Littelfuse®

Expertise Applied | Answers Delivered

Indoor LED Lighting Circuit Protection Resources

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www.littelfuse.com/led-lighting

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I. INTRODUCTION TO INDOOR LED PRODUCTS

The use of LED lighting in residential and commercial settings is growing at an accelerated rate across the entire global market. The advantages of LED lighting systems for indoor applications include large increases in energy savings compared to alternative lighting sources, reduced maintenance and labor costs, as well as reduced carbon dioxide emissions compared to incandescent and CFL lighting. Many LED lights are specifically designed to replace halogen and fluorescent lighting systems. Although LED lighting generally entails a higher initial cost than alternative lighting sources, the significantly longer operating life of LEDs and the increased energy savings make LED indoor lighting an attractive option and also accounts for their accelerated growth rate in the global market.

Owners of LED indoor lighting systems, particularly in commercial settings, currently report a high level of satisfaction with their LED lighting, as well as a high level of confidence in the technology. Users also reported that they were generally satisfied not only with the performance of their indoor LED lighting systems, but also with the associated commissioning and installation processes.

Advancements in energy efficiency, lumen output, and LED overall performance are continually improving. The global market for LED indoor lighting is projected to continue to increase at a high rate corresponding to these technological advancements. Although there is still room for improvement, LED indoor lighting merits significant consideration for both new and retrofitted lighting applications.

Safety and Surge Immunity Requirements

To ensure a long operating life and increased energy efficiency, circuit protection technologies for LED lighting are paramount. LEDs can be damaged by voltage or current surges, and by extreme temperatures. Circuit protection technology can protect LED assemblies from these potentially damaging causes. Important circuit protection technologies include metal-oxide varistors (MOVs), transient voltage suppression (TVS) diodes, and fuses.

- A MOV placed across the AC power input is used to protect the LED bulb from overvoltage surges by clamping short-duration voltage impulses. It will minimize the amount of transient energy that can travel downstream in the circuit. MOVs are available in a variety of sizes and should be selected based on voltage rating, peak pulse current, energy rating, disk size, and lead configuration. Littelfuse provides MOVs with a disk diameter as small as 5 mm that can be used in space-constrained power supply sections. Surface mount form factor is also available so that it could be mounted on PCB next to LEDs. For a more detailed explanation of MOV technology see Littelfuse Application Note 9767.

- TVS diodes are used as a second source of overvoltage protection. A TVS diode can be placed on the DC side of a LED circuit to protect against transient voltage levels entering the converter circuit. It will allow the LED circuit to survive by further clamping down on any voltage surges that manage to continue downstream of the MOV. At Littelfuse, a variety of TVS diode options are available based on form factor, space constraints, and electrical parameters.

- Fuses are widely used to provide overcurrent and overload protection. The fuse element is designed to melt if it receives too much current, and thus will interrupt the LED circuit and protect electrical components located downstream. Fuses and MOVs are used at the AC power input to provide both overcurrent and overvoltage protection. High voltage fuses may also used on the DC side of the LED circuit to provide overcurrent protection. To allow for design flexibility, Littelfuse offers fuses in a wide range of form factors, amperage ratings, voltage ratings, breaking capacities, and mounting options.

In the United States, uniform performance and safety standards have been established for certain indoor commercial lighting applications. The use of circuit protection technologies by lamp manufacturers enables the LED assemblies to pass regulatory and safety standards. One of these regulatory standards is the Energy Star transient voltage surge specifications for LED replacement bulb assemblies. Surge immunity requirements can be found in ANSI/IEEE C.62.41.2-2002.

Test requirements include:

- Transient voltage immunity test waveform: 0.5µs rise time × 10µs period (100kHz) ring wave.
- Test Level: 2.5kV/83A, ENERGY STAR® Program Requirements for Luminaires/Lamps.
- Number of surges: 7 strikes in common mode and 7 in differential mode, 1 minute between each strike.

If in-house surge testing equipment is not available, Littelfuse has facilities available for testing the robustness of the protection scheme and overall design for LED lighting customers.

LED Compliance with Global Standards

Due to the acceptance of LED indoor lighting in the global market, it is important to consider both US and global safety and surge immunity standards. In Europe and South America IEC standards are commonly enforced. Safety requirements in Europe and South America fall under IEC/EN 62560 bulb IEC/EN 60598 Luminaire IEC/EN 61347 driver IEC/EN 62031 LED array/module. Surge immunity requirements for indoor lighting are found in IEC/EN 61547 and IEC/EN 61000-4-5. Overvoltage surge testing for LED lighting assemblies must comply with IEC61000-4-5, and EMC immunity testing is required by IEC61547 "Equipment for General Lighting Purposes". Other test requirements include:

- For self-ballasted lamps and luminaires < 25W, 500V/250A: Apply 500V L-L with 2 ohm source impedance and 1kV L-G with 12 ohms impedance.
- For luminaire > 25W, 1000V/500A: Apply 1kV L-L with 2 ohm source impedance and 2kV L-G with 12 ohms impedance.
- Number of surges: 10 strikes, 5+ and 5- at phase angles 90/270, 1 minute between each strike.

The surge immunity standards in Asia include:

- Japan: JIS C 61000-4-5 (Based on IEC/EN 61000-4-5) 500V/250A 1kV/500A
- Taiwan: CNS 14676-5 (Based on IEC/EN 61000-4-5) 500V/250A 1kV/500A
- China: GB/T 18595 (Based on IEC/EN 61547) 500V/250A 1kV/500A
- Korea: K61547 (Based on IEC/EN 61547) 500V/250A 1kV/500A

Safety requirements for these countries are specified by:

- Japan: DENAN standards JEL 801
- Taiwan: CNS standards
- China:GB248192009/ IEC62031 LED Module for general lighting-safety
- Korea: KS standards

Part Selection Matrix for LED Lamp Protection

Table 1 lists several of the MOVs, TVS diodes, and fuses available at Littelfuse that can be used to meet certain surge test requirements. These circuit protection devises should be selected based on surge protection specifications, circuit operation parameters, and the operating environment in which they will be used.

Transient Surge Spec	Fuse Options	MOV Options	Oil
ENERGY STAR® Program Requirements for Integral LED Lamps (for USA)			
1. ANSI/IEEE C.62.41.2-2002, Category A Location. 0.5µs 100kHz Ring Wave, 2.5kV, 7 strikes common and differential modes	047001.5 (1.5A SMT 1206 125V) 0453001 (1A SMT 2410 125V) 0454001 (1A SMT 2410 125V) 0473001 (1A Pico 125V) 39211000000 (TE5 250V 1A) 38211000000 (TR5 250V 1A)	V150LA2P V175LA2P V240ZA05P V240CH8	P6KE300CA SMAJ400A SMAJ440A SMBJ400A SMBJ440A 1.5KE400A 1.5KE440CA
IEC 61547 Equipment for general lighting purposes - EMC immunity requirements (for Europe/ Asia / Australia)			
1. ANSI/IEEE C.62.41.2-2002, Category A Location. 0.5µs 100kHz Ring Wave, 2.5kV, 7 strikes common and differential modes	087601.6 (3.6x10 250V 1.6A) 39211000000 (TE5 250V 1A) 38211000000 (TR5 250V 1A) 0476003 (SMT 2410 250V 3A) 0465001 (SMT 4818 250V 1A)	V300LA2P V320LA7P V430CH8	P6KE300CA SMAJ400A SMAJ440A SMBJ400A SMBJ440A 1.5KE400A 1.5KE440CA
2. IEC 61000-4-5 Surge Immunity Test. For lamps > 25W: 1.2×50µs/8×20µs combination wave 1000V/500A line-to-line test (10 strikes, 5+ at phase angles 90, 5– at phase angle 270)	0877002 (2A 250V 3.6x10) 39211600000 (TE5 250V 1.6A) 38211600000 (TR5 250V 1.6A) 046501.6 (250V SMT 4818 1.6A)	V300LA10P V320LA10P V300SM7 V320SM7	P6KE300CA SMAJ400A SMAJ440A SMBJ400A SMBJ440A 1.5KE400A 1.5KE440CA

NOTE: MOVs were tested with 1.2×50µs open circuit voltage waveform and 8×20µs short circuit current waveform forming a combo waveform with 2 ohm source impedance. Standard method was used for testing the MOVs per datasheet specifications which consisted of driving relevant surge current through the part with the generated combination wave. In real world events, actual peak current through the lamp with typical circuit impedance path will likely be lower. Littelfuse has tested the above part selections to a more stringent level as it complies with our internal testing standards.

877 Series Fuse, Lead-free 3.6 × 10 mm, Time-Lag Fuse

Description

Single Pigtail Axial Lead 3.6×10mm, Time-Lag Fuse

Features

- Designed to meet IEC 60127-3 Standard Sheet 4
- Time-Lag, ceramic body fuse in a compact package
- Single Pigtail Axial Lead format
- Pb-free, RoHS compliant
- Available in ratings of 2 to 6.3 Amperes

Applications

This space saving fuse is ideally suited for lighting, power supply, and adapter applications.

Agency	Agency File Number	Ampere Range
VDE	40023242	2A – 6.3A
cULus	E10480	2A – 6.3A
CQC	CQC09012029601	2A – 6.3A
KC	SU05024-10002	2A
	SU05024-10001	3.15A - 6.3A
PSE	NBK240212-JP1021	2A – 4A

Additional Information

Datasheet | **Resources** | **Samples**

Electrical Characteristics

% of Ampere Rating	Opening Time
150%	60 minutes, Minimum
210%	2 minutes, Maximum
275%	400 ms., Min.; 10 sec. Max.
400%	150 ms., Min.; 3 sec. Max.
1000%	20 ms. Min.; 150 ms. Max.

Electrical Characteristics

Amp Code	Ampere Rating (A)	Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I^2t (A^2 sec)	Nominal Voltage Drop (mV)	Nominal Power Dissipation (mW)	Agency Approvals				
								VDE	cULus	PSE	KC	CQC
002.	2.0	250	35A @ 250 V AC	0.035	24.6	82	450	x	x	x	x	x
3.15	3.15	250	35A @ 250 V AC	0.020	67.6	76	690	x	x	x	x	x
004.	4.0	250	40A @ 250 V AC	0.0167	143.4	74	926	x	x	x	x	x
06.3	6.3	250	63A @ 250 V AC	0.0087	190	60	1130	x	x		x	x

Notes:
1. Cold resistance measured at less than 10% of rated current at 23°C.

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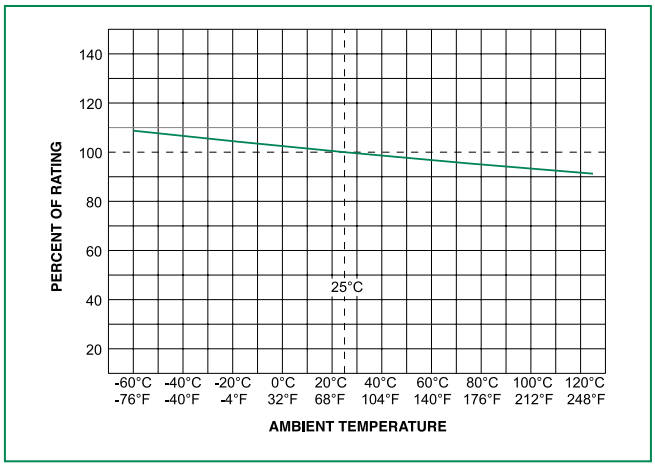
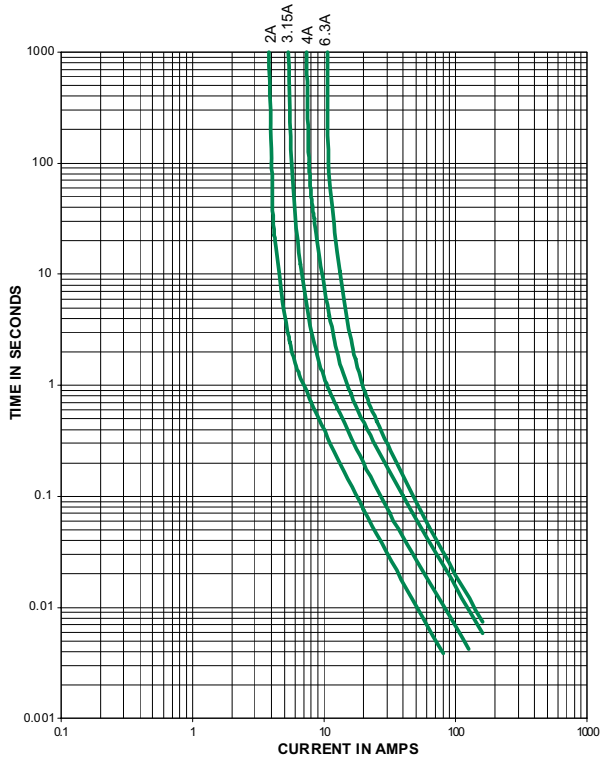
Revised: 05/12/15

Temperature Re-rating Curve

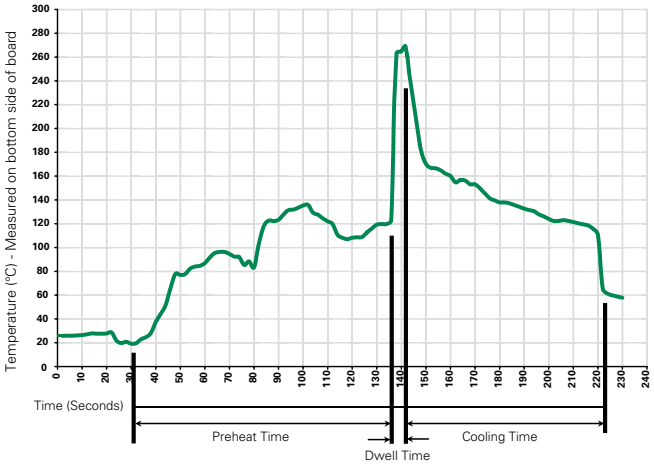


Note:
1. Rerating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

Average Time Current Curves



Soldering Parameters - Wave Soldering



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100°C
Temperature Maximum:	150°C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	260°C Maximum
Solder Dwell Time:	2-5 seconds

Recommended Hand-Solder Parameters:

Solder Iron Temperature: 350°C +/- 5°C
Heating Time: 5 seconds max.

Note: These devices are not recommended for IR or Convection Reflow process.

Revised: 05/12/15

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Axial Lead & Cartridge Fuses

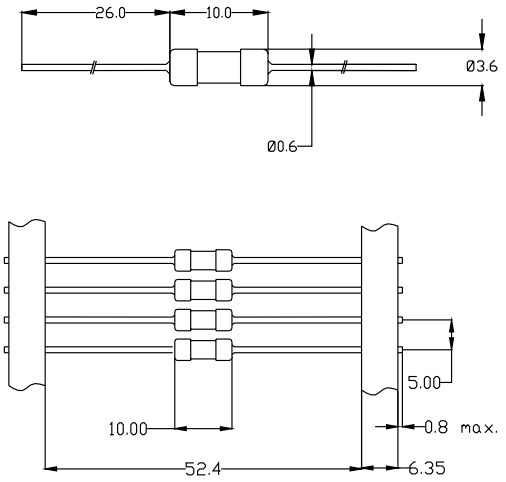
3.6 X 10 mm > Time-Lag Fuse > 877 Series

Product Characteristics

Materials	Body: Ceramic Cap: Nickel Plated Brass Tin Plated Copper
Terminal Strength	MIL-STD-202, Method 211, Test Condition A
Solderability	MIL-STD-202, Method 208
Product Marketing	Body: Brand Logo, Current Rating Characteristic "T", Agency approval marks
Packaging	Bulk (1000 pcs/pkg) Tape and Reel (1000 pcs/reel)

Operating Temperature	-55°C to 125°C
Thermal Shock	MIL-STD-202, Method 107 Test Condition B3 (5 cycles -65°C to +125°C)
Vibration	MIL-STD-202, Method 201 (10-55 Hz)
Humidty	MIL-STD-202, Method 106, High Humidity (90-98%RH), Heat (65°C)
Salt Spray	MIL-STD-202, Method 101, Test Condition B

Dimensions



All dimensions in mm

Part Numbering System

0877 xxxx M X E P

Series

Amp Code
Refer to Amp Code column of Electrical Characteristics Table

Quantity Code
M = 1000

Packaging Code
X = Filler

Option Code
E = Axial Leaded

Lead-free
P = Lead-Free
Others = Special Options
Please call Littelfuse for detail

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Taping Width
877 Series				
Bulk	Bulk	1000	MXE	N/A
Tape and Reel	EIA 296	1000	MRET1	T1 = 52mm (2.062")

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Revised: 05/12/15

876 Series Fuse, Lead-free 3.6×10 mm, Fast–Acting Fuse

Description

Single Pigtail Axial Lead 3.6 ×10mm Fast-Acting Fuse

Features

- Designed to meet IEC 60127-3 Standard Sheet 3
- Fast-Acting, ceramic body fuse in a compact package
- Single Pigtail Axial Lead format
- Pb-free, RoHS compliant
- Available in ratings of .125 to 5 Amperes

Agency Approvals

Agency	Agency File Number	Ampere Range
VDE	40022494	0.125A, 0.630A - 5A
cULus	E10480	0.125A - 5A
PSE	NBK240212-JP1021	1.6A - 5A
KC	SU05024-11001	0.125A - 0.630A
	SU05024-11002	1.6A - 2A
	SU05024-11003	4A - 5A
CQC	CQC09012035958	0.125A - 5A

Applications

- This space saving fuse is ideally suited for lighting, power supply, and adapter applications.

Electrical Characteristics

% of Ampere Rating	Opening Time
150%	60 minutes, Minimum
210%	30 minutes, Maximum
275%	10 ms., Min.; 3 sec. Max.
400%	3 ms., Min.; 300 ms. Max.
1000%	20 ms. Max.

Additional Information

Datasheet | **Resources** | **Samples**

Electrical Characteristics

Amp Code	Ampere Rating (A)	Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I^2t (A^2 sec)	Nominal Voltage Drop (mV)	Nominal Power Dissipation (mW)	Agency Approvals				
								VDE	cULus	PSE	KC	CQC
.125	0.125	250	35A @ 250 V AC	1.066	0.020	168	60	x	x		x	x
.160	0.160	250	35A @ 250 V AC	1.000	0.028	183	92		x		x	x
.250	0.250	250	35A @ 250 V AC	0.573	0.110	87	62		x		x	x
.630	0.630	250	35A @ 250 V AC	0.131	0.170	102	221	x	x		x	x
01.6	1.6	250	35A @ 250 V AC	0.0388	1.8	70	382	x	x	x	x	x
002.	2.0	250	35A @ 250 V AC	0.0329	2.51	70	470	x	x	x	x	x
004.	4.0	250	40A @ 250 V AC	0.0149	14.64	70	985	x	x	x	x	x
005.	5.0	250	50A @ 250 V AC	0.0111	26.85	66	1200	x	x	x	x	x

Notes:
Cold resistance measured at less than 10% of rated current at 23°C.

Revised: 09/17/15

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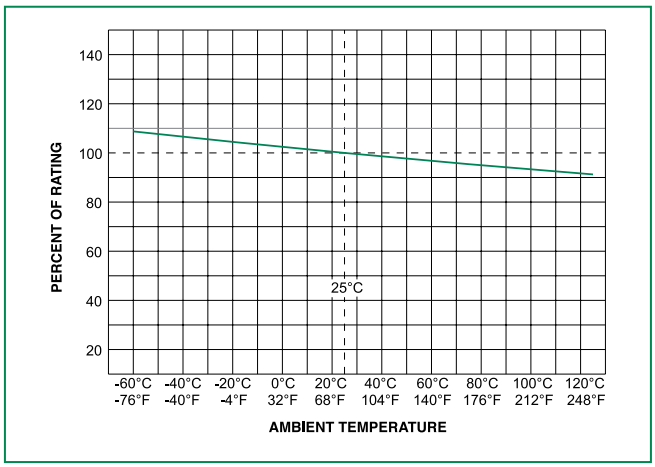
Axial Lead & Cartridge Fuses

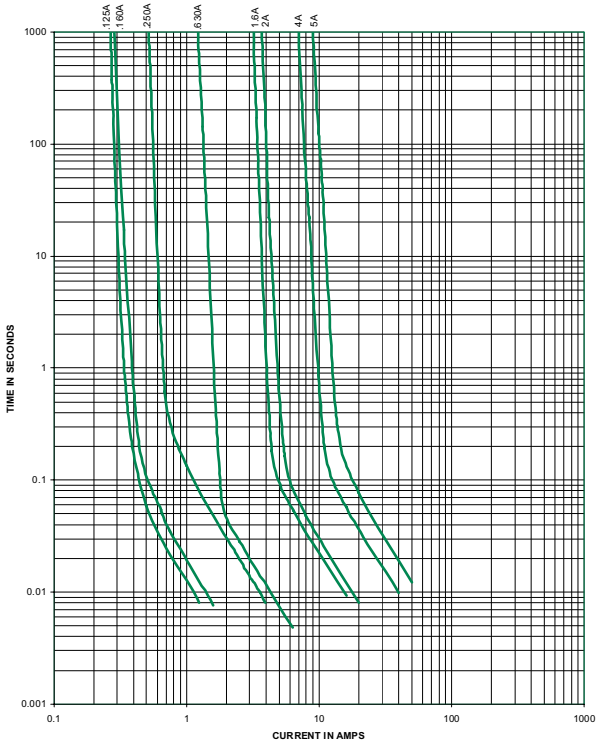
3.6 X 10 mm > Fast-Acting Fuse > 876 Series

Temperature Re-rating Curve

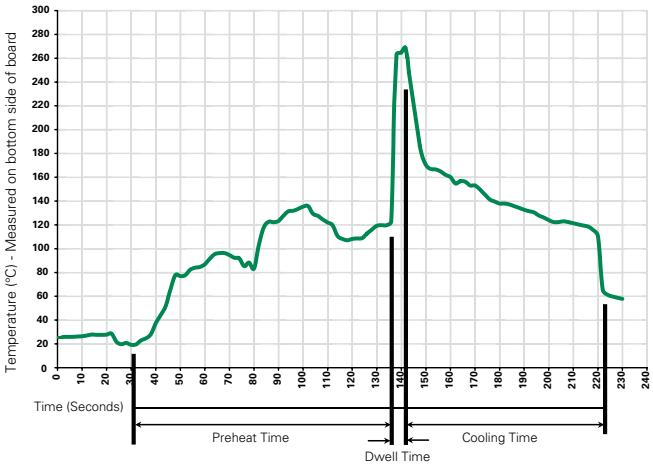


Note:
Rerating depicted in this curve is in addition to the standard derating of 25% for ontinuous operation.

Average Time Current Curves



Soldering Parameters - Wave Soldering



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100°C
Temperature Maximum:	150°C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	260°C Maximum
Solder Dwell Time:	2-5 seconds

Recommended Hand-Solder Parameters:

Solder Iron Temperature: 350°C +/- 5°C
Heating Time: 5 seconds max.

Note: These devices are not recommended for IR or Convection Reflow process.

