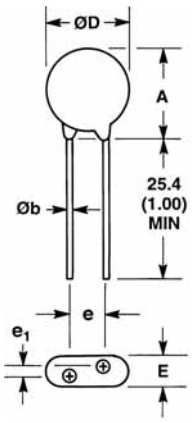
Example:

STANDARD MODEL	CRIMPED LEADS	STRAIGHT LEADS	UNDER-CRIMPED LEADS
V18ZA3	V18ZT3	V18ZS3	V18ZU3

SHIPPING QUANTITY

SIZE	RMS (MAX) VOLTAGE	QUANTITY PER REEL		
		"T" REEL	"S" REEL	"U" REEL
5mm	All	1000	1000	1000
7mm	All	1000	1000	1000
10mm	All	500	500	500
14mm	< 300V	500	500	500
14mm	≥ 300V	500	500	400
20mm	< 300V	500	500	500
20mm	≥ 300V	500	500	400

Mechanical Dimensions



SYMBOL	VOLTAGE MODEL	VARISTOR MODEL SIZE									
		5mm		7mm		10mm		14mm		20mm	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	All	- -	10 (0.394)	- -	12 (0.472)	- -	16 (0.630)	- -	20 (0.787)	- -	26.5 (1.043)
ØD	All	- -	7 (0.276)	- -	9 (0.354)	- -	12.5 (0.492)	- -	17 (0.669)	- -	23 (0.906)
e	All	4 (0.157)	6 (0.236)	4 (0.157)	6 (0.236)	6.5 (0.256)	8.5 (0.335)	6.5 (0.256)	8.5 (0.335)	6.5 (0.256) (Note 6)	8.5 (0.335) (Note 6)
e_1	V8ZA-V56ZA	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)
	V68ZA-V100ZA	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)	1.5 (0.059)	3.5 (0.138)
	V120ZA-V180ZA	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)	1 (0.039)	3 (0.118)	1 (0.038)	3 (0.118)	1 (0.038)	3 (0.118)
	V205ZA-V750ZA	1.5 (0.059)	3.5 (0.138)	- -	- -	- -	- -	- -	- -	- -	- -
E	V8ZA-V56ZA	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)
	V68ZA-V100ZA	- -	5.6 (0.220)	- -	5.6 (0.220)	- -	5.6 (0.220)	- -	5.6 (0.220)	- -	5.6 (0.220)
	V120ZA-V180ZA	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)	- -	5 (0.197)
	V205ZA-V750ZA	- -	5.6 (0.220)	- -	- -	- -	- -	- -	- -	- -	- -
Øb	All	0.585 (0.023)	0.685 (0.027)	0.585 (0.023)	0.685 (0.027)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)	0.76 (0.030)	0.86 (0.034)

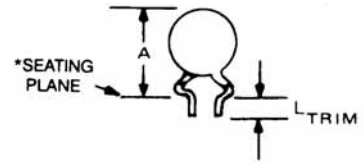
NOTES: Dimensions in millimeters, inches in parentheses.

6. 10mm ALSO AVAILABLE; See Additional Lead Style Options.
7. V24ZA50 and V24ZC50 only supplied with lead spacing of 6.35mm ± 0.5mm (0.25 ± 0.0196) Dimension e = 5.85 min. Does not apply to T&R parts.

ZA Varistor Series

Additional Lead Style Options

Radial lead types can be supplied with combination preformed crimp and trimmed leads. This option is supplied to the dimensions shown.



***SEATING PLANE INTERPRETATION PER IEC-717
CRIMPED AND TRIMMED LEAD**

SYMBOL	VARISTOR MODEL SIZE									
	5mm		7mm		10mm		14mm		20mm	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	- -	13.0 (0.512)	- -	15 (0.591)	- -	19.5 (0.768)	- -	22.5 (0.886)	- -	29.0 (1.142)
L_{TRIM}	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)	2.41 (0.095)	4.69 (0.185)

NOTE: Dimensions in millimeters, inches in parentheses.

- To order this crimped and trimmed lead style, standard radial type model numbers are changed by replacing the model letter “ZA” with “ZC”. This option is supplied in bulk only.

Example:

STANDARD CATALOG MODEL	ORDER AS:
V18ZA3	V18ZC3

For crimped leads without trimming and any varitions to the above, contact Littelfuse.

- For 10/±1mm lead spacing on 20mm diameter models only; append standard model numbers by adding “X10”.

Example:

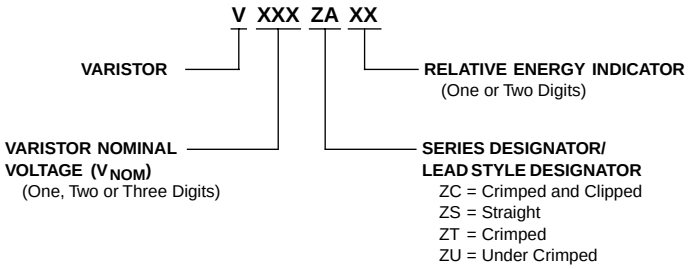
STANDARD CATALOG MODEL	ORDER AS:
V18ZA40	V18ZA40X10

ZA series varistors for Hi-Temperature operating conditions:

- Phenolic Coated ZA Series devices are available with improved maximum operating maximum temperature 125°C.
- These devices also have improved temperature cycling performance capability.
- Ratings and Specifications are as per standard ZA Series except Hi-Pot encapsulation Isolation Voltage Capability = 500V.
- To order: add X1347 to part number (e.g. V22ZA3X1347)
- Marked identifier will contain 'P' to denote Phenolic.
- These devices are not UL, CSA, VDE or CECC certified.
- Contact factory for further details.

Ordering Information

ZA series Varistors are shipped standard in bulk pack with straight leads and lead spacing outlined in the package dimensions on page 4-13. Contact your Littelfuse sales representative to discuss the non-standard options outlined below.



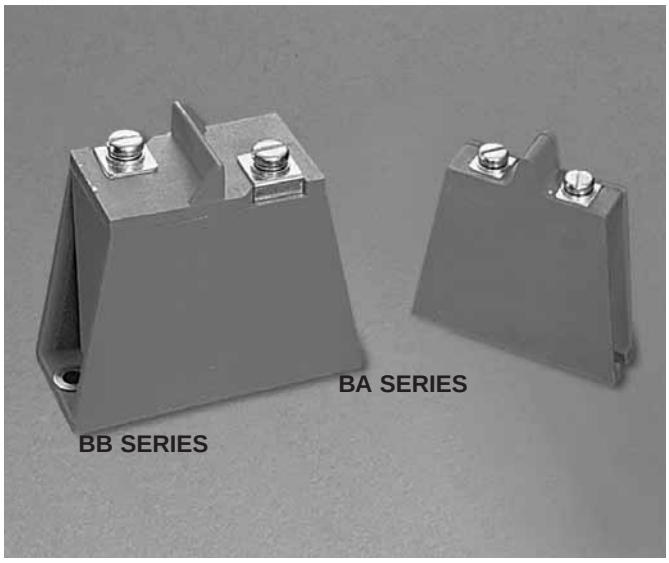
BA/BB Varistor Series

The BA and BB Series transient surge suppressors are heavy-duty industrial metal-oxide varistors (MOVs) designed to provide surge protection for motor controls and power supplies used in oil-drilling, mining, transportation equipment and other heavy industrial AC line applications.

These UL-recognized varistors have similar package construction but differ in size and ratings.The BA models are rated from 130 to 880$V_{M(AC)}$. The BB models from 1100 to 2800$V_{M(AC)}$.

Both the BA and BB Series feature improved creep and strike capability to minimize breakdown along the package surface, a package design that provides complete electrical isolation of the disc subassembly, and rigid terminals to insure secure wire contacts.

See BA/BB Series Device Ratings and Specifications table for part number and brand information.



Features

- High Energy Absorption Capability W_{TM}
  BA Series 3200J
  BB Series 10,000J
- Wide Operating Voltage Range $V_{M(AC)RMS}$
  BA Series . . . . . .130V to 880V
  BB Series . . . . . .1100V to 2800V
- Rigid Terminals for Secure Wire Contact
- Case Design Provides Complete Electrical Isolation of Disc Subassembly
- Littelfuse Largest Packaged Disc . . . . . .60mm Diameter
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories (BA Series only).

AGENCY FILE NUMBERS: UL E75961.

BA/BB Varistor Series

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

	BA SERIES	BB SERIES	UNITS
Continuous:			
Steady State Applied Voltage:			
AC Voltage Range ($V_{M(AC)RMS}$)	130 to 880	1100 to 2800	V
DC Voltage Range ($V_{M(DC)}$)	175 to 1150	1400 to 3500	V
Transient:			
Peak Pulse Current (I_{TM})			
For 8/20µs Current Wave (See Figure 2)	50,000 to 70,000	70,000	A
Single Pulse Energy Range			
For 2ms Current Squarewave (W_{TM})	450 to 3200	3800 to 10,000	J
Operating Ambient Temperature Range (T_A)	-55 to 85	-55 to 85	°C
Storage Temperature Range (T_{STG})	-55 to 125	-55 to 125	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	<0.01	%/°C
Hi-Pot Encapsulation (Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)	5000	5000	V
Insulation Resistance	1000	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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications

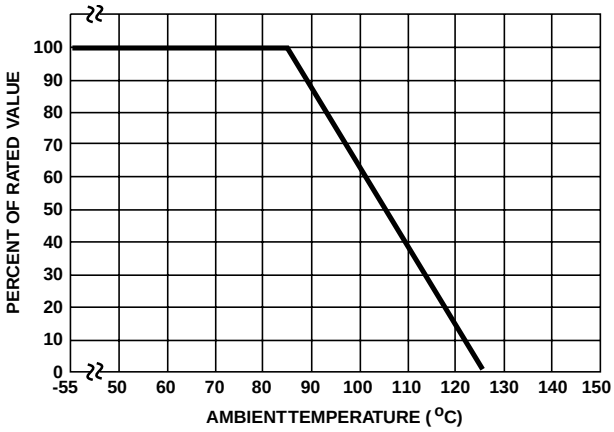
PART NUMBER AND DEVICE BRANDING	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
	CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT V_C AT 200A CURRENT (8/20µs)	TYPICAL CAPACI-TANCE
	V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)					
	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V131BA60	130	175	450	50000	184	200	228	340	20000
V151BA60	150	200	530	50000	212	240	268	400	16000
V251BA60	250	330	880	50000	354	390	429	620	10000
V271BA60	275	369	950	50000	389	430	473	680	9000
V321BA60	320	420	1100	50000	462	510	561	760	7500
V421BA60	420	560	1500	70000	610	680	748	1060	6000
V481BA60	480	640	1600	70000	670	750	825	1160	5500
V511BA60	510	675	1800	70000	735	820	910	1300	5000
V571BA60	575	730	2100	70000	805	910	1000	1420	4500
V661BA60	660	850	2300	70000	940	1050	1160	1640	4000
V751BA60	750	970	2600	70000	1080	1200	1320	1880	3500
V881BA60	880	1150	3200	70000	1290	1500	1650	2340	2700
V112BB60	1100	1400	3800	70000	1620	1800	2060	2940	2200
V142BB60	1400	1750	5000	70000	2020	2200	2550	3600	1800
V172BB60	1700	2150	6000	70000	2500	2700	3030	4300	1500
V202BB60	2000	2500	7500	70000	2970	3300	3630	5200	1200
V242BB60	2400	3000	8600	70000	3510	3900	4290	6200	1000
V282BB60	2800	3500	10000	70000	4230	4700	5170	7400	800

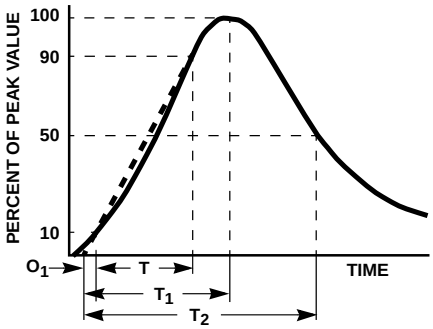
NOTE: Average power dissipation of transients not to exceed 2.5W. See Figures 3 and 4 for more information on power dissipation.

BA/BB Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Characteristics table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.





O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front Time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)

Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Typical Performance Curves

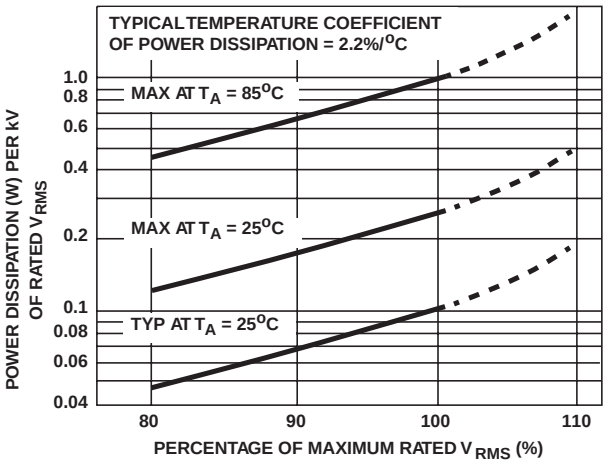


FIGURE 3. STANDBY POWER DISSIPATION vs APPLIED V_{RMS} AT VARIED TEMPERATURES

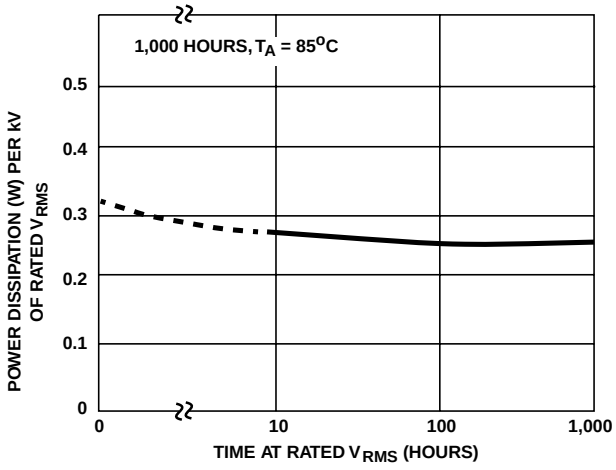


FIGURE 4. TYPICAL STABILITY OF STANDBY POWER DISSIPATION AT RATED V_{RMS} vs TIME

BA/BB Varistor Series

Transient V-I Characteristics Curves

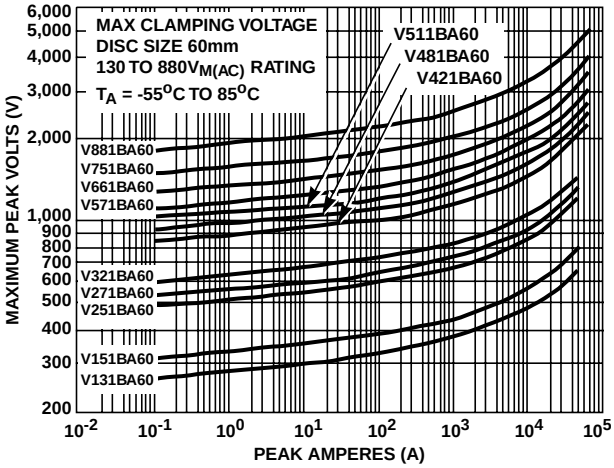


FIGURE 5. CLAMPING VOLTAGE FOR V131BA60 - V881BA60

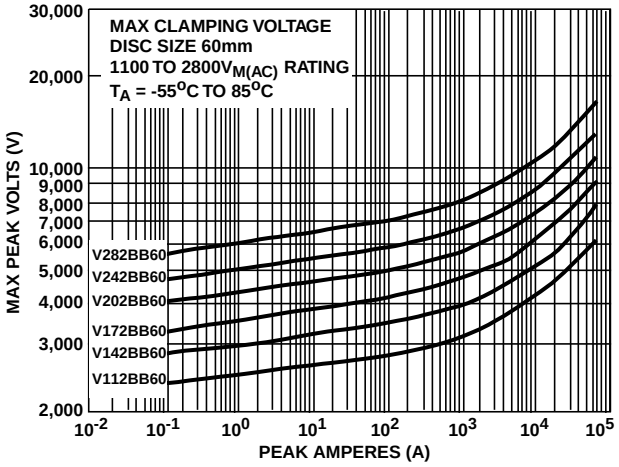


FIGURE 6. CLAMPING VOLTAGE FOR V112BB60 - V282BB60

Pulse Rating Curves

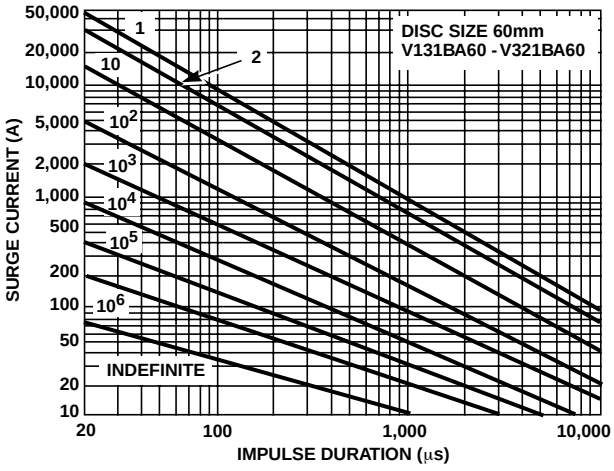


FIGURE 7. SURGE CURRENT RATING CURVES FOR V131BA60 - V321BA60

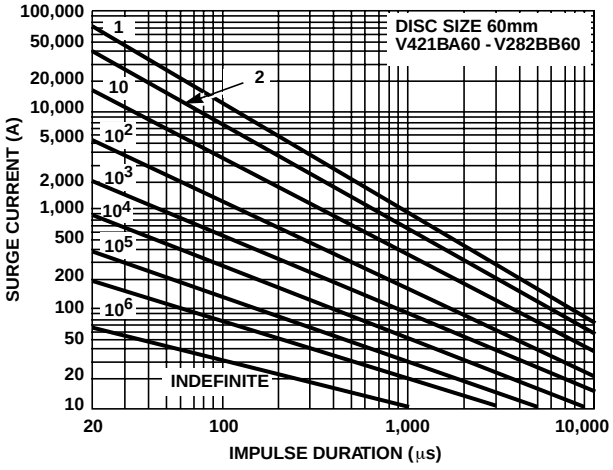


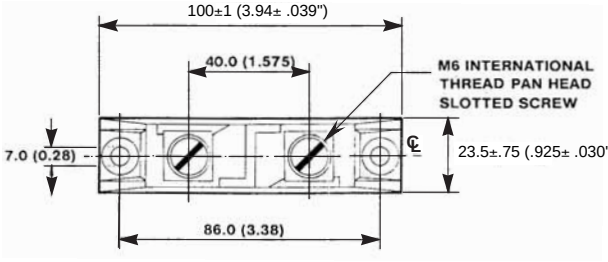
FIGURE 8. SURGE CURRENT RATING CURVES FOR V421BA60 - V282BB60

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result.This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

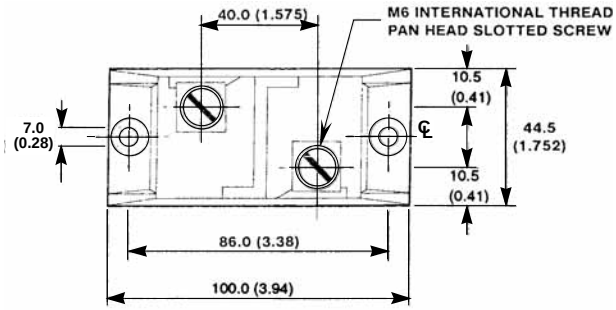
BA/BB Varistor Series

Mechanical Dimensions

BA SERIES



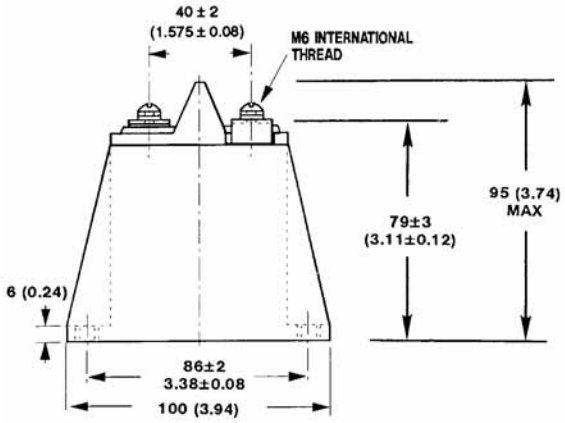
BB SERIES



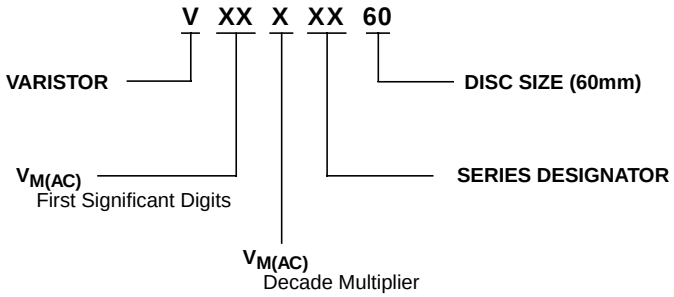
NOTES:

1. Typical weight:
   BA..... ..250g
   BB.....600g

Dimensions are in mm; inches in parentheses for reference only.



Ordering Information



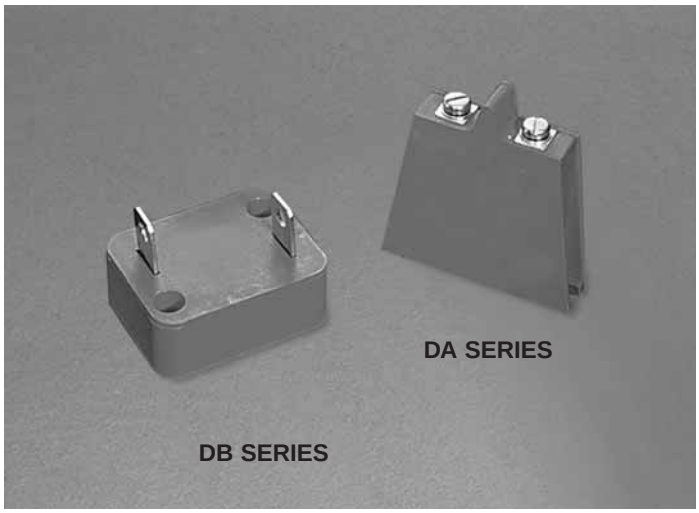
DA/DB Varistor Series

The DA and DB Series transient surge suppressors are heavy-duty industrial metal-oxide varistors designed to provide surge protection for motor controls and power supplies used in oil-drilling, mining, and transportation equipment.

These UL-recognized varistors have identical ratings and specifications but differ in case construction to provide flexibility in equipment designs.

DA series devices feature rigid terminals to insure secure wire contacts. Both the DA and DB series feature improved creep and strike distance capability to minimize breakdown along the package surface design that provides complete electrical isolation of the disc subassembly.

See DA/DB Series Device Ratings and Specifications table for part number and brand information.



Features

- High Energy Absorption Capability
  W_{TM} . . . . . Up To 1050J
- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . .130V to 750V
- Screw Terminals (DA Series),
  Quick Connect Push-On Connectors (DB Series)
- Case Design Provides Complete Electrical Isolation of Disc Subassembly
- 40mm Diameter Disc
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories.

AGENCY FILE NUMBERS: UL E75961.

DA/DB Varistor Series

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

	DA/DB SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	130 to 750	V
DC Voltage Range ($V_{M(DC)}$)	175 to 970	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	40,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	270 to 1050	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)	5000	V
(Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)		
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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications

PART NUMBER AND DEVICE BRANDING		MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT V_C AT 200A CURRENT (8/20µs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
DA	DB	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V131DA40	V131DB40	130	175	270	40000[1]	184	200	228	345	10000
V151DA40	V151DB40	150	200	300	40000[2]	212	240	268	405	8000
V251DA40	V251DB40	250	330	370	40000	354	390	429	650	5000
V271DA40	V271DB40	275	369	400	40000	389	430	473	730	4500
V321DA40	V321DB40	320	420	460	40000	462	510	561	830	3800
V421DA40	V421DB40	420	560	600	40000	610	680	748	1130	3000
V481DA40	V481DB40	480	640	650	40000	670	750	825	1240	2700
V511DA40	V511DB40	510	675	700	40000	735	820	910	1350	2500
V571DA40	V571DB40	575	730	770	40000	805	910	1000	1480	2200
V661DA40	V661DB40	660	850	900	40000	940	1050	1160	1720	2000
V751DA40	V751DB40	750	970	1050	40000	1080	1200	1320	2000	1800

NOTE: Average power dissipation of transients not to exceed 2.0W.
1: Peak current applies to applications rated up to $115V_{RMS}$. Peak Current is 30kA for applications greater than $115V_{RMS}$.
2: Peak current applies to applications rated up to $132V_{RMS}$. Peak Current is 30kA for applications greater than $132V_{RMS}$.