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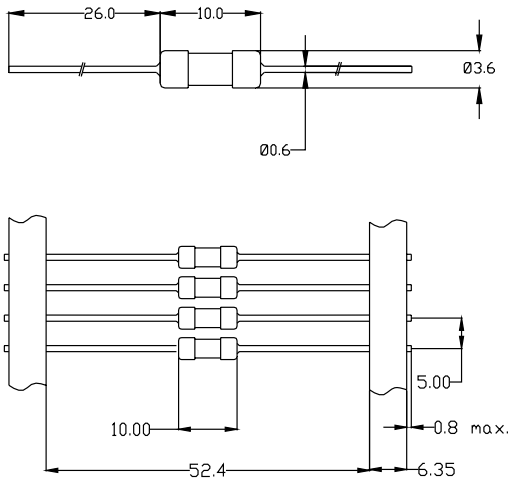
Revised: 09/17/15

Product Characteristics

Materials	Body: Ceramic Cap: Nickel Plated Brass Tin Plated Copper
Terminal Strength	MIL-STD-202 Method 211, Test Condition A
Solderability	Reference IEC 60127 Second Edition 2003-01 Annex A
Product Marketing	Body: Brand Logo, Current Rating Characteristic "F"
Packaging	Bulk (1000 pcs/pkg) Tape & Reel (1000 pcs/reel)

Operating Temperature	-55°C to 125°C
Thermal Shock	MIL-STD-202, Method 107 Test Condition B3 (5 cycles -65°C to +125°C)
Vibration	MIL-STD-202, Method 201 (10-55 Hz)
Humidty	MIL-STD-202, Method 106, High Humidity (90-98%RH), Heat (65°C)
Salt Spray	MIL-STD-202, Method 101, Test Condition B

Dimensions



All dimensions in mm

Part Numbering System

0876 xxxx M X E P

Series

Amp Code
Refer to Amp Code column of Electrical Characteristics Table

Quantity Code
M = 1000

Packaging Code
X = Filler

Option Code
E = Axial Leaded

Lead-free
P = Lead-Free
Others = Special Options
Please call Littelfuse for detail

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Taping Width
876 Series				
Bulk	Bulk	1000	MXE	N/A
Tape and Reel	EIA 296	1000	MRET1	T1 = 52mm (2.062")

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473 Series, PICO® II, Slo-Blo® Fuse

Description

The PICO® II Slo-Blo® Fuse combines time-delay performance characteristics with the proven reliability of a PICO® Fuse.

Features

- Enhanced inrush withstand
- Small size
- Wide range of current ratings (375mA - 7A)
- RoHS compliant
- Wide operating temperature range
- Low temperature de-rating)

Applications

- Flat–panel Display TV
- LCD monitor
- Lighting system
- Medical equipment
- Industrial equipment

Agency Approvals

Agency	Agency File Number	Ampere Range
	E10480	375mA - 7A
	LR 29862	375mA - 7A
	JET 1896-31007-1001	1A - 5A

Additional Information

Datasheet | Resources | Samples

Electrical Characteristics

% of Ampere Rating	Opening Time
100%	4 Hours, **Min.**
200%	1 Sec., **Min.**; 60 Sec., **Max.**
300%	0.2 Sec., **Min.**; 3 Sec., **Max.**
800%	0.02 Sec., **Min.**; 0.1 Sec., **Max.**

Electrical Characteristics

Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I^2t (A^2 sec)	Nom Voltage Drop (mV)	Agency Approvals		
0.375	.375	125	50 amperes at 125 VDC/ VAC	1.7400	0.085	0.840	X	X	
0.500	.500	125		1.1300	0.210	0.775	X	X	
0.750	.750	125		0.4600	0.760	0.429	X	X	
1.00	001.	125		0.3000	2.010	0.353	X	X	X
1.50	01.5	125		0.1160	3.940	0.208	X	X	X
2.00	002.	125		0.0712	7.600	0.180	X	X	X
2.25	2.25	125		0.0630	9.280	0.164	X	X	X
2.50	02.5	125		0.0520	13.00	0.153	X	X	X
3.00	003.	125		0.0380	21.00	0.140	X	X	X
3.50	03.5	125		0.0240	26.80	0.094	X	X	X
4.00	004.	125		0.0194	35.00	0.086	X	X	X
5.00	005.	125		0.0133	54.80	0.074	X	X	X
7.00	007.	125		0.0092	105.00	0.070	X	X	

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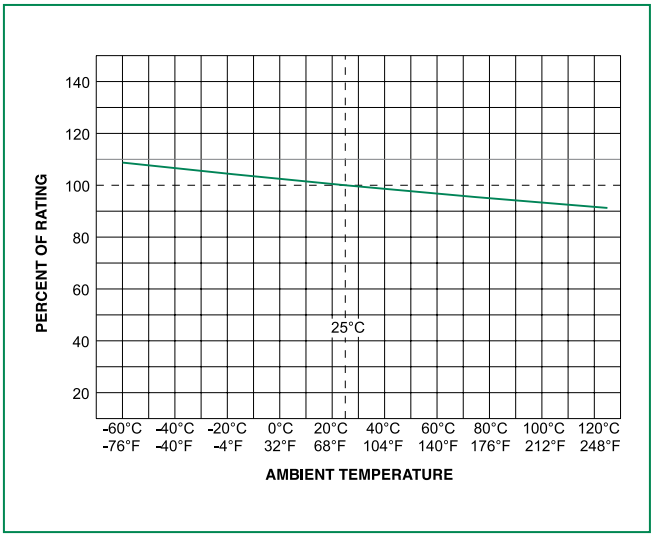
Temperature Rerating Curve



Note:
1. Derating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

Soldering Parameters

Recommended Process Parameters:

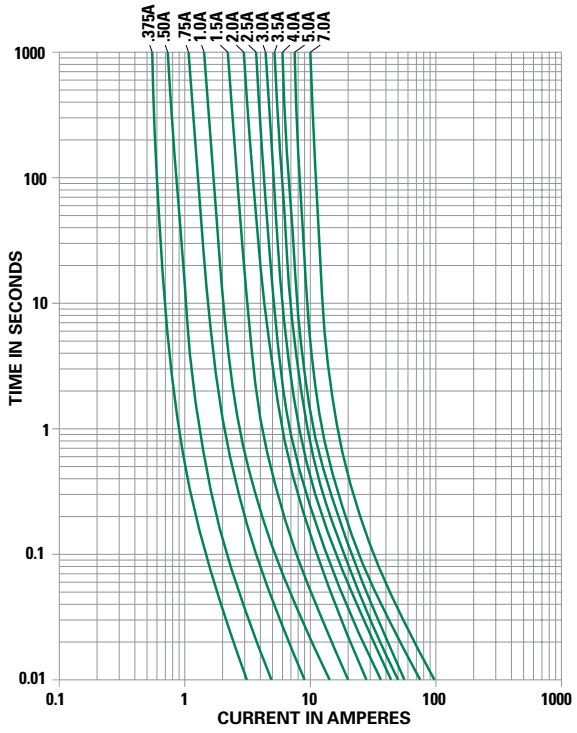
Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	260° C Maximum
Solder Dwell Time:	2-5 seconds

Recommended Hand-Solder Parameters:

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Note: These devices are not recommended for IR or Convection Reflow process.

Average Time Current Curves



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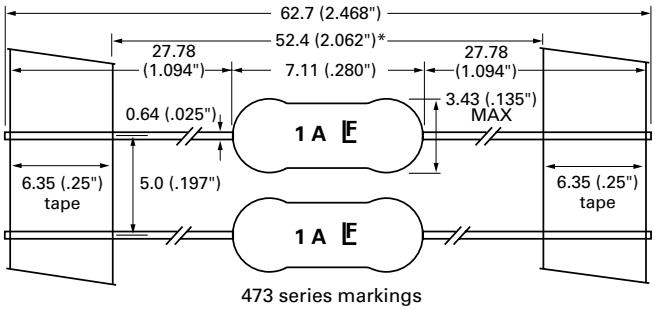
Product Characteristics

Materials	Encapsulated, Epoxy-Coated Body; Solder Coated Copper wire leads; RoHS compliant Product: Pure Tin-coated Copper wire leads
Solderability	MIL-STD-202, Method 208
Lead Pull Force	MIL-STD-202, Method 211, Test Condition A (will withstand 7 lbs. axial pull test)
Operating Temperature	–55°C to +125°C
Shock	MIL-STD-202, Method 213, Test Condition I (100 G's peak for 6 milliseconds)

Vibration	MIL-STD-202, Method 201 (10–55 Hz); MIL-STD-202, Method 204, Test Condition C (55–2000 Hz at 10 G's Peak)
Salt Spray	MIL-STD-202, Method 101, Test Condition B
Insulation Resistance (After Opening):	MIL-STD-202, Method 302, (10,000 ohms minimum at 100 volts)
Resistance to Soldering Heat	MIL-STD-202, Method 210, Test Condition C (20 sec at 260°C)
Thermal Shock	MIL-STD-202, Method 107, Test Condition B (–65°C to 125°C)
Moisture Resistance	MIL-STD-202, Method 106 (90–98% RH), Heat (65°C)

Dimensions



473 series markings

Part Numbering System

0473 xxxx Y R T1 L

Series

Current Rating
Refer to Amp Code column of Electrical Characteristics Table

Quantity
Y = 4000
P = 2000
M = 1000

Type of Packaging
R = Reel
A = Ammo Pack
X = Loose Pack

Lead Length
T1: 52.4mm (2.062")*

RoHS + HF

Packaging

Packaging Option	Packaging Specification	Quantity & Packaging Code
*T1: 52.4mm (2.062") Tape and Reel	EIA 296	Please refer to available quantities above in "Part Numbering System"

Notes: * T1 dimension is defined as the length of the component between the two tapes. The full component length is 62.7mm (2.468").

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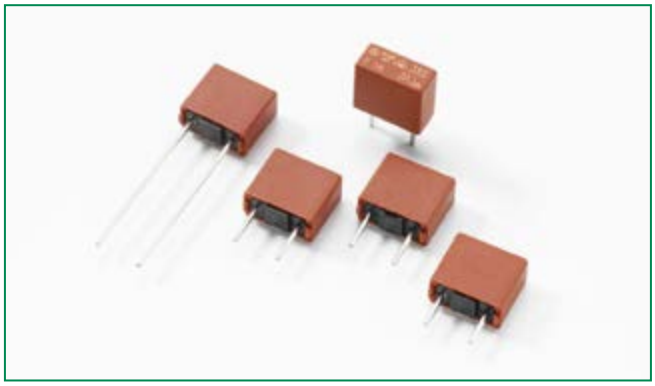
392 Series, TE5® Time-Lag Fuse



Description

TE5®, time-Lag type, 250V rated, designed in accordance to IEC 60127-3.

Features

- Lead-free
- Reduced PCB space requirements
- Direct solderable or plug-in versions
- Internationally approved
- Low internal resistance
- Shock safe casing
- Vibration resistant
- Halogen free

Applications

- Battery Charges
- Consumer Electronics
- Power supplies
- Industrial Controllers

Agency Approvals

Agency	Agency File Number	Ampere Range
VDE	126983	800mA - 6.3A
	1410866 1026673	800mA - 4A 5A - 6.3A
cULus	E67006	280mA - 6.3A
JET	JET1896-31007-2002	1A - 5A
CQC	CQC07012021162	800mA - 6.3A
	SU05024-7013 SU05024-7014 SU05024-7015 SU05024-7016 SU05024-7017 SU05024-7018	800mA - 6.3A

Additional Information

Datasheet | **Resources** | **Samples**

Electrical Characteristics for Series

% of Ampere Rating	Opening Time
150%	1 Hour, **Min.**
210%	120 s, **Max.**
275%	400 ms **Min.** ; 10 Sec. **Max.**
400%	150 ms **Min.** ; 3 Sec. **Max.**
1000%	20 ms **Min.** ; 150 ms **Max.**

Electrical Characteristic Specifications by Item

Rated Current	Amp Code	Voltage Rating	Breaking Capacity	Voltage Drop 1.0xI_N max. (mV)	Power Dissipation 1.5xI_N max. (mW)	Melting Integral 10xI_N min. (A^2s)	Agency Approvals					
							VDE		cULus	JET	CQC	
280 mA	0280	250V	35A/250 VAC	115	168	51.00			x			
800 mA	0800	250V	25A/250 VAC	110	280	3.80	x	x	x		x	x
1.00 A	1100	250V	25A/250 VAC	115	400	5.80	x	x	x	x	x	x
1.25 A	1125	250V	25A/250 VAC	100	500	9.75	x	x	x	x	x	x
1.60 A	1160	250V	25A/250 VAC	95	600	13.50	x	x	x	x	x	x
2.00 A	1200	250V	25A/250 VAC	90	700	21.00	x	x	x	x	x	x
2.50 A	1250	250V	25A/250 VAC	85	750	32.00	x	x	x	x	x	x
3.15 A	1315	250V	32A/250 VAC	80	1100	55.00	x	x	x	x	x	x
4.00 A	1400	250V	40A/250 VAC	75	1200	100.00	x	x	x	x	x	x
5.00 A	1500	250V	50A/250 VAC	70	1000	90.00	x	x	x	x	x	x
6.30 A	1630	250V	63A/250 VAC	65	1200	126.00	x	x	x		x	x

Note: 1.00 means the number one with two decimal places. 1,000 means the number one thousand.

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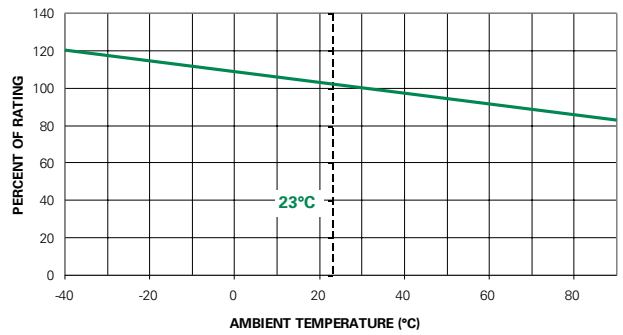
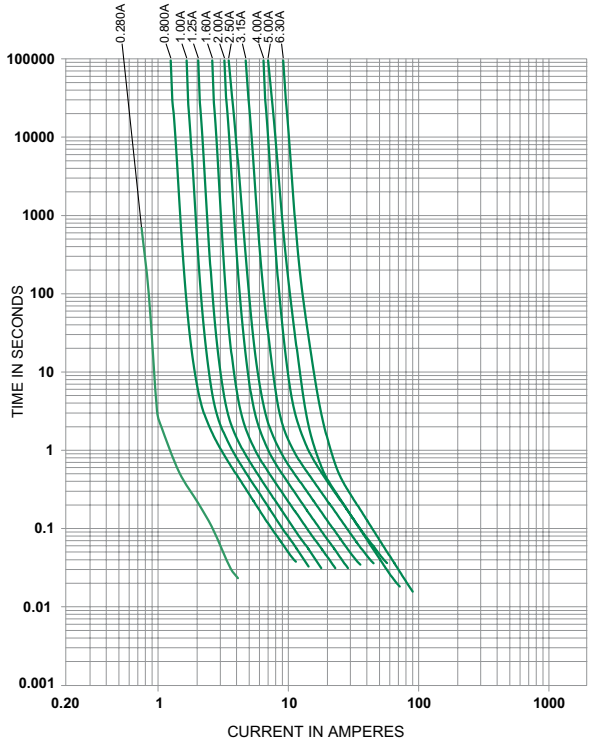
Revised: 04/06/15

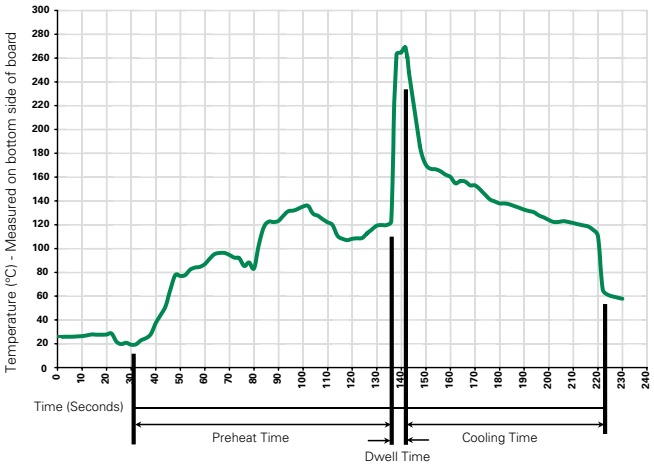
Temperature Re-rating Curve



Average Time Current Curves



Soldering Parameters - Wave Soldering



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	260° C Maximum
Solder Dwell Time:	2-5 seconds

Recommended Hand-Solder Parameters:

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Note: These devices are not recommended for IR or Convection Reflow process.

Revised: 04/06/15

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Radial Lead Fuses

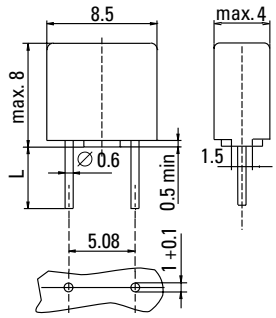
TE5® > Time-Lag > 392 Series

Product Characteristics

Materials	Base/Cap: Brown Thermoplastic Polyamide PA 6.6, UL 94 V-0 Round Pins: Copper, Tin-plated
Lead Pull Strength	10 N (IEC 60068-2-21)
Solderability	260°C, ≤ 3 sec. (Wave) 350°C, ≤ 3 sec. (Soldering iron)
Soldering Heat Resistance	260°C, 10 sec. (IEC 60068-2-20) 350°C, ≤ 3 sec. (Soldering iron)

Operating Temperature	–40°C to +85°C (consider de-rating)
Climatic Category	–40°C to +85°C/21 days (EN 60068-1, -2-1, -2-2, -2-78)
Stock Condition	+10 °C to +60 °C Relative humidity ≤ 75% yearly average, without dew, maximum value for 30 days - 95%
Vibration Resistance	24 cycles at 15 min. each (EN 60068-2-6) 10–60 Hz at 0.75 mm amplitude 60–2000 Hz at 10 g acceleration

Dimensions



Holes in the printed circuit board

Long Leads (L=18.8mm)
Short Leads (L=4.3mm)

Part Numbering System

392 xxxx 0000

Series

Amp Code
Refer to Amp Code column of Electrical Characteristics Table

Packaging Code
0000 Tape/Ammopack (1,400 pcs.)
0440 Short Leads - Bulk (1,400 pcs.)

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Taping Width
Tape & Ammopack	N/A	1,400	0000	N/A
Short Leads	N/A	1,400	0440	N/A

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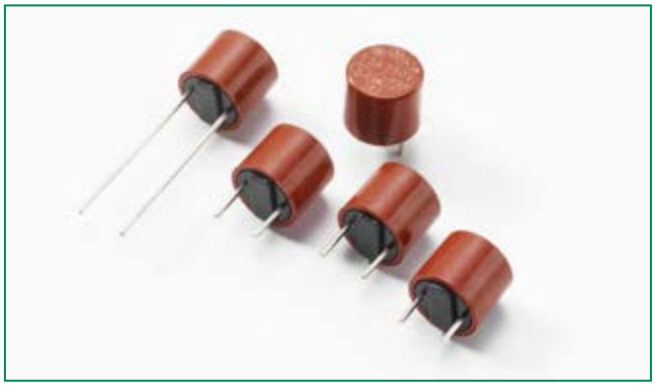
Revised: 04/06/15

382 Series, TR5®, Time-Lag Fuse



Agency Approvals

Agency	Agency File Number	Ampere Range
	5007679-1170-0038/82455	1A - 4A
	Liscense number: 5007679-1170-0006/82571	5A - 6.3A
	Certification: 1026674	1A - 6.3A
	File number: E 67006	1A - 10A
	JET1896-31007-2001 JET1896-31007-1003	1A - 10A
	2007010207240344	1A - 4A
	CQC07012020713	5A - 6.3A
	SU05024-7003 SU05024-7002 SU05024-7001 SU05024-7004 SU05024-7005	1A - 6.3A

Description

The 382 Series are TR5®, time-Lag type, 250V rated fuses, with enhanced breaking capacity designed in accordance to IEC 60127-3.

Features

- Lead-free
- Reduced PCB space requirements
- Direct solderable or plug-in versions
- 100A breaking capacity
- Internationally approved
- Low internal resistance
- Shock safe casing
- Vibration resistant
- Halogen free
- Available from 1A to 10A

Applications

- Battery Chargers
- Consumer Electronics
- Power supplies
- Industrial Controllers

Electrical Characteristics

% of Ampere Rating	Opening Time	
	1A - 6.3A	8A - 10A
150%	1 Hour, **Min.**	1 Hour, **Min.**
210%	2 Minutes, **Max.**	300 s, **Max.**
275%	400 ms, **Min.** ; 10 Sec., **Max.**	1 s, **Min.** ; 20 s, **Max.**
400%	150 ms, **Min.** ; 3 Sec., **Max.**	150 ms, **Min.** ; 3 Sec., **Max.**
1000%	20 ms, **Min.** ; 150 ms, **Max.**	20 ms, **Min.** ; 150 ms, **Max.**

Additional Information

Datasheet | **Resources** | **Samples**

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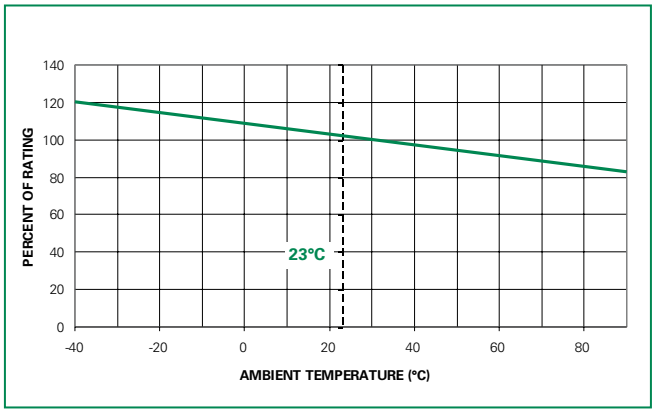
Revised: 04/06/15

Electrical Characteristics

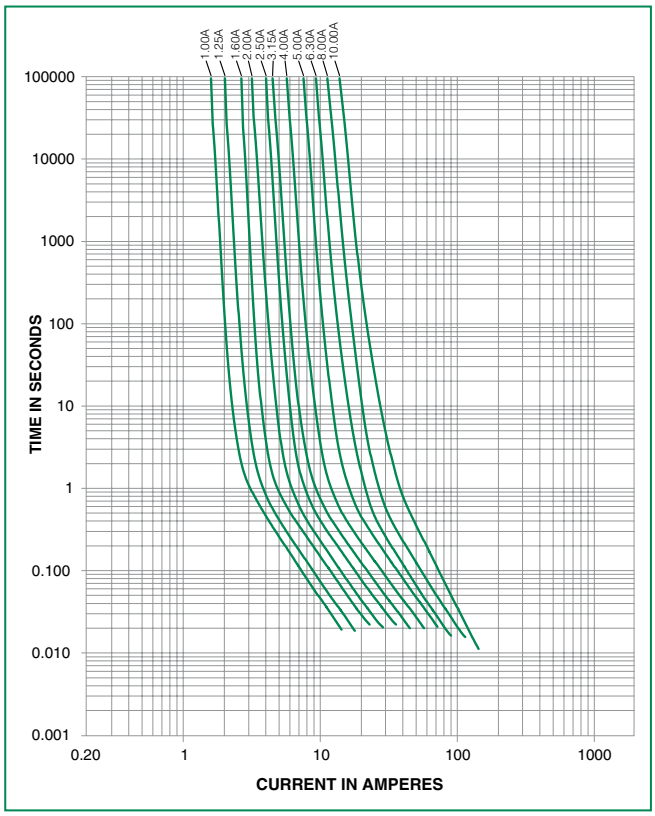
Amp Code	Rated Current	Voltage Rating	Breaking Capacity	Voltage Drop $1.0 \times I_N$ max. (mV)	Power Dissipation $1.5 \times I_N$ max. (mW)	Melting Integral $10 \times I_N$ min. (A^2s)	Agency Approvals					
							DVE		c UL us	PS E JET		
1100	1.00 A	250 V	100A / 250VAC 50-60 Hz cos φ = 1.0	100	400	3.0	X	X	X	X	X	X
1125	1.25 A	250 V		95	465	4.5	X	X	X	X	X	X
1160	1.60 A	250 V		90	490	9.0	X	X	X	X	X	X
1200	2.00 A	250 V		85	670	12	X	X	X	X	X	X
1250	2.50 A	250 V		80	750	22	X	X	X	X	X	X
1315	3.15 A	250 V		75	900	32	X	X	X	X	X	X
1400	4.00 A	250 V		70	1200	58	X	X	X	X	X	X
1500	5.00 A	250 V		65	1250	90	G	X	X	X	QCC	X
1630	6.30 A	250 V		65	1400	105	G	X	X	X	CQC	X
1800	8.00 A	250 V		63	1600	180			X	X		
2100	10.00 A	250 V		57	1600	260			X	X		

Note: 1.00 means the number one with two decimal places. 1,000 means the number one thousand.