DA/DB Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt- seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

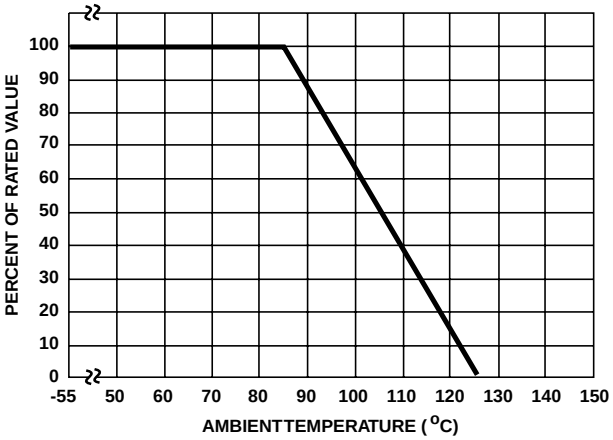
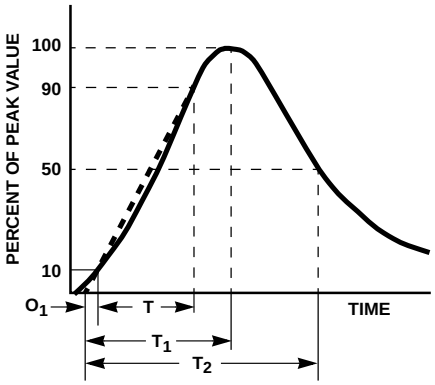


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curve

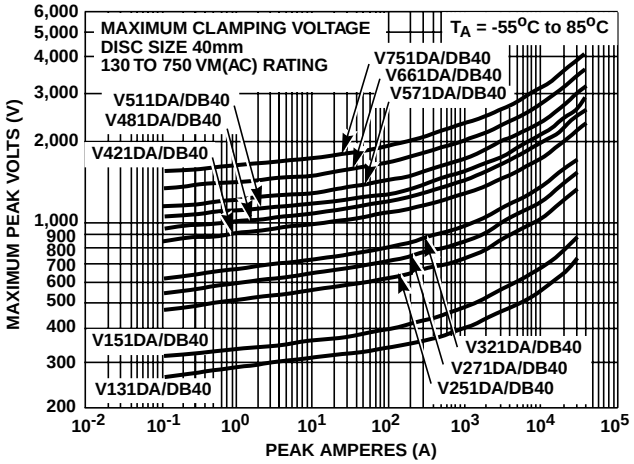


FIGURE 3. CLAMPING VOLTAGE FOR V131DA40, V131DB40 - V751DA40, V751DB40

DA/DB Varistor Series

Pulse Rating Curves

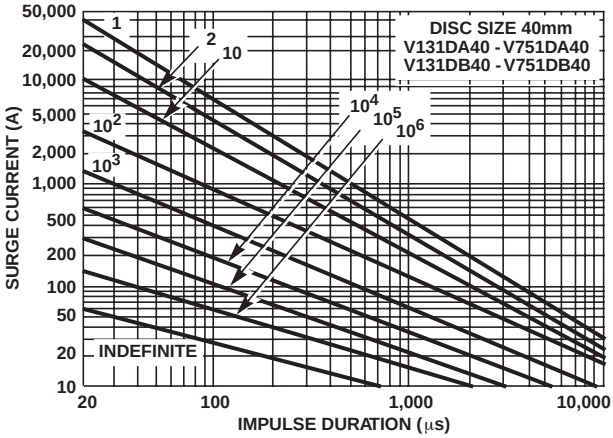
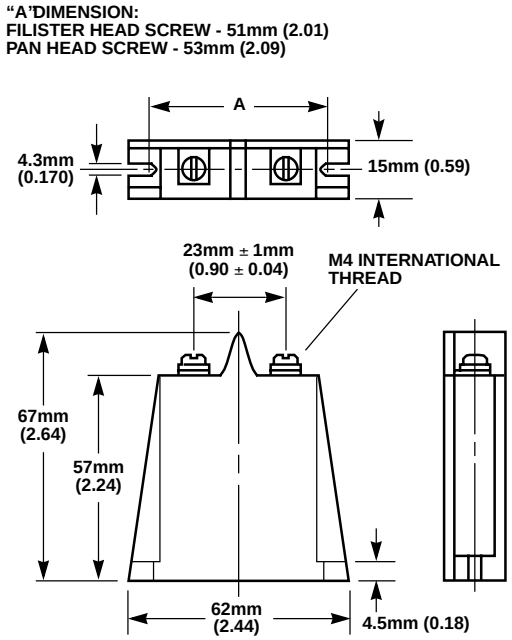


FIGURE 5. SURGE CURRENT RATING CURVES FOR V131DA40, V131DB40 - V751DA40, V751DB40

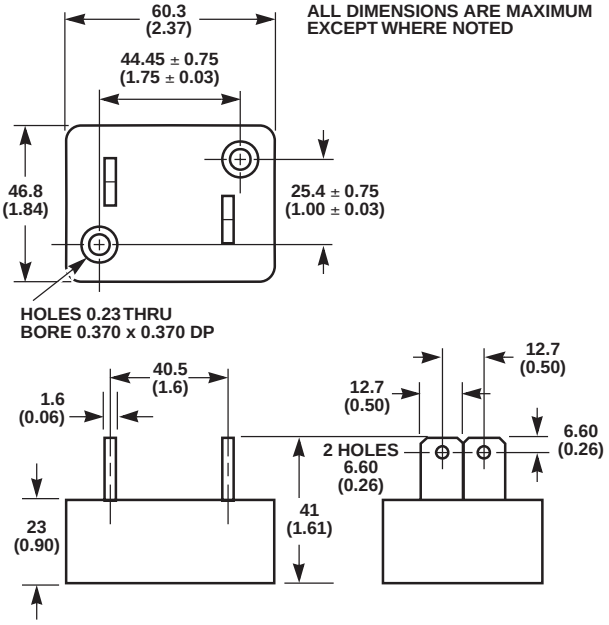
NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

Mechanical Dimensions

DA SERIES



DB SERIES



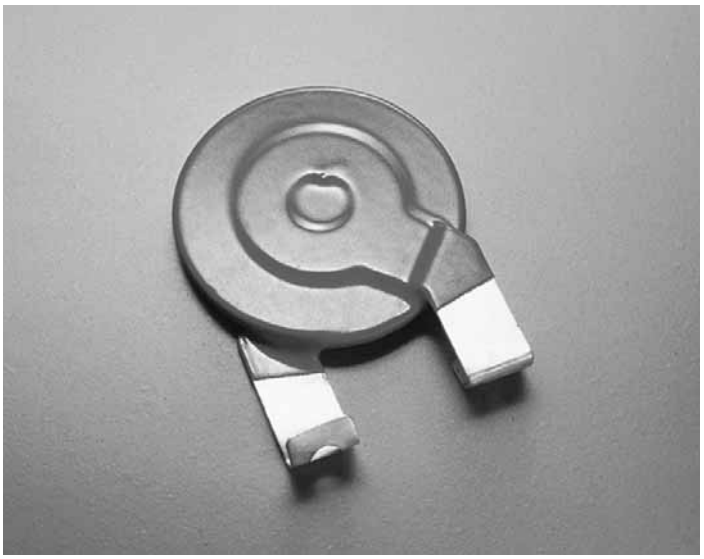
Dimensions in millimeters and (inches).

HA Varistor Series

HA Series transient surge suppressors are industrial high energy metal-oxide varistors (MOVs). They are designed to provide secondary surge protection in the outdoor and service entrance environment (distribution panels) of buildings, and also in industrial applications for motor controls and power supplies used in the oil-drilling, mining, and transportation fields.

The design of the HA Series of metal oxide varistors provide rigid terminals for screw mounting. Also available in a clipped lead version for through hole board placement or to accommodate soldered leads - designation “HC”.

See Ratings and Specifications table for part number and brand information.



Features

- Wide Operating Voltage Range $V_{M(AC)RMS}$ . . . . . .110V to 750V
- Two Disc Sizes Available . . . . . 32mm and 40mm
- High Energy Absorption Capability. . . . . .W_{TM} = 170J to 1050J
- High Peak Pulse Current Capability,. . . . . .I_{TM} = 25,000A to 40,000A
- Rigid Terminals for Secure Mounting
- Available in Trimmed Version for Through Hole Board Mounting - Designation “HC”
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA.

AGENCY FILE NUMBERS: UL E75961, CSA LR91788.

ALSO SEE HB34 SERIES

HA Varistor Series

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

	HA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	110 to 750	V
DC Voltage Range ($V_{M(DC)}$)	148 to 970	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	25,000 to 40,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	170 to 1050	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
(Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)		
Insulation Resistance	1000M	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

PART NUMBER AND DEVICE BRANDING	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
	CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20µs)	TYPICAL CAPACITANCE AT f = 1MHz
	V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	C
	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
	(V)	(V)	ENERGY	(A)	(V)	(V)	(V)	(V)	(pF)
V111HA32	110	148	160	25000	156	173	190	293	5450
V111HA40	110	148	220	40000[1]	156	173	190	288	11600
V131HA32	130	175	200	25000	184	200	228	350	4700
V131HA40	130	175	270	40000[1]	184	200	228	345	10000
V141HA32	140	188	210	25000	198	220	248	380	4230
V141HA40	140	188	290	40000[3]	198	220	248	375	9000
V151HA32	150	200	220	25000	212	240	268	410	4000
V151HA40	150	200	300	40000[2]	212	240	268	405	8000
V181HA32	180	240	240	25000	254	282	310	475	3200
V181HA40	180	240	330	40000	254	282	310	468	6800
V201HA32	200	265	260	25000	283	314	345	540	3180
V201HA40	200	265	350	40000	283	314	345	533	6350
V251HA32	250	330	330	25000	354	390	429	650	2500
V251HA40	250	330	370	40000	354	390	429	630	5000
V271HA32	275	369	360	25000	389	430	473	710	2200
V271HA40	275	369	400	40000	389	430	473	690	4500
V301HA32	300	410	370	25000	433	478	526	795	2050
V301HA40	300	410	430	40000	433	478	526	780	4100
V321HA32	320	420	390	25000	462	510	561	845	1900
V321HA40	320	420	460	40000	462	510	561	825	3800
V331HA32	330	435	385	25000	467	519	570	860	1870
V331HA40	330	435	475	40000	467	519	570	843	3750
V351HA32	350	460	390	25000	495	550	604	910	1800
V351HA40	350	460	500	40000	495	550	604	894	3600

NOTE: Average power dissipation of transients not to exceed 2.0W per varistor

1. 40kA capability depends on applications rated up to 97Vrms. 30kA applies if >97 Vrms.
2. 40kA capability depends on applications rated up to 115Vrms. 30kA applies if >115 Vrms.
3. 40kA capability depends on applications rated up to 123Vrms. 30kA applies if >123 Vrms.
1. 40kA capability depends on applications rated up to 132Vrms. 30kA applies if >132Vrms.

HA Varistor Series

Device Ratings and Specifications

PART NUMBER AND DEVICE BRANDING	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
	CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20μs)	TYPICAL CAPACITANCE AT f = 1MHz
	V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX	V_C	C
	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
	(V)	(V)	ENERGY	(A)	(V)	(V)	(V)	(V)	(pF)
V391HA32 V391HA40	385 385	510 510	395 550	25000 40000	545 545	604 604	663 663	1020 1000	1750 3500
V421HA32 V421HA40	420 420	560 560	400 600	25000 40000	610 610	680 680	748 748	1120 1100	1500 3000
V441HA32 V441HA40	440 440	585 585	420 630	25000 40000	622 622	691 691	759 759	1200 1147	1450 2900
V481HA32 V481HA40	480 480	640 640	450 650	25000 40000	670 670	750 750	825 825	1290 1230	1300 2700
V511HA32 V511HA40	510 510	675 675	500 700	25000 40000	735 735	820 820	910 910	1355 1295	1200 2500
V551HA32 V551HA40	550 550	710 710	530 755	25000 40000	778 778	864 864	949 949	1515 1430	1190 2390
V571HA32 V571HA40	575 575	730 730	550 770	25000 40000	805 805	910 910	1000 1000	1570 1480	1100 2200
V661HA32 V661HA40	660 660	850 850	600 900	25000 40000	940 940	1050 1050	1160 1160	1820 1720	1000 2000
V681HA32 V681HA40	680 680	875 875	610 925	25000 40000	962 962	1068 1068	1173 1173	1830 1780	850 1900
V751HA32 V751HA40	750 750	970 970	700 1050	25000 40000	1080 1080	1200 1200	1320 1320	2050 2000	800 1800

HA Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts for average power dissipation.

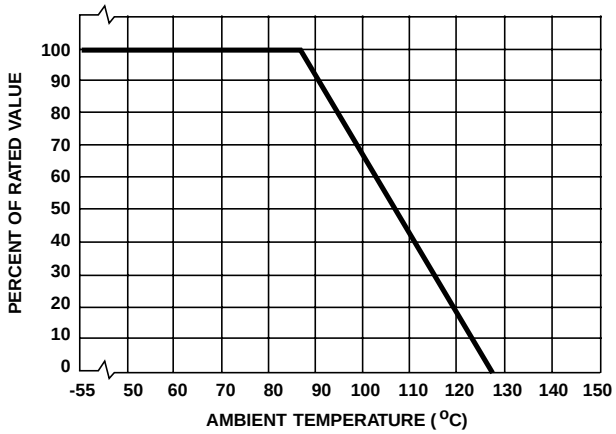
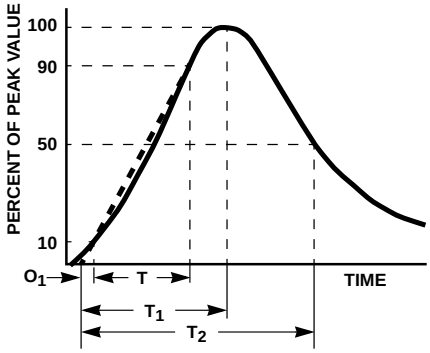


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front Time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)

Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT WAVEFORM

Transient V-I Characteristics Curves

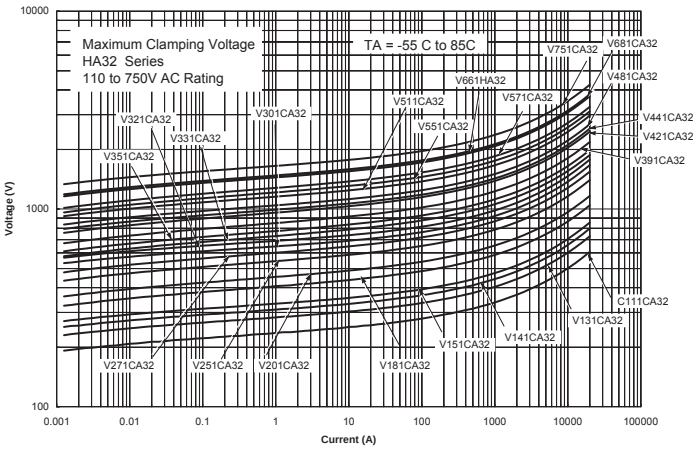


FIGURE 3. MAXIMUM CLAMPING VOLTAGE (V111HA32 - V751HA32)

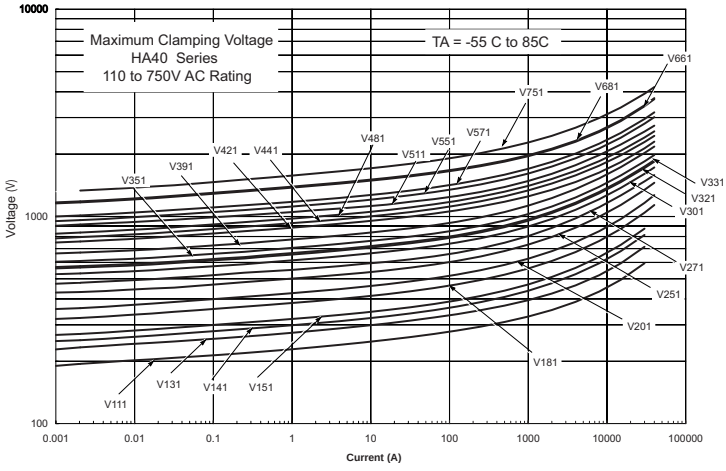


FIGURE 4. MAXIMUM CLAMPING VOLTAGE (V111HA40 - V751HA40)

HA Varistor Series

Pulse Rating Curves

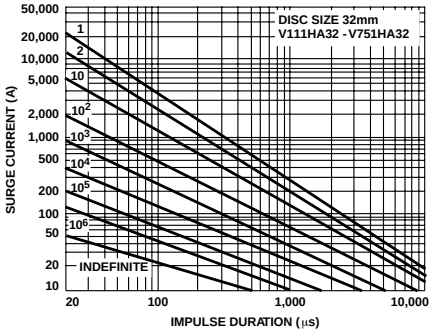


FIGURE 5. SURGE CURRENT RATING CURVES FOR V111HA32 - V751HA32

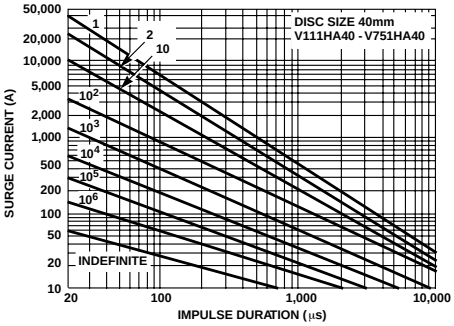
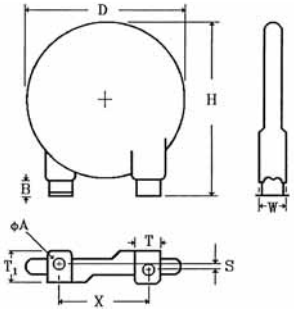


FIGURE 7. SURGE CURRENT RATING CURVES FOR V111HA40 - V751HA40

Mechanical Dimensions



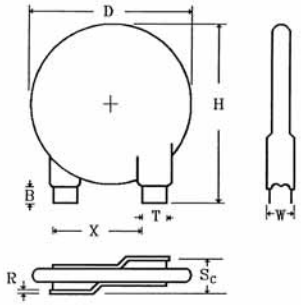


TABLE 1. HA SERIES OUTLINE SPECIFICATIONS

(Dimensions in Millimeters)

	D	H	B	X	T	T1	ϕA	S
	MAX	MAX	MIN	NOM	NOM	MAX	MAX	OFFSET
HA32	35.5	52.00	3.0	25	9.3	10.4	4.2	Depends on Device Voltage (See Table 2)
HA40	42.5	57.00	3.0	25	9.3	10.4	4.2	

TABLE 2. HA SERIES MAXIMUM THICKNESS AND TERMINAL OFFSETS (Dimensions in Millimeters)

VOLTAGE	THICKNESS "W"		DIMENSION "S" (±1mm)	
	HA32	HA40	HA32	HA40
V111 - V351	9.00	9.00	3.90	3.90
V391 - V511	11.00	11.00	2.60	2.60
V551 - V751	13.00	13.00	1.00	1.00

TABLE 3. HC SERIES OUTLINE SPECIFICATIONS

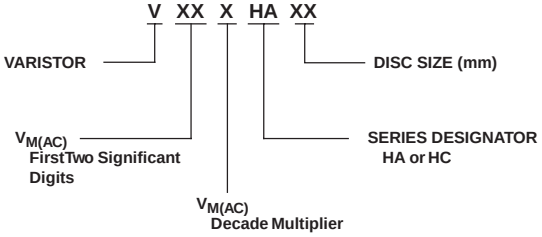
(Dimensions in Millimeters)

	D	H	B	X	T	R	S_C
	MAX	MAX	MIN	NOM	NOM	MAX	OFFSET
HC32	35.5	52.00	5.0	25	9.30	1.0	Depends on Device Voltage (See Table 4)
HC40	42.5	57.00	5.0	25	9.30	1.0	

TABLE 4. HC SERIES MAXIMUM THICKNESS AND TERMINAL OFFSETS (Dimensions in Millimeters)

VOLTAGE	THICKNESS "W"		DIMENSION "S_C" (±1mm)	
	HC32	HC40	HC32	HC40
V111 - V351	9.00	9.00	6.00	6.00
V391 - V511	11.00	11.00	7.30	8.10
V551 - V751	13.00	13.00	8.90	10.00

Ordering Information



TMOV34S® Varistor Series

The Littelfuse Industrial TMOV34S series thermally protected varistor represents a new development in circuit protection. It consists of a 34mm square format varistor element (MOV) with an integral thermally activated element designed to open in the event of overheating due to abnormal over-voltage, limited current conditions as outlined in UL1449 Feb. 1998 edition.The device has a third lead, an indicator lead, which may be used to indicate that the MOV has been disconnected from the circuit. This lead facilitates connection to monitoring circuitry. The TMOV34S devices 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 discreet solutions resulting in improved clamping performance to fast over-voltage transients.

Features

- US Patent for Thermally Protected MOV- Patent # 6636403
- Designed to facilitate compliance to UL1449 for TVSS product.
- Hi Peak Current Rating to 40 kA.
- -55 Deg C to +85 Deg C operating temp.
- Agency Recognition : UL
- Alternative Design available with narrow 3mm wide monitor (right) lead.

AGENCY APPROVALS:
Recognized by UL under File UL E75901

34mm Devices-Devices are approved as an MOV to UL1449. Devices with ratings greater than 420VAC are not affected by these abnormal voltage conditions.

Accelerated Aging Testing-34mm devices comply with Acclerated Aging Test requirements per. ANSI/IEEE C62.11 and may be used in secondary surge arrestors.

AGENCY FILE NUMBERS: ULE75961 (UL1449)

Applications

- TVSS Products
- AC Panel Protection Modules
- AC Line Power Supplies
- AC Power Meters
- UPS (Uninterruptable Power Supply)
- Inverters
- AC/DC Power Supplies
- DIN Rail

TMOV34S® Varistor Series

Absolute Maximum Ratings

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

		UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	115 to 750	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8x20µs Current Wave, single pulse	up to 40,000	A
Single-Pulse Energy Capability		
For 2ms Current Wave	235 to 1050	J
Operating Ambient Temperature Range (T_A)	-55 to +85	˚C
Storage Temperature (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
Thermal Protection Isolation Voltage Capability (when operated)		
-Under UL1449 Limited Current Test Procedure-see Note #1	600	V
Insulation Resistance	1,000	MΩ

I#1 - Under Ul1449 limited current testing parts rated >420V will not open due to 600V voltage limit. Devices with ratings >420V have not yet been evaluated.

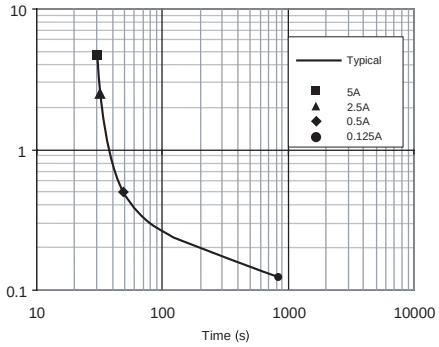
CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications - TMOV Varistor Series

	MAXIMUM RATING (85°C)					SPECIFICATIONS (25°C)			
	CONTINUOUS			TRANSIENT		VARISTOR VOLTAGE AT 1mA TEST CURRENT		MAXIMUM CLAMPING VOLTAGE 8/20µs at 200A	TYPICAL CAPACITANCE f = 1MHz
PART NUMBER	AC VOLTS VM(AC)RMS (V)	DC VOLTS VM(AC)	MCOV SURGE ARRESTER VM(AC)RMS (V)	ENERGY 2ms WTM 1 x PULSE (J)	PEAK SURGE CURRENT 8/20µs ITM 1 x PULSE (A)	VN(DC) MIN (V)	VN(DC) MAX (V)	VC (V)	C (pF)
TMOV34S111M	115	150	98	235	40000[1]	163	202	305	11500
TMOV34S131M	130	175	111	270	40000[2]	184	228	345	10000
TMOV34S141M	140	188	119	291	40000[3]	198	248	375	9000
TMOV34S151M	150	200	128	300	40000[4]	212	268	405	8000
TMOV34S181M	180	240	153	330	40000[5]	254	312	488	6800
TMOV34S201M	200	265	170	335	40000	283	357	540	6500
TMOV34S251M	250	330	213	370	40000	354	429	650	5000
TMOV34S271M	275	369	234	400	40000	389	473	730	4500
TMOV34S301M	300	400	255	435	40000	433	528	780	4050
TMOV34S321M	320	420	272	460	40000	462	561	830	3800
TMOV34S331M	330	435	281	475	40000	476	581	855	3700
TMOV34S351M	350	460	298	500	40000	505	616	910	3500
TMOV34S391M	385	506	327	550	40000	555	678	1005	3300
TMOV34S421M[6]	420	560	357	600	40000	610	748	1130	3000
TMOV34S461M[6]	460	610	391	620	40000	642	783	1188	2800
TMOV34S481M[6]	480	640	408	650	40000	670	825	1240	2700
TMOV34S511M[6]	510	675	434	700	40000	735	910	1350	2500
TMOV34S551M[6]	550	700	468	735	40000	770	939	1415	2250
TMOV34S571M[6]	575	730	489	770	40000	805	1000	1480	2200
TMOV34S621M[6]	620	800	527	840	40000	880	1074	1589	2100
TMOV34S661M[6]	660	850	561	900	40000	940	1160	1720	2000
TMOV34S681M[6]	680	890	578	950	40000	980	1195	1772	1970
TMOV34S751M[6]	750	970	638	1050	40000	1080	1320	2000	1800

TMOV34S® Varistor Series

Thermal Characteristics



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

Note : The Industrial TMOV Series TMOV34S devices are intended, in conjunction with appropriate enclosure design, to help facilitate TVSS module compliance to UL 1449, Section 37.4 (abnormal over-voltage limited current requirements). Under these extreme abnormal over-voltage 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.