Temperature Re-rating Curve



Average Time Current Curves



Revised: 04/06/15

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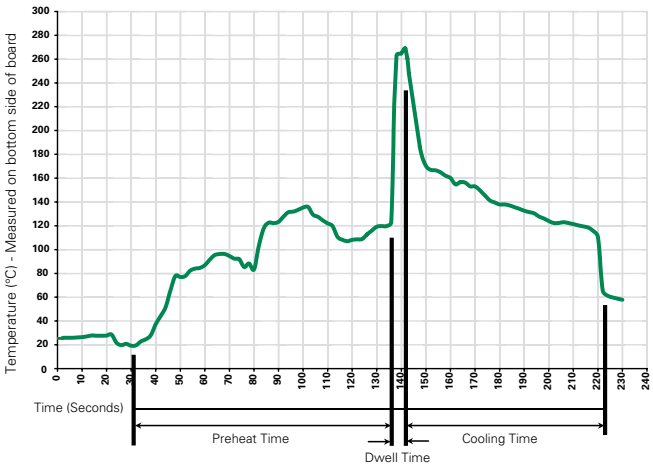
Soldering Parameters - Wave Soldering



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	260° C Maximum
Solder Dwell Time:	2-5 seconds

Recommended Hand-Solder Parameters:

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

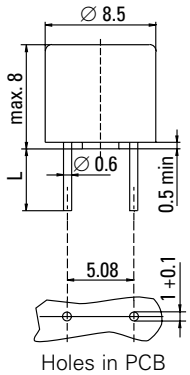
Note: These devices are not recommended for IR or Convection Reflow process.

Product Characteristics

Materials	Base/Cap: Brown Thermoplastic Polyamide PA 6.6, UL 94 V-0 Round Pins: Copper, Tin-plated
Lead Pull Strength	10 N (EN 60068-2-21)
Solderability	260°C, ≤ 3s. (Wave) 350°C, ≤ 1s. (Soldering Iron)
Soldering Heat Resistance	260°C, 10s. (IEC 60068-2-20) 350°C, 3s. (Soldering Iron)

Operating Temperature	-40°C to +85°C (consider de-rating)
Climatic Category	-40°C to +85°C /21 days (EN 60068-1,-2-1,-2-2,-2-78)
Stock Conditions	+10°C to +60°C RH ≤ 75% yearly average, without dew, maximum value for 30 days–95%
Vibration Resistance	24 cycles at 15 min. each (EN 60068-2-6) 10 - 60 Hz at 0.75 mm amplitude 60 - 2000 Hz at 10 g acceleration

Dimensions



Long Leads (L=18.8mm)
Short Leads (L=4.3mm)

Part Numbering System

382 xxxx 0000

Series

Amp Code
Refer to Amp Code column of Electrical Characteristics Table

Packaging Code
0000 Tape/Ammopack (1,000 pcs.)
0410 Short Leads - Bulk (1,000 pcs.)
0430 Short Leads - Bulk (200 pcs.)

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Taping Width
382 Series				
Tape & Ammopack	N/A	1,000	0000	N/A
Short Leads	N/A	1,000	0410	N/A
Short Leads	N/A	200	0430	N/A

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Revised: 04/06/15

451/453 Series Fuse

Agency Approvals

AGENCY	AGENCY FILE NUMBER	AMPERE RANGE
	E10480	6.3A - 20A
	29862	0.062A - 15A
	NBK030205-E10480A/B NBK101105-E184655	1A - 5A 6.3A - 15A
	E10480	0.062A - 5A

Electrical Characteristics for Series

% of Ampere Rating	Ampere Rating	Opening Time
100%	0.062 – 20	4 hours, Minimum
200%	0.062 – 10	5 sec., Maximum
	12 – 20	20 sec., Maximum

Additional Information

Datasheet 451 Series
Resources 451 Series
Samples 451 Series
Datasheet 453 Series
Resources 453 Series
Samples 453 Series

Description

The Nano2® SMF Fuse is a very small, Wire-in-Air (WIA) square shape surface mount fuse which is very suitable for the secondary side circuit over-current protection applications and is designed for PCB using surface mount technology.

Features

- Very fast acting
- Small size
- Wide range of current rating available (0.062A to 20A)
- Wide operating temperature range
- Low temperature rerating
- RoHS compliant and Halogen Free

Applications

- Notebook PC
- LCD/PDP TV
- LCD monitor
- LCD/PDP panel
- LCD backlight inverter
- Portable DVD player
- Power supply
- Networking
- PC server
- Cooling fan system
- Storage system
- Telecom system
- Wireless basestation
- White goods
- Game console
- Office Automation equipment
- Battery charging circuit protection
- Industrial equipment

Revised: 09/10/15

Electrical Specifications by Item

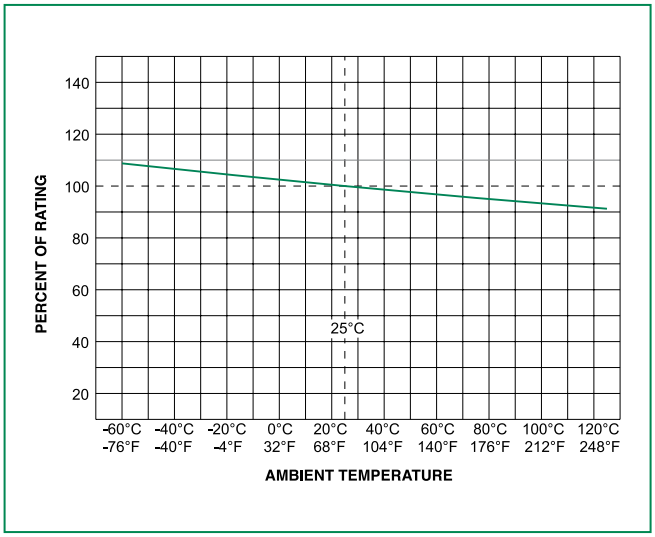
Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I²t (A²sec)	Agency Approvals			
0.062	.062	125	50A @125VAC/VDC 300A @32VDC PSE: 100A @100VAC	5.5000	0.00019		x		x
0.080	.080	125		4.0500	0.00033		x		x
0.100	.100	125		3.1000	0.00138		x		x
0.125	.125	125		1.7000	0.00286		x		x
0.160	.160	125		1.2157	0.0048		x		x
0.200	.200	125		0.8372	0.0089		x		x
0.250	.250	125		0.5765	0.0158		x		x
0.315	.315	125		0.3918	0.0311		x		x
0.375	.375	125		0.6100	0.0442		x		x
0.400	.400	125		0.5600	0.0551		x		x
0.500	.500	125		0.4200	0.0824		x		x
0.630	.630	125		0.3050	0.1381		x		x
0.750	.750	125		0.2450	0.2143		x		x
0.800	.800	125		0.2120	0.2654		x		x
1.00	001.	125		0.1530	0.6029		x	x	x
1.25	1.25	125		0.0780	0.664		x	x	x
1.50	01.5	125		0.0630	0.853		x	x	x
1.60	01.6	125		0.0580	1.060		x	x	x
2.00	002.	125	50A @125VAC/VDC 10,000A @75VDC 300A @32VDC PSE: 100A @100VAC	0.0367	0.530		x	x	x
2.50	02.5	125		0.0286	1.029		x	x	x
3.00	003.	125		0.0227	1.650		x	x	x
3.15	3.15	125		0.0215	1.920		x	x	x
3.50	03.5	125		0.0200	2.469		x	x	x
4.00	004.	125		0.0160	3.152		x	x	x
5.00	005.	125		0.0125	5.566		x	x	x
6.30	06.3	125	50A @125VAC/VDC 400A @32VDC PSE: 100A @100VAC	0.0096	9.170	x	x	x	
7.00	007.	125		0.0090	10.32	x	x	x	
8.00	008.	125		0.0077	20.23	x	x	x	
10.0	010.	125	35A @125 VAC/ 50A @125 VDC 400A @32 VDC PSE: 100A @100VAC	0.0056	26.46	x	x	x	
12.0	012.	65	150A @65VDC 100A @65VAC 400A @32VDC	0.0049	47.97	x	x	x	
15.0	015.	65		0.0037	97.82	x	x	x	
20.0	020.	65		0.00244	154	x			

Notes:
- I²t calculated at 8ms.
- Resistance is measured at 10% of rated current, 25ºC

Surface Mount Fuses

NANO2® > Very Fast-Acting Fuse > 451/453 Series

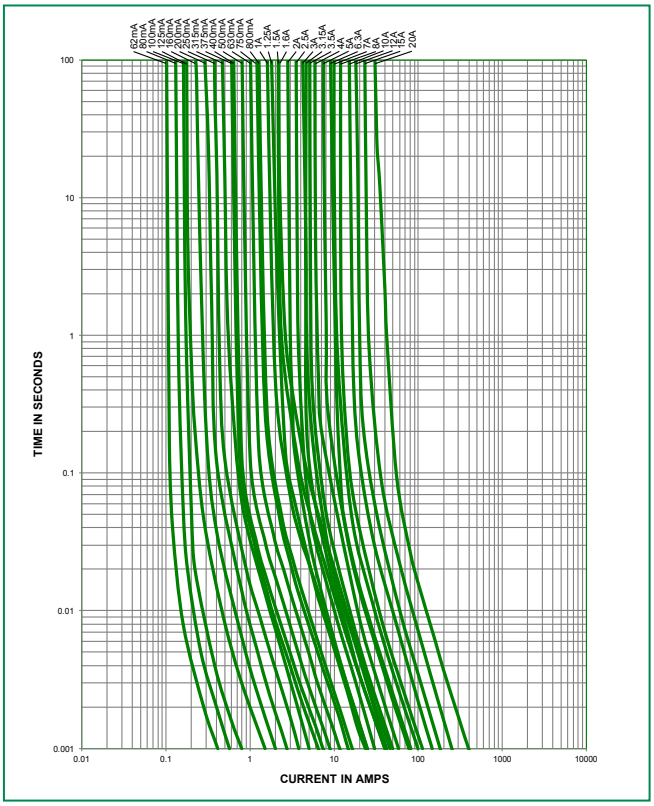
Temperature Re-rating Curve



Note:

1. Rerating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

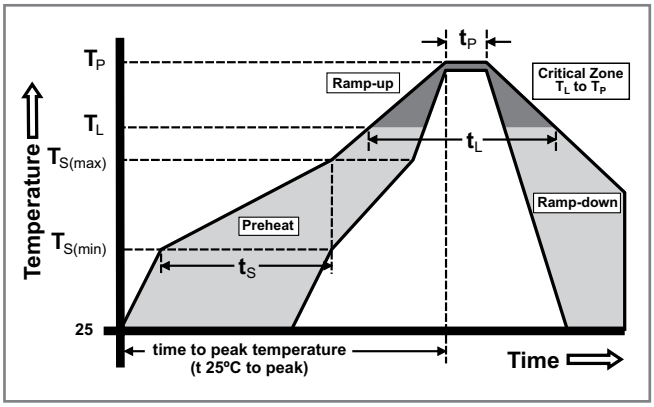
Average Time Current Curves



Soldering Parameters

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 120 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		5°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 90 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max.
Time 25°C to peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C

Wave Soldering Parameters	260°C Peak Temperature, 10 seconds max.



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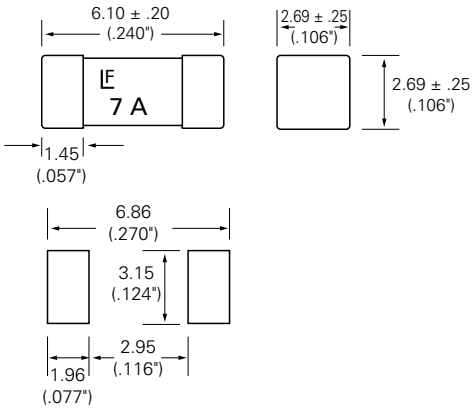
Revised: 09/10/15

Product Characteristics

Materials	**Body:** Ceramic **Terminations**: Gold-Plated Caps / Sn-dipped Silver Plated Caps (451 RoHS/HF series) SnPb Plated Caps (for 451 Non-RoHS series, 375mA-15A) Silver-plated Caps (451MR RoHS ratings below 375mA and 453 RoHS Series)
Product Marking	Brand, Ampere Rating
Operating Temperature	–55°C to 125°C
Moisture Sensitivity Level	Level 1, J-STD-020
Solderability	MIL-STD-202, Method 208
Insulation Resistance (after Opening)	MIL-STD-202, Method 302, Test Condition A (10,000 ohms minimum)

Thermal Shock	MIL-STD-202, Method 107, Test Condition B, 5 cycles, -65°C / +125°C, 15 minutes @ each extreme
Mechanical Shock	MIL-STD-202, Method 213, Test I: Deenergized. 100G's pk amplitude, sawtooth wave 6ms duration, 3 cycles XYZ+xyz = 18 shocks
Vibration	MIL-STD-202, Method 201: 0.03" amplitude, 10-55 Hz in 1 min. 2hrs each XYZ=6hrs
Moisture Resistance	MIL-STD-202, Method 106, 10 cycles
Salt Spray	MIL-STD-202, Method 101, Test Condition B (48hrs)
Resistance to Soldering Heat	MIL-STD-202, Method 210, Test condition B (10 sec at 260°C)

Dimensions



Recommended pad layout

Part Numbering System

0451 001. M R L

SERIES
451 = Gold / SnPb / Silver Plated Caps
453 = Silver Plated Caps

AMP Code
Refer to Electrical characteristics table

QUANTITY Code
M = 1000 pcs
N = 5000 pcs

PACKAGING Code
R = Tape and Reel

L-RoHS Compliant & Halogen Free (Gold Plated Caps)

SN-RoHS Compliant & Halogen Free (Sn-dipped Caps)

NOTE: "L" suffix applies to 451 series only

- 451 series may be ordered as either "RoHS and HF" ("L" suffix) or non-RoHS (no suffix) version.
- 453 series is available only as RoHS compliant version and does not require "L" suffix. Please do not include "L" suffix within 453 series ordering instructions.

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code
12mm Tape and Reel	EIA RS-481-2 (IEC 286, part 3)	5000	NR
12mm Tape and Reel	EIA RS-481-2 (IEC 286, part 3)	1000	MR

Revised: 09/10/15

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452/454 Series Fuse

Description

The NANO²® Slo-Blo® fuse has enhanced inrush withstand characteristics over the NANO²® Fast-Acting fuse. The unique time delay feature of this fuse design helps solve the problem of nuisance "opening" by accommodating inrush currents that normally cause a fast-acting fuse to open.

Features

- Small size
- Wide range of current rating available (0.375A to 12A)
- Wide operating temperature range
- Low temperature rerating
- RoHS compliant and Halogen Free

Applications

- Notebook PC
- LCD/PDP TV
- LCD monitor
- LCD/PDP panel
- LCD backlight inverter
- Portable DVD player
- Power supply
- Networking
- PC server
- Cooling fan system
- Storage system
- Telecom system
- Wireless basestation
- White goods
- Game console
- Office Automation equipment
- Battery charging circuit protection
- Industrial equipment

Agency Approvals

AGENCY	AGENCY FILE NUMBER	AMPERE RANGE
	E10480	0.375A - 12A
	29862	0.375A - 12A
	NBK030205-E10480B	1A - 5A

Electrical Characteristics for Series

% of Ampere Rating	Opening Time
100%	4 hours, Minimum
200%	1 sec., Min.; 60 sec., Max.
300%	0.2 sec., Min.; 3 sec., Max
800%	0.02 sec., Min.; 0.1 sec., Max.

Electrical Specifications by Item

Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I²t (A²sec)	Agency Approvals		
0.375	.375	125	50A @ 125 VAC/VDC 300A @ 32 VDC PSE: 100A @ 100 VAC	1.2000	0.101	x	x	
0.500	.500	125		0.7000	0.240	x	x	
0.750	.750	125		0.3600	0.904	x	x	
001.	001.	125		0.2250	1.98	x	x	x
1.50	01.5	125		0.0930	3.65	x	x	x
2.00	002.	125		0.0625	8.20	x	x	x
2.50	02.5	125		0.0450	15.0	x	x	x
3.00	003.	125		0.0340	20.16	x	x	x
3.50	03.5	125		0.0224	26.53	x	x	x
4.00	004.	125		0.0186	34.40	x	x	x
5.00	005.	125		0.0136	53.72	x	x	x
7.00	007.	75	50A @ 72 VAC 50A @ 60 VDC 100A @ 75 VDC	0.0105	123.83	x	x	
8	008.	75		0.0088	137.34	x	x	
12	012.	75		0.0061	260.46	x	x	

Notes:
- I²t calculated at 8ms.
- Resistance is measured at 10% of rated current, 25ºC

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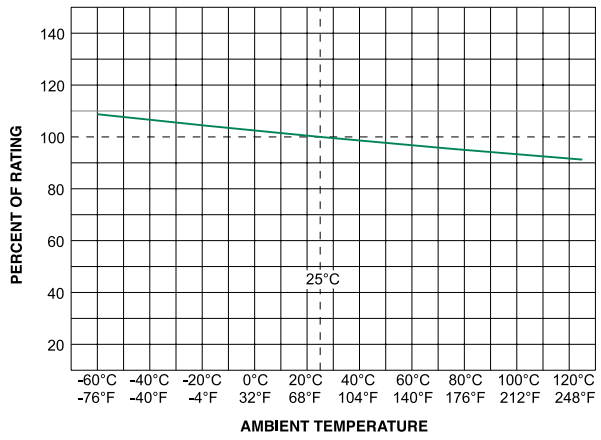
Revised: 07/01/15

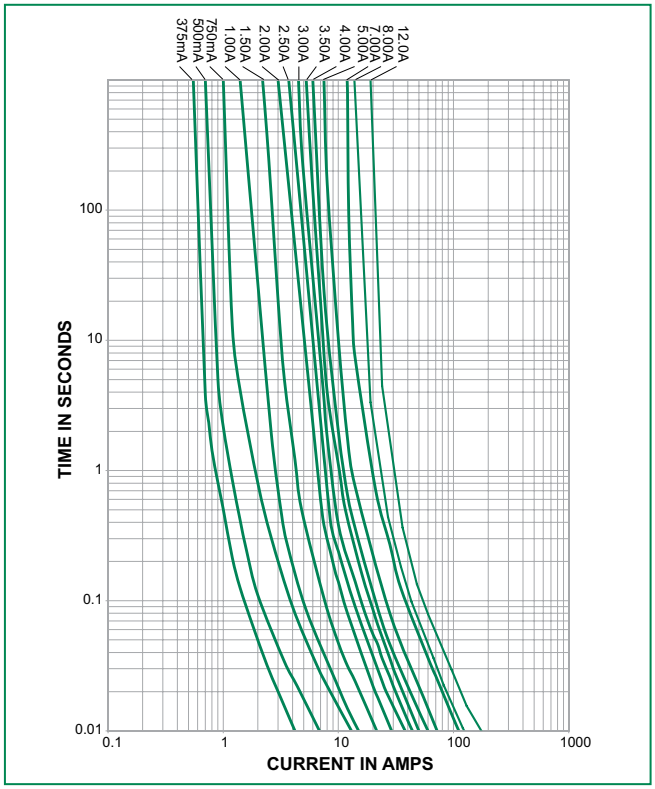
Temperature Re-rating Curve



Note:

1. Rerating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

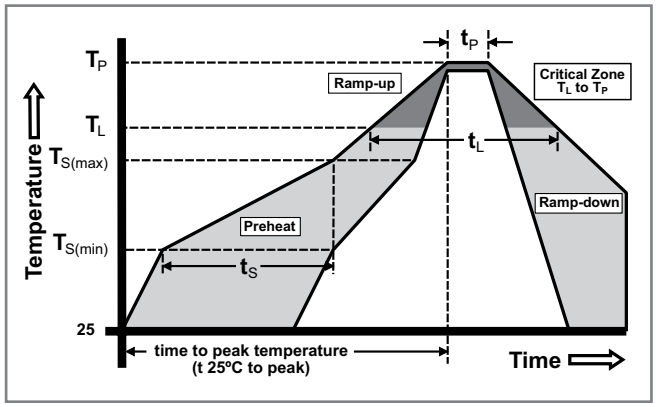
Average Time Current Curves



Soldering Parameters

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 120 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		5°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 90 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max.
Time 25°C to peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C

Wave Soldering Parameters	260°C Peak Temperature, 3 seconds max.



Revised: 07/01/15

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Surface Mount Fuses

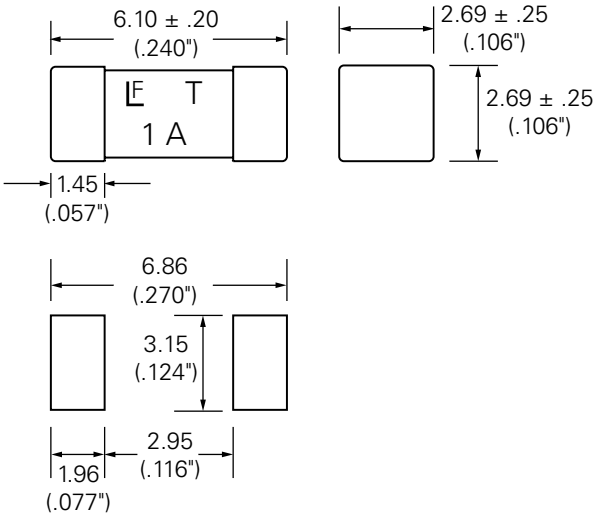
NANO²® > Slo-Blo® Fuse > 452/454 Series

Product Characteristics

Materials	**Body:** Ceramic **Terminations**: Gold-plated Caps / Sn-dipped Silver Plated Caps (452 Series) Silver-plated Caps (454 Series)
Product Marking	Brand, Ampere Rating
Operating Temperature	-55°C to 125°C
Moisture Sensitivity Level	Level 1, J-STD-020
Solderability	MIL-STD-202, Method 208
Insulation Resistance (after Opening)	MIL-STD-202, Method 302, Test Condition A (10,000 ohms minimum)

Thermal Shock	MIL-STD-202, Method 107, Test Condition B, 5 cycles, -65°C / +125°C, 15 minutes @ each extreme
Mechanical Shock	MIL-STD-202, Method 213, Test I: Deenergized. 100G's pk amplitude, sawtooth wave 6ms duration, 3 cycles XYZ+xyz = 18 shocks
Vibration	MIL-STD-202, Method 201: 0.03" amplitude, 10-55 Hz in 1 min. 2hrs each XYZ=6hrs
Moisture Resistance	MIL-STD-202, Method 106, 10 cycles
Salt Spray	MIL-STD-202, Method 101, Test Condition B (48hrs)
Resistance to Soldering Heat	MIL-STD-202, Method 210, Test condition B (10 sec at 260°C)

Dimensions



Recommended pad layout

Part Numbering System

0452 001. M R L

SERIES

AMP Code
Refer to Amp Code column in the Electrical Specifications table.
The dot is positioned at the end of the number sequence with whole ratings and within for fractional ratings.
Example: 0.375 Amp product is 0452.**375**MRL (1 amp product shown)

QUANTITY Code
M = 1000 pcs
N = 5000 pcs

PACKAGING Code
R = Tape and Reel

L - RoHS Compliant & Halogen Free (Gold Plated Caps)

SN-RoHS Compliant & Halogen Free (Sn-dipped Caps)

Notes:
452 series may be ordered as "RoHS and HF (Gold Plated Caps)" ("L" suffix).
454 series is available only as "RoHS and HF" version and does not require "L" suffix.
Please do not include "L" suffix within 454 series ordering instructions.

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code
12mm Tape and Reel	EIA RS-481-1 (IEC 286, part 3)	5000	NR
12mm Tape and Reel	EIA RS-481-1 (IEC 286, part 3)	1000	MR

Additional Information

Datasheet 452 Series
Resources 452 Series
Samples 452 Series
Datasheet 454 Series
Resources 454 Series
Samples 454 Series

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Revised: 07/01/15

465 Series Fuse

RoHS HF

Description

The Surface Mount Nano²® 250V UMF product family complies with IEC Publication IEC60127-4-Universal Modular Fuse-Links [UMF]. This IEC standard has been accepted world wide.