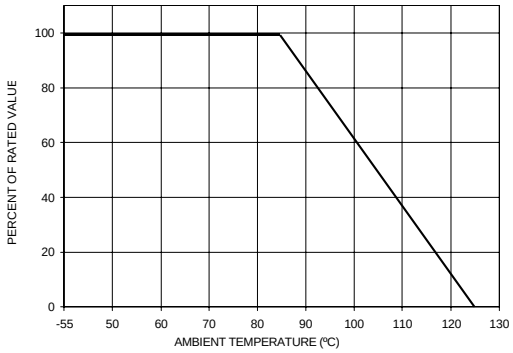


Figure 5: Peak Current & Energy Derating Curve

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

Pulse Rating Curves

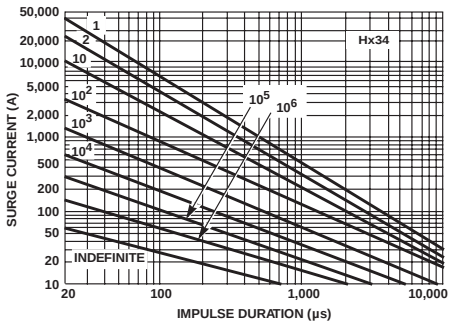


FIGURE 6. SURGE CURRENT RATING CURVES FOR HB34, HF34 and HG34

TMOV34S® Varistor Series

Transient V-I Characteristic Curves

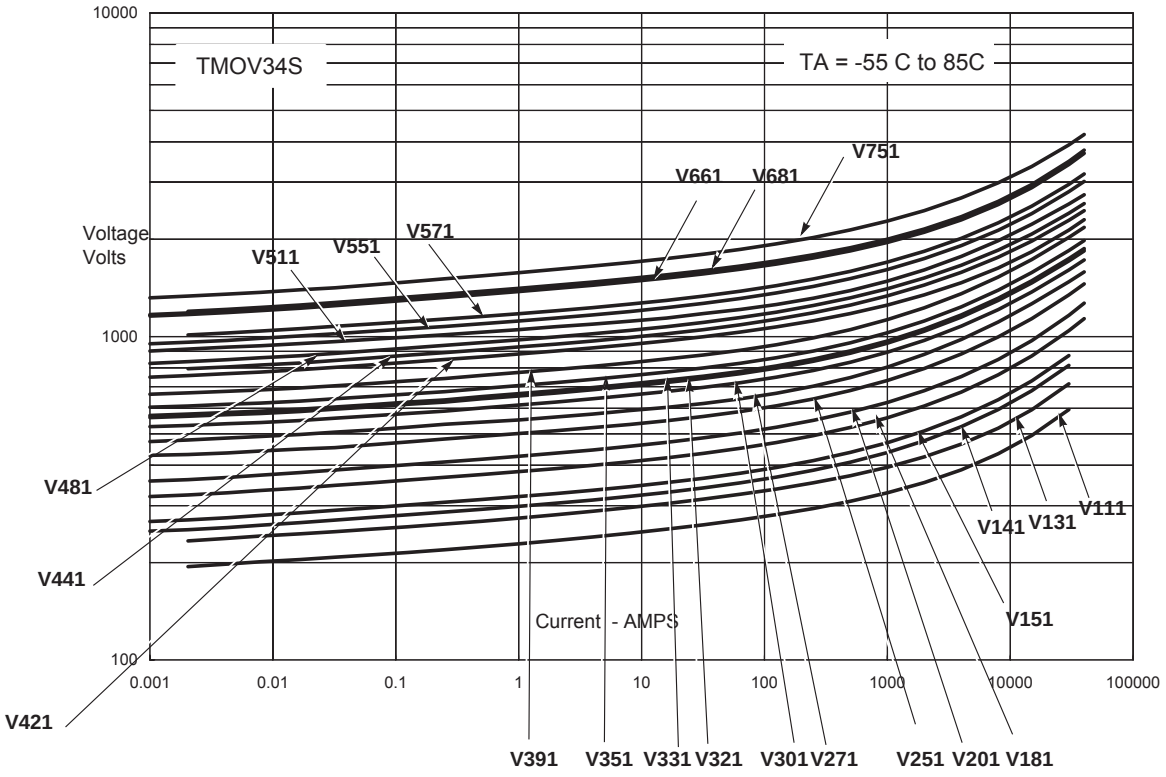
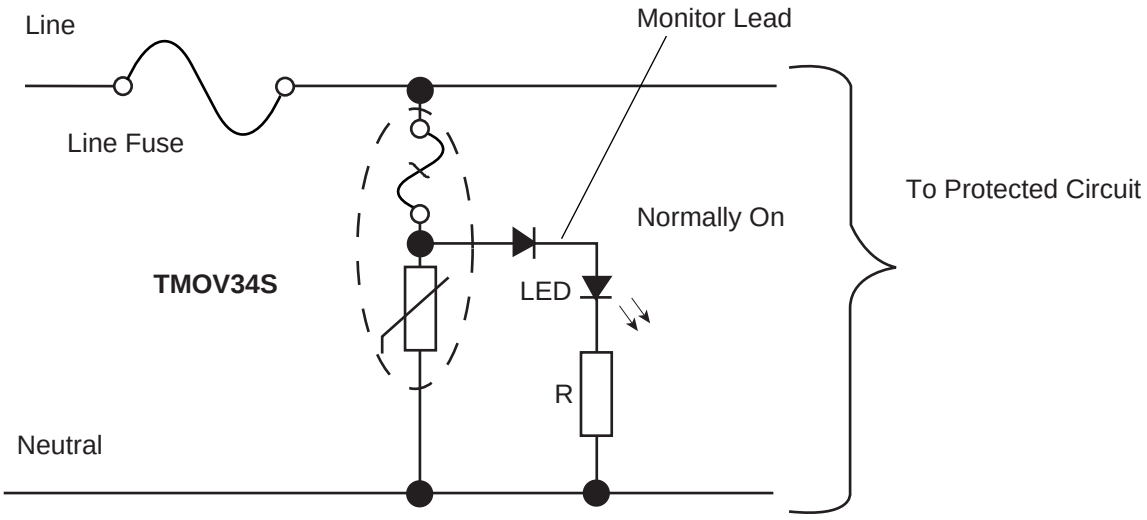


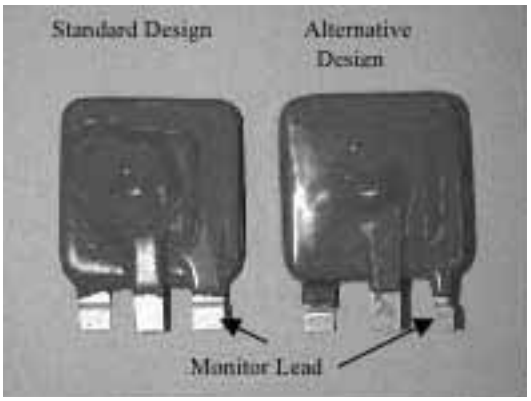
Fig 7. V-I Characteristic Curves For TMOV34S® Varistor

TMOV34S® Varistor Series

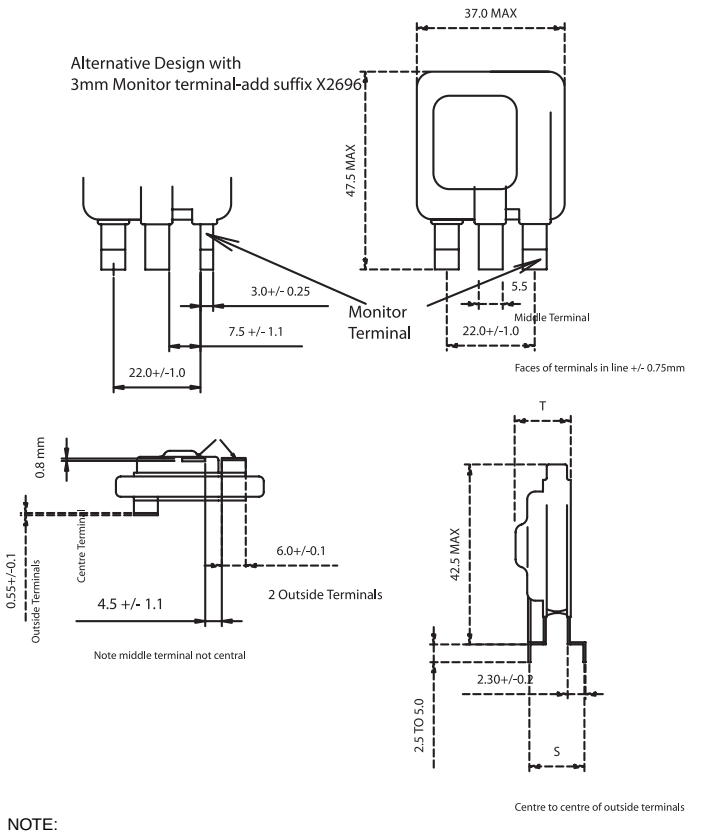
iTMOV Varistor Application Examples

The application examples below show how the indicator lead on the *i*TMOV 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.





TMOV34S® Varistor Series



NOTE:

Dimension in mm is typical, unless otherwise specified

To order alternative design with narrow 3mm monitor lead(right hand terminal as shown) add suffix X2696 to part number

Part Number	T max Body Thickness	S Mounting Terminal Offset
TMOV34S111M	11.9	5.2 ±.65
TMOV34S131M	12.2	5.5 ±.65
TMOV34S141M	12.3	5.7 ±0.85
TMOV34S151M	12.4	5.9 ±0.85
TMOV34S181M	12.8	6.3 ±0.85
TMOV34S201M	13.0	6.5 ±0.85
TMOV34S251M	11.8	6.25 ±0.85
TMOV34S271M	12.0	6.5 ±0.85
TMOV34S301M	12.3	6.8 ±1.0
TMOV34S321M	12.5	6.9 ±1.0
TMOV34S331M	13.0	7.2 ±1.0
TMOV34S351M	13.1	7.4 ±1.0
TMOV34S391M	13.2	7.6 ±1.0
TMOV34S421M	13.4	7.85 ±1.0
TMOV34S461M	13.7	8.15 ±1.0
TMOV34S481M	13.9	8.25 ±1.0
TMOV34S511M	14.2	8.6 ±1.0
TMOV34S551M	14.8	8.65 ±1.0
TMOV34S571M	15.0	8.85 ±1.0
TMOV34S621M	15.4	9.25 ±1.0
TMOV34S661M	15.8	9.65 ±1.0
TMOV34S681M	16.0	9.85 ±1.0
TMOV34S751M	16.3	10.65 ±1.0

Ordering Information

Standard Parts

TMOV 34 S 150 M X2696

DEVICE FAMILY
Littelfuse Thermally Protected MOV

DISC DIAMETER (mm)
34 mm

CERAMIC SHAPE
S: Square

$V_{M(AC)RMS}$
115V to 750V

Optional Design
5 digit suffix when alternative 3mm wide monitor lead is required

Series Designator
M: 3-Leaded TMOV34S Varistor Series Supplied in Bulk Pack

HB34, HF34 and HG34 Varistor Series

The HB34, HF34, and HG34 Series of transient surge suppressors are industrial high-energy Metal-Oxide Varistors (MOVs). They are designed to provide surge suppression in the AC mains outdoor and service entrance environment (distribution panels) of buildings. Applications also include industrial heavy motors, controls, and power supplies such as used in the oil-drilling, mining, and transportation fields, including HVAC and motor/generator applications.

The HB34 Series provides rigid terminals for through-hole solder mounting on printed circuit boards, thereby eliminating the need for screw mounting. The HF34 Series has the same rigid through-hole terminals as the HB34 with the addition of mounting holes for bolt-down mounting and longer terminals to allow for additional mounting flexibility. The HG34 has formed feet with mounting holes for vertical bolt-down mounting.

See Ratings and Specifications table for part numbers.

Features

- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . 110V to 750V
- High Energy Absorption
  Capability. . . . . W_{TM} = 220J to 1050J
- High Peak Pulse Current
  Capability . . . . . I_{TM} = 40,000A
- Rigid Terminals for Secure Through-Hole Solder Mounting
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA.

AGENCY FILE NUMBERS: UL E75961, CSA LR91788.

HB34, HF34 and HG34 Varistor Series

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

	Hx34 SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	110 to 750	V
DC Voltage Range ($V_{M(DC)}$)	148 to 970	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	40,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	220 to 1050	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

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

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20µs)	TYPICAL CAPACI-TANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V111HB34	34	110	148	220	40,000 [5]	156	173	190	288	11,600
V131HB34	34	130	175	270	40,000 [1]	184	200	228	345	10,000
V141HB34	34	140	188	291	40,000 [2]	198	220	248	375	9,000
V151HB34	34	150	200	300	40,000 [4]	212	240	268	405	8,000
V181HB34	34	180	240	330	40,000	254	282	310	468	6,800
V201HB34	34	200	265	350	40,000	283	314	345	533	6,350
V251HB34	34	250	330	370	40,000	354	390	429	650	5,000
V271HB34	34	275	370	400	40,000	389	430	473	730	4,500
V301HB34	34	300	410	430	40,000	433	478	526	780	4,100
V321HB34	34	320	420	460	40,000	462	510	561	830	3,800
V331HB34	34	330	435	475	40,000	467	519	570	843	3,750
V351HB34	34	350	460	500	40,000	495	550	604	894	3,600

NOTE: Average power dissipation of transients not to exceed 2.0W.

1. Peak current applies to applications rated up to 115 V_{RMS}. Peak current is 30kA for applications greater than 115V_{RMS}.
2. Peak current applies to applications rated up to 123V_{RMS}. Peak Current is 30kA for applications greater than 123V_{RMS}.
3. Peak current applies to applications rated up to 132V_{RMS}. Peak Current is 30kA for applications greater than 132V_{RMS}.
4. Peak current applies to applications rated up to 97V_{RMS}. Peak Current is 30kA for applications greater than 97V_{RMS}.
5. 40kA capability depends on applications rated up to 97Vrms. 30kA applies if >97 Vrms.

HB34, HF34 and HG34 Varistor Series

Device Ratings and Specifications

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20μs)	TYPICAL CAPACI-TANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20μs)					
	SIZE	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
	(mm)	(V)	(V)	(V)	(A)	(V)	(V)	(V)	(V)	(pF)
V391HB34	34	385	510	550	40,000	545	604	663	1000	3,500
V421HB34	34	420	560	600	40,000	610	680	748	1,130	3,000
V481HB34	34	480	640	650	40,000	670	750	825	1,240	2,700
V511HB34	34	510	675	700	40,000	735	820	910	1,350	2,500
V551HB34	34	550	710	755	40,000	778	864	949	1,404	2,390
V571HB34	34	570	730	770	40,000	805	910	1000	1,480	2,200
V661HB34	34	660	850	900	40,000	940	1050	1160	1,720	2,000
V681HB34	34	680	875	925	40,000	962	1068	1173	1,777	1,900
V751HB34	34	750	970	1050	40,000	1080	1200	1320	2,000	1,800

NOTE: Average power dissipation of transients not to exceed 2.0W.

1. Peak current applies to applications rated up to 115 V_{RMS}. Peak current is 30kA for applications greater than 115V_{RMS}.
2. Peak current applies to applications rated up to 123V_{RMS}. Peak Current is 30kA for applications greater than 123V_{RMS}.
3. Peak current applies to applications rated up to 132V_{RMS}. Peak Current is 30kA for applications greater than 132V_{RMS}.
4. Peak current applies to applications rated up to 97V_{RMS}. Peak Current is 30kA for applications greater than 97V_{RMS}.
5. 40kA capability depends on applications rated up to 97Vrms. 30kA applies if >97 Vrms.

HB34, HF34 and HG34 Varistor Series

Device Ratings and Specifications

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20μs)	TYPICAL CAPACI-TANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX		
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}				V_C	f = 1MHz
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V111HF34	34	110	148	220	40,000 [5]	156	173	190	288	11,600
V131HF34	34	130	175	270	40,000 [2]	184	200	228	345	10,000
V141HF34	34	140	188	291	40,000 [3]	198	220	248	375	9,000
V151HF34	34	150	200	300	40,000 [4]	212	240	268	405	8,000
V181HF34	34	180	240	330	40,000	254	282	310	468	6,800
V201HF34	34	200	265	350	40,000	283	314	345	533	6,350
V251HF34	34	250	330	370	40,000	354	390	429	650	5,000
V271HF34	34	275	370	400	40,000	389	430	473	730	4,500
V301HF34	34	300	410	430	40,000	433	478	526	780	4,100
V321HF34	34	320	420	460	40,000	462	510	561	830	3,800
V331HF34	34	330	435	475	40,000	467	519	570	843	3,750
V351HF34	34	350	460	500	40,000	495	550	604	894	3,600
V391HF34	34	385	510	550	40,000	545	604	663	1,000	3,500
V421HF34	34	420	560	600	40,000	610	680	748	1,130	3,000
V481HF34	34	480	640	650	40,000	670	750	825	1,240	2,700
V511HF34	34	510	675	700	40,000	735	820	910	1,350	2,500
V551HF34	34	550	710	755	40,000	778	864	949	1,404	2,390
V571HF34	34	570	730	770	40,000	805	910	1000	1,480	2,200
V661HF34	34	660	850	900	40,000	940	1050	1160	1,720	2,000
V681HF34	34	680	875	925	40,000	962	1068	1173	1777	1,900
V751HF34	34	750	970	1050	40,000	1080	1200	1320	2,000	1,800

NOTE:
1. Average power dissipation of transients not to exceed 2.0W per varistor
2. 40kA capability depends on applications rated up to 115V_{RMS}. 30kA applies if > 115V_{RMS}.
3. 40kA capability depends on applications rated up to 123V_{RMS}. 30kA applies if > 123V_{RMS}.
4. 40kA capability depends on applications rated up to 132V_{RMS}. 30kA applies if > 132V_{RMS}.
5. 40kA capability depends on applications rated up to 97Vrms. 30kA applies if > 97VRMS.

HB34, HF34 and HG34 Varistor Series

Device Ratings and Specifications

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20μs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX		
		$V^{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}				V_C	f = 1MHz
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V111HG34	34	110	148	220	40,000 [5]	156	173	190	288	11,600
V131HG34	34	140	175	270	40,000 [2]	184	200	228	345	10,000
V141HG34	34	130	188	291	40,000 [3]	198	220	248	375	9,000
V151HG34	34	150	200	300	40,000 [4]	212	240	268	405	8,000
V181HG34	34	180	240	330	40,000	254	282	310	468	6,800
V201HG34	34	200	265	350	40,000	283	314	345	533	6,350
V251HG34	34	250	330	370	40,000	354	390	429	650	5,000
V271HG34	34	275	370	400	40,000	389	430	473	730	4,500
V301HG34	34	300	410	430	40,000	433	478	526	780	4,100
V321HG34	34	320	420	460	40,000	462	510	561	830	3,800
V331HG34	34	330	435	475	40,000	467	519	570	843	3,750
V351HG34	34	350	460	500	40,000	495	550	604	894	3,600
V331HG34	34	385	510	550	40,000	545	604	663	1,000	3,500
V421HG34	34	420	560	600	40,000	610	680	748	1,130	3,000
V481HG34	34	480	640	650	40,000	670	750	825	1,240	2,700
V511HG34	34	510	675	700	40,000	735	820	910	1,350	2,500
V551HG34	34	550	710	755	40,000	778	864	949	1,404	2,390
V571HG34	34	570	730	770	40,000	805	910	1000	1,480	2,200
V661HG34	34	660	850	900	40,000	940	1050	1160	1,720	2,000
V681HG34	34	680	875	925	40,000	962	1068	1173	1,777	1,900
V751HG34	34	750	970	1050	40,000	1080	1200	1320	2,000	1,800

NOTE:
1. Average power dissipation of transients not to exceed 2.0W per varistor
2. 40kA capability depends on applications rated up to 115V_{RMS} 30kA applies if > 115 V_{RMS}.
3. 40kA capability depends on applications rated up to 123V_{RMS} 30kA applies if > 123 V_{RMS}.
4. 40kA capability depends on applications rated up to 132V_{RMS} 30kA applies if > 132 V_{RMS}.
5. 40kA capability depends on applications rated up to 97V_{RMS} 30kA applies if > 97 V_{RMS}.

HB34, HF34 and HG34 Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation result is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. The operating values must be derated as shown in Figure 1.

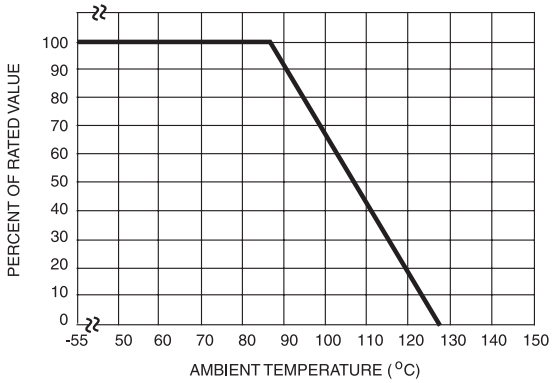
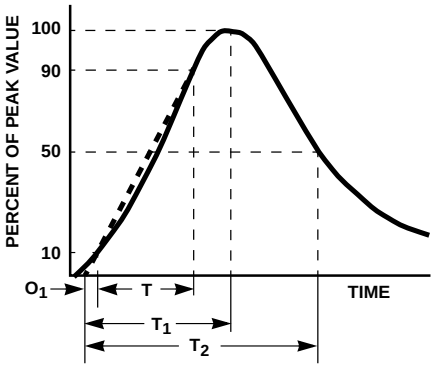


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

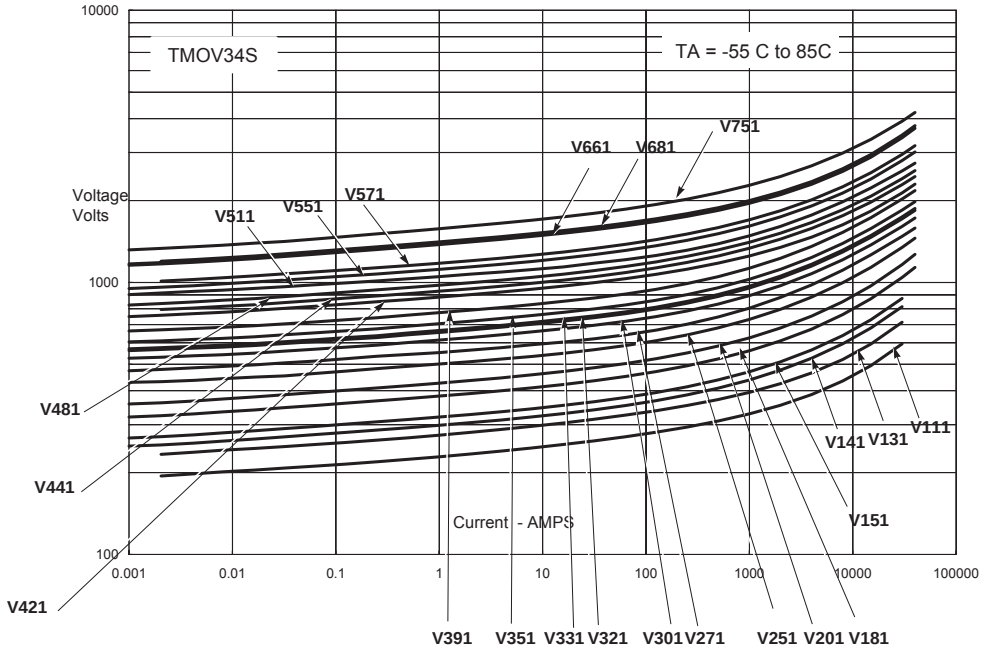


FIGURE 3. CLAMPING VOLTAGE FOR HB34, HF34 and HG34 SERIES

HB34, HF34 and HG34 Varistor Series

Pulse Rating Curves

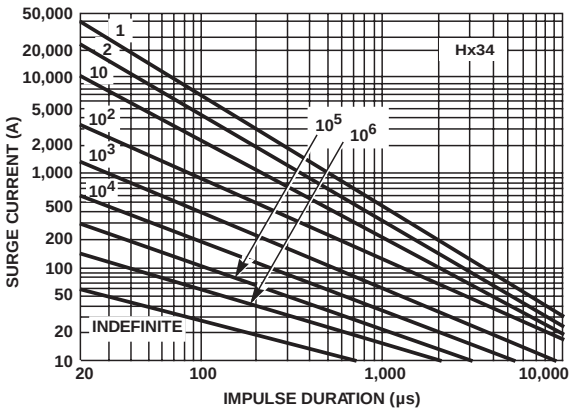
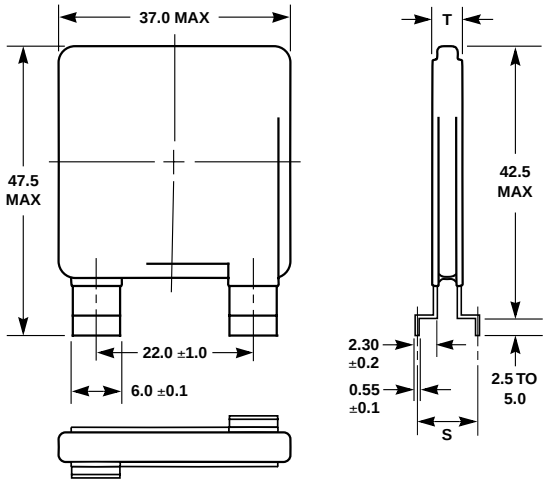


FIGURE 6. SURGE CURRENT RATING CURVES FOR HB34, HF34 and HG34

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

Mechanical Dimensions HB34

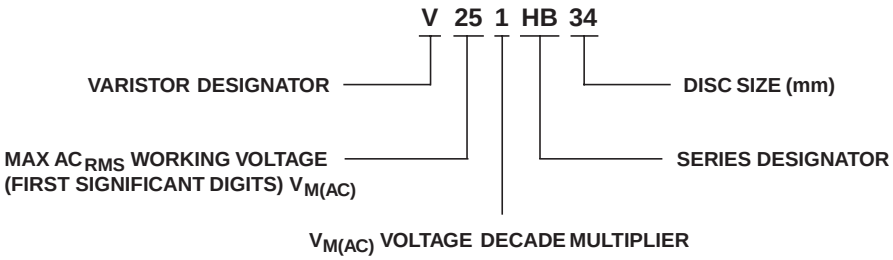


NOTE: Dimension in mm is typical, unless otherwise specified.

TABLE OF DIMENSIONS - THICKNESS AND TERMINAL OFFSETS

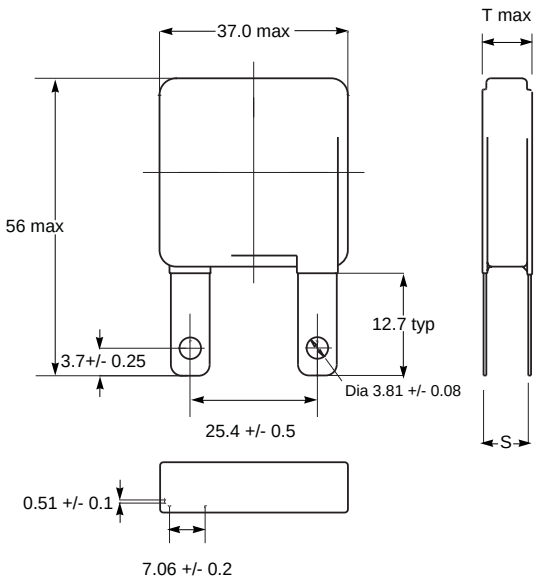
PART TYPE	T BODY THICKNESS (MAXIMUM)	S MOUNTING TERMINAL OFFSET
V111HB34	5.5	5.30 ±0.65
V131HB34	5.7	5.50 ±0.65
V141HB34	5.8	5.70 ±0.65
V151HB34	5.9	5.90 ±0.65
V181HB34	6.0	6.10 ±0.65
V201HB34	6.0	6.10 ±0.65
V251HB34	6.1	6.25 ±0.65
V271HB34	6.4	6.50 ±0.65
V301HB34	6.7	6.70 ±0.65
V321HB34	6.9	6.90 ±0.65
V331HB34	7.0	6.95 ±0.85
V351HB34	7.3	7.20 ±0.85
V391HB34	7.6	7.50 ±0.85
V421HB34	7.8	7.85 ±0.85
V441HB34	8.0	7.95 ±1.00
V481HB34	8.3	8.25 ±1.00
V511HB34	8.8	8.60 ±1.00
V551HB34	9.1	8.55 ±1.5
V571HB34	9.4	8.85 ±1.5
V661HB34	10.2	9.65 ±1.5
V681HB34	10.4	10.35 ±1.5
V751HB34	10.7	10.65 ±1.5

Ordering Information



HB34, HF34 and HG34 Varistor Series

Mechanical Dimensions HF34

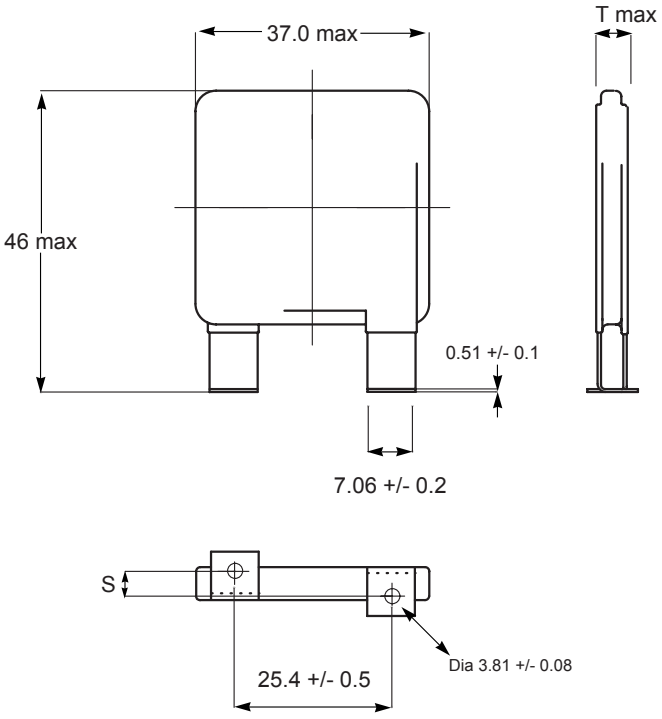


Note: Terminal Material Tin Plated Copper

TABLE OF DIMENSIONS -
THICKNESS AND TERMINAL OFFSETS

PART TYPE	T BODY THICKNESS (MAXIMUM)	S MOUNTING TERMINAL OFFSET
V111HF34	5.5	2.0 ±0.65
V131HF34	5.7	2.1 ±0.65
V141HF34	5.8	2.2 ±0.65
V151HF34	5.9	2.4 ±0.65
V181HF34	6.0	2.5 ±0.65
V201HF34	6.0	2.6 ±0.65
V251HF34	6.1	2.7 ±0.85
V271HF34	6.4	2.9 ±0.85
V301HF34	6.7	3.2 ±0.85
V321HF34	6.9	3.4 ±0.85
V331HF34	7.0	3.5 ±0.85
V351HF34	7.3	3.9 ±0.85
V391HF34	7.6	4.2 ±0.85
V421HF34	7.8	4.4 ±0.85
V441HF34	8.0	4.5 ± 0.85
V481HF34	8.3	4.8 ± 1.0
V511HF34	8.8	5.2 ± 1.0
V551HF34	9.1	5.5 ± 1.0
V571HF34	9.4	5.7 ± 1.5
V661HF34	10.2	6.5 ± 1.5
V681HF34	10.4	6.7 ± 1.5
V751HF34	10.7	7.3 ± 1.5

Mechanical Dimensions HG34



Note: Terminal Material Tin Plated Copper

TABLE OF DIMENSIONS -
THICKNESS AND TERMINAL OFFSETS

PART TYPE	T BODY THICKNESS (MAXIMUM)	S MOUNTING TERMINAL OFFSET
V111HG34	5.5	6.0±0.65
V131HG34	5.7	5.8±0.65
V141HG34	5.8	5.6±0.65
V151HG34	5.9	5.5±0.65
V181HG34	6.0	5.4±0.65
V201HG34	6.0	5.4±0.65
V251HG34	6.1	5.2±0.65
V271HG34	6.4	4.9±0.65
V301HG34	6.7	4.7±0.85
V321HG34	6.9	4.5±0.85
V331HG34	7.0	4.4±0.85
V351HG34	7.3	4.1±0.85
V391HG34	7.6	3.8±0.85
V421HG34	7.8	3.5±0.85
V441HG34	8.0	3.3±0.85
V481HG34	8.3	3.1±1.0
V511HG34	8.8	2.7±1.0
V551HG34	9.1	2.4±1.0
V571HG34	9.4	2.2±1.5
V661HG34	10.2	1.4±1.5
V681HG34	10.4	1.2±1.5
V751HG34	10.7	0.6±1.5

DHB34 Varistor Series

NEW

The DHB34 Series of transient surge suppressors are industrial high-energy Metal-Oxide Varistors (MOVs). They are designed to provide surge suppression in the AC mains outdoor and service entrance environment (distribution panels) of buildings. DHB34 applications also include industrial heavy motors, controls, and power supplies such as used in the oil-drilling, mining, and transportation fields, including HVAC and motor/generator applications.

The DHB34 Series provides rigid terminals for through-hole solder mounting on printed circuit boards, thereby eliminating the need for screw mounting.

See Ratings and Specifications table for part numbers.

Features

- Wide Operating Voltage Range $V_{M(AC)RMS}$ . . . . . 110V to 750V
- High Energy Absorption Capability. . . . . W_{TM} = 220J to 1050J
- High Peak Pulse Current Capability . . . . . I_{TM} = 40,000A*
- Rigid Terminals for Secure Through-Hole Solder Mounting
- No Derating Up to 85°C Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA.

AGENCY FILE NUMBERS: UL 1449, E75961, UL1414, E56529, CSA LR91788.

* NOTE: Ratings are for each individual varistor element in a dual assembly.

DHB34 Varistor Series

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

	DHB34 SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	110 to 750	V
DC Voltage Range ($V_{M(DC)}$)	148 to 970	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	40,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	220 to 1050	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

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

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20µs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX		
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}				V_C	f = 1MHz
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V111DHB34	34	110	148	220	40,000 [1]	156	173	190	288	11,600
V131DHB34	34	130	175	270	40,000 [2]	184	200	228	345	10,000
V141DHB34	34	140	188	291	40,000 [3]	198	220	248	375	9,000
V151DHB34	34	150	200	300	40,000 [4]	212	240	268	405	8,000
V181DHB34	34	180	240	330	40,000	254	282	310	468	6,800
V201DHB34	34	200	265	350	40,000	283	314	345	533	6,350
V251DHB34	34	250	330	370	40,000	354	390	429	650	5,000
V271DHB34	34	275	369	400	40,000	389	430	473	730	4,500
V301DHB34	34	300	410	430	40,000	433	478	526	780	4,100
V321DHB34	34	320	420	460	40,000	462	510	561	830	3,800
V331DHB34	34	330	435	475	40,000	467	519	570	843	3,750
V351DHB34	34	350	460	500	40,000	495	550	604	894	3,600

NOTE: Ratings are for each individual varistor element in dual assembly.

1. Average power dissipation of transients not to exceed 2.0W per varistor element (2 varistors per device).
2. 40kA capability depends on applications rated up to 115V_{RMS}. 30kA applies if > 115 V_{RMS}.
3. 40kA capability depends on applications rated up to 123V_{RMS}. 30kA applies if > 123 V_{RMS}.
4. 40kA capability depends on applications rated up to 132V_{RMS}. 30kA applies if > 132 V_{RMS}.
5. 40kA capability depends on applications rated up to 97V_{RMS}. 30kA applies if > 97 V_{RMS}.

DHB34 Varistor Series

Device Ratings and Specifications

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20μs)	TYPICAL CAPACI-TANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20μs)					
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
	(mm)	(V)	(V)	(V)	(A)	(V)	(V)	(V)	(V)	(pF)
V391DHB34	34	385	510	550	40,000	545	604	663	1,000	3,500
V421DHB34	34	420	560	600	40,000	610	680	748	1,130	3,000
V441DHB34	34	440	585	630	40,000	622	691	759	1,147	2,900
V481DHB34	34	480	640	650	40,000	670	750	825	1,240	2,700
V511DHB34	34	510	675	700	40,000	735	820	910	1,350	2,500
V551DHB34	34	550	710	755	40,000	778	864	949	1,404	2,390
V571DHB34	34	575	730	770	40,000	805	910	1000	1,480	2,200
V661DHB34	34	660	850	900	40,000	940	1050	1160	1,720	2,000
V681DHB34	34	680	875	925	40,000	962	1068	1173	1,777	1,900
V751DHB34	34	750	970	1050	40,000	1080	1200	1320	2,000	1,800

NOTE: Ratings are for each individual varistor element in dual assembly.

1. Average power dissipation of transients not to exceed 2.0W per varistor element (2 varistors per device).
2. 40kA capability depends on applications rated up to 115V_{RMS}. 30kA applies if > 115 V_{RMS}.
3. 40kA capability depends on applications rated up to 123V_{RMS}. 30kA applies if > 123 V_{RMS}.
4. 40kA capability depends on applications rated up to 132V_{RMS}. 30kA applies if > 132 V_{RMS}.
5. 40kA capability depends on applications rated up to 97V_{RMS}. 30kA applies if > 97 V_{RMS}.

DHB34 Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation result is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. The operating values must be derated as shown in Figure 1.

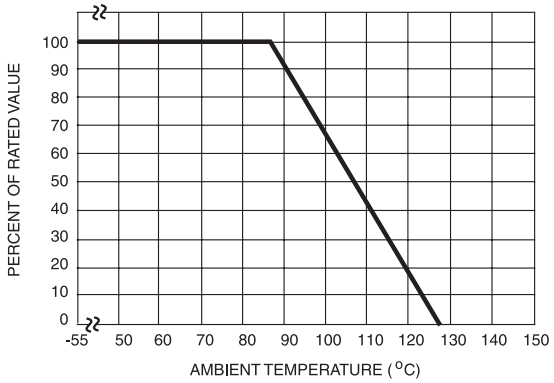
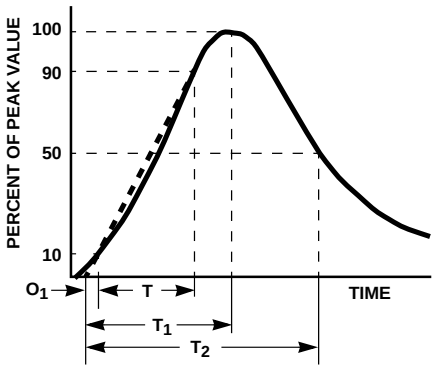


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20µs Current Waveform:
8µs = T_1 = Virtual Front Time
20µs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

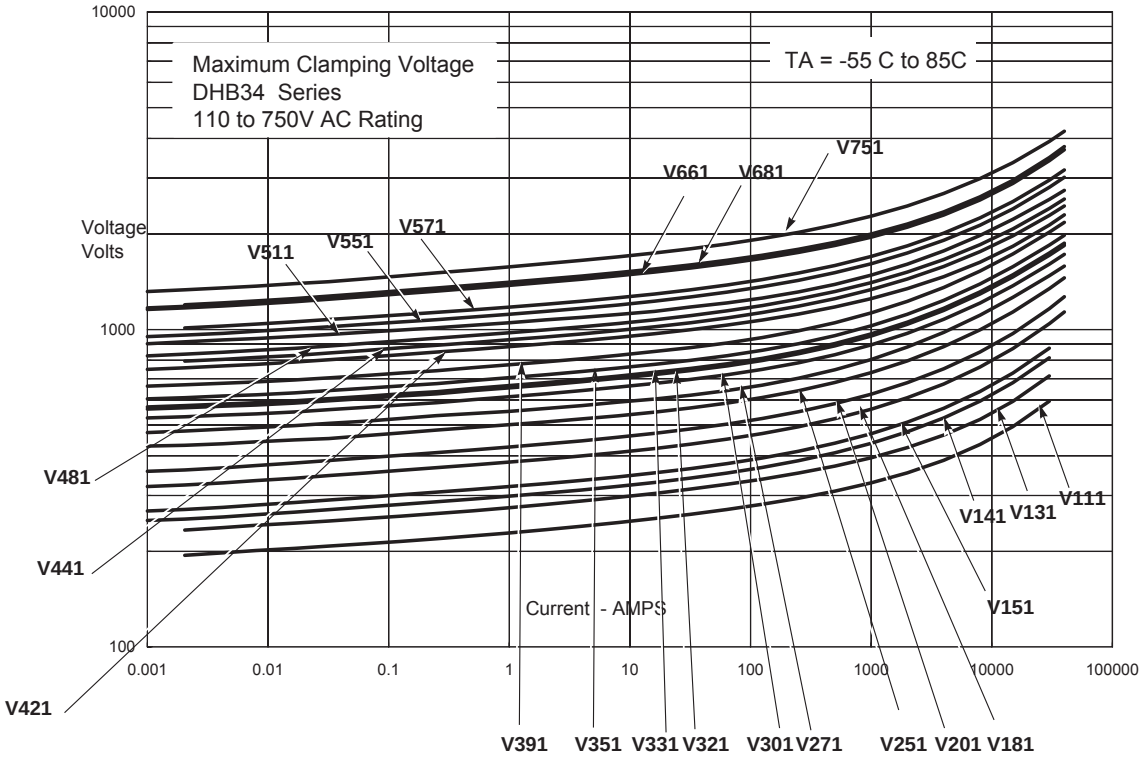


FIGURE 3. CLAMPING VOLTAGE FOR DHB34 SERIES

DHB34 Varistor Series

Pulse Rating Curves

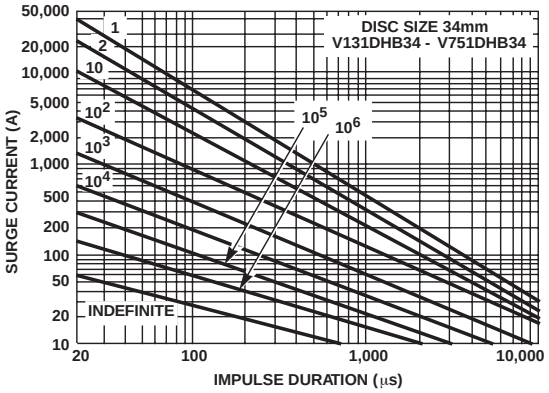
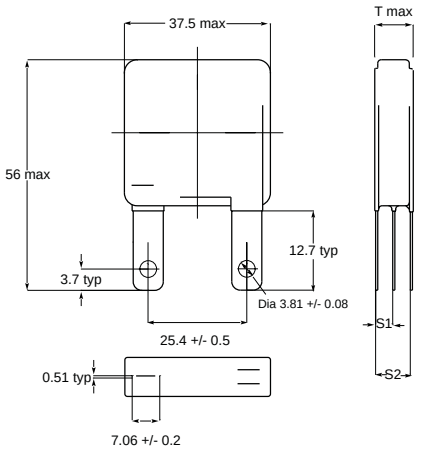


FIGURE 4. SURGE CURRENT RATING CURVES FOR V131DHB34 - V751DHB34

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

Mechanical Dimensions

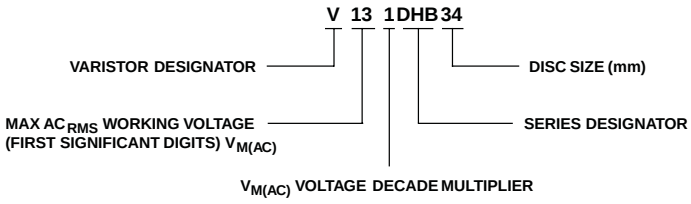


Terminals Configuration: Terminals A & B are connected to one varistor element. Terminals B & C connected to second varistor element.
Terminal materials: Tin Plated over copper.

TABLE OF DIMENSIONS - THICKNESS AND TERMINAL OFFSETS

TYPE	T MAX	S1 +/- 1.15 mm	S2 +/- 2.30mm
V111DHB34	7.6	2.65	5.50
V131DHB34	7.8	2.85	5.70
V141DHB34	8.2	3.00	6.00
V151DHB34	8.8	3.15	6.30
V181DHB34	9.0	3.25	6.50
V201DHB34	9.2	3.35	6.70
V251DHB34	7.8	3.00	6.00
V271DHB34	8.7	3.25	6.50
V301DHB34	8.9	3.50	7.00
V321DHB34	9.3	3.66	7.24
V331DHB34	9.5	3.70	7.40
V351DHB34	10.5	4.10	8.20
V391DHB34	11.2	4.45	8.90
V421DHB34	11.3	4.50	9.00
V441DHB34	11.5	4.55	9.10
V481DHB34	12.2	4.80	9.60
V511DHB34	13.4	5.25	10.50
V551DHB34	14.6	5.70	11.40
V571DHB34	14.8	5.80	11.60
V661DHB34	17.20	6.65	13.30
V681DHB34	17.5	7.00	14.00
V751DHB34	18.20	7.35	14.70

Ordering Information



CA Varistor Series

The CA Series of transient surge suppressors are industrial high-energy disc varistors (MOVs) intended for special applications requiring unique electrical contact or packaging methods provided by the customer. The electrode finish of these devices is solderable and can also be used with pressure contacts. Discs of the same diameter may be stacked.

This series of industrial disc varistors are available in three diameter sizes of 32, 40, and 60mm, with disc thicknesses ranging from 1.8mm minimum to 32mm maximum. They offer a wide voltage range of from 250 to 2800 $V_{M(AC)RMS}$ ·

For information on soldering considerations, refer to AN8820 update. “Recommendations for Soldering Terminal Leads to MOV Varistor Discs”.

Features

- Provided In Disc Form For Unique Packaging By Customer
- Solderable Electrode Finish Options
- Pressure Contacts and/or Disc Stacking May be Utilized
- Standard Disc Sizes 32mm, 40mm, and 60mm Diameter
- Available Edge Passivation Insulation
- Wide Operating Voltage Range $V_{M(AC)RMS}$ 250V to 2800V
- High Peak Pulse Current Range . . . . . I_{TM} 20,000A to 70,000A
- Very High Energy Capability W_{TM} . . . . . .330J to 10,000J
- No Derating Up to 85°C Ambient

CA Varistor Series

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

	CA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	250 to 2800	V
DC Voltage Range ($V_{M(DC)}$)	330 to 3500	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	20,000 to 70,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	330 to 10,000	J
Operating Ambient Temperature Range (T_A)	55 to 85	°C
Storage Temperature Range (T_{STG})	55 to 85	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%°C

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

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT V_C AT 200A CURRENT (8/20µs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V131CA32	32	130	175	200	20000	184	200	228	350	4700
V151CA32	32	150	200	220	20000	212	240	268	410	4000
V251CA32	32	250	330	330	20000	354	390	429	680	2500
V251CA40	40			370	40000				650	5000
V251CA60	60			880	50000				620	10000
V271CA32	32	275	369	360	20000	389	430	473	750	2200
V271CA40	40			400	40000				730	4500
V271CA60	60			950	50000				680	9000
V321CA32	32	320	420	390	20000	462	510	561	850	1900
V321CA40	40			460	40000				830	3800
V321CA60	60			1100	50000				760	7500
V421CA32	32	420	560	400	25000	610	680	748	1200	1500
V421CA40	40			600	40000				1130	3000
V421CA60	60			1500	70000				1060	6000
V481CA32	32	480	640	450	25000	670	750	825	1300	1300
V481CA40	40			650	40000				1240	2700
V481CA60	60			1600	70000				1160	5500
V511CA32	32	510	675	500	25000	735	820	910	1440	1200
V511CA40	40			700	40000				1350	2500
V511CA60	60			1800	70000				1300	5000
V571CA32	32	575	730	550	25000	805	910	1000	1600	1100
V571CA40	40			770	40000				1480	2200
V571CA60	60			2100	70000				1420	4500
V661CA32	32	660	850	600	25000	940	1050	1160	1820	1000
V661CA40	40			900	40000				1720	2000
V661CA60	60			2300	70000				1640	4000

CA Varistor Series

Device Ratings and Specifications (continued)

MODEL NUMBER	SIZE (mm)	MAXIMUM RATINGS (85°C) CONTINUOUS V_{RMS} (V)	CONTINUOUS V_{DC} (V)	TRANSIENT ENERGY (2ms) W_{TM} (J)	TRANSIENT PEAK CURRENT (8/20μs) I_{TM} (A)	SPECIFICATIONS (25°C) VARISTOR VOLTAGE AT 1mA DC TEST CURRENT MIN $V_{M(AC)}$ (V)	VARISTOR VOLTAGE AT 1mA DC TEST CURRENT $V_{N(DC)}$ (V)	VARISTOR VOLTAGE AT 1mA DC TEST CURRENT MAX $V_{M(DC)}$ (V)	MAX CLAMPING VOLT V_C AT 200A CURRENT (8/20μs) V_C (V)	TYPICAL CAPACITANCE f = 1MHz (pF)
V751CA32	32	750	970	700	25000	1080	1200	1320	2050	800
V751CA40	40			1050	40000				2000	1800
V751CA60	60			2600	70000				1880	3500
V881CA60	60	880	1150	3200	70000	1290	1500	1650	2340	2700
V112CA60	60	1100	1400	3800	70000	1620	1800	2060	2940	2200
V142CA60	60	1400	1750	5000	70000	2020	2200	2550	3600	1800
V172CA60	60	1700	2150	6000	70000	2500	2700	3030	4300	1500
V202CA60	60	2000	2500	7500	70000	2970	3300	3630	5200	1200
V242CA60	60	2400	3000	8600	70000	3510	3900	4290	6200	1000
V282CA60	60	2800	3500	10000	70000	4230	4700	5170	7400	800

NOTE: Average power dissipation of transients not exceed 1.5W, 2.0W and 2.5W for model 32mm, 40mm and 60mm, respectively.
1. Peak current applies to applications rated up to $115V_{RMS}$. Peak Current is 30kA for applications greater than $115V_{RMS}$.
2. Peak current applies to applications rated up to $132V_{RMS}$. Peak Current is 30kA for applications greater than $132V_{RMS}$.

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation result is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

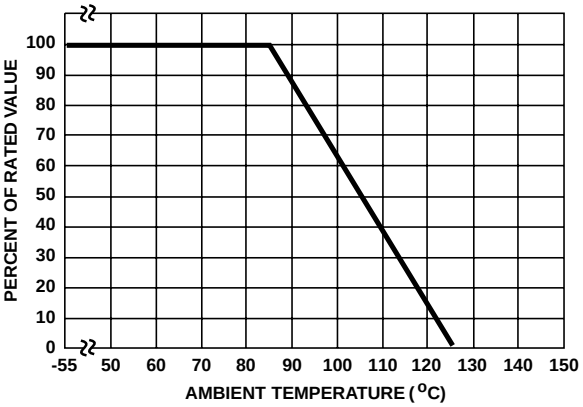
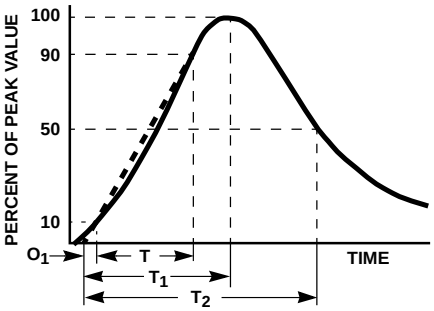


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front Time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)

Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

CA Varistor Series

Transient V-I Characteristics Curves

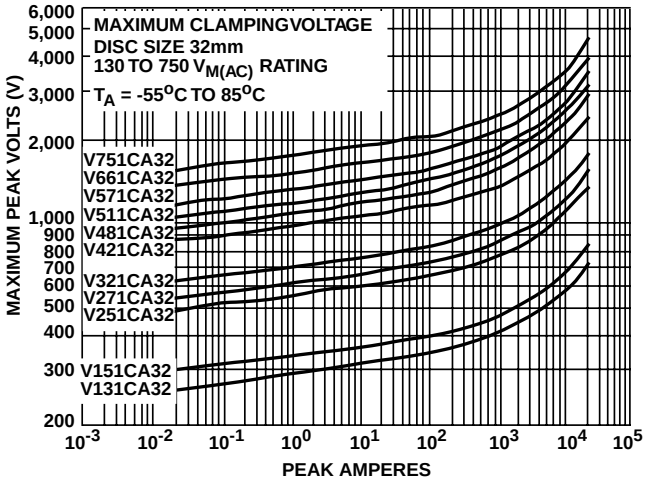


FIGURE 3. CLAMPING VOLTAGE FOR V131CA32 - C751CA32

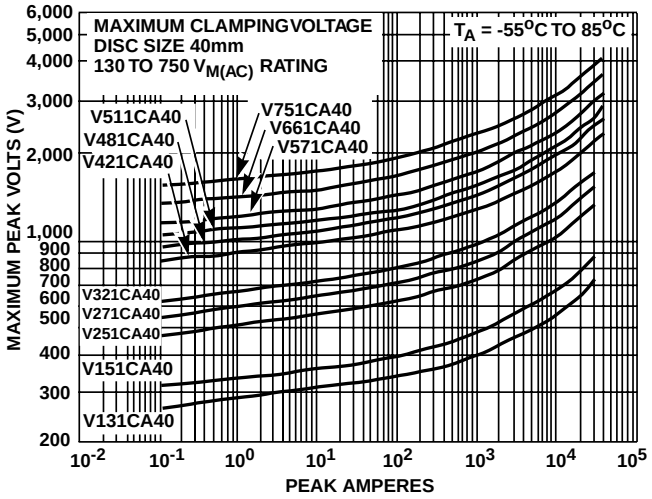


FIGURE 4. CLAMPING VOLTAGE FOR V131CA40 - V751CA40

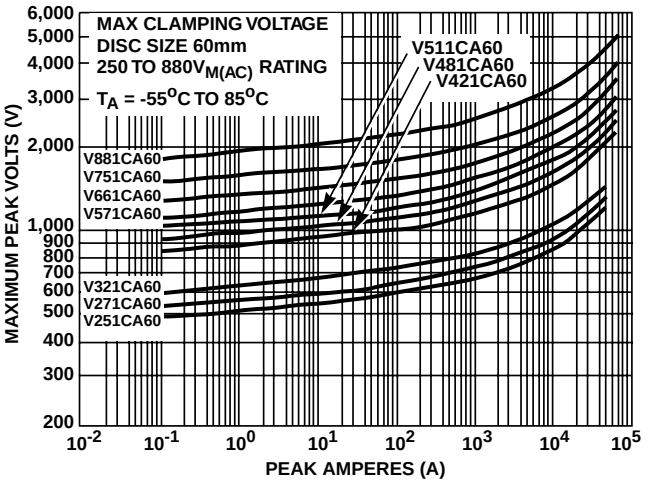


FIGURE 5. CLAMPING VOLTAGE FOR V251CA60 - V881CA60

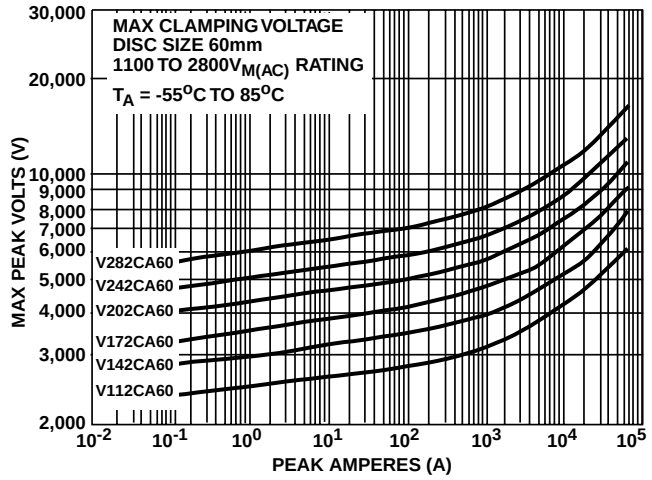


FIGURE 6. CLAMPING VOLTAGE FOR V112CA60 - V282CA60

CA Varistor Series

Pulse Rating Curves

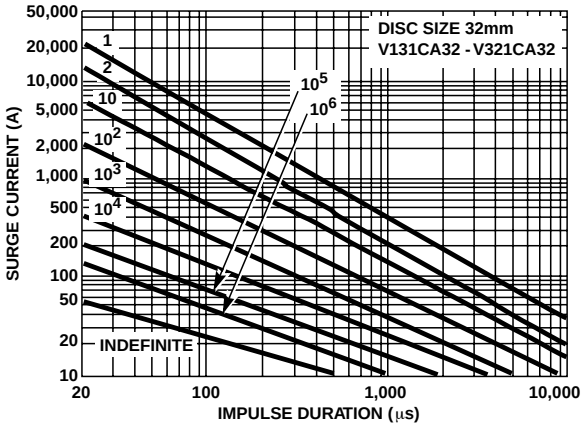


FIGURE 7. SURGE CURRENT RATING CURVES FOR V131CA32 - V321CA32

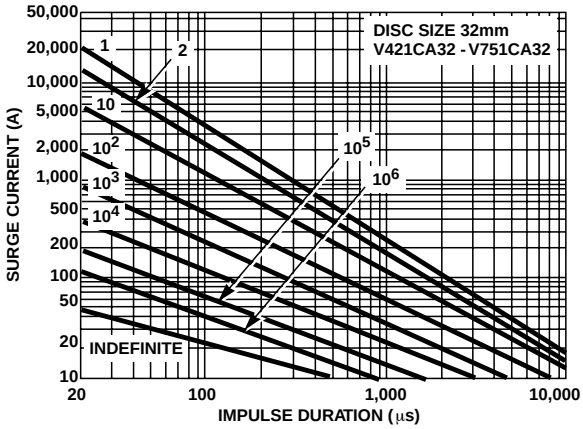


FIGURE 8. SURGE CURRENT RATING CURVES FOR V421CA32 - V751CA32

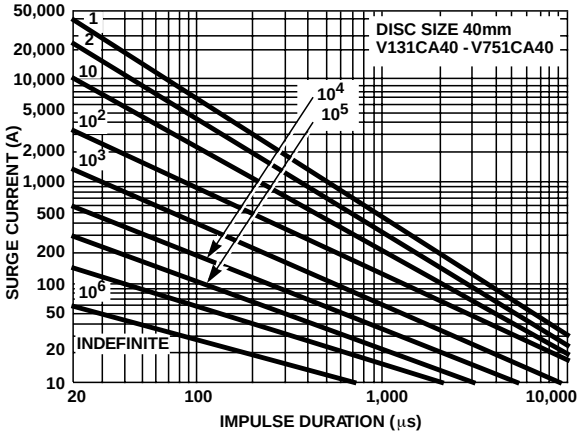


FIGURE 9. SURGE CURRENT RATING CURVES FOR V131CA40 - V751CA40

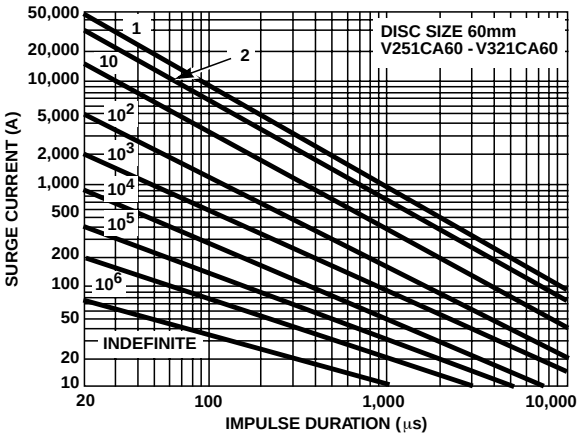


FIGURE 10. SURGE CURRENT RATING CURVES FOR V251CA60 - V321CA60

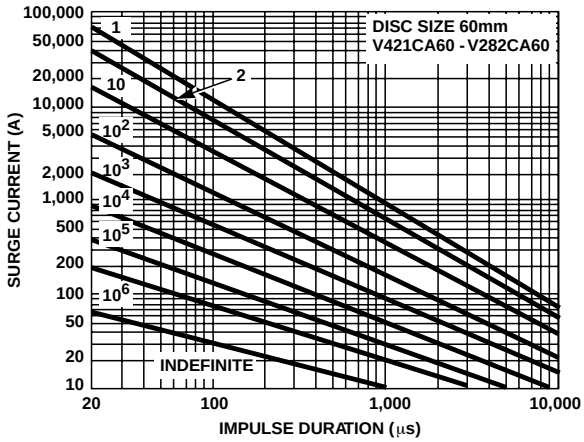
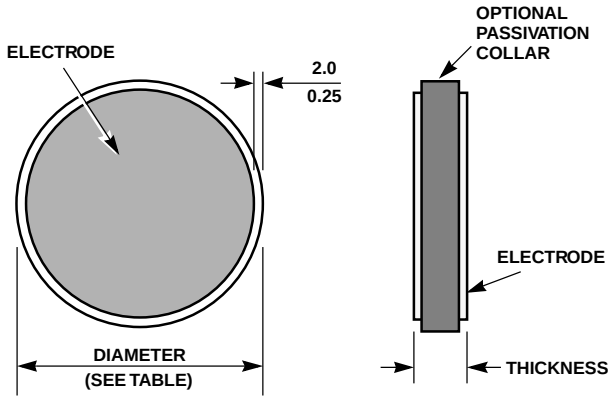


FIGURE 11. SURGE CURRENT RATING CURVES FOR V421CA60 - V282CA60

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but does not prevent the device from continuing to function, and to provide ample protection.