Features

- Listed to IEC 60127-4, Universal Modular Fuse-Links (UMF)
- 250VAC Voltage rating
- RoHS compliant and Halogen Free

Agency Approvals

AGENCY	AGENCY FILE NUMBER	AMPERE RANGE
PS E	NBK030205-E10480B	1A - 5A
PS E	NBK101105-E184655	6.3A
M	E184655	0.25A - 6.3A

Applications

- Power supply
- Lighting system
- White goods
- Industrial equipment

Electrical Characteristics for Series

% of Ampere Rating	Opening Time
125%	1 hour, Minimum
200%	2 minutes, Maximum
1000%	0.01 sec., Min.; 0.1 sec., Max.

Additional Information

Datasheet | **Resources** | **Samples**

Electrical Specifications by Item

Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I²t (A²sec)	Agency Approvals	
						PS E	M
1.00	001.	250	100A@250VAC	0.1070	2.5	x	x
1.25	1.25	250		0.0830	5.6	x	x
1.60	01.6	250		0.0560	9.0	x	x
2.00	002.	250		0.0390	14.4	x	x
2.50	02.5	250		0.0260	19.6	x	x
3.15	3.15	250		0.0210	32.4	x	x
4.00	004.	250		0.0160	48.4	x	x
5.00	005.	250		0.0130	90.0	x	x
6.30	06.3	250		0.0088	144.4	x	x

Notes:
- I²t calculated at 8ms.
- Resistance is measured at 10% of rated current, 25°C
- For information and availability of additional ratings please contact Littelfuse

Revised: 07/14/15

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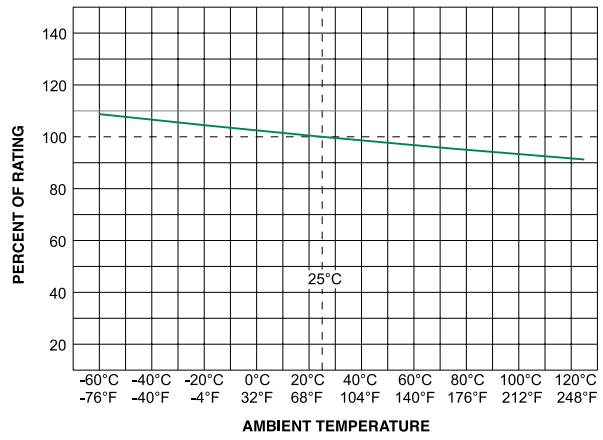
Surface Mount Fuses

NANO²® > 250V UMF Time Lag Fuse > 465 Series

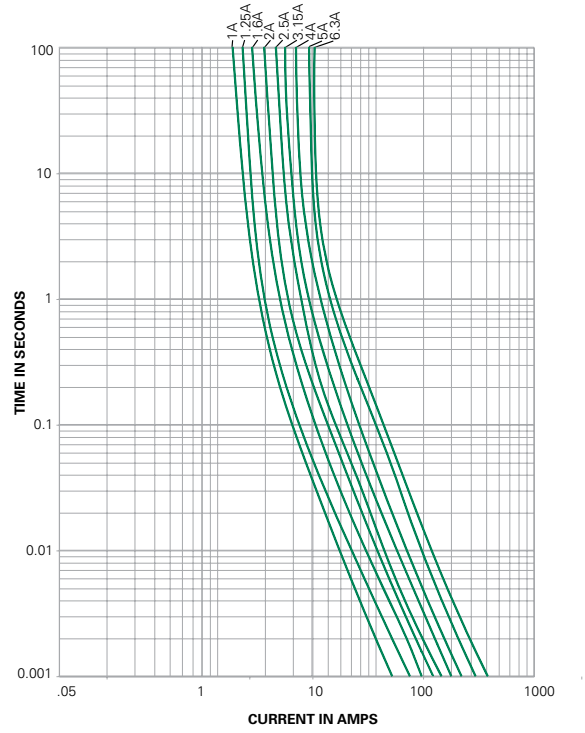
Temperature Re-rating Curve



Note:

1. Rerating depicted in this curve is in addition to the standard derating of 15% for continuous operation.

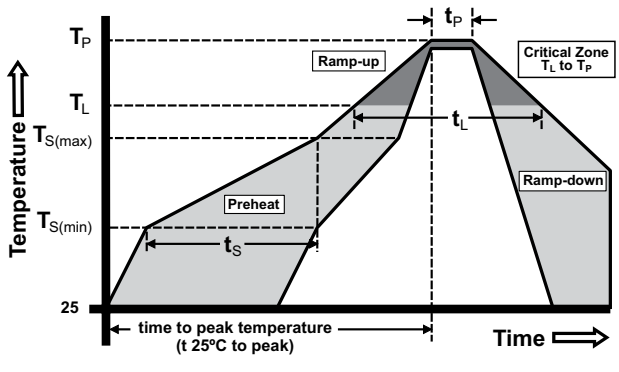
Average Time Current Curves



Soldering Parameters

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 120 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		5°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 90 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max.
Time 25°C to peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C

Wave Soldering Parameters	260°C Peak Temperature, 3 seconds max.



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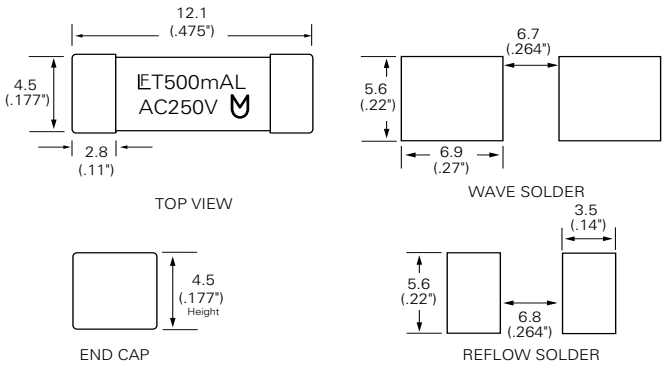
Product Characteristics

Materials	Body: High Performance Ceramic Terminations: Silver plated brass.
Product Marketing	Brand, Ampere Rating, Voltage Rating, UMF Logo
Operating Temperature	–55°C to 125°C.
Moisture Sensitivity Level	J-STD-020, Level 1
Solderability	IEC60127-4
Insulation Resistance (after opening	IEC 60127-4 (0.1Mohm min @ 500VDC)
Shock	MIL-STD-202, Method 213, Test Condition A

Thermal Shock	MIL-STD-202, Method 107, Test Condition B , 5 cycles, –65°C to 125°C
Mechanical Shock	MIL-STD-202, Method 213, Test Condition A
Vibration	MIL-STD-202, Method 201 (10-55 Hz)
Moisture Resistance	MIL-STD-202, Method 106, 10 cycles
Salt Spray	MIL-STD-202, Method 101, Test Condition B (48hrs)
Resistance to Soldering Heat	IEC 60127-4

Dimensions



Part Numbering System

0465 .500 D R

SERIES — 0465

AMP Code* — .500
Refer to Electrical Characteristics table

QUANTITY Code — D
D = 1500 pcs

PACKAGING Code — R
R = Tape and Reel

***Example:**
2.5 amp product is 0465**02.5**DR
(0.5 amp product shown above).

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code
24mm Tape and Reel	EIA RS-481-1 (IEC 286, part 3)	1500	DR

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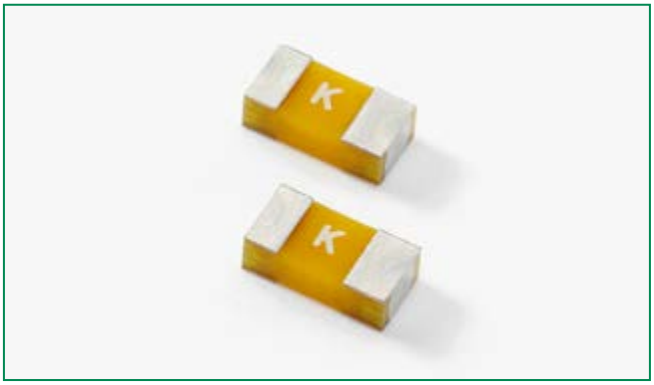
Surface Mount Fuses

NANO²® Fuse > 470 Series >1206 Fast Acting

470 Series Fuse



Description

The 470 series is a family of 125V rated high energy SMD fuses, perfect for space constrained applications. It offers the standard Nano Fuse circuit protection capability with a very small 1206 foot print.

This product is RoHS compliant, Halogen-Free and 100% Pb-Free with guaranteed operating temperature of up to 125°C.

Features

- Very Small 1206 Footprint
- 125V Voltage Rating
- Fast-Acting
- Pb-Free, RoHS Compliant and Halogen-Free
- Wide Operating temperature range of -55°C to 125°C
- ENERGY STAR® Surge Immunity test compliant (100kHz Ring Wave, 2.5kV, 7 strikes common and differential modes) - 1.5A and above ampere rating only

Agency Approvals

Agency	Agency File Number	Ampere Range
c UL us	E10480	0.500 - 2A
PS E	Pending	0.500 - 2A

Applications

- LED Lighting
- LCD/LED TVs
- Notebooks/PCs
- Gaming Consoles
- Battery Charging Circuit Protection
- Power Supply Units
- Telecom Systems
- White Goods

Electrical Characteristics for Series

% of Ampere Rating	Opening Time
100%	4 Hours, Minimum
200%	5 Seconds, Maximum

Electrical Characteristic

Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I²t (A² sec.)	Agency Approvals	
						c UL us	PS E
0.500	.500	125V	50A @ 125VDC 50A @ 125VAC 300A @ 32VDC	0.5455	0.02874	x	P
1.00	001.	125V		0.2242	0.14785	x	P
1.25	1.25	125V		0.1637	0.30269	x	P
1.50	01.5	125V		0.1263	0.45970	x	P
1.60	01.6	125V		0.1212	0.51400	x	P
2.00	002	125V		0.1004	0.75625	x	P

Note: I²t values stated for 8msec opening time.

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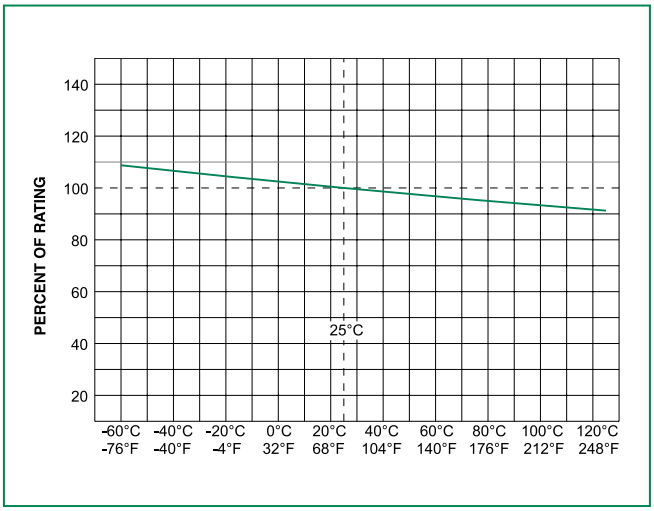
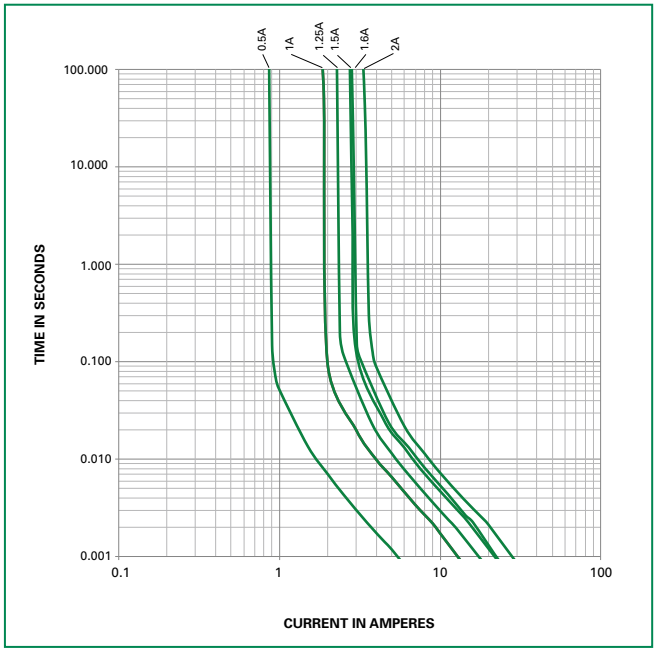
Temperature Rerating Curve



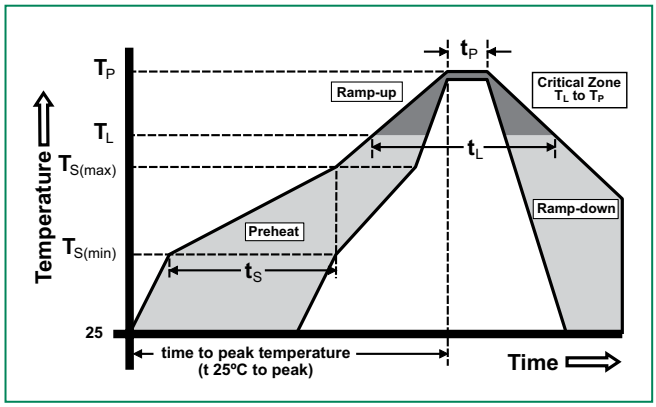
NOTE: Derating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

Average Time Current Curves



Soldering Parameters

Reflow Condition		Pb – free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		5°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 90 seconds
Peak Temperature (T_P)		$250^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max.
Time 25°C to peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



Revised: 02/08/15

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Surface Mount Fuses

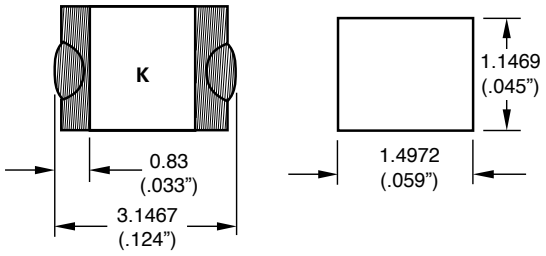
NANO²® Fuse > 470 Series >1206 Fast Acting

Product Characteristics

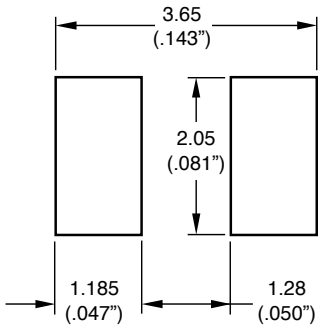
Materials	**Body:** Epoxy Resin **Terminations:** Cu/Ni/Sn (100% Pb-free)
Product Marking	**Body:** Current Rating
Operating Temperature	–55°C to +125°C
Solderability	MIL-STD-202
Insulation Resistance (after opening)	IEC 60127-4 (0.1Mohm Min)

Thermal Shock	MIL-STD-202, Method 107, Test Condition B, 5 cycles, -65°C to 125°C, 15 minutes @ each extreme
Mechanical Shock	MIL-STD-202, Method 213B, Test Condition I: De-energized. 100G's peak amplitude, sawtooth wave 6ms duration, 3 cycles XYZ+xyz = 18 shocks
Vibration	MIL-STD-202, Method 201: 0.03" amplitude, 10-55 Hz in 1 min. 2 hrs. each XYZ = 6hrs (10- 55 Hz)
Moisture Resistance	MIL-STD-202, Method 106, 10 cycles Condition A
Salt Spray	MIL-STD-202, Method 101, Test Condition B (48 hrs)
Resistance to Soldering Heat	Method 210, Test Condition B (10 sec at 260°C)

Dimensions



Recommended Pad Layout



Part Marking System

Amp Code	Marking Code
.500	**F**
001.	**H**
1.25	**J**
01.5	**K**
01.6	**M**
002.	**N**

Part Numbering System

0470 002. D R

Series

Amp Code*
Refer to Amp Code column of Electrical Characteristics Table

Quantity Code
D = 1500 pieces

Packaging Code
R = Tape and Reel

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Reel Size
8mm Tape and Reel	EIA-RS-481-1	1500	DR	N/A

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476 Series Fuse

Description

The 476 Series is a family of 250V rated fuses with a very small 2410 footprint. It is the smallest SMD fuse with this high voltage rating and is designed to mainly serve as primary side circuit protection for compact devices with high voltage requirements.

Features

- Small 2410 Footprint
- 250V Voltage Rating (1A to 5A)
- High Interrupting Ratings
- Fast-Acting
- RoHS Compliant and Halogen-Free
- Designed in accordance with IEC 60127-4 Universal Modular Fuse requirement
- Wide Operating temperature range of -55°C to 125°C
- IEC 61000-4-5 2 ed. Surge Immunity Test Compliant (1.2 x 50us/8x20us combination wave 500V/250A for <25W Lamp Category) – 3A and above ampere rating only

Agency Approvals

Agency	Agency File Number	Ampere Range
c UL us	E10480	1A - 15A
CQC	Pending	1A - 5A
VDE	Pending	1A - 5A

Applications

- LED Lighting
- LCD/LED TVs
- Power Supply Units
- White Goods

Electrical Characteristics for Series

% of Ampere Rating	Ampere Rating	Opening Time
100%	1A - 15A	4 Hour, Minimum
125%	1A - 5A	1 Hour, Minimum
200%	1A - 15A	120 Sec., Maximum
1000%	1A - 5A	0.001 Sec., Min; 0.01 Sec., Max

Electrical Characteristic

Ampere Rating (A)	Amp Code	Max Voltage Rating (V)	Interrupting Rating	Nominal Cold Resistance (Ohms)	Nominal Melting I²t (A² sec.)	Agency Approvals		
						c UL us	CQC	VDE
1.00	001	250V	100A @ 250VAC 300A @ 125VDC 10kA @ 86VDC	0.1575	0.193	x	P	P
1.25	1.25	250V		0.122	0.276	x	P	P
1.60	01.6	250V		0.0825	0.620	x	P	P
2.00	002	250V		0.0448	0.530	x	P	P
2.50	02.5	250V		0.0363	0.910	x	P	P
3.00	003	250V		0.0277	1.660	x	P	P
3.50	03.5	250V		0.0234	2.356	x	P	P
4.00	004	250V		0.01839	2.820	x	P	P
5.00	005	250V		0.0157	4.000	x	P	P
6.30	06.3	125V	100A@125VAC 300A@125VDC 10kA@86VDC	0.0126	7.500	x		
7.00	007	125V		0.0116	7.800	x		
8.00	008	125V		0.0112	9.757	x		
10.0	010	125V		0.0096	14.879	x		
12.0	012	125V		0.006	20.635	x		
15.0	015	125V		0.0045	61.286	x		

Notes: 1. Cold resistance measured at less than 10% of rated current at 25°C

2. Agency Approval Table Key: X = Approved or Certified, P=Pending and Blank=Not Approved.

3. I²t values stated for 8msec opening time.

4. For 15A rating with 10kA@86VDC IR, please use suffix "S" for ordering. Refer to Part Numbering System for reference.

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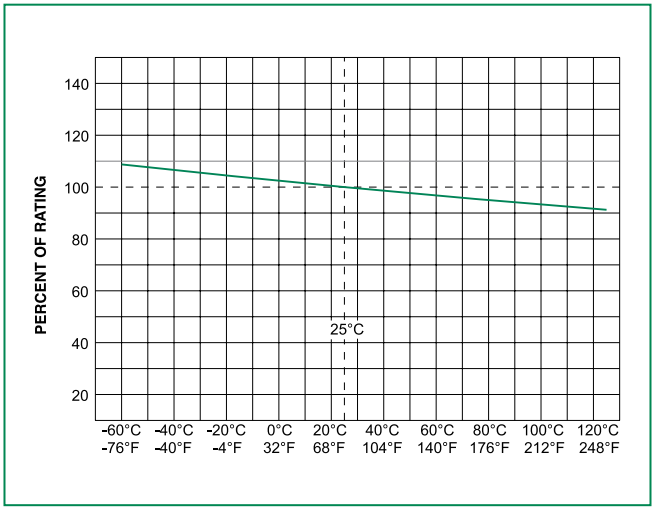
Surface Mount Fuses

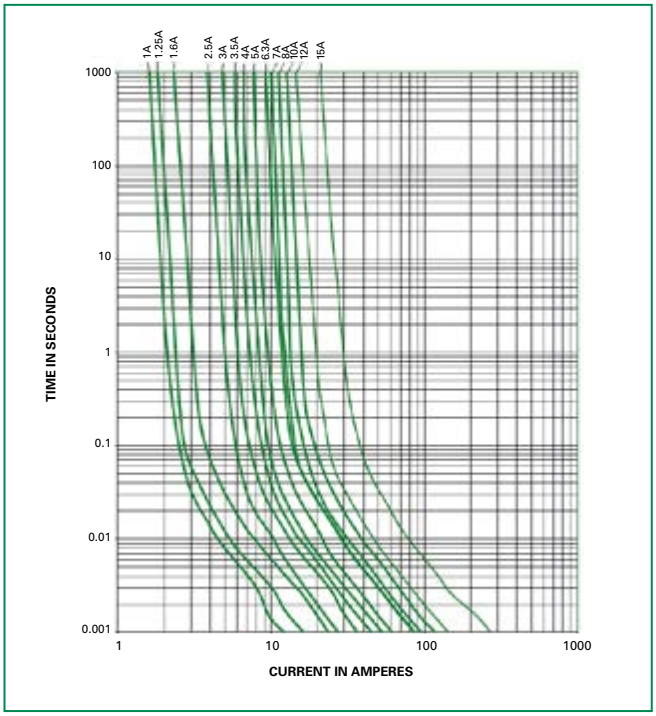
NANO²® Fuse > 250V > Fast Acting > 476 Series

Temperature Rerating Curve



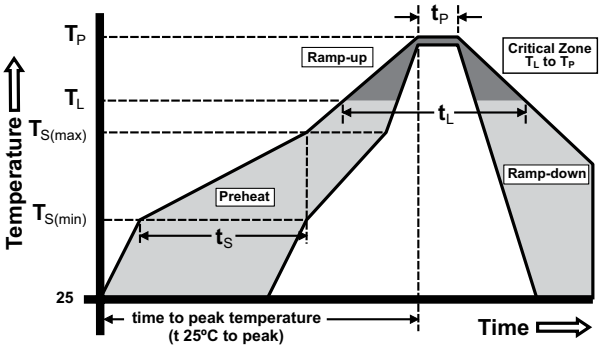
NOTE: Derating depicted in this curve is in addition to the standard derating of 25% for continuous operation.