CA Varistor Series

Series Dimensions



MODEL SIZE	DISC DIAMETER			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
32	31.0	33.0	1.220	1.299
40	38.0	40.0	1.496	1.575
60	58.0	62.0	2.283	2.441

MODEL V_{RMS} $V_{M(AC)}$	THICKNESS (32mm DISC MODELS)				THICKNESS (40mm AND 60mm DISC MODELS)			
	MILLIMETERS		INCHES		MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
130†	1.4	2.4	0.071	0.094	1.4	2.8	0.055	0.134
150†	1.7	2.8	0.083	0.110	1.5	3.0	0.06	0.150
250	1.6	2.2	0.063	0.087	2.0	2.7	0.079	0.106
275	1.8	2.5	0.071	0.098	2.2	3.0	0.087	0.118
320	2.1	2.9	0.083	0.114	2.6	3.5	0.102	0.138
420	2.9	3.9	0.114	0.154	3.5	4.7	0.138	0.185
480	3.1	4.3	0.122	0.169	3.8	5.2	0.150	0.205
510	3.5	4.7	0.138	0.185	4.2	5.7	0.165	0.224
575	3.8	5.1	0.150	0.201	4.6	6.3	0.181	0.248
660	4.4	6.0	0.173	0.236	5.3	7.2	0.209	0.283
750	5.1	6.9	0.240	0.327	6.1	8.3	0.240	0.327
880††	-	-	-	-	7.3	10.3	0.287	0.406
1100††	-	-	-	-	9.2	13.0	0.362	0.512
1400††	-	-	-	-	11.5	16.0	0.453	0.630
1700††	-	-	-	-	14.0	19.0	0.551	0.748
2000††	-	-	-	-	17.0	22.5	0.669	0.886
2400††	-	-	-	-	20.0	27.0	0.787	1.063
2800††	-	-	-	-	24.0	32.0	0.945	1.260

† Available in 32mm and 40mm only.

†† Available in 60mm size only.

CA Varistor Series

MODEL NUMBER	SIZE (mm)	TYPICAL DISC WEIGHT (GRAMS)
V131CA32 V131CA40	32 40	9 21
V151CA32 V151CA40	32 40	11 23
V251CA32 V251CA40 V251CA60	32 40 60	8 17 39
V271CA32 V271CA40 V271CA60	32 40 60	10 18 42
V321CA32	32	11
V321CA40	40	22
V321CA60	60	50
V421CA32	32	15
V421CA40	40	28
V421CA60	60	66
V481CA32	32	16
V481CA40	40	31
V481CA60	60	71
V511CA32	32	18
V511CA40	40	35
V511CA60	60	80
V571CA32	32	20
V571CA40	40	38
V571CA60	60	88
V661CA32	32	23
V661CA40	40	44
V661CA60	60	101
V751CA32	32	26
V751CA40	40	51
V751CA60	60	116
V881CA60	60	141
V112CA60 V142CA60 V172CA60 V202CA60 V242CA60 V282CA60	60 60 60 60 60 60	178 220 265 317 377 450

Passivation Layer

The standard CA Series is supplied with passivation layer around the outside perimeter of the disc forming an electrical insulator as detailed in the dimensional drawing. The CA Series is also available without a passivation layer for applications where the customer provides a suitable encapsulation or potting material as recommended below. (See Ordering Information.)

Encapsulated Recommendations

After lead attachment, the disc/lead assembly may be coated or encapsulated in a package to provide electrical insulation and isolation from environmental contamination as required by the application. Coating/Filler materials for containers may include silicones, polyurethanes, and some epoxy resins.Two examples of acceptable polyurethanes are Dexter Hysol (US7013, parts A and B) and Rhenatech (resin 4714, hardener 4900), or their equivalents. Materials containing halogens, sulfides, or alkalines are not recommended.

Electrode Metallization

The standard CA Series is supplied with sintered silver electrodes on CA32 devices and arc-sprayed copper-over-aluminum electrodes for CA40 and CA60 series. CA40 parts are also available with sintered silver electrode, see “Ordering information.” In general, when discs are stacked to attain a specific operating voltage or energy capability, the copper finish is typically chosen. Likewise, the copper finish is used with high temperature lead attach soldering operations (wave solder). The silver metallization is typically used for solder reflow lead attach operations (I-R, Vapour-Phase). The recommended temperature profile of a belt-fed convection oven is shown in Figure 13.

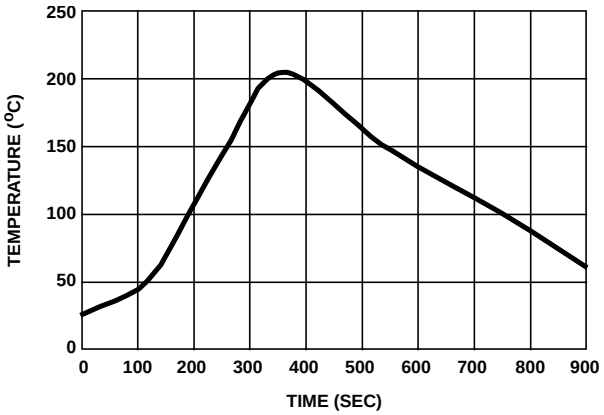


FIGURE 13. TYPICAL BELT OVEN TEMPERATURE PROFILE

Stacking and Contact Pressure Recommendations

When applications require the stacking of Littelfuse CA discs or when electrical connection is made by pressure contacts, the minimum pressure applied to the disc electrode surface should be 2.2kGs (5 pounds). The maximum recommended pressure applied to the disc electrode is dependent upon diameter size and is given in the following table.

MODEL SIZE (mm)	MAXIMUM PRESSURE
32	16N/CM^2 (23LBs/IN^2)
40	8N/CM^2 (11.5LBs/IN^2)
60	4N/CM^2 (5.7LBs/IN^2)

CA Varistor Series

Ordering Information

The CA Series offers optional electrode finish materials and a glass passivation edge option which must be designated. When ordering, the code letters suffix as shown in the following table must be selected and appended to the standard Model number.

NOTES:

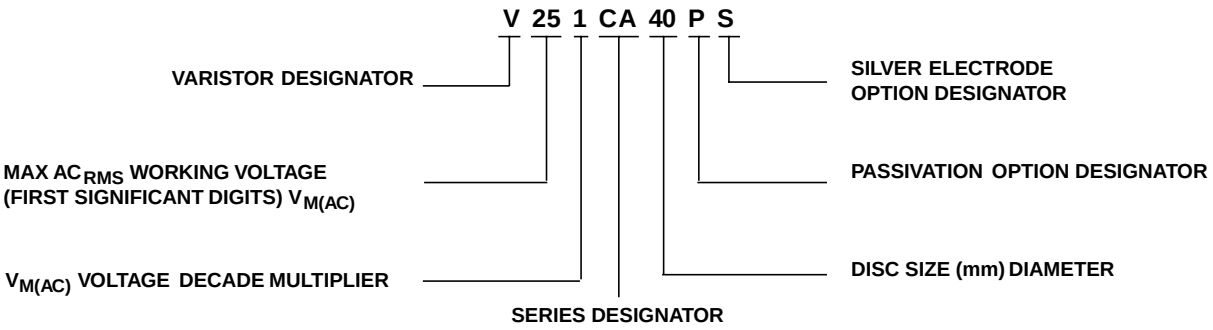
1. The 60mm disc types V112CA60 to V282CA60, inclusive, are only supplied with glass passivation and arc-sprayed copper finish electrodes. (That is, with the “PC” option suffix code.)
2. The 32mm size discs are only available with silver metallization.

Note also that the CA Series receives no branding on the disc itself.

ELECTRODE MATERIAL	NON-PASSIVATED DISC	PASSIVATED DISC
Arc-Sprayed Copper	NC	PC
Sintered Silver	NS	PS

Packaging and Shipping

The CA Series is supplied in bulk for shipment. Discs are packaged in compartmentalized cartons to protect from scratching or edge-chipping during shipment.

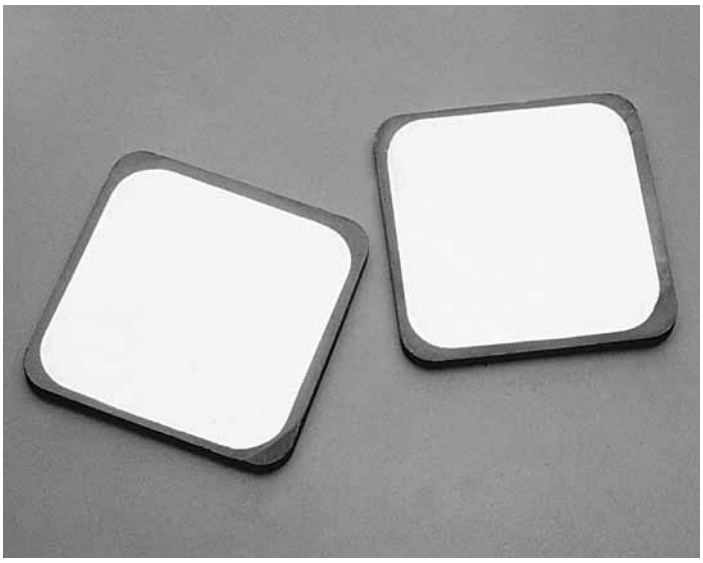


NA Varistor Series

The NA Series of transient surge suppressors are varistors (MOVs) in square disc form, intended for special industrial high-energy applications requiring unique electrical contact or packaging methods provided by the customer. The electrode finish of these devices is solderable and can also be used with pressure contacts. Discs may also be stacked.

The NA Series varistor is a square 34mm device, with thicknesses ranging from 1.7mm minimum for the 250V device to 7.5mm maximum for the 750V device. For information on mounting considerations refer to Application Note AN8820.

This disc is also available with encapsulation and PCB leads. See Littelfuse HB34 Sales.



Features

- Provided in Disc Form for Unique Packaging by Customer
- Solderable Electrode Finish.
- Pressure Contacts and/or Disc Stacking may be Utilized
- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . .250V to 750V
- Peak Pulse Current Capability (I_{TM}). 40,000A
- High Energy Capability (W_{TM}). . . . . .370J to 1050J
- No Derating Up to 8°C Ambient

ALSO SEE HB34 SERIES

NA Varistor Series

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

	NA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	250 to 750	V
DC Voltage Range ($V_{M(DC)}$)	330 to 970	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	40,000	A
Single Pulse Energy Range		
For 2ms Current Square Wave (W_{TM})	370 to1050	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

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

MODEL NUMBER	SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAXIMUM CLAMPING VOLTAGE (V_C) AT 200A (8/20µs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (2ms)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
	(mm)	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V131NA34	34	130	175	270	40,000[1]	184	200	228	345	10,000
V141NA34	34	140	188	291	40,000[3]	198	220	248	375	9,000
V151NA34	34	150	200	300	40,000[2]	212	240	268	405	8,000
V251NA34	34	250	330	370	40,000	354	390	429	650	5,000
V271NA34	34	275	369	400	40,000	389	430	473	730	4,500
V321NA34	34	320	420	460	40,000	462	510	561	830	3,800
V421NA34	34	420	560	600	40,000	610	680	748	1,130	3,000
V481NA34	34	480	640	650	40,000	670	750	825	1,240	2,700
V511NA34	34	510	675	700	40,000	735	820	910	1,350	2,500
V571NA34	34	575	730	770	40,000	805	910	1000	1,480	2,200
V661NA34	34	660	850	900	40,000	940	1050	1160	1,720	2,000
V751NA34	34	750	970	1050	40,000	1080	1200	1320	2,000	1,800

NOTE: Average power dissipation of transients not to exceed 2.0W.
1. Peak current applies to applications rated up to $115V_{RMS}$. Peak current is 30kA for applications greater than $115V_{RMS}$.
2. Peak current applies to applications rated up to $132V_{RMS}$. Peak current is 30kA for applications greater than $132V_{RMS}$.
3. Peak current applies to applications rated up to $123V_{RMS}$. Peak current is 30kA for applications greater than $123V_{RMS}$.

NA Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. The operating values must be derated as shown in Figure 1.

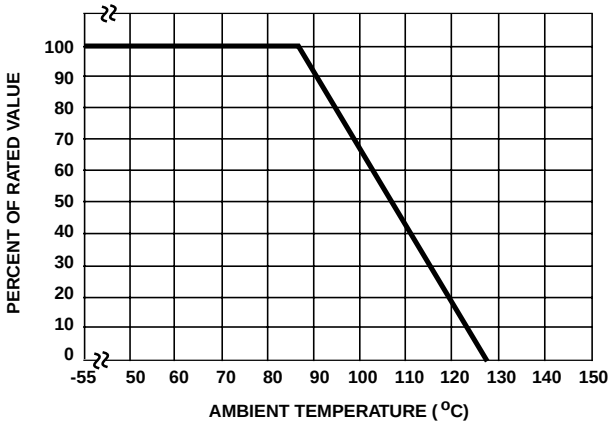
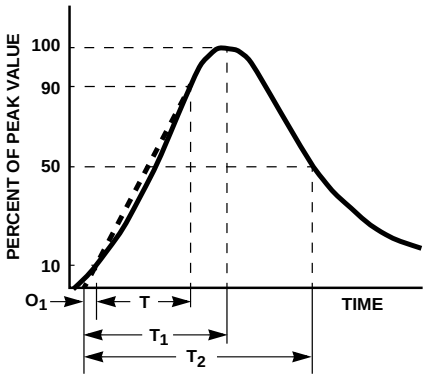


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

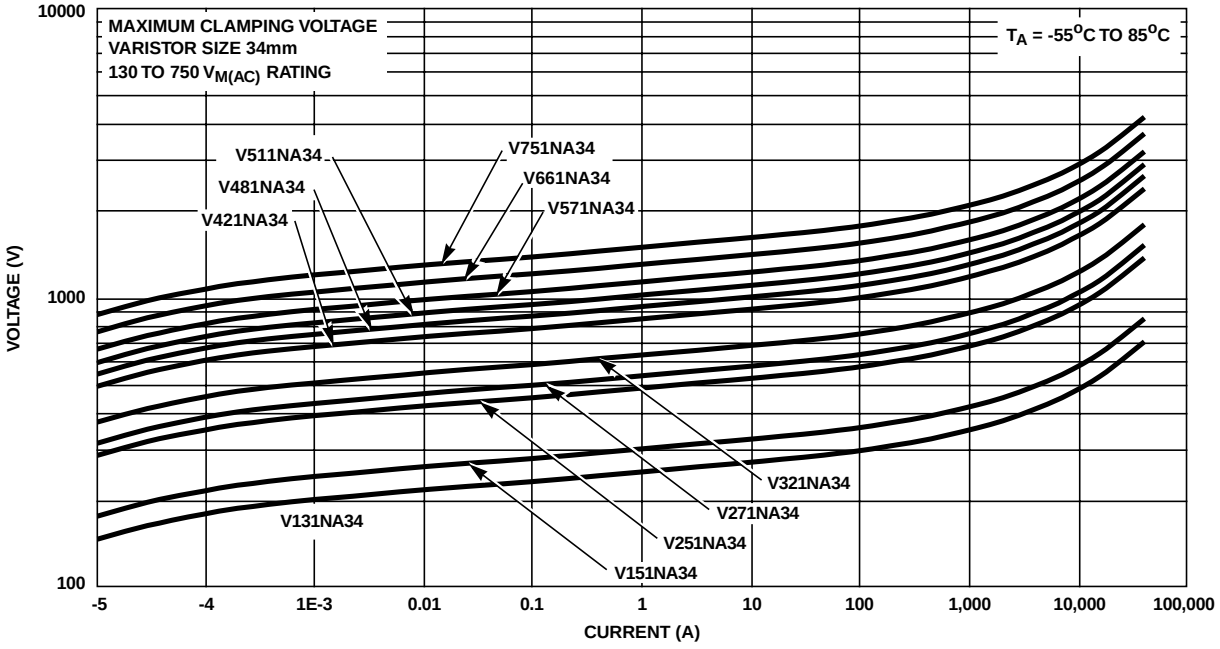


FIGURE 3. CLAMPING VOLTAGE FOR V131NA34 - V751NA34

NA Varistor Series

Pulse Rating Curves

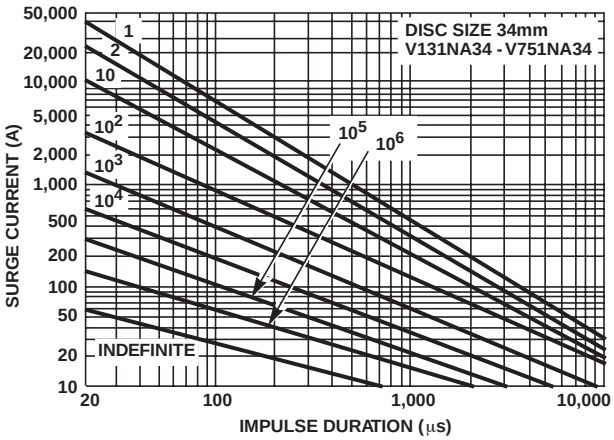
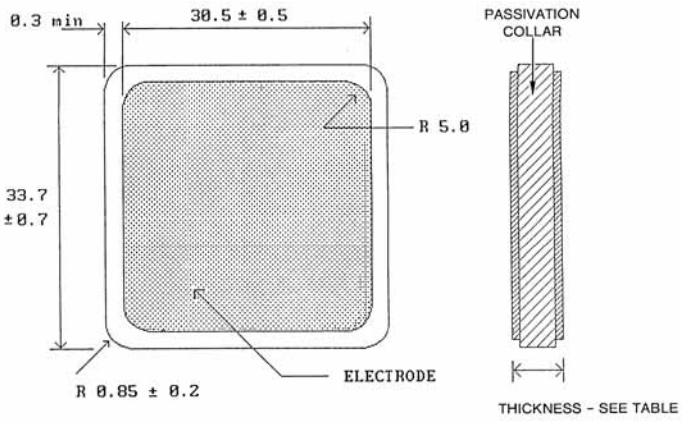


FIGURE 4. SURGE CURRENT RATING CURVES FOR V131NA34 - V751NA34

NOTE:If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

Mechanical Dimensions

(MILLIMETERS)



MODEL NUMBER	NA SERIES VARISTOR THICKNESS			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
V131NA34	1.40	2.30	0.055	0.090
V141NA34	1.45	2.55	0.057	0.100
V151NA34	1.50	2.80	0.059	0.011
V251NA34	1.70	2.30	0.066	0.090
V271NA34	1.80	2.70	0.070	0.106
V321NA34	2.10	3.00	0.082	0.118
V421NA34	3.00	4.00	0.118	0.157
V481NA34	3.20	4.40	0.125	0.173
V511NA34	3.60	4.90	0.141	0.192
V571NA34	4.00	5.60	0.118	0.220
V661NA34	4.50	6.80	0.176	0.267
V751NA34	5.20	7.50	0.204	0.294

NOTE: Parts available encapsulated with soldered tabs, to standard design or customer specific requirements. Also see HB34 Series.

NA Varistor Series

Passivation Layer

The standard NA Series is supplied with passivation layer around the outside perimeter of the disc forming an electrical insulator as detailed in the dimensional drawing.

Encapsulated Recommendations

After lead attachment, the disc/lead assembly may be coated or encapsulated in a package to provide electrical insulation and isolation from environmental contamination as required by the application. Coating/Filler materials for containers may include silicones, polyurethanes, and some epoxy resins. Two examples of acceptable polyurethanes are Dexter Hysol (US7013, parts A and B) and Rhenatech (resin 4714, hardener 4900), or their equivalents. Materials containing halogens, sulfides, or alkalines are not recommended.

Electrode Metallization

The NA Series is supplied with a sintered silver metallization for the electrode finish. The silver metallization is typically used for solder reflow lead attach operations (I-R, Vapour-Phase).

The recommended temperature profile of a belt-fed convection oven is shown in Figure 6.

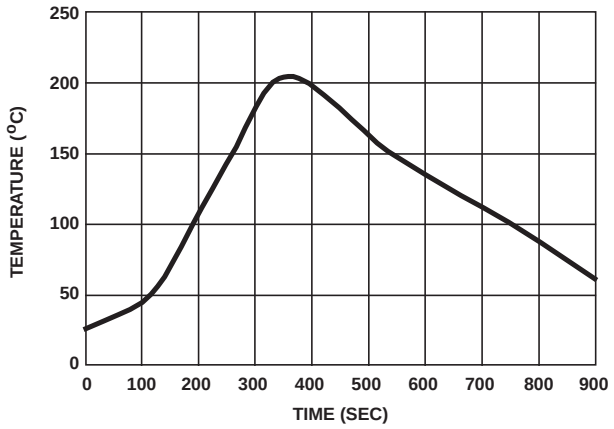


FIGURE 6. TYPICAL BELT OVEN TEMPERATURE PROFILE

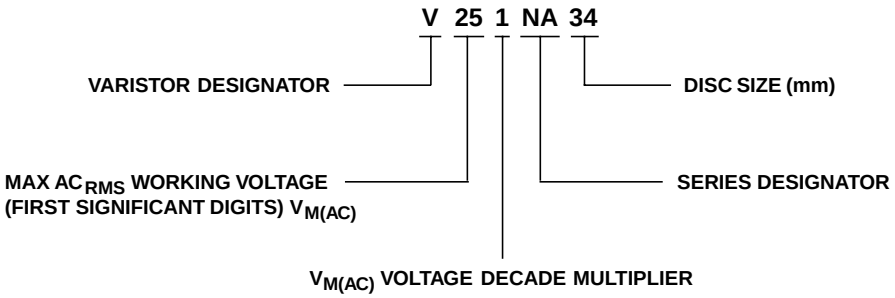
Stacking and Contact Pressure Recommendations

When applications require the stacking of Littelfuse NA discs or when electrical connection is made by pressure contacts, the minimum pressure applied to the disc electrode surface should be 2.2kGs (5 pounds). The maximum recommended pressure applied to the disc electrode is 16N/CM^2 (23LBs/IN^2).

Packaging and Shipping

The NA Series is supplied in bulk for shipment. Discs are packaged in compartmentalized cartons to protect from scratching or edge-chipping during shipment.

Ordering Information

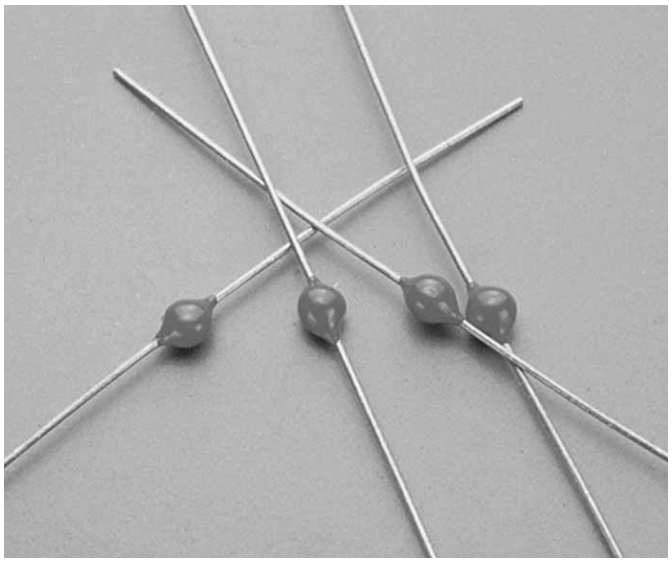


MA Varistor Series

The MA Series of transient surge suppressors are axial-lead metal-oxide varistors (MOVs) for use in a wide variety of board level industrial and commercial electronic equipment. They are intended to protect components and signal/data lines from low energy transients where the small axial lead package is required.

The MA Series is offered with standard (S suffix) or tightened (B suffix) clamping voltage.

See MA Series Device Ratings and Specifications table for part number and brand information.