Average Time Current Curves



Soldering Parameters

Reflow Condition		Pb – free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		5°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max.
Time 25°C to peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



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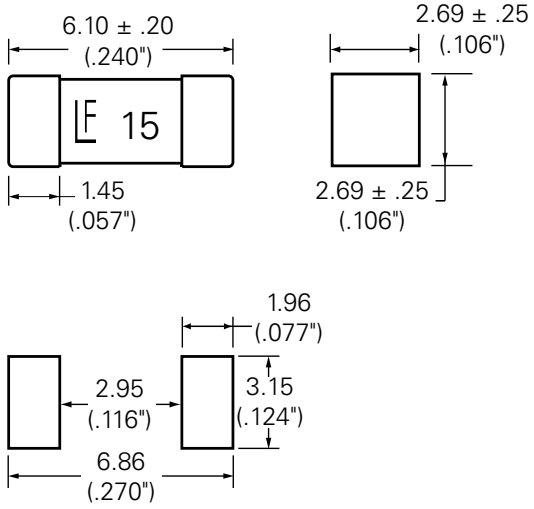
Revised: 07/17/15

Product Characteristics

Materials	**Body:** Ceramic **Cap:** Silver Plated Brass/Sn Dipped Silver Plated Brass/Gold Plated Brass
Product Marking	**Body:** Brand Logo, Current Rating
Operating Temperature	–55ºC to +125ºC
Moisture Sensitivity Level	Level 1
Solderability	MIL-STD-202, Method 208
Insulation Resistance (after opening)	IEC 60127-4 (0.1Mohm Min)

Thermal Shock	MIL-STD-202, Method 107 Test Condition B, 5 cycles, -65°C to 125°C, 15 minutes @ each extreme
Mechanical Shock	MIL-STD-202, Method 213 Test Condition I: De-energized. 100G's peak amplitude, sawtooth wave 6ms duration, 3 cycles XYZ+xyz = 18 shocks
Vibration	MIL-STD-202, Method 201: 0.03" amplitude, 10-55 Hz in 1 min. 2 hrs. each XYZ = 6hrs (10- 55 Hz)
Moisture Resistance	MIL-STD-202, Method 106 10 cycles
Salt Spray	MIL-STD-202, Method 101 Test Condition B (48 hrs)
Resistance to Soldering Heat	MIL-STD-202, Method 210, Test Condition B (10 sec at 260°C)

Dimensions



Recommended Pad Layout

Part Numbering System

0476 015. M R SN

Series

Amp Code*
Refer to Amp Code column of Electrical Characteristics Table

Quantity Code
M = 1000 pieces

Packaging Code
R = Tape and Reel

SN — Sn-dipped Caps
S — For 15A only - Gold Plated Caps with 10kA@86VDC IR

Packaging

Packaging Option	Packaging Specification	Quantity	Quantity & Packaging Code	Reel Size
12mm Tape and Reel	EIA-RS-481-2 (IEC 286 part 3)	1000	MR	N/A

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LA Varistor Series

Agency Approvals

Agency	Agency Approval	Agency File Number
cULus	UL1449	E320116
VDE	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q) for 14mm and 20mm only	116895
SEV	22.2-1	91788
CQC	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q) for 14mm and 20mm only	E1273/F

Description

The LA Varistor Series of transient voltage surge suppressors are radial leaded 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 Varistor Series 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

Features

- Lead–free, Halogen-Free and RoHS compliant.
- Energy absorption capability (W_{TM}) up to 360J
- Wide operating voltage range $V_{M(AC)RMS}$ 130V to 1000V
- No derating up to 85ºC ambient
- Available in tape and reel or bulk pack

Additional Information

Datasheet | Resources | Samples

Absolute Maximum Ratings

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

Continuous	LA Series	Units
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	ºC
Storage Temperature Range (T_{STG})	-55 to +125	ºC
Temperature Coefficient (a^V) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/ºC
Hi-Pot Encapsulation (COATING Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)	2500	V
COATING 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.

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Revised: 02/23/15

LA Series Ratings & Specifications

Part Number	Branding	Model Size Disc Dia. (mm)	Maximum Rating (85°C)				Specifications (25°C)				
			Continuous		Transient		Varistor Voltage at 1mA DC Test Current		Maximum Clamping Voltage 8 x 20 μs		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)	(V)	(A)	(pF)
V130LA1P	P1301	7	130	175	11	1200	198	242	390	10	180
V130LA2P	P1302	7	130	175	11	1200	184.5	225.5	340	10	180
V130LA5P	P1305	10	130	175	20	2500	184.5	225.5	340	25	450
V130LA10AP	P130L10	14	130	175	38	4500	184.5	225.5	340	50	1000
V130LA20AP	P130L20	20	130	175	70	6500	184.5	225.5	340	100	1900
V130LA20BP	P130L20B	20	130	175	70	6500	190	220	325	100	1900
V140LA2P	P1402	7	140	180	12	1200	198	242	360	10	160
V140LA5P	P1405	10	140	180	22	2500	198	242	360	25	400
V140LA10AP	P140L10	14	140	180	42	4500	198	242	360	50	900
V140LA20AP	P140L20	20	140	180	75	6500	198	242	340	100	1750
V150LA1P	P1501	7	150	200	13	1200	225	275	430	10	150
V150LA2P	P1502	7	150	200	13	1200	216	264	395	10	150
V150LA5P	P1505	10	150	200	25	2500	216	264	395	25	360
V150LA10AP	P150L10	14	150	200	45	4500	216	264	395	50	800
V150LA20AP	P150L20	20	150	200	80	6500	216	264	395	100	1600
V150LA20BP	P150L20B	20	150	200	80	6500	216	243	360	100	1600
V175LA2P	P1752	7	175	225	15	1200	243	297	455	10	130
V175LA5P	P1755	10	175	225	30	2500	243	297	455	25	350
V175LA10AP	P175L10	14	175	225	55	4500	243	297	455	50	700
V175LA20AP	P175L20	20	175	225	90	6500	243	297	455	100	1400
V230LA4P	P2304	7	230	300	20	1200	324	396	595	10	100
V230LA10P	P230L	10	230	300	35	2500	324	396	595	25	250
V230LA20AP	P230L20	14	230	300	70	4500	324	396	595	50	550
V230LA40AP	P230L40	20	230	300	122	6500	324	396	595	100	1100
V250LA2P	P2502	7	250	330	21	1200	369	451	730	10	90
V250LA4P	P2504	7	250	330	21	1200	351	429	650	10	90
V250LA10P	P250L	10	250	330	40	2500	351	429	650	25	220
V250LA20AP	P250L20	14	250	330	72	4500	351	429	650	50	500
V250LA40AP	P250L40	20	250	330	130	6500	351	429	650	100	1000
V250LA40BP	P250L40B	20	250	330	130	6500	354	413	620	100	1000
V275LA2P	P2752	7	275	369	23	1200	405	495	775	10	80
V275LA4P	P2754	7	275	369	23	1200	387	473	710	10	80
V275LA10P	P275L	10	275	369	45	2500	387	473	710	25	200
V275LA20AP	P275L20	14	275	369	75	4500	387	473	710	50	450
V275LA40AP	P275L40	20	275	369	140	6500	387	473	710	100	900
V275LA40BP	P275L40B	20	275	369	140	6500	389	453	680	100	900
V300LA2P	P3002	7	300	405	25	1200	441	539	870	10	70
V300LA4P	P3004	7	300	405	25	1200	423	517	775	10	70
V300LA10P	P300L	10	300	405	46	2500	423	517	775	25	180
V300LA20AP	P300L20	14	300	405	77	4500	423	517	775	50	400
V300LA40AP	P300L40	20	300	405	165	6500	423	517	775	100	800
V320LA7P	P3207	7	320	420	25	1200	459	561	850	10	65
V320LA10P	P320L	10	320	420	48	2500	459	561	850	25	170
V320LA20AP	P320L20	14	320	420	80	4500	459	561	850	50	380
V320LA40BP	P320L40	20	320	420	150	6500	462	540	810	100	750
V385LA7P	P3857	7	385	505	27	1200	558	682	1025	10	60

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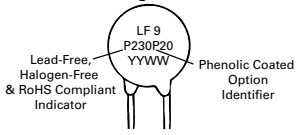
LA Series Ratings & Specifications (Continued...)

Part Number	Branding	Model Size Disc Dia. (mm)	Maximum Rating (85°C)				Specifications (25°C)				
			Continuous		Transient		Varistor Voltage at 1mA DC Test Current		Maximum Clamping Voltage 8 x 20 μs		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)	(V)	(A)	(pF)
V385LA10P	P385L	10	385	505	51	2500	558	682	1025	25	160
V385LA20AP	P385L20	14	385	505	85	4500	558	682	1025	50	360
V385LA40BP	P385L40	20	385	505	160	6500	558	682	1025	100	700
V420LA7P	P4207	7	420	560	30	1200	612	748	1120	10	55
V420LA10P	P420L	10	420	560	55	2500	612	748	1120	25	140
V420LA20AP	P420L20	14	420	560	90	4500	612	748	1120	50	300
V420LA40BP	P420L40	20	420	560	160	6500	610	720	1060	100	600
V460LA7P	P4607	7	460	615	37	1200	643.5	786.5	1190	10	55
V460LA10P	P460L	10	460	615	56	2500	643.5	786.5	1190	25	120
V460LA20AP	P460L20	14	460	615	100	4500	643.5	786.5	1190	50	280
V460LA40BP	P460L40	20	460	615	170	6500	643.5	755.5	1110	100	560
V480LA7P	P4807	7	480	640	35	1200	675	825	1240	10	50
V480LA10P	P480L	10	480	640	60	2500	675	825	1240	25	120
V480LA40AP	P480L40	14	480	640	105	4500	675	825	1240	50	270
V480LA80BP	P480L80	20	480	640	180	6500	675	790	1160	100	550
V510LA10P	P510L	10	510	675	63	2500	738	902	1350	25	100
V510LA40AP	P510L40	14	510	675	110	4500	738	902	1350	50	250
V510LA80BP	P510L80	20	510	675	190	6500	738	860	1280	100	500
V575LA10P	P575L	10	575	730	65	2500	819	1001	1500	25	90
V575LA40AP	P575L40	14	575	730	120	4500	819	1001	1500	50	220
V575LA80BP	P575L80	20	575	730	220	6500	819	960	1410	100	450
V625LA10P	P625L	10	625	825	67	2500	900	1100	1650	25	80
V625LA40AP	P625L40	14	625	825	125	4500	900	1100	1650	50	210
V625LA80BP	P625L80	20	625	825	230	6500	900	1100	1650	100	425
V680LA10P	P680L	10	680	875	75	2500	990	1210	1875	25	65
V680LA80AP	P680L80	14	680	875	145	4500	990	1210	1875	50	190
V680LA100BP	P680L100	20	680	875	260	6500	990	1130	1700	100	380
V660LA10P	P660L	10	660	850	70	2500	972	1188	1820	25	70
V660LA50AP	P660L50	14	660	850	140	4500	972	1188	1820	50	200
V660LA100BP	P660L100	20	660	850	250	6500	940	1100	1650	100	400
V1000LA80AP	P1000L8	14	1000	1200	220	4500	1500	1800	2700	50	130
V1000LA160BP	P1000L16	20	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.

Phenolic Coating Option -- 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.
- These devices are not UL, CSA, VDE or CECC certified.
- To order: add X1347 to end of part number (e.g. V230LA20A**PX1347**).
- Product marking:



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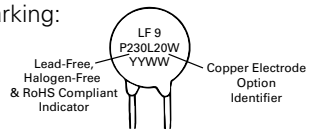
Copper Electrode Option:

- Add 'W' to the end of the part number (e.g. V230LA20AP**W**)
- Product marking:



Current Energy and 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 above. 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 1A - Power Derating for Epoxy Coated

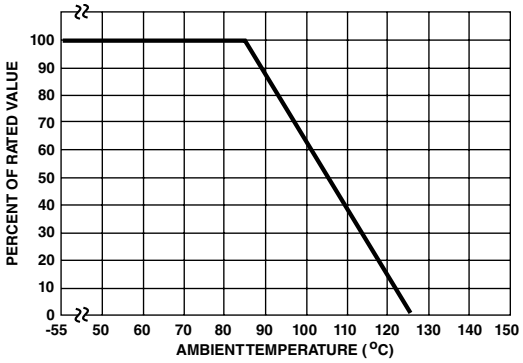
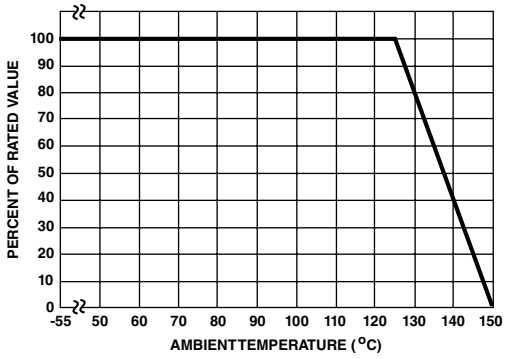


Figure 1B - Power Derating for Phenolic Coated



Peak Pulse Current Test Waveform

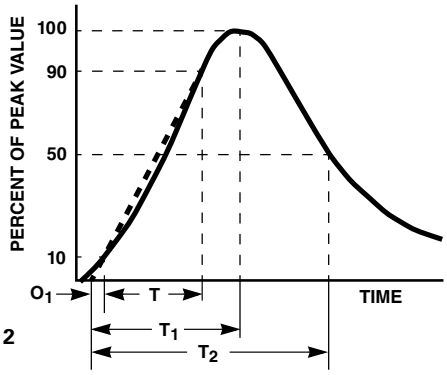


Figure 2

0_1 = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
T_1 = Rise Time = 1.25 x T
T_2 = Decay Time

Example - For an 8/20 μs Current Waveform:
8μs = T_1 = Rise Time
20μs = T_2 = Decay Time

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Transient V-I Characteristics Curves

Maximum Clamping Voltage for 7mm Parts

V130LA1(P) - V300LA2(P)

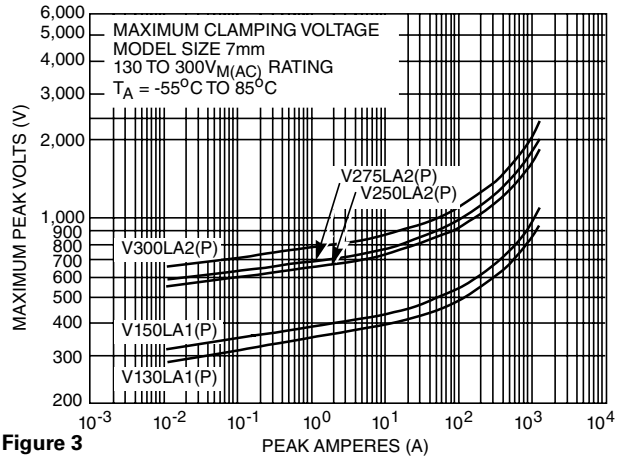

Figure 3

V130LA2(P) - V300LA4(P)

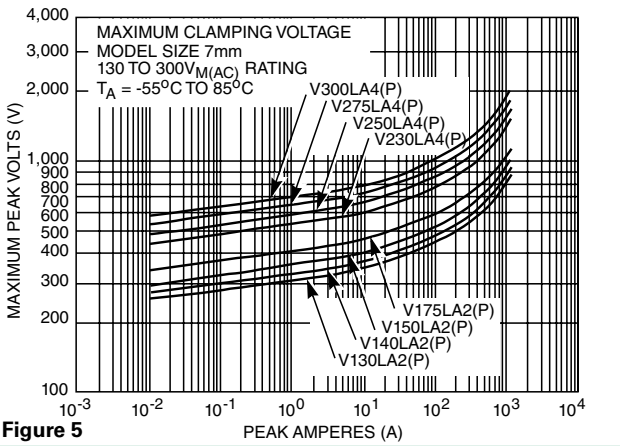

Figure 5

V320LA7(P) - V480LA7(P)

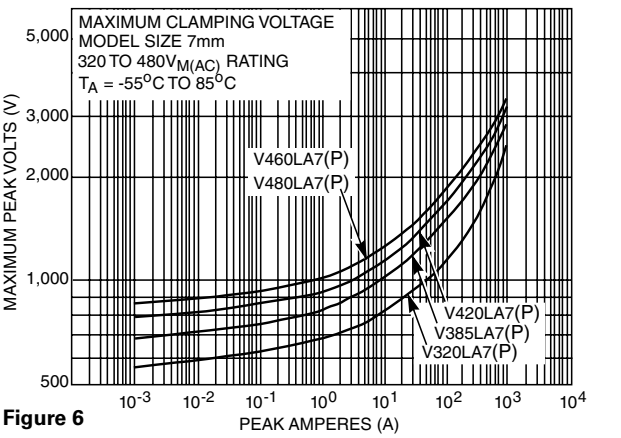

Figure 6

Pulse Rating Curves

Repetitive Surge Capability for 7mm Parts

V130LA1(P) - V480LA7(P)

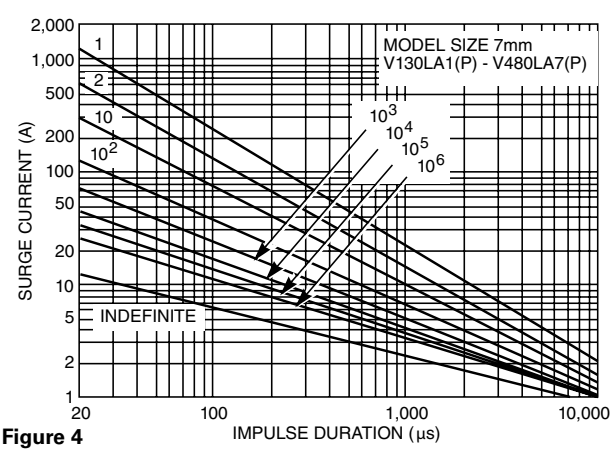

Figure 4

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Transient V-I Characteristics Curves (Continued...)

Maximum Clamping Voltage for 10mm Parts

V130LA5(P) - V420LA10(P)

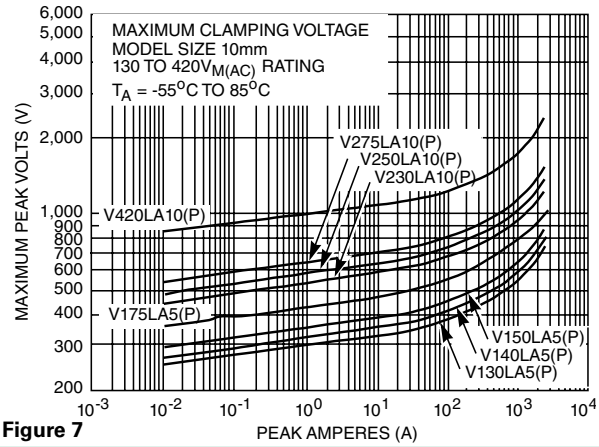

Figure 7

V300LA10(P) - V680LA10(P)

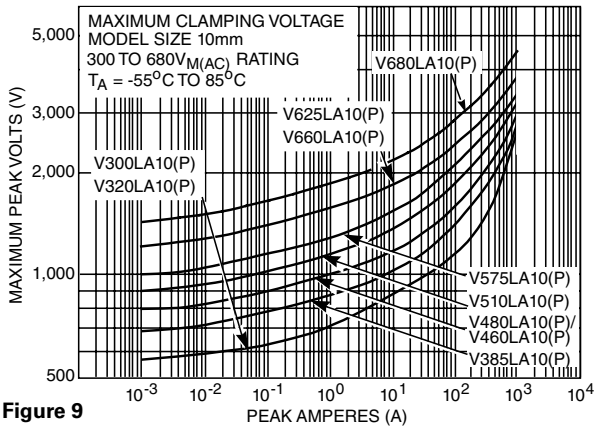

Figure 9

Pulse Rating Curves (Continued...)

Repetitive Surge Capability for 10mm Parts

V130LA5(P) - V680LA10(P)

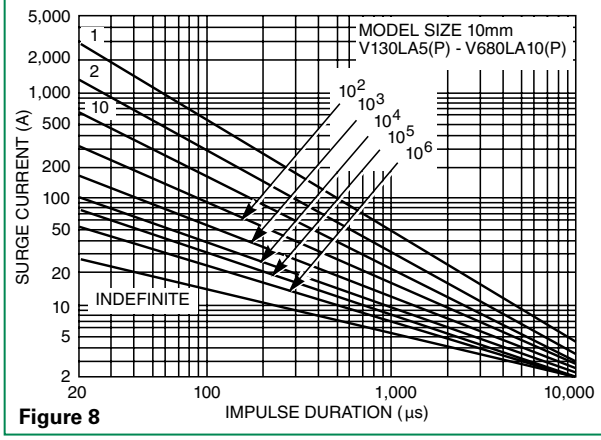

Figure 8

Revised: 02/23/15

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Transient V-I Characteristics Curves (Continued...)

Maximum Clamping Voltage for 14mm Parts

V130LA10A(P) - V320LA20A

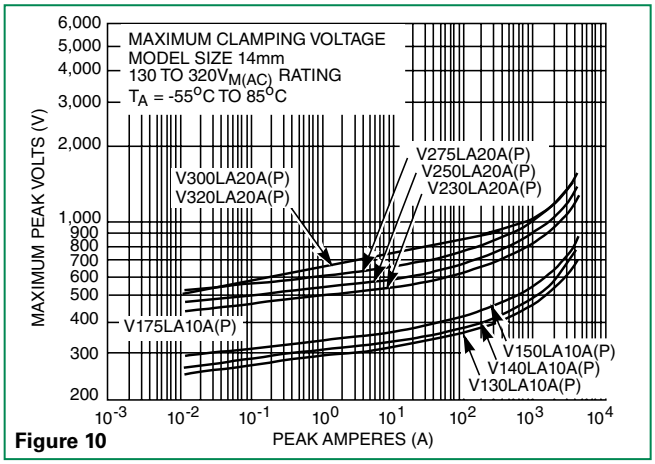

Figure 10

V385LA20A(P) V1000LA80A(P)

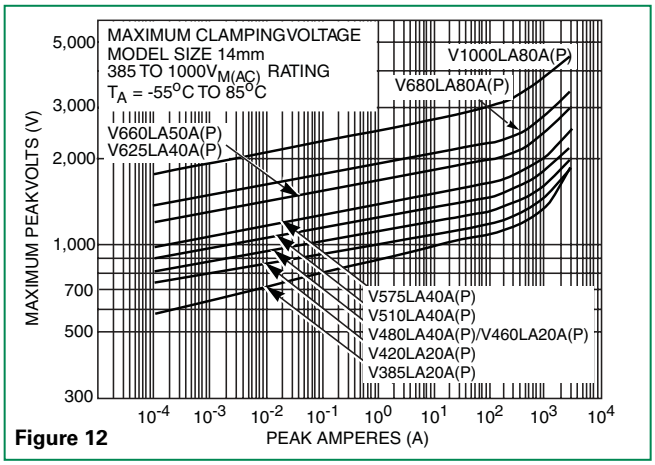

Figure 12

Pulse Rating Curves (Continued...)

Repetitive Surge Capability for 14mm Parts

V130LA10A(P) - V320LA20A(P)

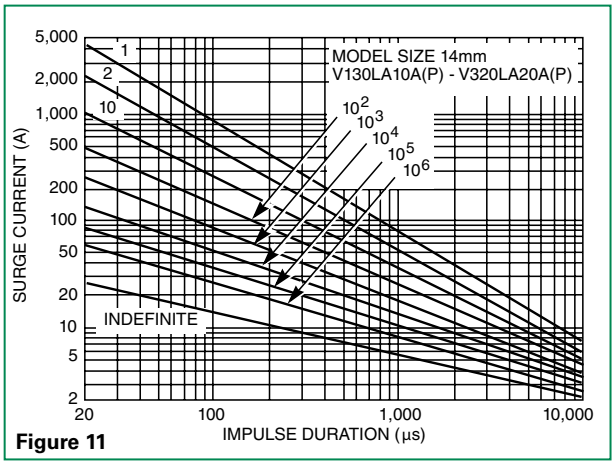

Figure 11

V385LA20A(P) - V1000LA80A(P)

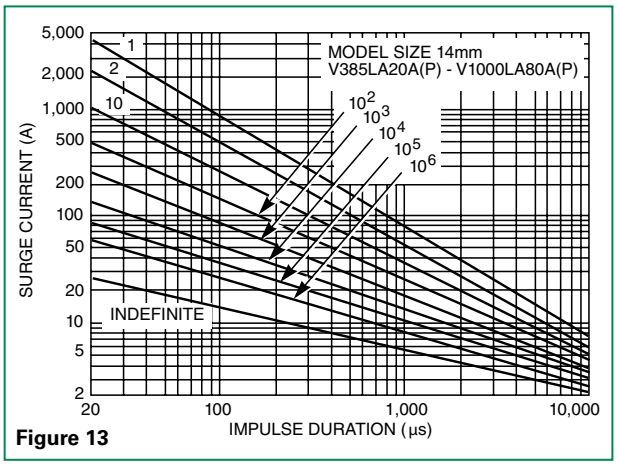

Figure 13

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Transient V-I Characteristics Curves (Continued...)

Maximum Clamping Voltage for 20mm Parts

V130LA20A(P) - V275LA40A(P)

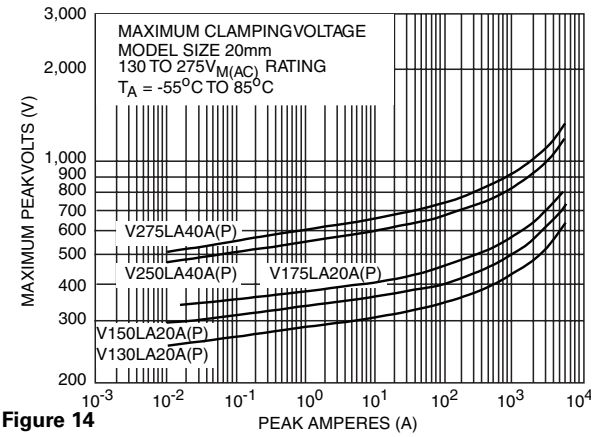

Figure 14

V130LA20B(P) - V275LA40(P)

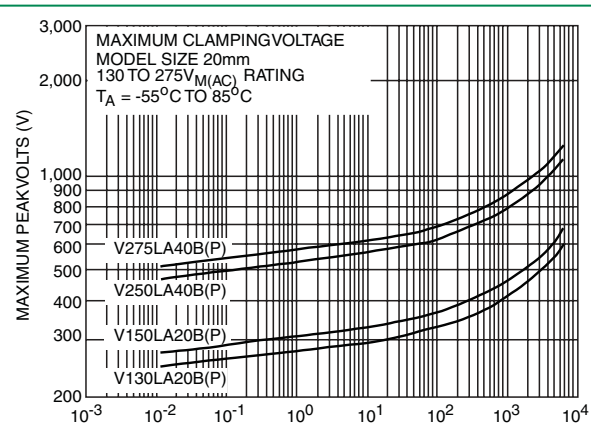

Figure 16

V130LA20A(P) - V275LA40A(P)

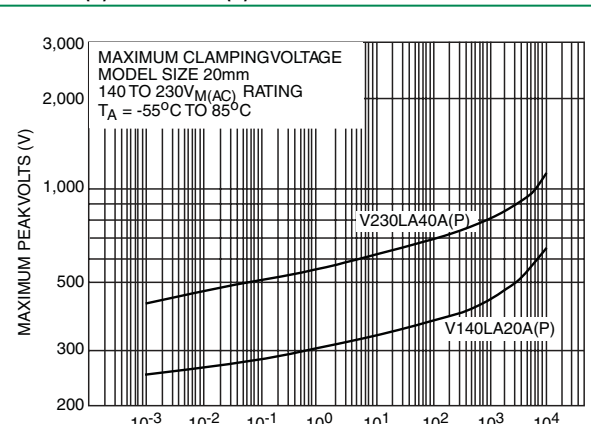

Figure 17

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.

Pulse Rating Curves (Continued...)

V300LA40A - V1000LA160B

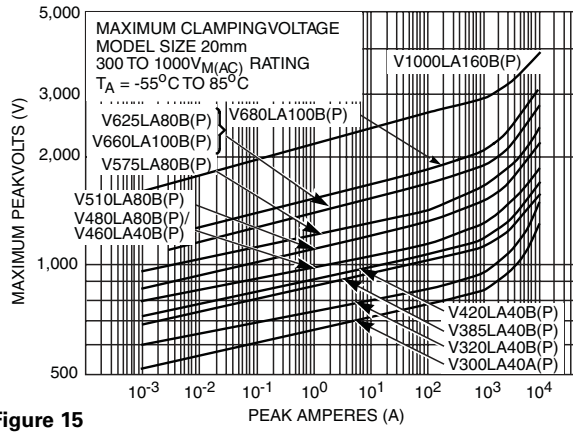

Figure 15

Repetitive Surge Capability for 20mm Parts

V130LA20A(P) - V320LA40B(P)

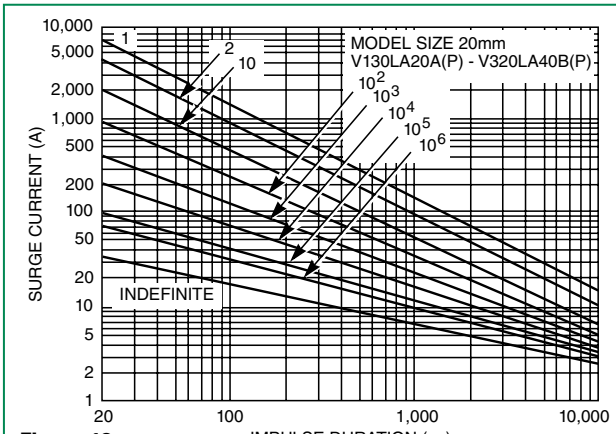

Figure 18

V385LA40B(P) - V1000LA160B(P)

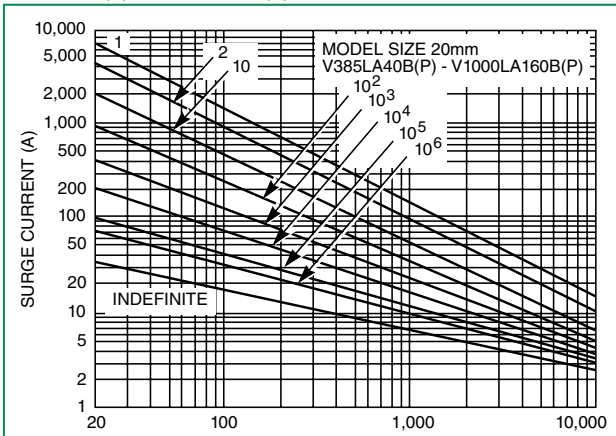

Figure 19

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Wave Solder Profile

Non Lead–free Profile

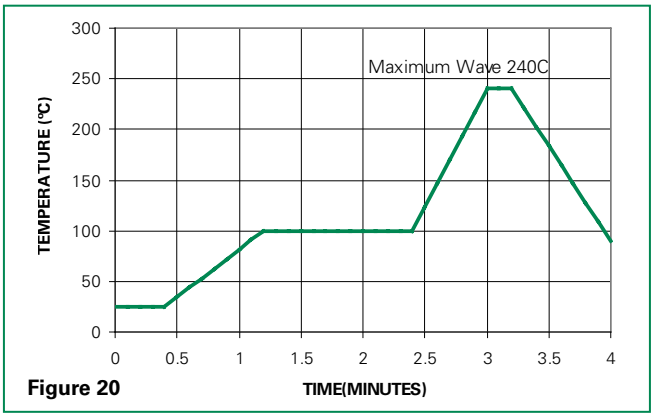

Figure 20

Lead–free Profile

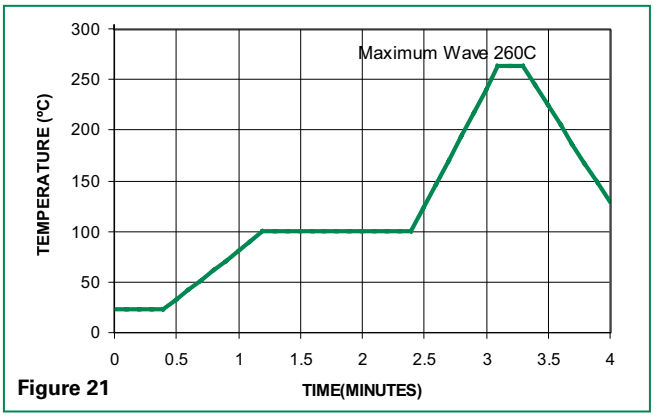

Figure 21

Physical Specifications

Lead Material	Copper Clad Steel Wire
Soldering Characteristics	Solderability per MIL–STD–202, Method 208
Insulating Material	Cured, flame retardant epoxy polymer meets UL94V–0 requirements
Device Labeling	Marked with LF, voltage, UL/CSA logos, and date code

Environmental Specifications

Operating Ambient Temperature Range	-55°C to +85°C
Storage Temperature Range	-55°C to +125°C
Humidity Aging	+85°C, 85% RH, 1000 hours +/-10% typical voltage change
Thermal Shock	+85°C to -40°C 5 times +/-10% typical voltage change
Solvent Resistance	MIL–STD–202, Method 215
Moisture Sensitivity	Level 1, J-STD-020

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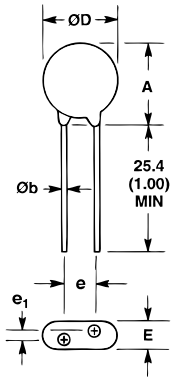
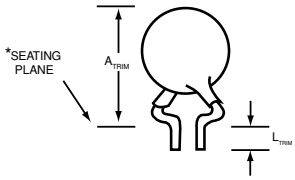
Product Dimensions (mm)





CRIMPED AND TRIMMED LEAD

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.

*Seating plane interpretation per IEC-717

Dimension	V_{RMS} Voltage Model	7mm Size		10mm Size		14mm Size		20mm Size	
		Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)
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 (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)
	V385LA-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-V510LA	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)
	V550LA-V680LA	-	8.3 (0.327)	-	8.3 (0.327)	-	8.3 (0.327)	-	8.3 (0.327)
	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)
A_{TRIM}	All	-	15 (0.591)	-	19.5 (0.768)	-	22.5 (0.886) (NOTE 4)	-	29.0 (1.142)
L_{TRIM}	All	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)

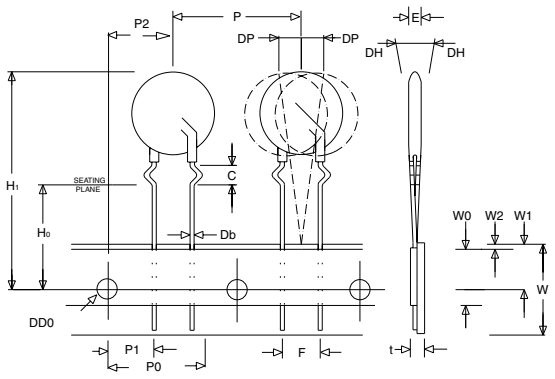
Notes :
1. Dimensions in millimeters, (inches) in parentheses.
2. 10mm (9mm Min. & 11mm Max.) ALSO AVAILABLE; see additional lead style options
3. 1000V parts supplied with lead wire of diameter 1.00 -/+ 0.05 (0.039 -/+ 0.002)
4. 'A' Max. for V1000LC80A (P) = 24.00 (0.945")

Tape and Reel Specifications

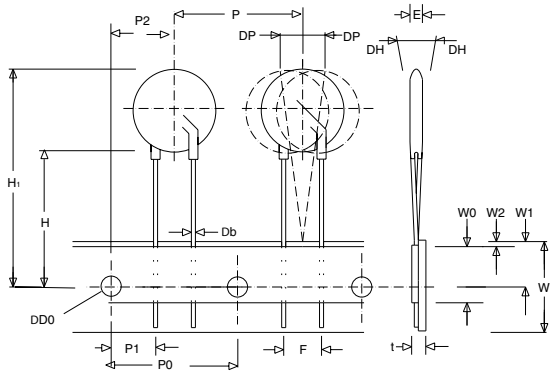
(Dimensions presented on following page.)

7mm Devices

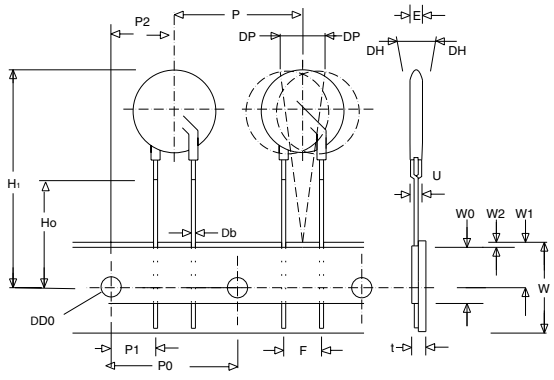
CRIMPED LEADS "LT"



STRAIGHT LEADS "LS"

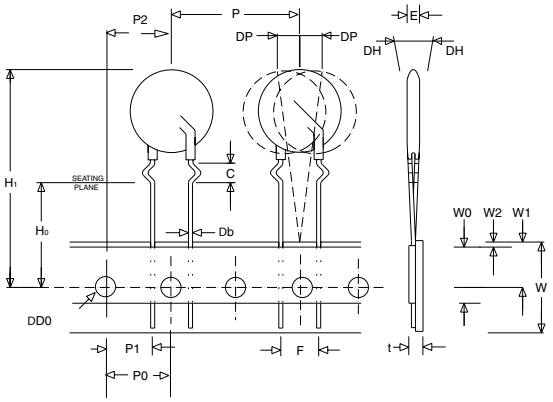


UNDER-CRIMPED LEADS "LU"

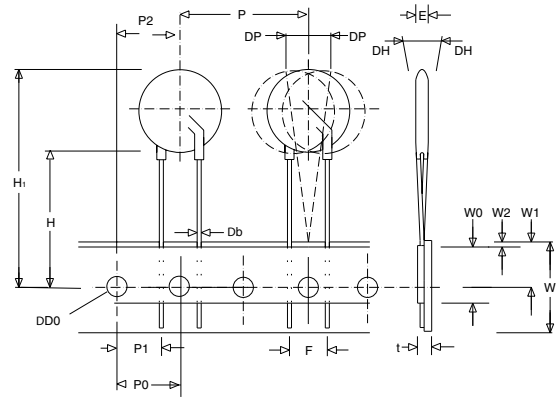


10, 14 and 20mm Devices

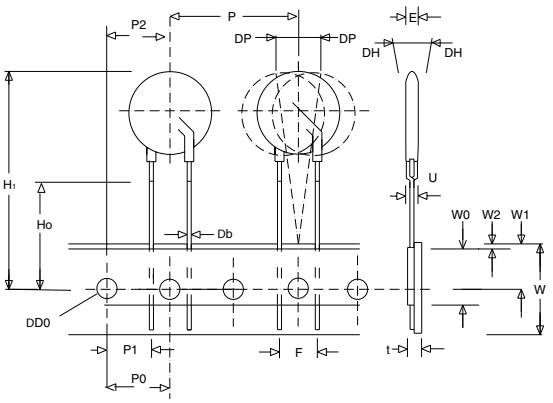
CRIMPED LEADS "LT"



STRAIGHT LEADS "LS"



UNDER-CRIMPED LEADS "LU"



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Tape and Reel Specifications (continued)

- Can be supplied to IEC Publication 286-2
- Radial devices on tape are supplied with crimped leads, straight leads, or under-crimped leads
- 7mm parts are available on tape and reel up to 480 VAC only
- 10mm parts are available on tape and reel up to 510 VAC only
- 14mm and 20mm parts are available on tape and reel up to 550 VAC only

Symbol	Description	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 / -0.5	18.0 +1.0 / -0.5	18.0 +1.0 / -0.5	18.0 +1.0 / -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 / -0.50	9.0 +0.75 / -0.50	9.0 +0.75 / -0.50	9.0 +0.75 / -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 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -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° Max 1.00mm	3° Max 1.00mm	3° Max 1.00mm	3° Max

NOTE: Dimensions are in mm.

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	1000	600	400
510-625	1500	1000	500	400
660	N/A	1000	500	400
680	N/A	1000	400	300
1000	N/A	N/A	300	200

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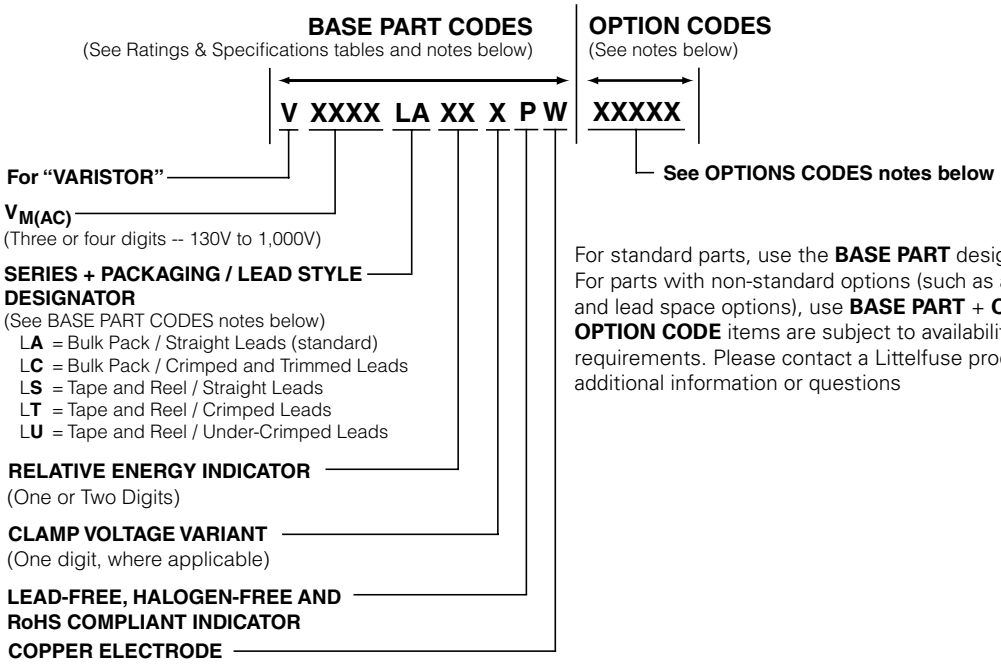
Part Numbering System



For standard parts, use the **BASE PART** designator only.
For parts with non-standard options (such as additional form, packaging and lead space options), use **BASE PART** + **OPTION CODE**.
OPTION CODE items are subject to availability and minimum order requirements. Please contact a Littelfuse products representative for additional information or questions

Ordering Notes:

BASE PART CODES:

Series + Packaging / Lead Style Designators:

Ordering examples:

Straight Lead Bulk Pack (standard)	Straight Lead Tape & Reel	Crimped Lead Tape & Reel	Crimped & Trimmed Lead Bulk Pack	Under-Crimp Lead Tape & Reel
V130**LA**2P	V130**LS**2P	V130**LT**2P	V130**LC**2P	V130**LU**2P

Crimped leads are standard on LA Series varistors supplied in tape and reel, denoted with "LT." For crimped leads without trimming and any varitions other than that described above, please contact Littelfuse.

Littelfuse LA Series varistors are shipped standard in bulk pack with straight leads and lead spacing outlined in the Package Dimensions section of this data sheet. Contact your Littelfuse sales representative to discuss non-standard options.

OPTION CODES:

X10: 10mm lead spacing option --

For 10 (-/+1) mm lead spacing (available on 20mm diameter models only), append standard model BASE PART number with "X10." Example:

Standard Model	Order As
V130LA20AP	V130LA20AP**X10**

X2855: Nickel Barrier coated wire option --

All standard parts use tinned copper clad steel wire. Nickel Barrier coated wire is available as an option, consisting of Copper wire with a flashing of Nickel followed by a top coating of Tin. To order append standard model BASE PART number with "X2855." Example:

Standard Model	Order As
V130LA20AP	V130LA20AP**X2855**

X1347: Hi-Temperature phenolic coating option --

Phenolic Coated LA Series devices are available with improved maximum operating maximum temperature of 125°C.

To order, add X1347 to end of part number (Example: V230LA20AP**X1347**).

For additional information please refer to the section labeled "Phenolic Coating Option" on the third page of this document under the "Electrical Characteristics" table.

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ZA Varistor Series

Description

The ZA Series of transient voltage surge suppressors are radial leaded 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.

Agency Approvals

Agency	Agency Approval	Agency File Number
cULus	UL144*	E320116
VDE	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q)**	116895
SEMKO	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q)**	E1273/F

Notes:
* - Except parts V8ZAxxP and V12ZAxxP.
** - For 14mm (V120 to V180) and 20mm (V120 to V180).

Features

- Lead–free, Halogen-Free and RoHS compliant
- 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

Additional Information

Datasheet | **Resources** | **Samples**

Absolute Maximum Ratings

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

Continuous	ZA Series	Units
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
Transients:		
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 to +85	°C
Storage Temperature Range (T_{STG})	-55 to +125	°C
Temperature Coefficient (a^V) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/°C
Hi-Pot Encapsulation (COATING Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL–STD–202, Method 301)	2500	V
COATING 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.

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ZA Series Ratings & Specifications

Part Number	Branding	Model Size Disc Dia. (mm)	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_C	I_{PK}	C
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
V8ZA05P	PZ08	5	4	5.5	0.1	50	6	11	30	1	2000
V8ZA1P	P08Z1	7	4	5.5	0.4	100	6	11	22	2.5	4190
V8ZA2P	P08Z2	10	4	5.5	0.8	250	6	11	20	5	7000
V12ZA05P	PZ12	5	6	8	0.14	50	9	16	37	1	1700
V12ZA1P	P12Z1	7	6	8	0.6	100	9	16	34	2.5	3350
V12ZA2P	P12Z2	10	6	8	1.2	250	9	16	30	5	6100
V18ZA05P	PZ18	5	10	14	0.17	100	16.2	19.8	36	1	1400
V18ZA1P	P18Z1	7	10	14	0.8	250	16.2	19.8	36	2.5	2700
V18ZA2P	P18Z2	10	10	14	1.5	500	16.2	19.8	36	5	5300
V18ZA3P	P18Z3	14	10	14	3.5	1000	16.2	19.8	36	10	18870
V18ZA20P	P18Z20	20	10	14	10	2000	16.2	19.8	37	20	22000
V18ZA40P	P18Z40	20	10	14	80 (Note2)	2000	16.2	19.8	37	20	22000
V22ZA05P	PZ22	5	14	18	0.2	100	19.8	24.2	43	1	1220
V22ZA1P	P22Z1	7	14	18	0.9	250	19.8	24.2	43	2.5	2375
V22ZA2P	P22Z2	10	14	18	2	500	19.8	24.2	43	5	4500
V22ZA3P	P22Z3	14	14	18	4	1000	19.8	24.2	43	10	14730
V24ZA20P	P24Z20	20	14	18	12	2000	19.8	24.2	43	20	18000
V24ZA50P	P24Z50	20	14	18 (Note 4)	100 (Note 2)	2000	20.7	25.3	43	20	18000
V27ZA05P	PZ27	5	17	22	0.25	100	24.3	29.7	53	1	920
V27ZA1P	P27Z1	7	17	22	1	250	24.3	29.7	53	2.5	1875
V27ZA2P	P27Z2	10	17	22	2.5	500	24.3	29.7	53	5	3850
V27ZA4P	P27Z4	14	17	22	5	1000	24.3	29.7	53	10	11480
V27ZA20P	P27Z20	20	17	22	14	2000	24.3	29.7	53	20	13000
V27ZA60P	P27Z60	20	17	22	100 (Note 2)	2000	24.3	29.7	50	20	13000
V33ZA05P	PZ33	5	20	26	0.3	100	29.7	36.3	65	1	790
V33ZA1P	P33Z1	7	20	26	1.2	250	29.7	36.3	65	2.5	1620
V33ZA2P	P33Z2	10	20	26	3	500	29.7	36.3	65	5	3495
V33ZA5P	P33Z5	14	20	26	6	1000	29.7	36.3	65	10	9290
V33ZA20P	P33Z20	20	20	26	18	2000	29.7	36.3	65	20	13000
V33ZA70P	P33Z70	20	21	27	100 (Note 2)	2000	29.7	36.3	58	20	13000
V36ZA20P	P36Z20	20	23	28	20	2000	32.4	39.6	70	20	12000
V36ZA80P	P36Z80	20	23	28	100 (Note 2)	2000	32.4	39.6	63	20	12000
V39ZA05P	PZ39	5	25	31	0.3	100	35.1	42.9	79	1	675
V39ZA1P	P39Z1	7	25	31	1.2	250	35.1	42.9	79	2.5	1350
V39ZA3P	P39Z3	10	25	31	3	500	35.1	42.9	76	5	3100
V39ZA6P	P39Z6	14	25	31	7.2	1000	35.1	42.9	76	10	7000
V39ZA20P	P39Z20	20	25	31	20	2000	35.1	42.9	76	20	12000
V47ZA05P	PZ47	5	30	38	0.4	100	42.3	51.7	93	1	585
V47ZA1P	P47Z1	7	30	38	1.8	250	42.3	51.7	93	2.5	1245
V47ZA3P	P47Z3	10	30	38	4.5	500	42.3	51.7	93	5	2590
V47ZA7P	P47Z7	14	30	38	8.8	1000	42.3	51.7	93	10	6270
V47ZA20P	P47Z20	20	30	38 (Note 6)	23 (Note 7)	2000	42.3	51.7	93	20	11000

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ZA Series Ratings & Specifications (Continued...)