Features

- 3mm Diameter Disc Size
- Small Axial Lead Package
- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . 9V to 264V
  $V_{M(DC)}$ . . . . . 13V to 365V
- Available in Tape and Reel or Bulk Packaging
- No Derating Up to 85°C Ambient

MA Varistor Series

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

	MA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	9 to 264	V
DC Voltage Range ($V_{M(DC)}$)	13 to 365	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	40 to 100	A
Single Pulse Energy Range		
For 10/1000µs Current Wave (W_{TM})	0.06 to 1.7	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)	1000	V
(Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)	1000	MΩ
Insulation Resistance		

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

PART NUMBER	BRAND	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLTAGE V_C AT 2.0A (8/20µs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (10/1000µs)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	f = 1MHz
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
		(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V18MA1A	18A	9	13	0.06	40	14	18	23	49	550
V18MA1B	18B	10	14	0.07	40	15	18	21	44	550
V18MA1S	18S	10	14	0.06	40	15	18	21	49	550
V22MA1A	22A	10	15	0.09	40	16	22	28	55	410
V22MA1B	22B	14	18	0.10	40	19	22	26	51	410
V22MA1S	22S	14	18	0.09	40	19	22	26	55	410
V27MA1A	27A	13	19	0.10	40	21	27	34	67	370
V27MA1B	27B	17	22	0.11	40	24	27	31	59	370
V27MA1S	27S	17	22	0.10	40	24	27	31	67	370
V33MA1A	33A	18	23	0.13	40	26	33	40	73	300
V33MA1B	33B	20	26	0.15	40	29.5	33	36.5	67	300
V33MA1S	33S	20	26	0.14	40	29.5	33	36.5	73	300
V39MA2A	39A	22	28	0.16	40	31	39	47	86	250
V39MA2B	39B	25	31	0.18	40	35	39	43	79	250
V39MA2S	39S	25	31	0.17	40	35	39	43	86	250
V47MA2A	47A	27	34	0.19	40	37	47	57	99	210
V47MA2B	47B	30	38	0.21	40	42	47	52	90	210
V47MA2S	47S	30	38	0.19	40	42	47	52	99	210
V56MA2A	56A	32	40	0.23	40	44	56	68	117	180
V56MA2B	56B	35	45	0.25	40	50	56	62	108	180
V56MA2S	56S	35	45	0.23	40	50	56	62	117	180
V68MA3A	68A	38	48	0.26	40	54	68	82	138	150
V68MA3B	68B	40	56	0.30	40	61	68	75	127	150
V68MA3S	68S	40	56	0.27	40	61	68	75	138	150
V82MA3A	82A	45	60	0.33	40	65	82	99	163	120
V82MA3B	82B	50	66	0.37	40	73	82	91	150	120
V82MA3S	82S	50	66	0.34	40	73	82	91	163	120

MA Varistor Series

Device Ratings and Specifications (Continued)

PART NUMBER	BRAND	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)				
		CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLTAGE V_C AT 2.0A (8/20μs)	TYPICAL CAPACITANCE
		V_{RMS}	V_{DC}	ENERGY (10/1000μs)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX		
		$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}				V_C	f = 1MHz
		(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(pF)
V100MA4A	100	57	72	0.40	40	80	100	120	200	100
V100MA4B	101	60	81	0.45	40	90	100	110	185	100
V100MA4S	102	60	81	0.42	40	90	100	110	200	100
V120MA1A	120	72	97	0.40	100	102	120	138	220	40
V120MA2B	121	75	101	0.50	100	108	120	132	205	40
V120MA2S	122	75	101	0.46	100	108	120	132	220	40
V150MA1A	150	88	121	0.50	100	127	150	173	255	32
V150MA2B	151	92	127	0.60	100	135	150	165	240	32
V180MA1A	180	105	144	0.60	100	153	180	207	310	27
V180MA3B	181	110	152	0.70	100	162	180	198	290	27
V220MA2A	220	132	181	0.80	100	187	220	253	380	21
V220MA4B	221	138	191	0.90	100	198	220	242	360	21
V270MA2A	270	163	224	0.90	100	229	270	311	460	17
V270MA4B	271	171	235	1.00	100	243	270	297	440	17
V330MA2A	330	188	257	1.00	100	280	330	380	570	14
V330MA5B	331	200	274	1.10	100	297	330	363	540	14
V390MA3A	390	234	322	1.20	100	331	390	449	670	12
V390MA6B	391	242	334	1.30	100	351	390	429	640	12
V430MA3A	430	253	349	1.50	100	365	430	495	740	11
V430MA7B	431	264	365	1.70	100	387	430	473	700	11

NOTE: Average power dissipation of transients not to exceed 200mW.

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

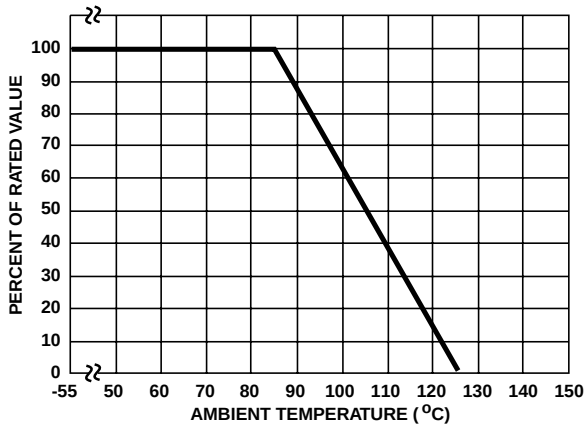
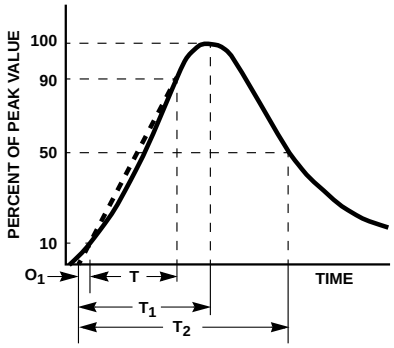


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE

MA Varistor Series



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20µs Current Waveform:
8µs = T_1 = Virtual Front Time
20µs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

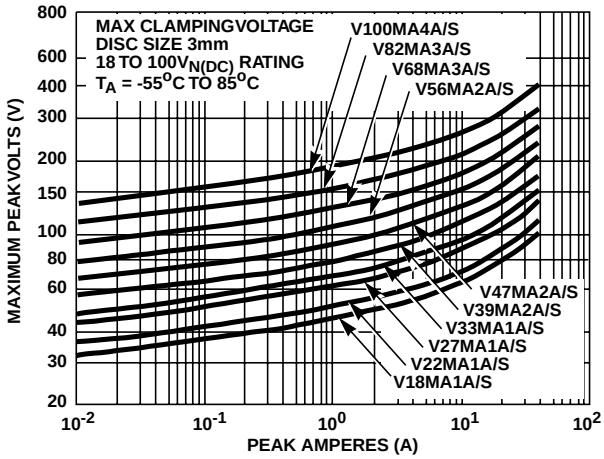
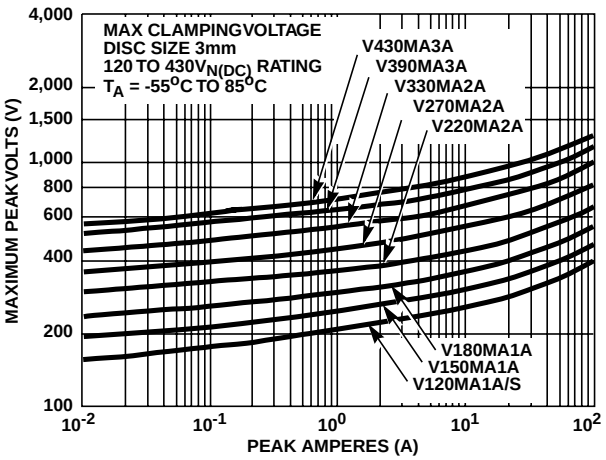


FIGURE 3. CLAMPING VOLTAGE FOR V18MA1A/S - V100MA4A/S



FI GURE 4. CLAMPING VOLTAGE FOR V120MA1A/S - V430MA3A

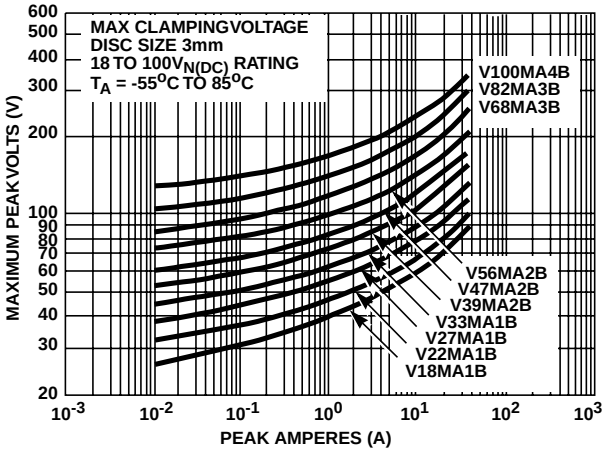


FIGURE 5. CLAMPING VOLTAGE FOR V18MA1B - V100MA4B

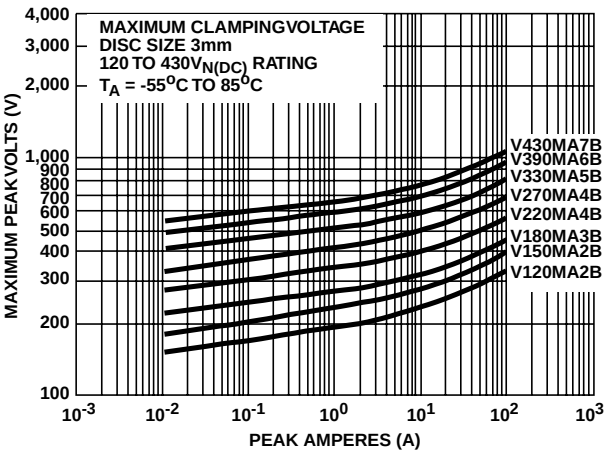


FIGURE 6. CLAMPING VOLTAGE FOR V120MA2B - V430MA7B

MA Varistor Series

Pulse Rating Curves

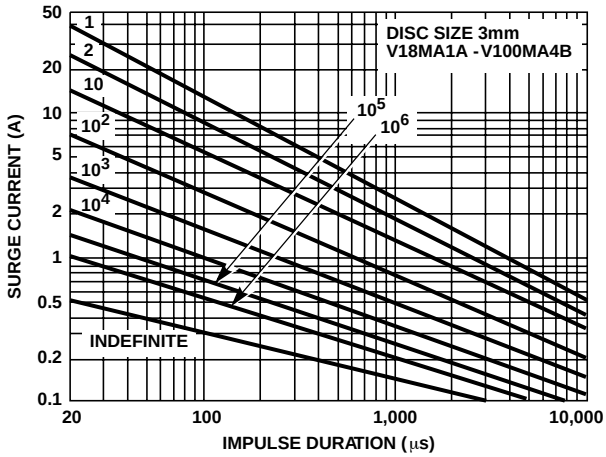


FIGURE 7. SURGE CURRENT RATING CURVES FOR V18MA SERIES - V100MA SERIES

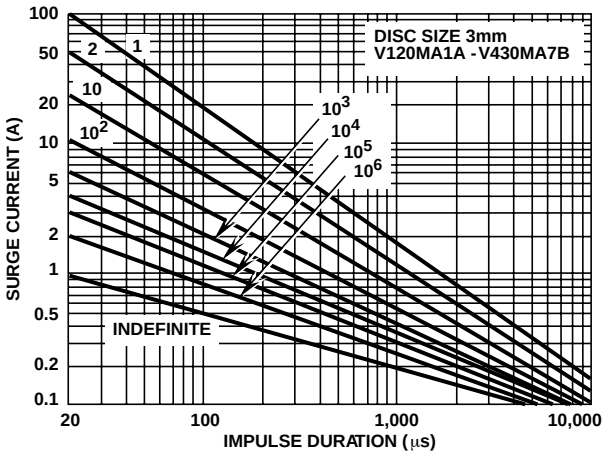
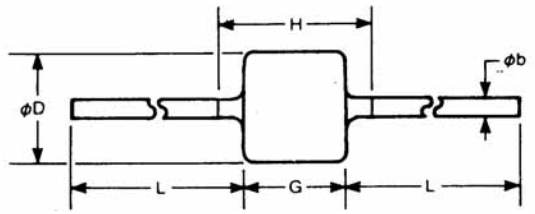


FIGURE 8. SURGE CURRENT RATING CURVES FOR V120MA SERIES - V430MA SERIES

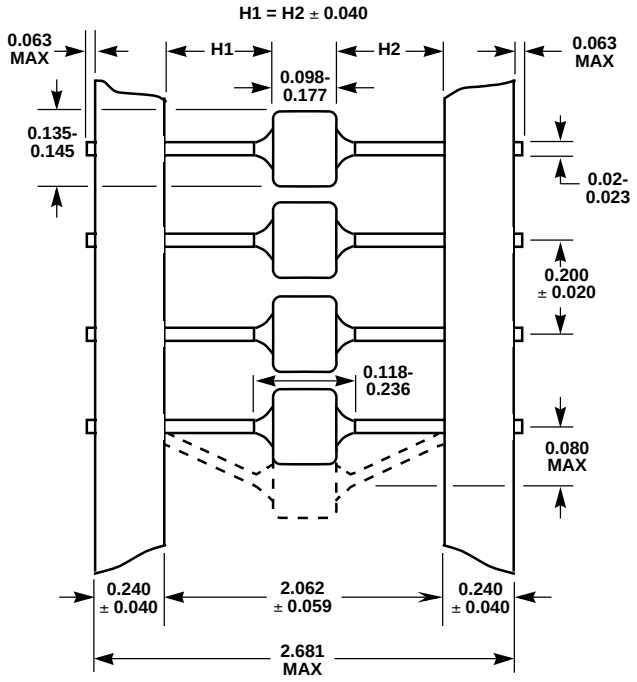
NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result. This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

Mechanical Dimensions



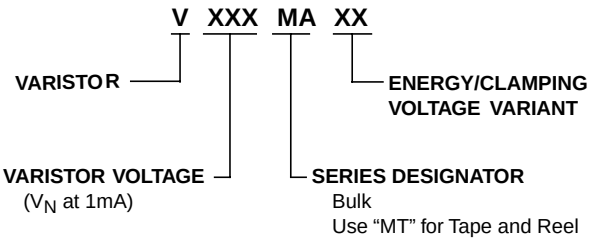
SYMBOL	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
Øb	0.024	0.026	0.61	0.66
ØD	0.135	0.177	3.43	4.5
G	0.098	0.177	3.43	4.5
H	0.118	0.236	3.0	6.0
L	1.130	1.220	28.70	31.0
Typical Weight = 25g				

Tape and Reel Specification



- Conforms to EIA Standard RS-296E

Ordering Information



PA Varistor Series

The PA Series of transient surge suppressors are metal-oxide varistors (MOVs) featuring a rigid base mount package construction, and are useful in applications which are subject to vibration.

These UL and CSA recognized varistors are available in a wide range of operating voltages, from 130V to 660V $V_{M(AC)RMS}$. The base-mount package has a quick-connect tab terminal that provides a fast, secure lead attach. The mounting base forms the second electrical connection, usually chassis ground. Meeting rigid NEMA standards, PA series varistors have a creep and strike distance capability that minimizes breakdown along the package surface.

See PA Series Device Ratings and Specifications table for part number and brand information.

Features

- Wide Operating Voltage Range $V_{M(AC)RMS}$ . . . . . .130V to 660V
- Creep and Strike Distance Capability Meets Rigid NEMA Standards
- Base Mount Construction Forms One Electrical Connection
- Quick Connect Tab Terminal
- No Derating Up to 85ºC Ambient

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA.

AGENCY FILE NUMBERS: UL E75961, CSA LR91788.

PA Varistor Series

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

	PA SERIES	UNITS
Continuous:		
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	130 to 660	V
DC Voltage Range ($V_{M(DC)}$)	175 to 850	V
Transient:		
Peak Pulse Current (I_{TM})		
For 8/20µs Current Wave (See Figure 2)	6500	A
Single Pulse Energy Range		
For 10/1000µs Current Wave (W_{TM})	70 to 250	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

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

PART NUMBER AND DEVICE BRANDING	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)					
	CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLT V_C AT TEST CURRENT (8/20µs)		TYPICAL CAPACI-TANCE
	V_{RMS}	V_{DC}	ENERGY (10/1000µs)	PEAK CURRENT (8/20µs)						
	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	MIN	$V_{N(DC)}$	MAX	V_C	I_P	f = 1MHz
	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(A)	(pF)
V130PA20A	130	175	70	6500	184	200	243	360	100	1900
V130PA20C	130	175	70	6500	184	200	220	325	100	1900
V150PA20A	150	200	80	6500	212	240	284	420	100	1600
V150PA20C	150	200	80	6500	212	240	243	360	100	1600
V250PA40A	250	330	130	6500	354	390	453	675	100	1000
V250PA40C	250	330	130	6500	354	390	413	620	100	1000
V275PA40A	275	369	140	6500	389	430	494	740	100	900
V275PA40C	275	369	140	6500	389	430	453	680	100	900
V320PA40A	320	420	160	6500	462	510	565	850	100	750
V320PA40C	320	420	160	6500	462	510	540	800	100	750
V350PA40A	350	460	165	6500	500	559	618	910	100	700
V350PA40C	350	460	165	6500	500	535	570	840	100	700
V420PA40A	420	560	170	6500	610	680	790	1160	100	600
V420PA40C	420	560	170	6500	610	680	690	1050	100	600
V480PA80A	480	640	180	6500	670	750	860	1280	100	550
V480PA80C	480	640	180	6500	670	750	790	1160	100	550
V510PA80A	510	675	190	6500	735	820	963	1410	100	500
V510PA80C	510	675	190	6500	735	820	860	1280	100	500
V575PA80A	575	730	220	6500	805	910	1050	1560	100	450
V575PA80C	575	730	220	6500	805	910	960	1410	100	450
V660PA100A	660	850	250	6500	940	1050	1210	1820	100	400

PA Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

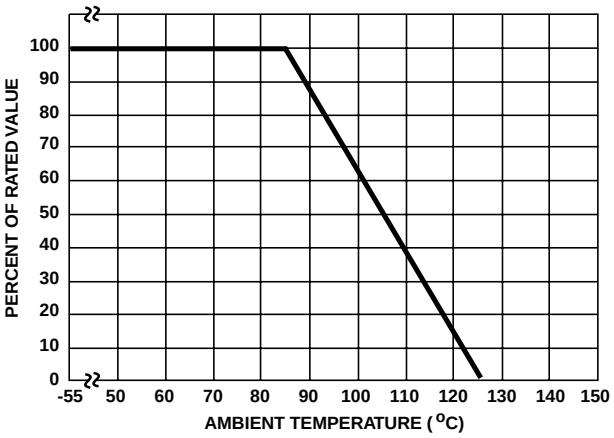
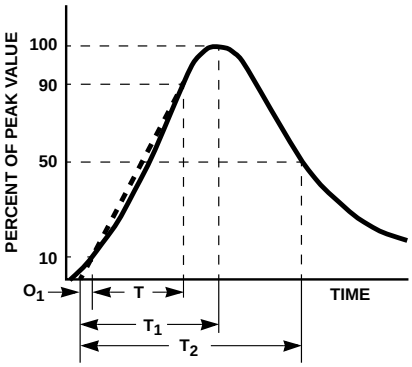


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)
Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

Transient V-I Characteristics Curves

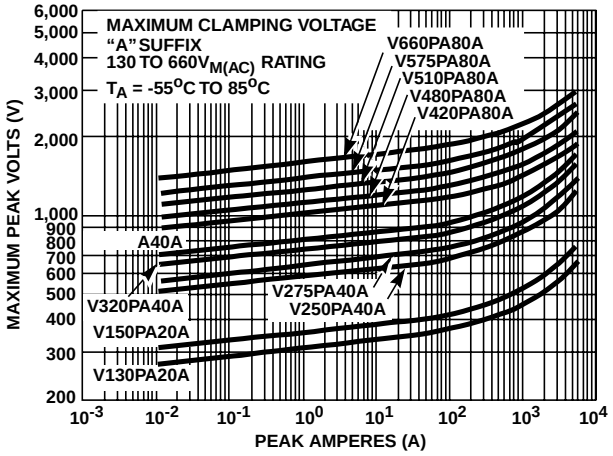


FIGURE 3. CLAMPING VOLTAGE FOR V130PA20A - V660PA100A

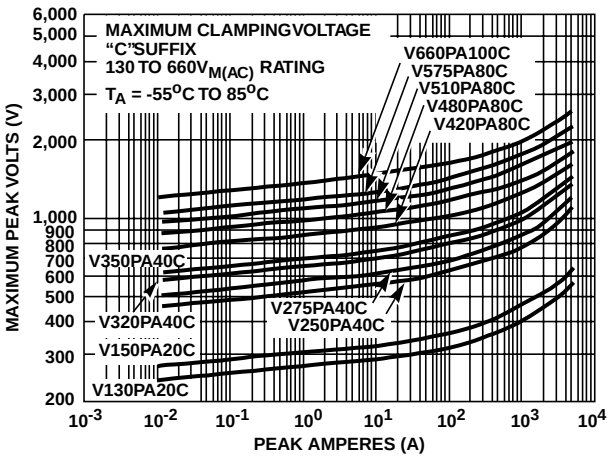


FIGURE 4. CLAMPING VOLTAGE FOR V130PA20C - V660PA100C

PA Varistor Series

Pulse Rating Curves

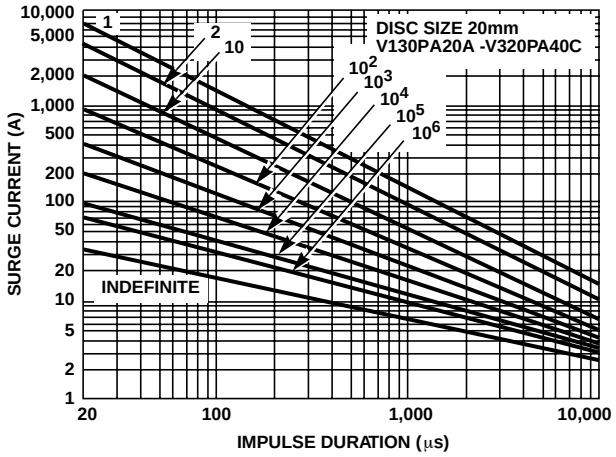


FIGURE 5. SURGE CURRENT RATING CURVES FOR V130PA20A - V320PA40C

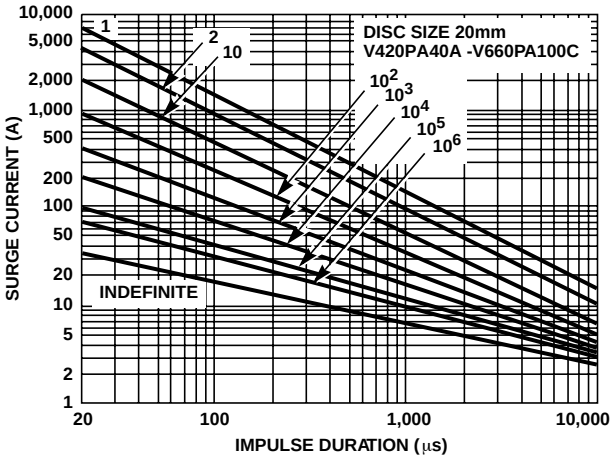
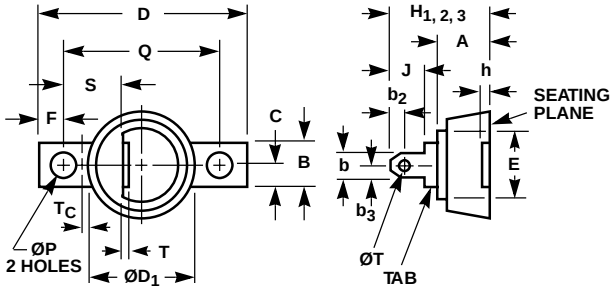


FIGURE 6. SURGE CURRENT RATING CURVES FOR V420PA40A - V660PA100C

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result.This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide transient protection

Mechanical Dimensions



NOTES:

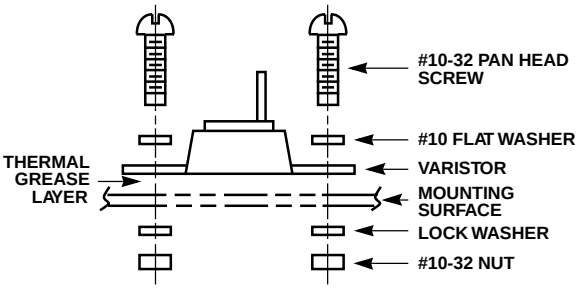
1. Tab is designed to fit 1/4" quick-connect terminal.
2. Case temperature is measured at T_C on top surface of base plate.
3. H_1 (130-150V_{RMS} devices).
   H_2 (250-320V_{RMS} devices).
   H_3 (420-660V_{RMS} devices).
4. Electrical connection: top terminal and base plate.
5. Typical weight: 30g.

SYM-BOL	MILLIMETERS			INCHES			NOTES
	MIN	NOM	MAX	MIN	NOM	MAX	
A	-	-	14.3	-	-	0.570	-
b	-	-	6.6	-	-	0.260	1
b2	3.94	4.06	4.18	0.155	0.160	0.165	-
b3	3.05	3.17	3.29	0.120	0.125	0.130	-
B	-	-	12.9	-	-	0.510	-
C	-	-	6.6	-	-	0.260	-
D	-	-	66.3	-	-	2.610	-
ØD1	-	-	33.5	-	-	1.320	-
E	-	11.2	-	-	0.440	-	-
F	7.50	7.62	7.75	0.295	0.300	0.305	-
h	-	0.8	1.0	-	0.030	0.040	-
H_1	-	-	25.6	-	-	1.010	3
H_2	-	-	28.3	-	-	1.120	3
H_3	-	-	32.8	-	-	1.290	3
J	-	-	8.1	-	-	0.320	-
ØP	5.6	-	6.0	0.220	-	0.240	-
Q	50.6	50.8	51.0	1.990	2.000	2.010	-
S	18.4	19.2	20.0	0.72	0.75	0.78	-
T	-	-	1.0	-	-	0.040	-
ØT	2.8	-	-	0.110	-	-	-
T_C	-	3.2	-	-	0.126	-	2

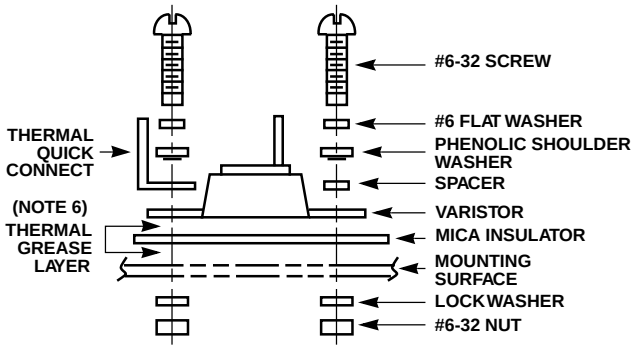
PA Varistor Series

Suggested Hardware and Mounting Arrangements

TYPICAL NON-ISOLATED MOUNTING



TYPICAL ISOLATED MOUNTING



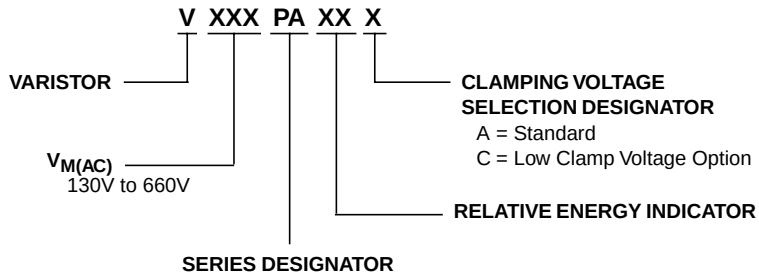
NOTE:

6. GE G623, Dow Corning, DC3, 4, 340, or 640 Thermal Grease recommended for best heat transfer.

1,000V Isolation Kit containing the following parts can be ordered by part #A7811055 (Qty).