Part Number	Branding	Model Size Disc Dia. (mm)	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_C	I_{PK}	C
			$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}					
			(V)	(V)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
V56ZA05P	PZ56	5	35	45	0.5	100	50.4	61.6	110	1	500
V56ZA2P	P56Z2	7	35	45	2.3	250	50.4	61.6	110	2.5	1035
V56ZA3P	P56Z3	10	35	45	5.5	500	50.4	61.6	110	5	2150
V56ZA8P	P56Z8	14	35	45	10	1000	50.4	61.6	110	10	4840
V56ZA20P	P56Z20	20	35	45	30	2000	50.4	61.6	110	20	10000
V68ZA05P	PZ68	5	40	56	0.6	100	61.2	74.8	135	1	400
V68ZA2P	P68Z2	7	40	56	3	250	61.2	74.8	135	2.5	910
V68ZA3P	P68Z3	10	40	56	6.5	500	61.2	74.8	135	5	1850
V68ZA10P	P68Z10	14	40	56	13	1000	61.2	74.8	135	10	3870
V68ZA20P	P68Z20	20	40	56	33	2000	61.2	74.8	135	20	9000
V82ZA05P	PZ82	5	50	68	2	400	73.8	90.2	135	5	355
V82ZA2P	P82Z2	7	50	68	4	1200	73.8	90.2	135	10	700
V82ZA4P	P82Z4	10	50	68	8	2500	73.8	90.2	135	25	1485
V82ZA12P	P82Z12	14	50	68	15	4500	73.8	90.2	145	50	3380
V82ZA20P	P82Z20	20	50	68	25	6500	73.8	90.2	145	100	7000
V100ZA05P	PZ100	5	60	81	2.5	400	90	110	165	5	310
V100ZA3P	P100Z	7	60	81	5	1200	90	110	165	10	600
V100ZA4P	P100Z4	10	60	81	10	2500	90	110	165	25	1200
V100ZA15P	P100Z15	14	60	81	20	4500	90	110	175	50	2900
V100ZA20P	P100Z20	20	60	81	30	6500	90	110	175	100	6500
V120ZA05P	PZ120	5	75	102	3	400	108	132	205	5	250
V120ZA1P	P120Z	7	75	102	6	1200	108	132	205	10	515
V120ZA4P	P120Z4	10	75	102	12	2500	108	132	200	25	1100
V120ZA6P	P120Z6	14	75	102	22	4500	108	132	210	50	2450
V120ZA20P	P120Z20	20	75	102	33	6500	108	132	210	100	5000
V150ZA05P	PZ150	5	92	127	4	400	135	165	250	5	190
V150ZA1P	PZ051	7	95	127	8	1200	135	165	250	10	460
V150ZA4P	P150Z4	10	95	127	15	2500	135	165	250	25	860
V150ZA8P	P150Z8	14	95	127	20	4500	135	165	250	50	1910
V150ZA20P	P150Z20	20	95	127	45	6500	135	165	250	100	3500
V180ZA05P	PZ180	5	110	153	5	400	162	198	295	5	100
V180ZA1P	P180Z	7	115	153	10	1200	162	198	300	10	320
V180ZA5P	P180Z5	10	115	153	18	2500	162	198	300	25	465
V180ZA10P	P180Z10	14	115	153	35	4500	162	198	300	50	1190
V180ZA20P	P180Z20	20	115	153	52	6500	162	198	300	100	2400
V205ZA05P	PZ205	5	130	170	5.5	400	184.5	225.5	340	5	100
V220ZA05P	PZ220	5	140	180	6	400	198	242	360	5	95
†V240ZA05P	PZ240	5	150	200	7	400	216	264	395	5	90
†V270ZA05P	PZ270	5	175	225	7.5	400	243	297	455	5	75
†V330ZA05P	PZ330	5	210	275	9	400	306	374	540	5	70
†V360ZA05P	PZ360	5	230	300	9.5	400	324	396	595	5	60
†V390ZA05P	PZ390	5	250	330	10	400	351	429	650	5	80
†V430ZA05P	PZ430	5	275	369	11	400	387	473	710	5	75
†V470ZA05P	PZ470	5	300	385	12	400	423	517	775	5	70
†V620ZA05P	PZ620	5	385	505	13	400	558	682	1025	5	45
†V680ZA05P	PZ680	5	420	560	14	400	612	748	1120	5	40
†V715ZA05P	PZ715	5	440	585	15.5	400	643.5	786.5	1180	5	35
†V750ZA05P	PZ750	5	460	615	17	400	675	825	1240	5	30

Note:
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 (auto load dump) for impulse duration of 40ms minimum to one half of peak current, 60 sec interval (ISO7637-2 pulse 5a and ISO16750-2 Table 5A)
3. 10mA DC test current.
4. Also rated to withstand 24V for 5 minutes.
5. Higher voltages available, contact Littelfuse.
6. Also rated to withstand 48V for 5 minutes.
7. Energy rating for impulse duration of 30ms minimum to one half of peak current (Auto Load Dump): 100J
8. The typical capacitance rating is the discrete component test result.

† Also Recognized to UL 1449, Transient Voltage Surge Suppressors File E320116

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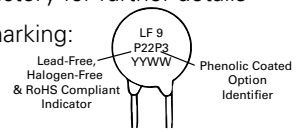
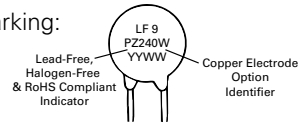
Phenolic Coating Option -- ZA Series Varistors for Hi-Temperature Operating Conditions:

- Phenolic coated ZA Series devices are available with improved maximum operating temperature of 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. V22ZA3PX1347)
- These devices are not UL, VDE or CECC certified
- Contact factory for further details
- Product marking:



Copper Electrode Option:

- Add 'W' to the end of the part number (e.g. V240ZA05PW)
- Copper electrode option is only available for V240~V750 for ZA series.
- Product marking:



Current Energy and 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 above. 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 1A - Power Derating for Epoxy Coated

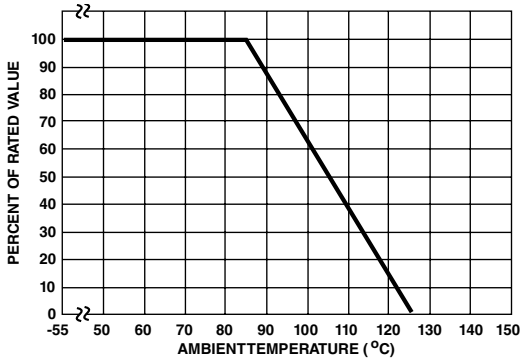
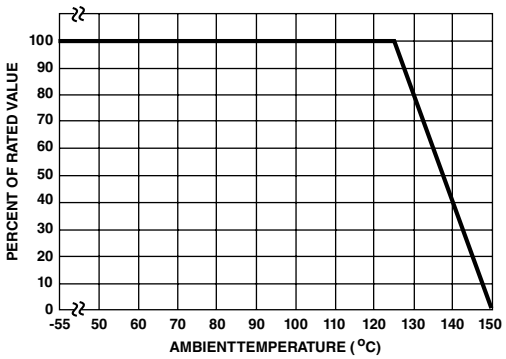


Figure 1B - Power Derating for Phenolic Coated



Peak Pulse Current Test Waveform

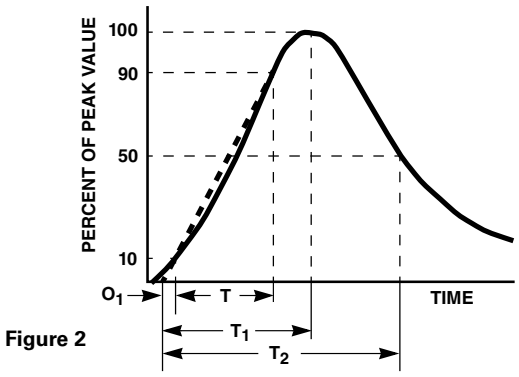


Figure 2

0_1 = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
T_1 = Rise Time = 1.25 x T
T_2 = Decay Time

Example - For an 8/20 μs Current Waveform:
8μs = T_1 = Rise Time
20μs = T_2 = Decay Time

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Maximum Clamping Voltage for 5mm Parts

V8ZA05(P) - V68ZA05(P)

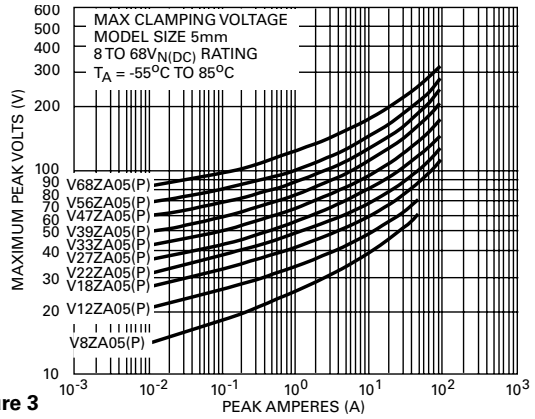

Figure 3

V82ZA05(P) - V33ZA05(P)

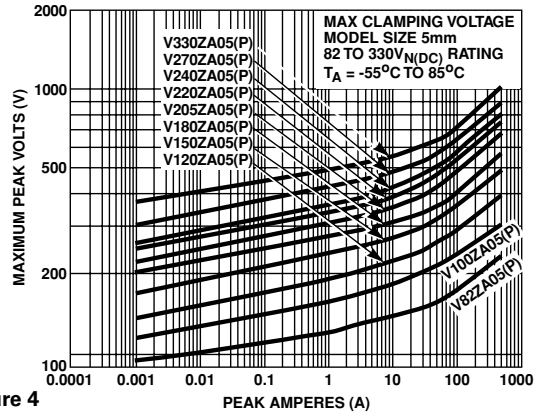

Figure 4

V360ZA05(P) - V750ZA05(P)

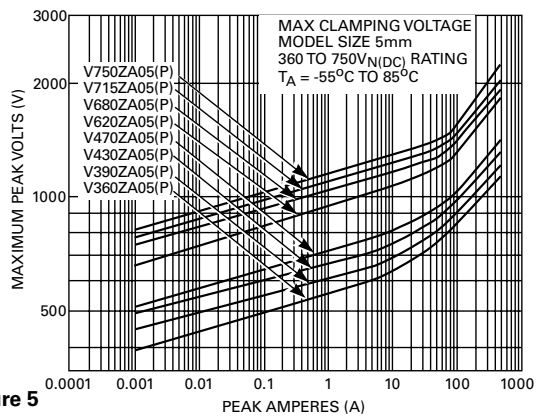

Figure 5

Maximum Clamping Voltage for 7mm Parts

V8ZA1(P) - V68ZA2(P)

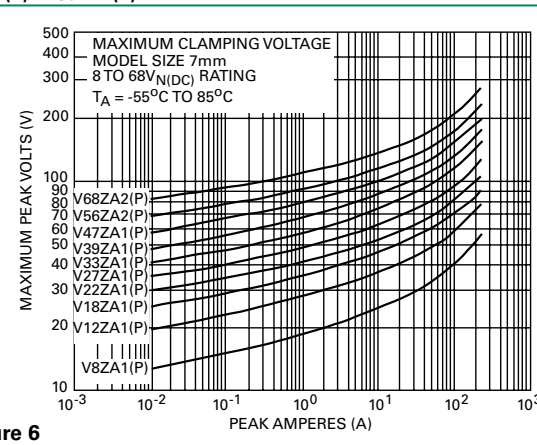

Figure 6

V82ZA2(P) - V180ZA1(P)

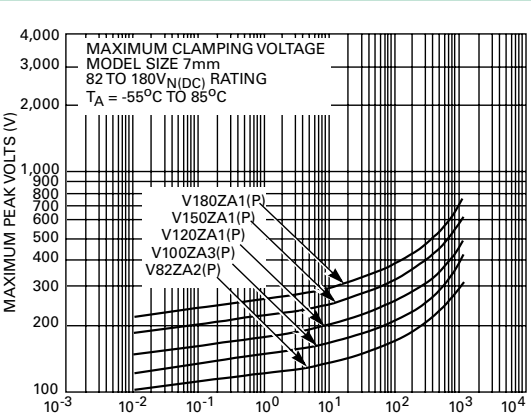

Figure 7

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Maximum Clamping Voltage for 10mm Parts

V8ZA2(P) - V68ZA3(P)

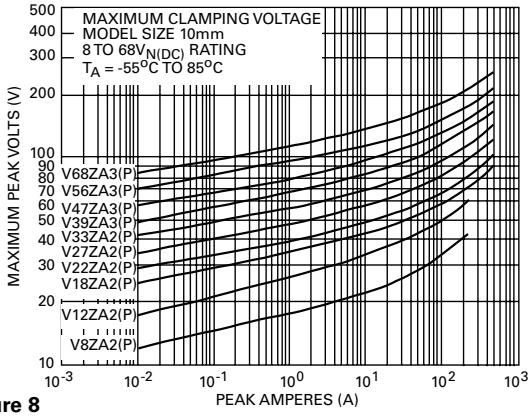

Figure 8

V82ZA4(P) - V180ZA5(P)

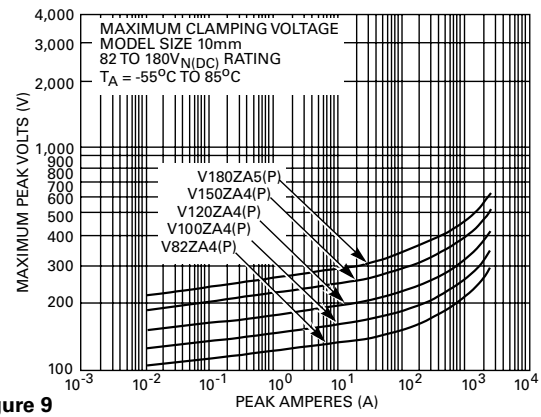

Figure 9

Maximum Clamping Voltage for 14mm Parts

V18ZA3(P) - V68ZA10(P)

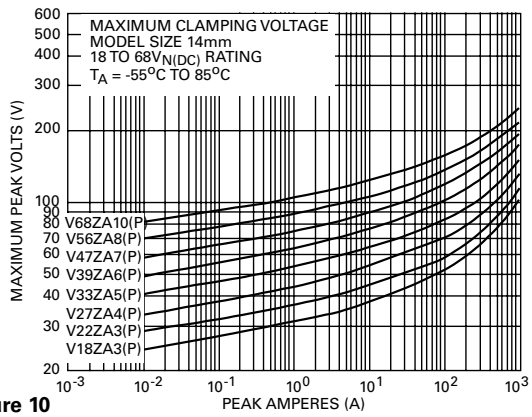

Figure 10

V82ZA12(P) - V180ZA10(P)

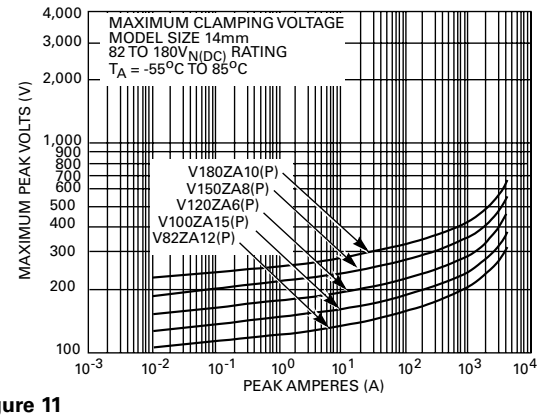

Figure 11

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Maximum Clamping Voltage for 20mm Parts

V18ZA20(P) - V36ZA80(P)

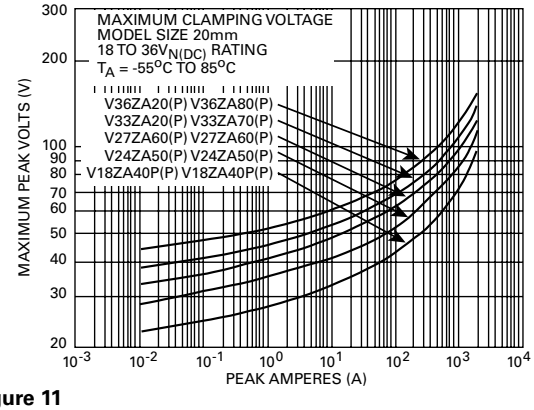

Figure 11

V39ZA20(P) - V180ZA20(P)

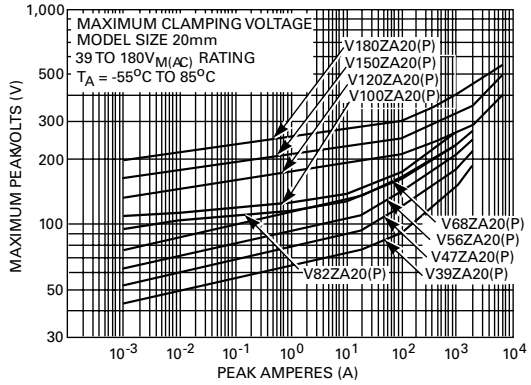

Figure 12

Repetitive Surge Capability for 5mm Parts

V8ZA05P - V12ZA05P

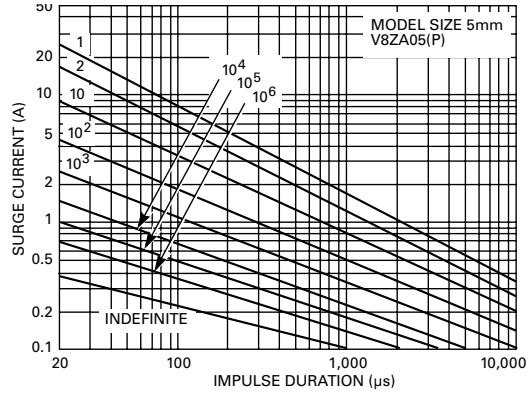

Figure 13

V18ZA05(P) - V68ZA05(P)

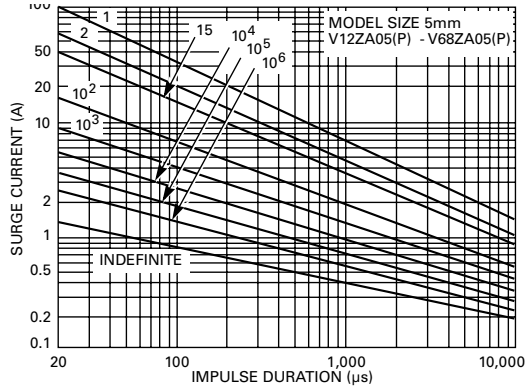

Figure 14

V82ZA05(P) - V750ZA05(P)

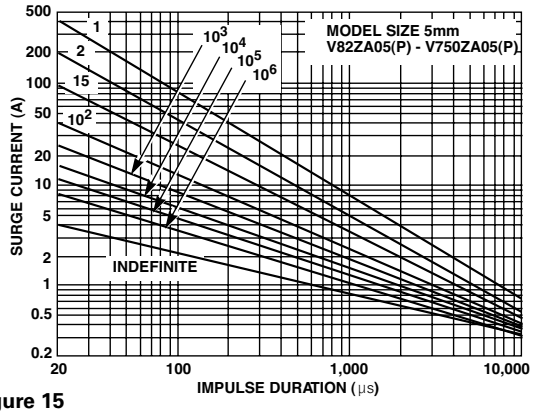

Figure 15

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Repetitive Surge Capability for 7mm Parts

V8ZA1(P) - V12ZA1(P)

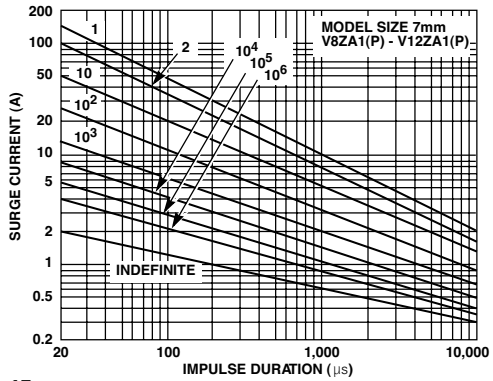

Figure 15

V18ZA1(P) - V68ZA2(P)

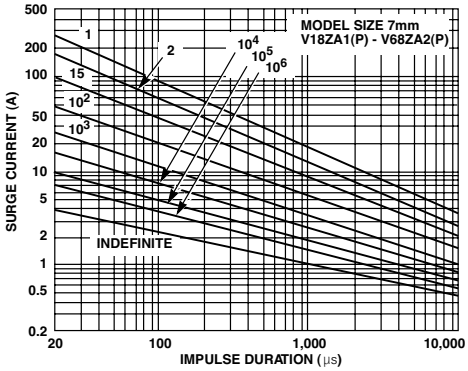

Figure 16

V82ZA2(P) - V180ZA1(P)

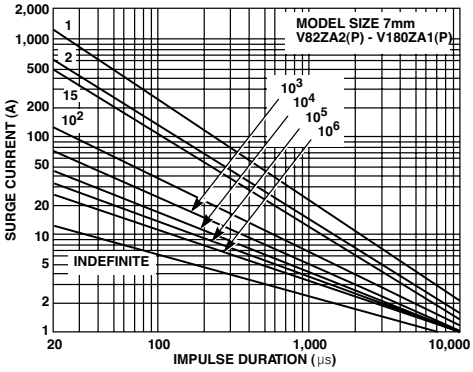

Figure 17

Repetitive Surge Capability for 10mm Parts

V8ZA2(P) - V12ZA2(P)

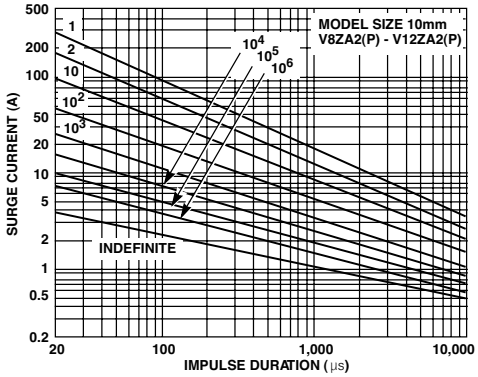

Figure 18

V18ZA2(P) - V68ZA3(P)

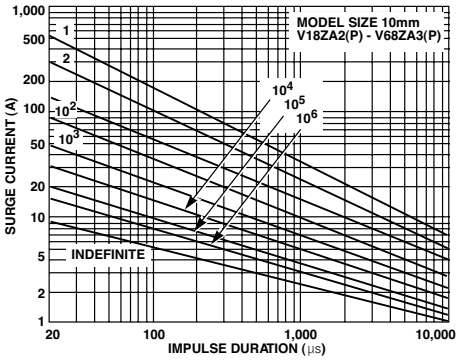

Figure 19

V82ZA4(P) - V180ZA5(P)

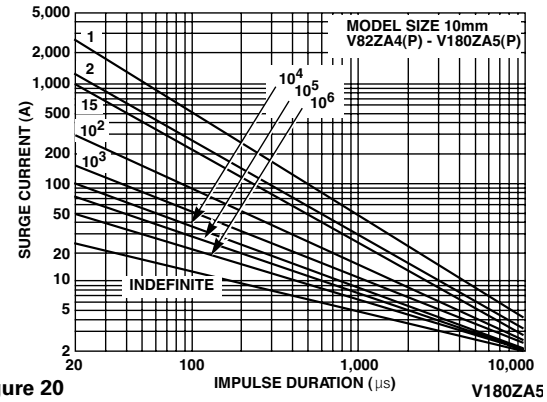

Figure 20

Repetitive Surge Capability for 14mm Parts

V18ZA3(P) - V68ZA10(P)

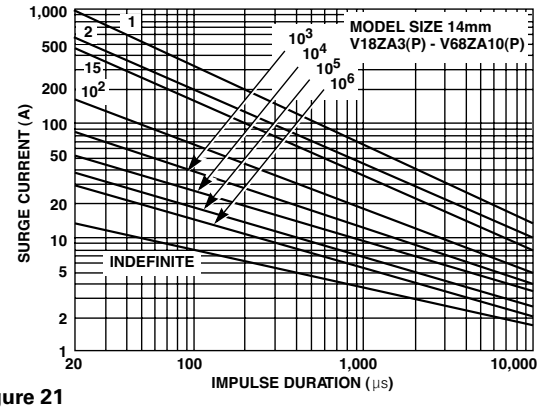

Figure 21

V82ZA12(P) - V180ZA10(P)

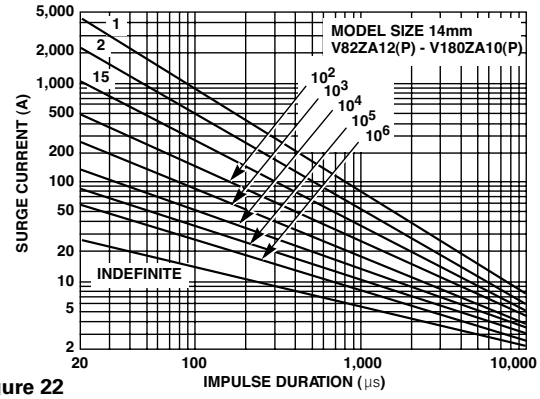

Figure 22

Repetitive Surge Capability for 20mm Parts

V18ZA40(P) - V68ZA20(P)

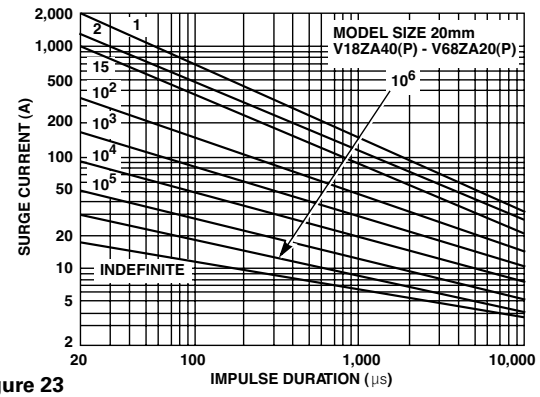

Figure 23

V82ZA20(P) - V180ZA20(P)

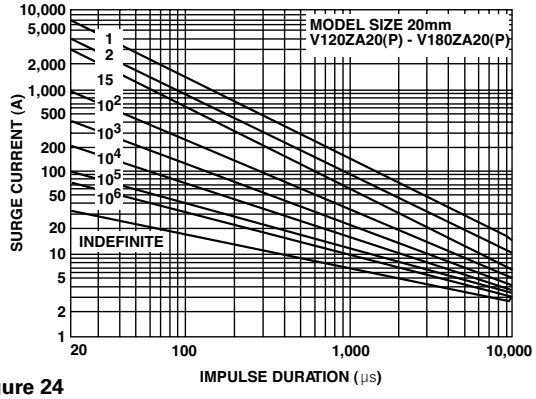

Figure 24

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.