(1) MICA insulation 1"/3.1"/0.005" thick	(2) Phenolic shoulder washer	(2) #6-32/3 / 4 screw	(2) #6 internal tooth lock washer
(1) 1/4 " quick-connect terminal	(1) Spacer	(2) #6-32 nut	(2) #6 flat washer

Ordering Information

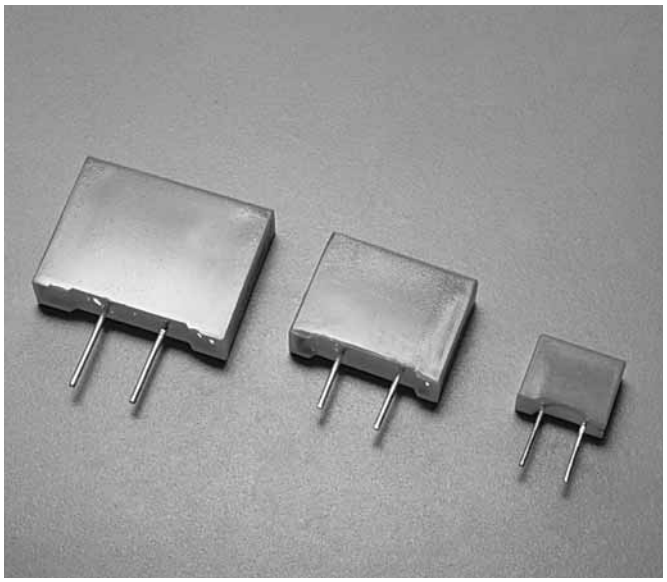


RA Varistor Series

The RA Series transient surge suppressors are varistors (MOVs) supplied in a low-profile box that features a precise seating plane to increase mechanical stability for secure circuit-board mounting. This feature makes these devices suitable for industrial applications critical to vibration. Their construction permits operation up to 125°C (ambient) without derating.

The RA series are available in voltage ratings up to 275V $V_{M(AC)RMS}$, and energy levels up to 140J. These varistors are used in automotive, motor-control, telecommunication, and military applications.

See RA Series Device Ratings and Specifications table for part number and brand information.



Features

- Low Profile Outline with Precise Seating Plane
- No Derating up to 125°C Ambient
- Wide Operating Voltage Range
  $V_{M(AC)RMS}$ . . . . . 4V to 275V
  $V_{M(DC)}$ . . . . . .5.5V to 369V
- High Energy Absorption Capability W TM . . . . . up to 140J
- 3 Model Sizes Available . . . . . RA8, RA16, and RA22
- In-Line Leads

AGENCY APPROVALS: Recognized under the components program of Underwriters Laboratories. Certified by CSA.

AGENCY FILE NUMBERS: UL E75961, E56529, E135010; CSA LR91788.

RA Varistor Series

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

Continuous:	RA8 SERIES	RA16 SERIES	RA22 SERIES	UNITS
Steady State Applied Voltage:				
AC Voltage Range ($V_{M(AC)RMS}$)	4 to 275	10to 275	4 to 275	V
DC Voltage Range ($V_{M(DC)}$)	5.5 to 369	14 to 369	18 to 369	V
Transient:				
Peak Pulse Current (I_{TM})				
For 8/20µs Current Wave (See Figure 2)	100 to1200	1000 to 4500	2000 to 6500	A
Single Pulse Energy Range ($_{Note\ 1}$)				
For 10/1000µs Current Wave (W_{TM})	0.4 to 23	3.5 to 75	70 to 160	J
Operating Ambient Temperature Range (T_A)	-55 to 125	-55 to -125	-55 to -125	°C
Storage Temperature Range (T_{STG})	-55 to 150	-55 to 150	-55 to 150	°C
Temperature Coefficient (αV) of Clamping Voltage (V_C) at Specified Test Current	<0.01	<0.01	<0.01	%/°C
Hi-Pot Encapsulation (Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)	5000	5000	5000	V
Insulation Resistance	1000	1000	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 any other conditions above those indicated in the operational sections of this specification is not implied.

Device Ratings and Specifications (Note 1)

			MAXIMUM RATINGS (125°C)				SPECIFICATIONS (25°C)					
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLTAGE V_C AT TEST CURRENT (8/20µs)		TYPICAL CAPACI-TANCE
	PART NUMBER	BRAND	V_{RMS}	V_{DC}	ENERGY (10/1000µs)	PEAK CURRENT (8/20µs)	MIN	$V_{N(DC)}$	MAX	V_C	I_P	f = 1MHz
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}						
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(A)	(pF)
†	RA8 SERIES											
	V8RA8	8R	4	5.5	0.4	150	6	8.2	11.2	22	5	3000
	V12RA8	12R	6	8	0.6	150	9	12	16	34	5	2500
	V18RA8	18R	10	14	0.8	250	14.4	18	21.6	42	5	2000
	V22RA8	22R	14	18 (Note 3)	10 (Note 2)	250	18.7	22	26	47	5	1600
	V27RA8	27R	17	22	1.0	250	23	27	31.1	57	5	1300
	V33RA8	33R	20	26	1.2	250	29.5	33	36.5	68	5	1100
	V39RA8	39R	25	31	1.5	250	35	39	43	79	5	900
	V47RA8	47R	30	38	1.8	250	42	47	52	92	5	800
	V56RA8	56R	35	45	2.3	250	50	56	62	107	5	700
	V68RA8	68R	40	56	3.0	250	61	68	75	127	5	600
	V82RA8	82R	50	66	4.0	1200	74	82	91	135	10	500
	V100RA8	100R	60	81	5.0	1200	90	100	110	165	10	400
	V120RA8	120R	75	102	6.0	1200	108	120	132	205	10	300
	V150RA8	150R	95	127	8.0	1200	135	150	165	250	10	250
	V180RA8	180R	115	153	10.0	1200	162	180	198	295	10	200
	V200RA8	200R	130	175	11.0	1200	184	200	228	340	10	180
†	V220RA8	220R	140	180	12.0	1200	198	220	242	360	10	160
†	V240RA8	240R	150	200	13.0	1200	212	240	268	395	10	150
†	V270RA8	270R	175	225	15.0	1200	247	270	303	455	10	130
†	V360RA8	360R	230	300	20.0	1200	324	360	396	595	10	100

RA Varistor Series

Device Ratings and Specifications (Note 1) (Continued)

	PART NUMBER	BRAND	MAXIMUM RATINGS (125°C)				SPECIFICATIONS (25°C)					
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA DC TEST CURRENT			MAX CLAMPING VOLTAGE V_C AT TEST CURRENT (8/20μs)		TYPICAL CAPACITANCE
			V_{RMS}	V_{DC}	ENERGY (10/1000μs)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX	V_C	I_P	f = 1MHz
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}						
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(A)	(pF)
†	V390RA8	390R	250	330	21.0	1200	354	390	429	650	10	90
†	V430RA8	430R	275	369	23.0	1200	389	430	473	710	10	80
†	**RA16 SERIES**											
	V18RA16	18R16	10	14	3.5	1000	14.4	18	21.6	39	10	11000
	V22RA16	22R16	14	18 (Note 3)	50 (Note 2)	1000	18.7	22	26	43	10	9000
	V27RA16	27R16	17	22	5.0	1000	23	27	31.1	53	10	7000
	V33RA16	33R16	20	26	6.0	1000	29.5	33	36.5	64	10	6000
	V39RA16	39R16	25	31	7.2	1000	35	39	43	76	10	5000
	V47RA16	47R16	30	38	8.8	1000	42	47	52	89	10	4500
	V56RA16	56R16	35	45	10.0	1000	50	56	62	103	10	3900
	V68RA16	68R16	40	56	13.0	1000	61	68	75	123	10	3300
	V82RA16	82R16	50	66	15.0	4500	74	82	91	145	50	2500
	V100RA16	100R16	60	81	20.0	4500	90	100	110	175	50	2000
	V120RA16	120R16	75	102	22.0	4500	108	120	132	205	50	1700
	V150RA16	150R16	95	127	30.0	4500	135	150	165	255	50	1400
	V180RA16	180R16	115	153	35.0	4500	162	180	198	300	50	1100
†	V200RA16	200R16	130	175	38.0	4500	184	200	228	340	50	1000
†	V220RA16	220R16	140	180	42.0	4500	198	220	242	360	50	900
†	V240RA16	240R16	150	200	45.0	4500	212	240	268	395	50	800
†	V270RA16	270R16	175	225	55.0	4500	247	270	303	455	50	700
†	V360RA16	360R16	230	300	70.0	4500	324	360	396	595	50	550
†	V390RA16	390R16	250	330	72.0	4500	354	390	429	650	50	500
†	V430RA16	430R16	275	369	75.0	4500	389	430	473	710	50	450
†	**RA22 SERIES**											
	V24RA22	24R22	14	18 (Note 3)	100.0 (Note 2)	2000	19.2	24 (Note 4)	26	43	20	18000
	V36RA22	36R22	23	31	160.0 (Note 2)	2000	32	36 (Note 4)	40	63	20	12000
†	V200RA22	200R22	130	175	70.0	6500	184	200	228	340	100	1900
†	V240RA22	240R22	150	200	80.0	6500	212	240	268	395	100	1600
†	V270RA22	270R22	175	225	90.0	6500	247	270	303	455	100	1400
†	V390RA22	390R22	250	330	130.0	6500	354	390	429	650	100	1000
†	V430RA22	430R22	275	369	140.0	6500	389	430	473	710	100	900

NOTES:

1. Average power dissipation of transients not to exceed 0.25W for RA8 Series, 0.60W for RA16 Series, or 1.0W for RA22 Series.
2. Energy ratings for impulse duration of 30ms minimum to one half of peak current value.
3. Also rated to withstand 24V for 5 minutes.
4. 10mA DC Test Current.

† Under UL File No. E75961 as a recognized component. CSA approved File No. LR91788.

RA Varistor Series

Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in Figure 1. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

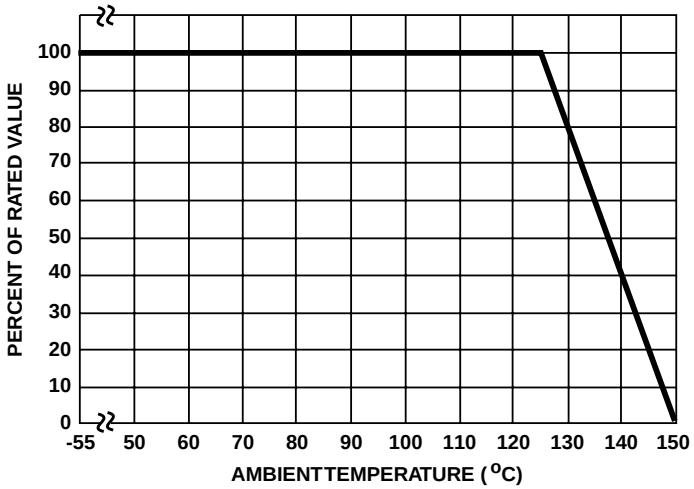
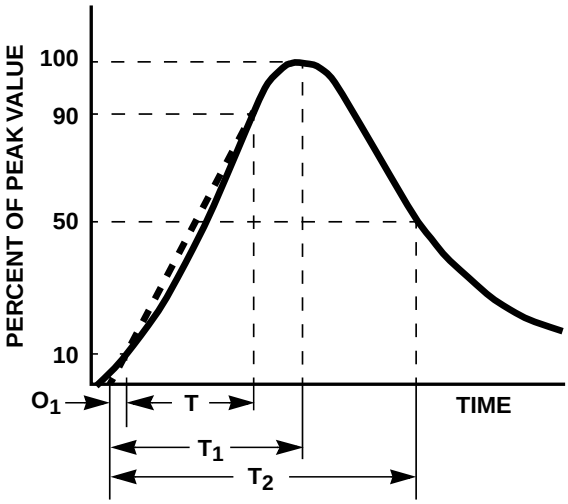


FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE



O_1 = Virtual Origin of Wave
T = Time From 10% to 90% of Peak
T_1 = Virtual Front time = 1.25 • t
T_2 = Virtual Time to Half Value (Impulse Duration)

Example: For an 8/20μs Current Waveform:
8μs = T_1 = Virtual Front Time
20μs = T_2 = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

RA Varistor Series

Transient V-I Characteristics Curves (Continued)

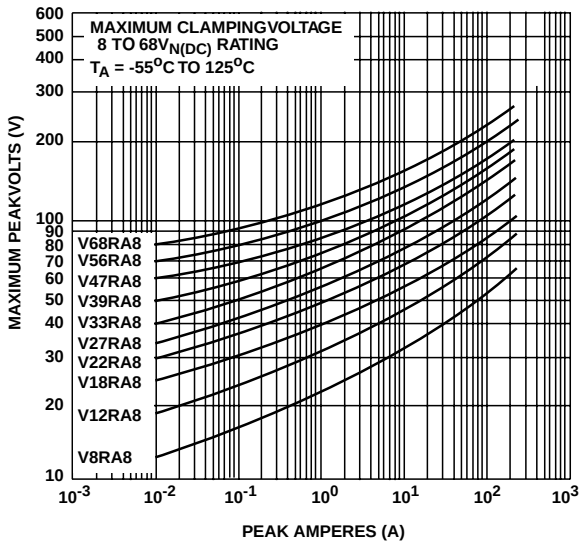


FIGURE 3. CLAMPING VOLTAGE FOR V8RA8 - V68RA8

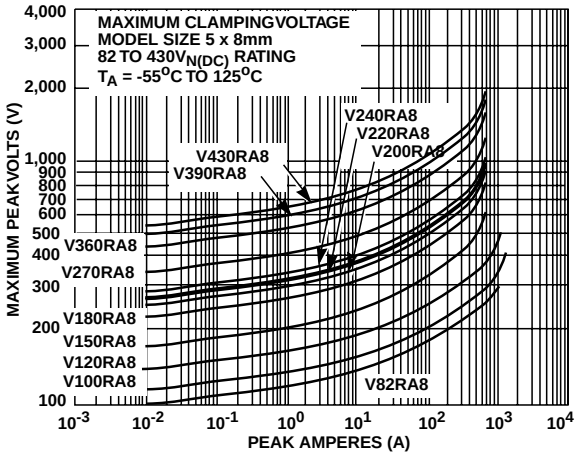


FIGURE 4. CLAMPING VOLTAGE FOR V82RA8 - V430RA8

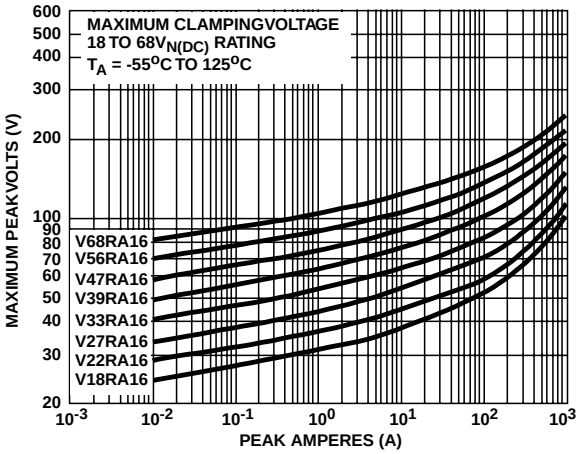


FIGURE 5. CLAMPING VOLTAGE FOR V18RA16 - V68RA16

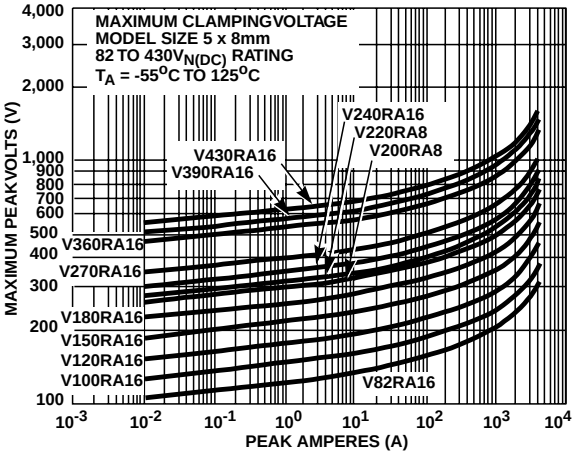


FIGURE 6. CLAMPING VOLTAGE FOR V82RA16 - V430RA16

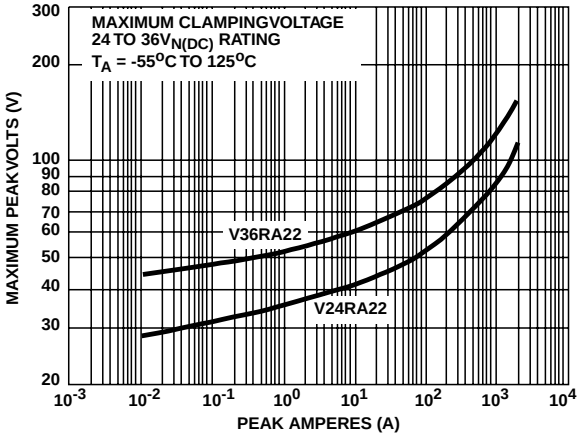


FIGURE 7. CLAMPING VOLTAGE FOR V24RA22 - V36RA22

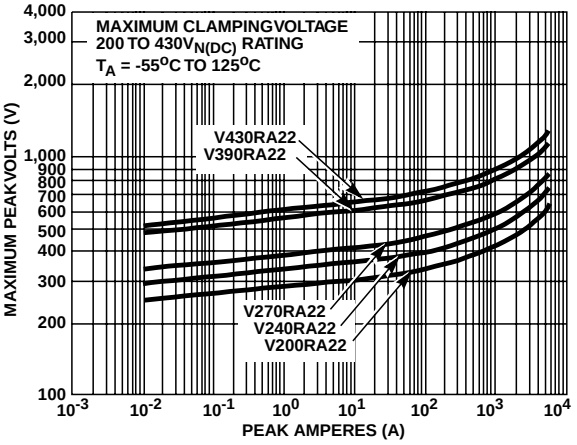


FIGURE 8. CLAMPING VOLTAGE FOR V200RA22 - V430RA22

RA Varistor Series

Pulse Rating Curves (Continued)

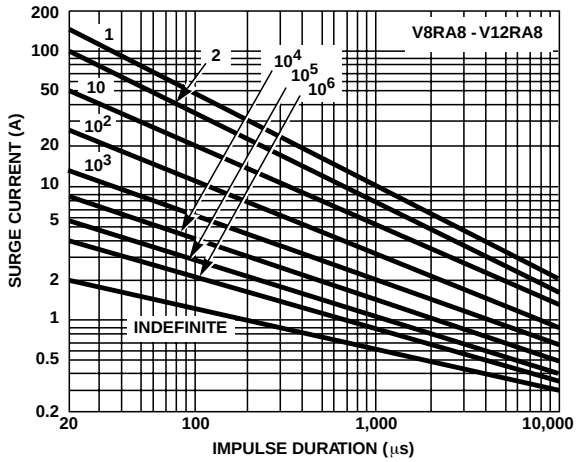


FIGURE 9. SURGE CURRENT RATING CURVES FOR V8RA8 - V12RA8

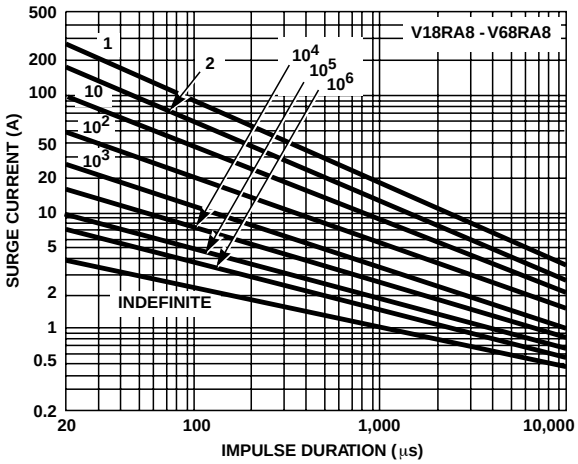


FIGURE 10. SURGE CURRENT RATING CURVES FOR V18RA8 - V68RA8

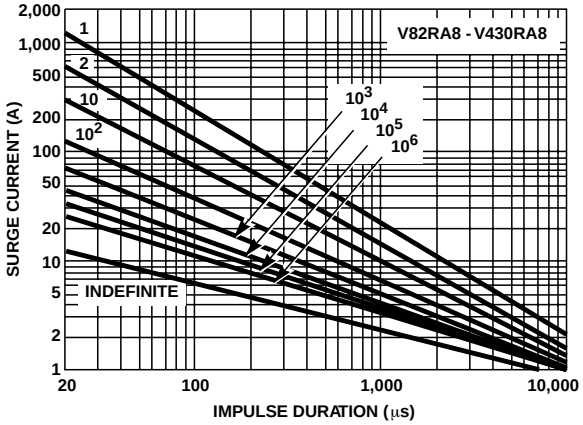


FIGURE 11. SURGE CURRENT RATING CURVES FOR V82RA8 - V430RA8

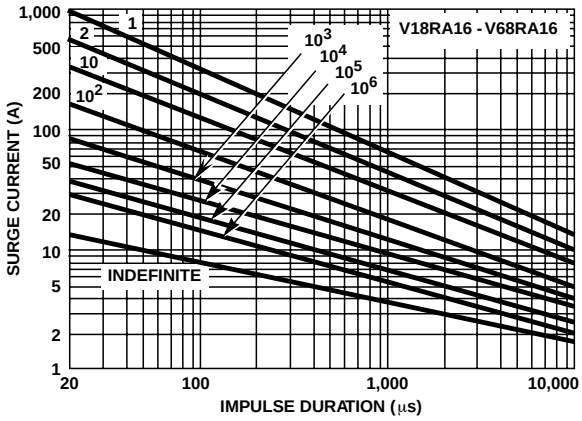


FIGURE 12. SURGE CURRENT RATING CURVES FOR V18RA16 - V68RA16

NOTE: If pulse ratings are exceeded, a shift of $V_{N(DC)}$ (at specified current) of more than ±10% could result.This type of shift, which normally results in a decrease of $V_{N(DC)}$, may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

RA Varistor Series

Pulse Rating Curves (Continued)

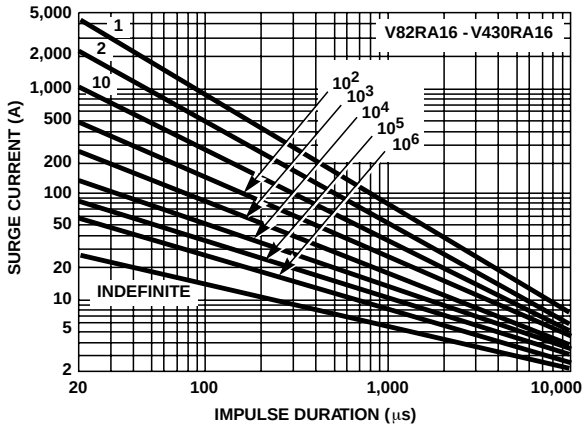


FIGURE 13. SURGE CURRENT RATING CURVES FOR V82RA16 - V430RA16

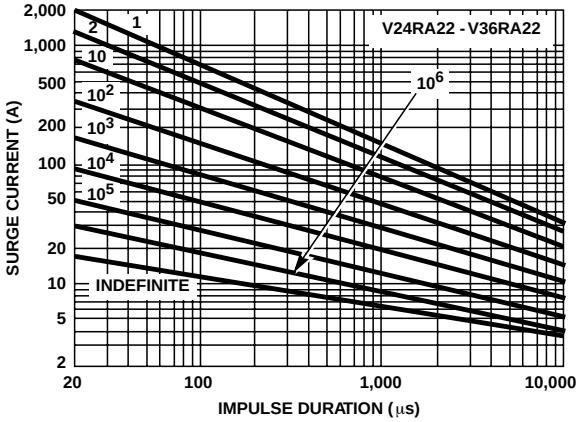


FIGURE 14. SURGE CURRENT RATING CURVES FOR V24RA22 - V36RA22

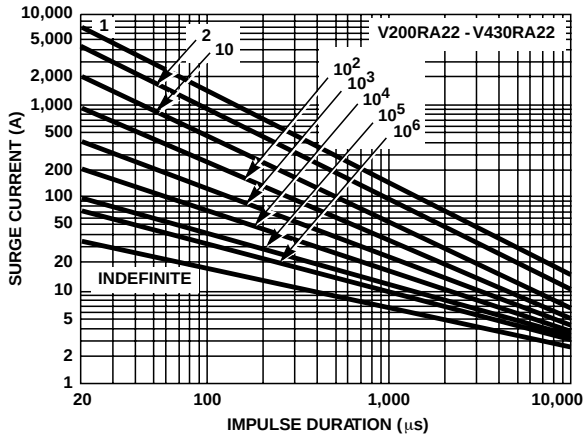
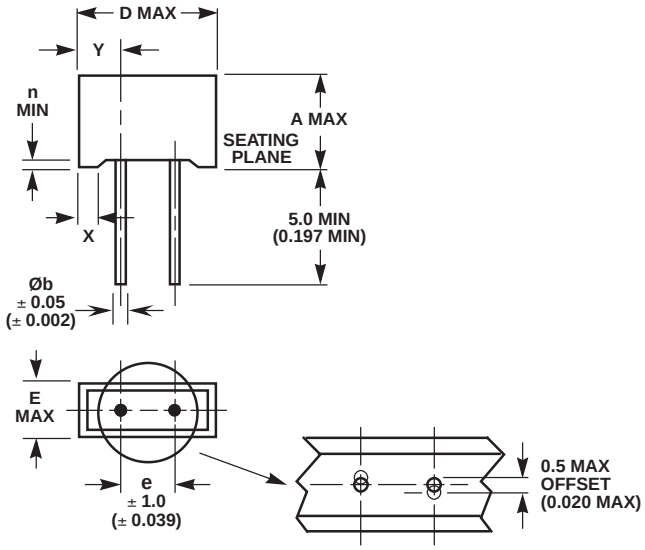


FIGURE 15. SURGE CURRENT RATING CURVES FOR V200RA22 - V430RA22

RA Varistor Series

Mechanical Dimensions



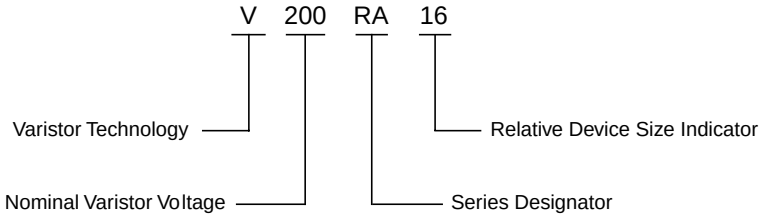
SYMBOL	RA8 SERIES	RA16 SERIES	RA22 SERIES
A MAX	8.85 (0.348)	15.1 (0.594)	19.1 (0.752)
D MAX	11.45 (0.450)	19.7 (0.776)	25.5 (1.004)
e	5 (0.197)	7.5 (0.295)	7.5 (0.295)
E MAX	5.2 (0.205)	6.3 (0.248)	6.3 (0.248)
n MAX	0.7 (0.027)	0.7 (0.027)	0.7 (0.027)
Øb	0.635 (0.025)	0.81 (0.032)	0.81 (0.032)
WEIGHT TYP	1 Gram	3.4 Grams	4.4 Grams
X	22 (0.087)	2.2 (0.087)	4.4 (0.173)
Y	3.1 ± 0.5 (0.122 ± 0.02)	6 ± 1 (0.236 ± 0.04)	8.9 ± 1 (0.35 ± 0.04)

NOTES:

5. Dimensions in mm, dimensions in inches in parentheses.
6. Inches for reference only.

Ordering Information

The RA Series is supplied in bulk pack.



High Reliability Varistors

MIL QPL

The high reliability Littelfuse varistor is the latest step in increased product performance, and is available for applications requiring quality and reliability assurance levels consistent with military or other standards. (MIL-STD-19500, MIL-S-750, Method 202). Additionally, Littelfuse varistors are inherently radiation hardened compared to silicon diode suppressors as illustrated in Figure 1.

This series of high-reliability varistors involve five categories:

- DSSC Qualified Parts List (QPL) MIL-R-83530 4 Types Presently Available
- DSSC Standard Military Drawings Based on MIL-R 83530 63 Types Presently Available:
  - ZA Series - Drawing # 87063
  - DB Series - Drawing # 90065
- Littelfuse High Reliability Series Offers TX Equivalents 29 Types Presently Available
- Custom Types Processed to Customer-Specific Requirements - (SCD) or to Standard Military Flow
- Commercial Items have been identified for Government use as follows:
  - Commercial Item Description AA-55564-3 - Littelfuse ZA Series
  - Commercial Item Description AA-55564-2 - Littelfuse DA, DB Series
  - Commercial Item Description AA-55564-1 - Littelfuse PA Series

AGENCY APPROVALS

- DSSC Approved
- QPL Listed
- CECC Certified
- ISO Approved
- UL Recognized
- CSA Certified

DSSC Qualified Parts List (QPL) MIL-R-83530

TABLE 1. MIL-R-83530/1 RATINGS AND CHARACTERISTICS

PART NUMBER M83530/	NOMINAL VARISTOR VOLTAGE (V)	TOLERANCE (%)	VOLTAGE RATING (V)		ENERGY RATING (J)	CLAMPING VOLTAGE AT 100A (V)	CAPACITANCE AT 1MHz (pF)	CLAMPING VOLTAGE AT PEAK CURRENT RATING (V)	I_{TM} (A)	NEAREST COMMERCIAL EQUIVALENT
			(RMS)	(DC)						
1-2000B	200	±10	130	175	50	325	3800	570	6000	V130LA20B
1-2200D	220	+10, -5	150	200	55	360	3200	650	6000	V150LA20B
1-4300E	430	+5, -10	275	369	100	680	1800	1200	6000	V275LA40B
1-5100E	510	+5, -10	320	420	120	810	1500	1450	6000	V320LA40B

This series of varistors are screened and conditioned in accordance with MIL-R-83530 as outlined in Table 2. Manufacturing system conforms to MIL-I-45208; MIL-Q-9858.

High Reliability Varistors

MIL-R-83530 Inspections

TABLE 2. MIL-R-83530 GROUP A, B, AND C INSPECTIONS

INSPECTION		AQL (PERCENT DEFECTIVE)	MAJOR	MINOR	NUMBER OF SAMPLE UNITS	FAILURES ALLOWED
Group A	SUBGROUP 1					
	High Temperature Life (Stabilization Bake)	100%	-	-	-	-
	Thermal Shock	100%	-	-	-	-
	Power Burn-In	100%	-	-	-	-
	Clamping Voltage	100%	-	-	-	-
	Nominal Varistor Voltage	100%	-	-	-	-
	SUBGROUP 2					
	Visual and Mechanical Examination	-	1.0% AQL 7.6% LQ	25% AQL 13.0% LQ	Per Plan	-
	Body Dimensions	-			Per Plan	-
	Diameter and Length of Leads	-			Per Plan	-
	Marking	-			Per Plan	-
	Workmanship	-			Per Plan	-
	SUBGROUP 3					
	Solderability	-	-	-	Per Plan	-
Group B	SUBGROUP 1					
	Dielectric Withstanding Voltage	-	-	-	Per Plan	-
	SUBGROUP 2					
	Resistance to Solvents	-	-	-	Per Plan	-
	SUBGROUP 3					
	Terminal Strength (Lead Fatigue)	-	-	-	Per Plan	-
	Moisture Resistance	-	-	-	Per Plan	-
	Peak Current	-	-	-	Per Plan	-
	Energy	-	-	-	Per Plan	-
Group C	EVERY 3 MONTHS					
	High Temperature Storage	-	-	-	10	0
	Operating Life (Steady State)	-	-	-	10	0
	Pulse Life	-	-	-	10	0
	Shock	-	-	-	10	0
	Vibration	-	-	-	10	0
	Constant Acceleration	-	-	-	10	0
	Energy	-	-	-	10	0

High Reliability Varistors

DSSC Standard Military Drawing # 87063

Based on MIL-R-83530

TABLE 3. ZA SERIES RATINGS AND SPECIFICATIONS

87063 DASH NO.	(SEE CHAPTER 2) NEAREST COMM. EQUIV.	(PAGE 143) SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)					
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA$_{DC}$ TEST CURRENT			MAXIMUM CLAMPING VOLTAGE V_C AT TEST CURRENT (8/20µs)		TYPICAL CAPACITANCE
			RMS	DC	ENERGY (10/1000µs)	PEAK CURRENT (8/20µs)						
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	MIN	$V_{N(DC)}$	MAX	V_C	I_C	f = 1MHz
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(A)	(pF)
001	V22ZA05	1	14	18	0.2	35	18.7	22	26	51	2	400
002	V22ZA1	2	14	18	0.9	150	18.7	22	26	47	5	1600
003	V22ZA2	3	14	18	2.0	350	18.7	22	26	43	5	4000
004	V22ZA3	4	14	18	4.0	750	18.7	22	26	43	10	9000
005	V24ZA50	5	14	18	6.5	1500	19.2	24 (PAGE 143)	26	43	20	18000
006	V27ZA05	1	17	22	0.25	35	23	27	31.1	59	2	300
007	V27ZA1	2	17	22	1.0	150	23	27	31.1	57	5	1300
008	V27ZA2	3	17	22	2.5	350	23	27	31.1	53	5	3000
009	V27ZA4	4	17	22	5.0	750	23	27	31.1	53	10	7000
010	V27ZA60	5	17	22	8.0	1500	23	27 (PAGE 143)	31.1	50	20	15000
011	V33ZA05	1	20	26	0.3	35	29.5	33	38	67	2	250
012	V33ZA1	2	20	26	1.2	150	29.5	33	36.5	68	5	1100
013	V33ZA2	3	20	26	3.0	350	29.5	33	36.5	64	5	2700
014	V33ZA5	4	20	26	6.0	750	29.5	33	36.5	64	10	6000
015	V33ZA70	5	21	27	9.0	1500	29.5	33 (PAGE 143)	36.5	58	20	13000
016	V36ZA80	5	23	31	10.0	1500	32	36 (PAGE 143)	40	63	20	12000
017	V39ZA05	1	25	31	0.35	35	35	39	46	79	2	220
018	V39ZA1	2	25	31	1.5	150	35	39	43	79	5	900
019	V39ZA3	3	25	31	3.5	350	35	39	43	76	5	2200
020	V39ZA6	4	25	31	7.2	750	35	39	43	76	10	5000
021	V47ZA05	1	30	38	0.4	35	42	47	55	90	2	200
022	V47ZA1	2	30	38	1.8	150	42	47	52	92	5	800
023	V47ZA3	3	30	38	4.5	350	42	47	52	89	5	2000
024	V47ZA7	4	30	38	8.8	750	42	47	52	89	10	4500
025	V56ZA05	1	35	45	0.5	35	50	56	66	108	2	180

High Reliability Varistors

TABLE 3. ZA SERIES RATINGS AND SPECIFICATIONS (Continued)

87063 DASH NO.	(SEE SECTION 4) NEAREST COMM. EQUIV.	(NOTE 1) SIZE	MAXIMUM RATINGS (85°C)				SPECIFICATIONS (25°C)					
			CONTINUOUS		TRANSIENT		VARISTOR VOLTAGE AT 1mA$_{DC}$ TEST CURRENT			MAXIMUM CLAMPING VOLTAGE V_C AT TEST CURRENT (8/20μs)		TYPICAL CAPACITANCE
			RMS	DC	ENERGY (10/1000μs)	PEAK CURRENT (8/20μs)	MIN	$V_{N(DC)}$	MAX	V_C	I_C	f = 1MHz
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}						
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(V)	(A)	(pF)
026	V56ZA2	2	35	45	2.3	150	50	56	62	107	5	700
027	V56ZA3	3	35	45	5.5	350	50	56	62	103	5	1800
028	V56ZA8	4	35	45	10.0	750	50	56	62	103	10	3900
029	V68ZA05	1	40	56	0.6	35	61	68	80	127	2	150
030	V68ZA2	2	40	56	3.0	150	61	68	75	127	5	600
031	V68ZA3	3	40	56	6.5	350	61	68	75	123	5	1500
032	V68ZA10	4	40	56	13.0	750	61	68	75	123	10	3300
033	V82ZA05	1	50	66	1.2	70	73	82	97	145	2	120
034	V82ZA2	2	50	66	3.5	300	73	82	91	135	10	500
035	V82ZA4	3	50	66	7.3	750	73	82	91	135	25	1100
036	V82ZA12	4	50	66	13.0	1500	73	82	91	145	50	2500
037	V100ZA05	1	60	81	1.5	70	90	100	117	175	2	90
038	V100ZA3	2	60	81	4.3	300	90	100	110	165	10	400
039	V100ZA4	3	60	81	8.9	750	90	100	110	165	25	900
040	V100ZA15	4	60	81	16.0	1500	90	100	110	175	50	2000
041	V120ZA05	1	75	102	1.8	100	108	120	138	205	2	70
042	V120ZA1	2	75	102	5.3	400	108	120	132	205	10	300
043	V120ZA4	3	75	102	11.0	1000	108	120	132	200	25	750
044	V120ZA6	4	75	102	19.0	2000	108	120	132	210	50	1700
045	V150ZA05	1	92	127	2.3	100	135	150	173	240	2	60
046	V150ZA1	2	95	127	6.5	400	135	150	165	250	10	250
047	V150ZA4	3	95	127	13.0	1000	135	150	165	250	25	600
048	V150ZA8	4	95	127	23.0	2000	135	150	165	255	50	1400
049	V180ZA05	1	110	153	2.7	150	162	180	207	290	2	50
050	V180ZA1	2	115	153	7.7	500	162	180	198	295	10	200
051	V180ZA5	3	115	153	16.0	1500	162	180	198	300	25	500
052	V180ZA10	4	115	153	27.0	3000	162	180	198	300	50	1100

High Reliability Varistors

DSSC Standard Military Drawing # 90065

Based on MIL-R-83530

90065 DASH NO.	VOLTAGE RATING MAX (RMS)	ENERGY MAX (J)	PEAK CURRENT (A)	NOMINAL VARISTOR VOLTAGE (V)		MAX CLAMPING VOLTAGE AT TEST CURRENT		TYPICAL CAPACITANCE (pF)
						(V)	(I)	
012	130	170	22500	200	+28, -16	345	200	10000
013	150	200	22500	240	±28	405	200	8000
014	250	270	22500	390	+39, -36	650	200	5000
015	275	300	22500	430	±43	730	200	4500
016	320	350	22500	510	+29, -48	830	200	3800
017	420	460	28800	680	+68, -70	1130	200	3000
018	480	510	28800	750	+74, -80	1240	200	2700
019	510	550	28800	820	+91, -85	1350	200	2500
020	575	600	28800	910	+95, -105	1480	200	2200
021	660	690	28800	1050	±110	1720	200	2000
022	750	810	28800	1200	±120	2000	200	1800

NOTE: See Section 4 (DB Series) for nearest equivalent commercial type.

TABLE 4. DB SERIES RATINGS AND SPECIFICATIONS

Littelfuse High Reliability Series TX Equivalents

TABLE 5. AVAILABLE TX MODEL TYPES

TX MODEL	MODEL SIZE	DEVICE MARK	(SEE SECTION 4) NEAREST COMMERCIAL EQUIVALENT
V8ZTX1	7mm	8TX1	V8ZA1
V8ZTX2	10mm	8TX2	V8ZA2
V12ZTX1	7mm	12TX1	V12ZA1
V12ZTX2	10mm	12TX2	V12ZA2
V22ZTX1	7mm	22TX1	V22ZA1
V22ZTX3	14mm	22TX3	V22ZA3
V24ZTX50	20mm	24TX50	V24ZA50
V33ZTX1	7mm	33TX1	V33ZA1
V33ZTX5	14mm	33TX5	V33ZA5
V33ZTX70	20mm	33TX70	V33ZA70
V68ZTX2	7mm	68TX2	V68ZA2
V68ZTX10	14mm	68TX10	V68ZA10
V82ZTX2	7mm	82TX2	V82ZA2
V82ZTX12	14mm	82TX12	V82ZA12
V130LTX2	7mm	130TX	V130LA2
V130LTX10A	14mm	130TX10	V130LA10A
V130LTX20B	20mm	130TX20	V130LA20A

TX MODEL	MODEL SIZE	DEVICE MARK	(SEE SECTION 4) NEAREST COMMERCIAL EQUIVALENT
V150LTX2	7mm	150TX	V150LA2
V150LTX10A	14mm	150TX10	V150LA10A
V150LTX20B	20mm	150TX20	V150LA20B
V250LTX4	7mm	250TX	V250LA4
V250LTX20A	14mm	250TX20	V250LA20A
V250LTX40B	20mm	250TX40	V250LA40B
V420LTX20A	14mm	420TX20	V420LA20A
V420LTX40B	20mm	420TX40	V420LA40B
V480LTX40A	14mm	480TX40	V480LA40A
V480LTX80B	20mm	480TX80	V480LA80B
V510LTX40A	14mm	510TX40	V510LA40A
V510LTX80B	20mm	510TX80	V510LA80B

High Reliability Varistors

The TX series of varistors are 100% screened and conditioned in accordance with MIL-STD-750. Tests are as outlined in Table 6.

TABLE 6. TX EQUIVALENTS SEREIES 100% SCREENING

	MIL-STD-105		
	LEVEL	AQL	LTPD
Electrical (Bidirectional) $V_{N(DC)}$, V_C (Per Specifications Table)	II	0.1	-
Dielectric Withstand Voltage MIL-STD-202, Method 301, 2500V Min at 1.0μA_{DC}	-	-	15
Solderability MIL-STD-202, Method 208, No Aging, Non-Activated	-	-	15

TABLE 7. QUALITY ASSURANCE ACCEPTANCE TEST

SCREEN	MIL-STD-750 METHOD	CONDITION	TX REQUIREMENTS
High Temperature Life (Stabilization Bake)	1032	24 hours min at max rated storage temperature.	100%
Thermal Shock (Temperature Cycling)	1051	No dwell is required at 25^oC. Test condition A1, 5 cycles -55^oC to 125 ^oC (extremes) >10 minutes.	100%
Humidity Life		85^oC, 85% R.H., 168Hr.	100%
Interim Electrical $V_{N(DC)}$ V_C (Note 3)		As specified, but including delta parameter as a minimum.	100% Screen
Power Burn-In	1038	Condition B, 85^oC, rated $V_{M(AC)}$, 72 hours min.	100%
Final Electrical +$V_{N(DC)}$ V_C (Note 3)		As specified - All parameter measurements must be completed within 96 hours after removal from burn-in conditions.	100% Screen
External Visual Examination	2071	To be performed after complete marking.	100%

High Reliability Varistors

Custom Types

In addition to our comprehensive high-reliability series as referenced above. Additional mechanical and environmental capabilities are defined in Table 8. Littelfuse can screen and condition to customer-specific requirements.

TABLE 8. MECHANICAL AND ENVIRONMENTAL CAPABILITIES (TYPICAL CONDITIONS)

TEST NAME	TEST METHOD	DESCRIPTION
Terminal Strength	MIL-STD-750-2036	3 Bends, 90^{O} Arc, 16oz. Weight
Drop Shock	MIL-STD-750-2016	1500g's, 0.5ms, 5 Pulses, X_1, V_1, Z_1
Variable Frequency Vibration	MIL-STD-750-2056	20g's, 100-2000Hz, X_1, V_1, Z_1
Constant Acceleration	MIL-STD-750-2006	V_2, 20,000g's Min
Salt Atmosphere	MIL-STD-750-1041	35^{O}C, 24Hr, 10-50g/m^2 Day
Soldering Heat/Solderability	MIL-STD-750-2031/2026	260^{O}C, 10s, 3 Cycles, Test Marking
Resistance to Solvents	MIL-STD-202-215	Permanence, 3 Solvents
Flammability	MIL-STD-202-111	15s Torching, 10s to Flameout
Flammability	UL1414	3 x 15s Torching
Cyclical Moisture Resistance	MIL-STD-202-106	10 Days
Steady-State Moisture Resistance		85/85 96Hr
Biased Moisture Resistance		Not Recommended for High-Voltage Types
Temperature Cycle	MIL-STD-202-107	-55^{O}C to 125^{O}C, 5 Cycles
High-Temperature Life (Nonoperating)	MIL-STD-750-1032	125^{O}C, 24Hr
Burn-In	MIL-STD-750-1038	Rated Temperature and V_{RMS}
Hermetic Seal	MIL-STD-750-1071	Condition D

Radiation Hardness

For space applications, an extremely important property of a protection device is its response to imposed radiation effects.

Electron Irradiation

A Littelfuse MOV and a silicon transient suppression diode were exposed to electron irradiation. The V-I curves, before and after test, are shown in Figure 1.

It is apparent that the Littelfuse MOV was virtually unaffected, even at the extremely high dose of 10^8 rads, while the silicon transient suppression diode showed a dramatic increase in leakage current.

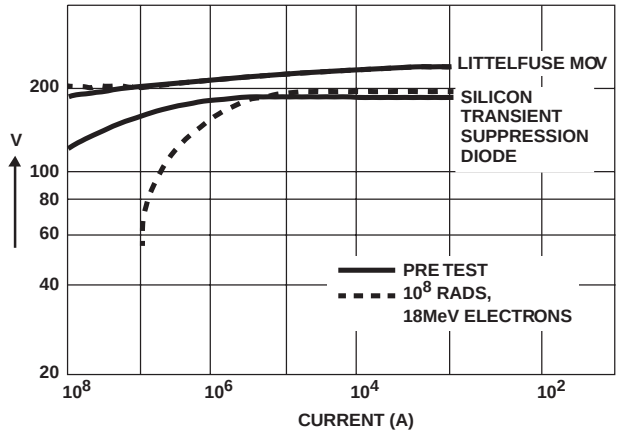


FIGURE 1. RADIATION SENSITIVITY OF LITTELFUSEV130LA1 AND SILICON TRANSIENT SUPPRESSION DIODE

High Reliability Varistors

Neutron Effects

A second MOV-zener comparison was made in response to neutron fluence. The selected devices were equal in area.

Figure 2 shows the clamping voltage response of the MOV and the zener to neutron irradiation to as high as 10^{15} N/cm^2 . It is apparent that in contrast to the large change in the zener, the MOV is unaltered. At higher-currents where the MOV's clamping voltage is again unchanged, the zener device clamping voltage increases by as much as 36%.

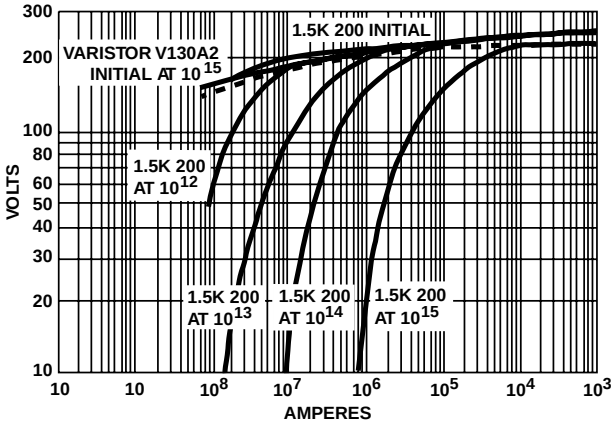


FIGURE 2. V-I CHARACTERISTIC RESPONSE TO NEUTRON IRRADIATION FOR MOV AND ZENER DIODE DEVICES

Counterclockwise rotation of the V-I characteristics is observed in silicon devices at high neutron irradiation levels; in other words, increasing leakage at low current levels and increasing clamping voltage at higher current levels.

The solid and open circles for a given fluence represent the high and low breakdown currents for the sample of devices tested. Note that there is a marked decrease in current (or energy) handling capability with increased neutron fluence.

Failure threshold of silicon semiconductor junctions is further reduced when high or rapidly increasing currents are applied. Junctions develop hot spots, which enlarge until a short occurs if current is not limited or quickly removed.

The characteristic voltage current relationship of a PN-Junction is shown in Figure 3.

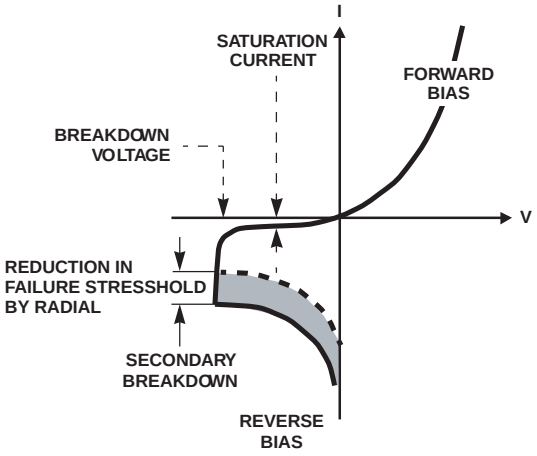


FIGURE 3. V-I CHARACTERISTIC OF PN-JUNCTION

At low reverse voltage, the device will conduct very little current (the saturation current). At higher reverse voltage V_{BO} (breakdown voltage),the current increases rapidly as the electrons are either pulled by the electric field (Zener effect) or knocked out by other electrons (avalanching). A further increase in voltage causes the device to exhibit a negative resistance characteristic leading to secondary breakdown.

This manifests itself through the formation of hotspots, and irreversible damage occurs. This failure threshold decreases under neutron irradiation for zeners, but not for Zinc Oxide Varistors.

Gamma Radiation

Radiation damage studies were performed on type V130LA2 varistors. Emission spectra and V-I characteristics were collected before and after irradiation with 10^6 rads Co^{60} gamma radiation.

Both show no change, within experimental error, after irradiation.

High Reliability Varistors

Commercial Item Descriptions

The General Services Administration has authorized the use of the Commercial Item Description (CID) for all government agencies. There are 3 listed series within Littelfuse leaded/Industrial range:

A-A-55564-3 ZA Series
A-A-55564-2 DA/DB Series
A-A-55564-1 PA Series

The PIN number should be used to buy commercial product to the CID. The manufacturer's number shown should not be used for ordering purposes.

PIN consists of:
Abbreviated CID number + Applicable Sheet (2 digits) + Dash number (-3 digits)
e.g. AA55564 + 02 + -001 = AA5556402-001

ZA Series A-A-55564-3

DASH NUMBER AA5556403-	EQUIV.. LITTELFUSE COMMERCIAL PART	DASH NUMBER AA5556403-	EQUIV. LITTELFUSE COMMERICAL PART	DASH NUMBER AA5556403-	EQUIV. LITTELFUSE COMMERCIAL PART	MFR'S CAGE
001	V22ZA05	022	V47ZA1	043	V120ZA4	S6019
002	V22ZA1	023	V47ZA3	044	V120ZA6	
003	V22ZA2	024	V47ZA7	045	V150ZA05	
004	V22ZA3	025	V56ZA05	046	V150ZA1	
005	V24ZA50	026	V56ZA2	047	V150ZA4	
006	V27ZA05	027	V56ZA3	048	V150ZA8	
007	V27ZA1	028	V56ZA8	049	V180ZA05	
008	V27ZA2	029	V68ZA05	050	V180ZA1	
009	V27ZA4	030	V68ZA2	051	V180ZA5	
010	V27ZA60	031	V68ZA3	052	V180ZA10	
011	V33ZA05	032	V68ZA10	053	V8ZA05	
012	V33ZA1	033	V82ZA05	054	V8ZA1	
013	V33ZA2	034	V82ZA2	055	V8ZA2	
014	V33ZA5	035	V82ZA4	056	V12ZA05	
015	V33ZA70	036	V82ZA12	057	V12ZA1	
016	V36ZA80	037	V100ZA05	058	V12ZA2	
017	V39ZA05	038	V100ZA3	059	V18ZA05	
018	V39ZA1	039	V100ZA4	060	V18ZA1	
019	V39ZA3	040	V100ZA15	061	V18ZA2	
020	V39ZA6	041	V120ZA05	062	V18ZA3	
021	V47ZA05	042	V120ZA1	063	V18ZA40	

High Reliability Varistors

DA/DB SERIES A-A-55564-2

DASH NUMBER AA5556402-	MFR's CAGE	EQUIV. LITTELFUSE COMMERCIAL PART	DASH NUMBER AA5556402-	MFR'S CAGE	EQUIV. LITTELFUSE COMMERCIAL PART
001	S6019	V131DA40	012	S6019	V131DB40
002		V151DA40	013		V151DB40
003		V251DA40	014		V251DB40
004		V271DA40	015		V271DB40
005		V321DA40	016		V321DB40
006		V421DA40	017		V421DB40
007		V481DA40	018		V481DB40
008		V511DA40	019		V511DB40
009		V571DA40	020		V571DB40
010		V661DA40	021		V661DB40
011		V751DA40	022		V751DB40

PA SERIES A-A-55564-1

DASH NUMBER AA5556401-	MFR's CAGE	EQUIV. LITTELFUSE COMMERCIAL PART	DASH NUMBER AA5556401-	MFR'S CAGE	EQUIV. LITTELFUSE COMMERCIAL PART
001	S6019	V130PA20A	011	S6019	V420PA40A
002		V130PA20C	012		V420PA40C
003		V150PA20A	013		V480PA80A
004		V150PA20C	014		V480PA80C
005		V250PA40A	015		V510PA80A
006		V250PA40C	016		V510PA80C
007		V275PA40A	017		V575PA80A
008		V275PA40C	018		V575PA80C
009		V320PA40A	019		V660PA100A
010		V320PA40C	020		V660PA100C