Wave Solder Profile

Non Lead–free Profile

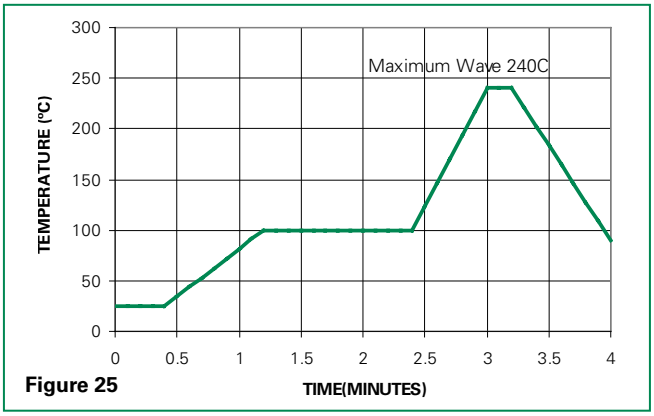

Figure 25

Lead–free Profile

Figure 26

Physical Specifications

Lead Material	Copper Clad Steel Wire
Soldering Characteristics	Solderability per MIL–STD–202, Method 208
Insulating Material	Cured, flame retardant epoxy polymer meets UL94V–0 requirements
Device Labeling	Marked with LF, voltage, UL/CSA logos, and date code

Environmental Specifications

Operating Ambient Temperature Range	-55°C to +85°C
Storage Temperature Range	-55°C to +125°C
Humidity Aging	+85°C, 85% RH,1000 hours +/-10% typical voltage change
Thermal Shock	+85°C to -40°C 5 times +/-10% typical voltage change
Solvent Resistance	MIL–STD–202, Method 215
Moisture Sensitivity	Level 1, J-STD-020

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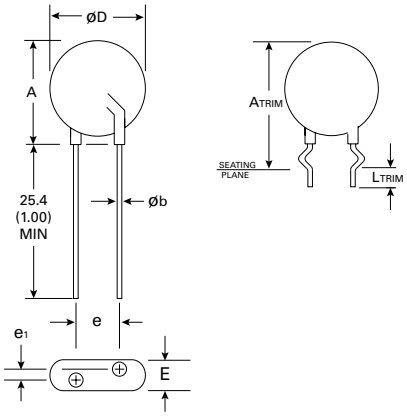
Product Dimensions (mm)



CRIMPED AND TRIMMED LEAD

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

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 Model	Order As
V18ZA3P	V18ZC3P

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

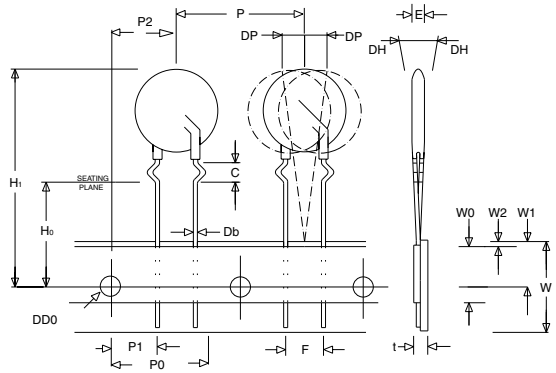
Dimension	V_{RMS} Voltage Model	5mm Size		7mm Size		10mm Size		14mm Size		20mm Size	
		Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)
A	All	-	10 (0.394)	-	12 (0.472)	-	16 (0.630)	-	20 (0.787)	-	26.5 (1.043)
ØD	All	-	7 (0.276)	-	9 (0.354)	-	12.5 (0.492)	-	17 (0.669)	-	23 (0.906)
e (see notes below)	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 1 below)	8.5 (0.335) (note 1 below)
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)
A_{TRIM}	All	-	13.0 (0.512)	-	15 (0.591)	-	19.5 (0.768)	-	22.5 (0.886)	-	29.0 (1.142)
L_{TRIM}	All	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)

NOTES: Dimensions in millimeters, inches in parentheses.
1. For 20mm size devices, a 10mm "e" dimension option is also available. Please refer to "Ordering Notes" section "X10" option code for additional information.
2. V24ZA50(P) and V24ZC50(P) only supplied with lead spacing of 6.35mm -/+0.5mm (0.25 -/+0.0196) Dimension e = 5.85 min. Does not apply to Tape and Reel parts.

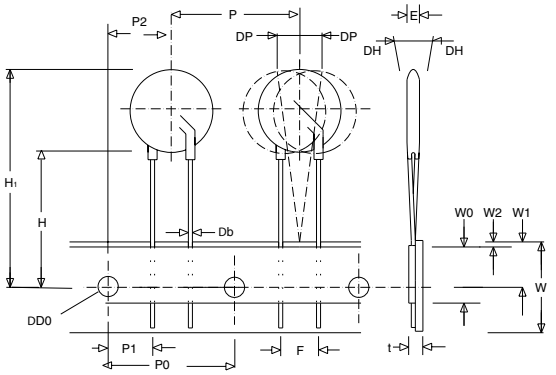
Tape and Reel Specifications

5 and 7mm Devices

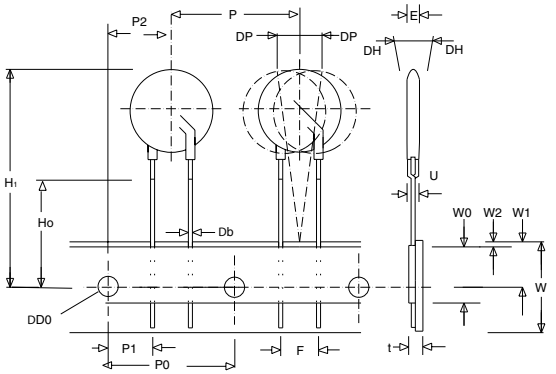
CRIMPED LEADS "ZT"



STRAIGHT LEADS "ZS"

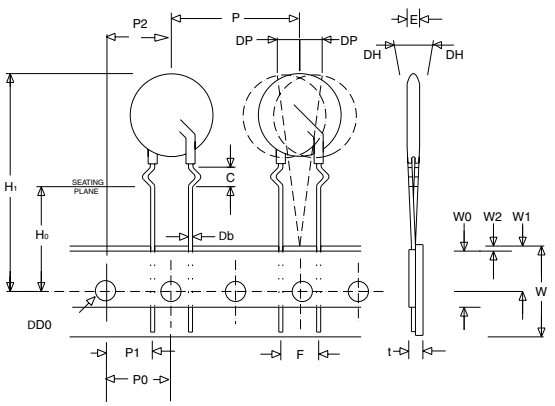


UNDER CRIMPED LEADS "ZU"

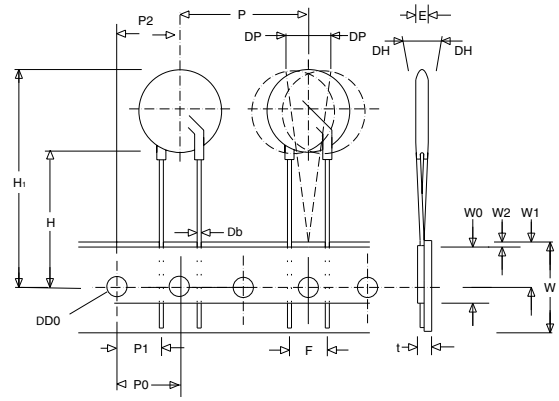


10, 14 and 20mm Devices

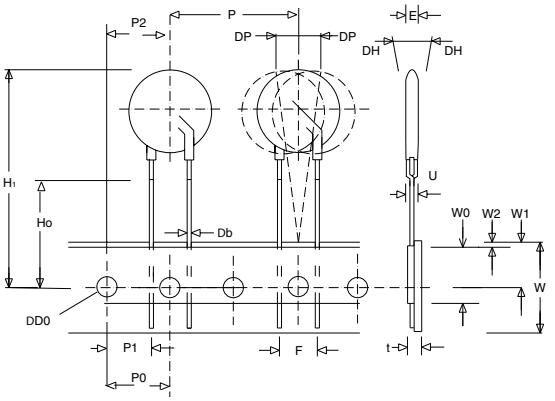
CRIMPED LEADS "ZT"



STRAIGHT LEADS "ZS"



UNDER CRIMPED LEADS "ZU"



Refer to next page for dimension measurement specifics.

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Tape and Reel Specifications (continued)

NOTES:
- Radial devices on tape are supplied with crimped leads, straight leads, or under-crimped leads
- Leads are offset by product dimension e1
- Conforms to ANSI and EIA specifications
- Can be supplied to IEC Publication 286-2
- 5mm parts are available on tape and reel up to 385 VAC only

SYMBOL	DESCRIPTION	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 / -0.5	18.0 +1.0 / -0.5	18.0 +1.0 / -0.5	18.0 +1.0 / -0.5	18.0 +1.0 / -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 / -0.50	9.0 +0.75 / -0.50	9.0 +0.75 / -0.50	9.0 +0.75 / -0.50	9.0 +0.75 / -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 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -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	Undercrimp Width	8.0 Max	8.0 Max	8.0 Max	8.0 Max	8.0 Max
p	Component Alignment	3° Max	3° Max	3° Max	3° Max	3° Max

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Part Numbering System

BASE PART CODES
(See Ratings & Specifications tables and notes below)

OPTION CODES
(See notes below)

V XXX ZA XX P W | **XXXXX**

For "VARISTOR"

NOMINAL VOLTAGE (V_{NOM})
(One, Two or Three Digits)

SERIES + PACKAGING / LEAD STYLE DESIGNATOR
(See BASE PART CODES notes below)
- Z**A** = Bulk Pack / Straight Leads (standard)
- Z**C** = Bulk Pack / Crimped and Trimmed Leads
- Z**S** = Tape and Reel / Straight Leads
- Z**T** = Tape and Reel / Crimped Leads
- Z**U** = Tape and Reel / Under-Crimped Leads

RELATIVE ENERGY INDICATOR
(One or Two Digits)

LEAD-FREE, HALOGEN-FREE AND RoHS COMPLIANT INDICATOR

COPPER ELECTRODE

See OPTIONS CODES notes below

For standard parts, use the **BASE PART** designator only.
For parts with non-standard options (such as additional form, packaging and lead space options), use **BASE PART** + **OPTION CODE**.
OPTION CODE items are subject to availability and minimum order requirements. Please contact a Littelfuse products representative for additional information or questions

Ordering Notes:

BASE PART CODES:

Series + Packaging / Lead Style Designators:

Ordering examples:

Straight Lead Bulk Pack (standard)	Straight Lead Tape & Reel	Crimped Lead Tape & Reel	Crimped & Trimmed Lead Bulk Pack	Under-Crimp Lead Tape & Reel
V18**ZA**3P	V18**ZS**3P	V18**ZT**3P	V18**ZC**3P	V18**ZU**3P

Crimped lead ZA Series varistors are supplied standard in tape and reel, denoted with "ZT."

"ZC" style is supplied in bulk only.

"ZU" style is supplied in tape and reel only.

For crimped leads without trimming and any varitions other than that described above, please contact Littelfuse.

Packaging and Quantities:

Littelfuse ZA Series varistors are shipped standard in bulk pack with straight leads and lead spacing outlined in the Package Dimensions section of this data sheet. Contact your Littelfuse sales representative to discuss non-standard options.

Tape & Reel Quantities:

Device Size	Voltage	Quantity Per Reel		
		"S" Reel	"T" Reel	"U" Reel
5mm	All	1000	1000	1000
7mm	All	1000	1000	1000
10mm	All	500	500	500
14mm	< 300V	500	500	500
20mm	< 300V	500	500	400

OPTION CODES:

X10: 10MM LEAD SPACING OPTION --

For 10 -/+1 mm (0.394-/+0.039 in) lead spacing (available on 20mm diameter models only), append standard model BASE PART number with "X10." Example:

Standard Model	Order As
V18ZA40P	V18ZA40P**X10**

X2855: Nickel Barrier COATED WIRE OPTION --

All standard parts use tinned copper clad steel wire. Nickel Barrier Coated wire is available as an option, consisting of Copper wire with a flashing of Nickel followed by a top coating of Tin. To order append standard model BASE PART number with "X2855." Example:

Standard Model	Order As
V18ZA40P	V18ZA40P**X2855**

X1347: Hi-Temperature phenolic coating option --

Phenolic Coated C-III Series devices are available with improved maximum operating maximum temperature of 125°C.

To order, add X1347 to end of part number (Example: V22ZA3PX1347).

For additional information please refer to the section labeled "Phenolic Coating Option" within this document.

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UltraMOV™ Varistor Series

Agency Approvals

Agency	Agency Approval	Agency File Number
cULus	UL1449	E320116
VDE	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q) for 14mm and 20mm only	116895
CSA	22.2-1	91788
	CECC 42201-006 IEC 61051-1 IEC 61051-2 IEC 60950-1 (Annex Q) for 14mm and 20mm only	E1273/F

Additional Information

Datasheet | **Resources** | **Samples**

Description

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 Surge Protection Device (SPD), 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. UltraMOV™ varistor are manufactured with recognized epoxy encapsulation and are rated for ambient temperatures up to 85ºC with no derating. This Series is LASER-branded and is supplied in bulk, ammo pack (fan-fold), or tape and reel packaging.

Features

- Lead–free, Halogen-Free and RoHS compliant
- 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 (130 V_{AC} to 625 V_{AC})
- Characterized for maximum standby current (Leakage)
- Custom voltage types available
- Standard lead form and lead space options
- High operating temperature range up to 125'C (phenolic coating option). 10mm, 14mm and 20mm devices are UL recognized with 800V isolation voltage rating

Absolute Maximum Ratings

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

Continuous	UltraMOV™ Varistor Series	Units
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	130 to 625	V
Transients:		
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
Operating Ambient Temperature Range (T_A)	-55 to +85	ºC
Storage Temperature Range (T_{STG})	-55 to +125	ºC
Temperature Coefficient (a^V) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/ºC
Hi-Pot Encapsulation (COATING Isolation Voltage Capability)	2500	V
COATING 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.

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UltraMOV™ Series Ratings & Specifications

Part Number	Branding	Maximum Rating (85°C)					Specifications (25°C)				
		Continuous		Transient			Varistor Voltage at 1mA DC Test Current		Maximum Clamping Voltage 8 x 20μs		Typical Capacitance
		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)	(V)	(A)	(pF)
V07E130P	P7V130	130	170	12.5	1750	1200	184.5	225.5	340	10	180
V10E130P	P10V130	130	170	25	3500	2500	184.5	225.5	340	25	450
V14E130P	P14V130	130	170	50	6000	4500	184.5	225.5	340	50	1000
V20E130P	P20V130	130	170	100	10000	6500	184.5	225.5	340	100	1900
V07E140P	P7V140	140	180	13.5	1750	1200	198	242	360	10	160
V10E140P	P10V140	140	180	27.5	3500	2500	198	242	360	25	400
V14E140P	P14V140	140	180	55	6000	4500	198	242	360	50	900
V20E140P	P20V140	140	180	110	10000	6500	198	242	360	100	1750
V07E150P	P7V150	150	200	15	1750	1200	216	264	395	10	150
V10E150P	P10V150	150	200	30	3500	2500	216	264	395	25	360
V14E150P	P14V150	150	200	60	6000	4500	216	264	395	50	800
V20E150P	P20V150	150	200	120	10000	6500	216	264	395	100	1600
V07E175P	P7V175	175	225	17	1750	1200	243	297	455	10	130
V10E175P	P10V175	175	225	35	3500	2500	243	297	455	25	350
V14E175P	P14V175	175	225	70	6000	4500	243	297	455	50	700
V20E175P	P20V175	175	225	135	10000	6500	243	297	455	100	1400
V07E230P	P7V230	230	300	20	1750	1200	324	396	595	10	100
V10E230P	P10V230	230	300	42	3500	2500	324	396	595	25	250
V14E230P	P14V230	230	300	80	6000	4500	324	396	595	50	550
V20E230P	P20V230	230	300	160	10000	6500	324	396	595	100	1100
V07E250P	P7V250	250	320	25	1750	1200	351	429	650	10	90
V10E250P	P10V250	250	320	50	3500	2500	351	429	650	25	220
V14E250P	P14V250	250	320	100	6000	4500	351	429	650	50	500
V20E250P	P20V250	250	320	170	10000	6500	351	429	650	100	1000
V07E275P	P7V275	275	350	28	1750	1200	387	473	710	10	80
V10E275P	P10V275	275	350	55	3500	2500	387	473	710	25	200
V14E275P	P14V275	275	350	110	6000	4500	387	473	710	50	450
V20E275P	P20V275	275	350	190	10000	6500	387	473	710	100	900
V07E300P	P7V300	300	385	30	1750	1200	423	517	775	10	70
V10E300P	P10V300	300	385	60	3500	2500	423	517	775	25	180
V14E300P	P14V300	300	385	125	6000	4500	423	517	775	50	400
V20E300P	P20V300	300	385	250	10000	6500	423	517	775	100	800
V07E320P	P7V320	320	420	32	1750	1200	459	561	840	10	65
V10E320P	P10V320	320	420	67	3500	2500	459	561	840	25	170
V14E320P	P14V320	320	420	136	6000	4500	459	561	840	50	380
V20E320P	P20V320	320	420	273	10000	6500	459	561	840	100	750
V07E385P	P7V385	385	505	36	1750	1200	558	682	1025	10	60
V10E385P	P10V385	385	505	75	3500	2500	558	682	1025	25	160
V14E385P	P14V385	385	505	150	6000	4500	558	682	1025	50	360
V20E385P	P20V385	385	505	300	10000	6500	558	682	1025	100	700
V07E420P	P7V420	420	560	40	1750	1200	612	748	1120	10	55
V10E420P	P10V420	420	560	80	3500	2500	612	748	1120	25	140
V14E420P	P14V420	420	560	160	6000	4500	612	748	1120	50	300
V20E420P	P20V420	420	560	320	10000	6500	612	748	1120	100	600
V07E440P	P7V440	440	585	44	1750	1200	643.5	786.5	1180	10	50
V10E440P	P10V440	440	585	85	3500	2500	643.5	786.5	1180	25	130
V14E440P	P14V440	440	585	170	6000	4500	643.5	786.5	1180	50	260
V20E440P	P20V440	440	585	340	10000	6500	643.5	786.5	1180	100	500
V07E460P	P7V460	460	615	48	1750	1200	675	825	1240	10	45
V10E460P	P10V460	460	615	90	3500	2500	675	825	1240	25	120
V14E460P	P14V460	460	615	180	6000	4500	675	825	1240	50	220

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Ratings & Specifications (Continued...)

Part Number	Branding	Maximum Rating (85°C)					Specifications (25°C)				
		Continuous		Transient			Varistor Voltage at 1mA DC Test Current		Maximum Clamping Voltage 8 x 20μs		Typical Capacitance
		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)	(V)	(A)	(pF)
V20E460P	P20V460	460	615	360	10000	6500	675	825	1240	100	400
V07E510P	P7V510	510	670	52	1750	1200	738	902	1355	10	40
V10E510P	P10V510	510	670	92	3500	2500	738	902	1355	25	110
V14E510P	P14V510	510	670	185	6000	4500	738	902	1355	50	200
V20E510P	P20V510	510	670	365	10000	6500	738	902	1355	100	350
V10E550P	P10V550	550	745	95	3500	2500	819	1001	1500	25	100
V14E550P	P14V550	550	745	190	6000	4500	819	1001	1500	50	180
V20E550P	P20V550	550	745	370	10000	6500	819	1001	1500	100	300
V10E625P	P10V625	625	825	100	3500	2500	900	1100	1650	25	90
V14E625P	P14V625	625	825	200	6000	4500	900	1100	1650	50	160
V20E625P	P20V625	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.

Current Energy and 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 above. 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 1A - Power Derating for Epoxy Coated

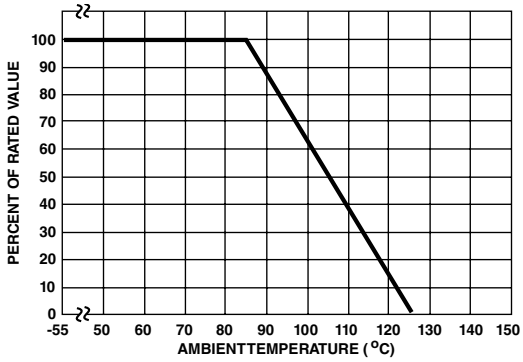
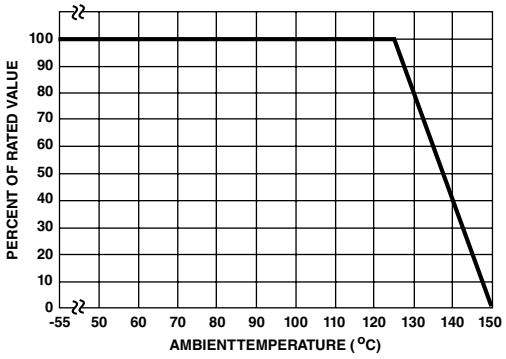


Figure 1B - Power Derating for Phenolic Coated



Peak Pulse Current Test Waveform

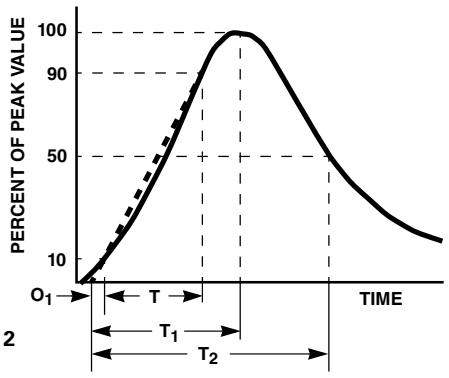


Figure 2

0_1 = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
T_1 = Rise Time = 1.25 x T
T_2 = Decay Time

Example - For an 8/20 μs Current Waveform:
8μs = T_1 = Rise Time
20μs = T_2 = Decay Time

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Transient V-I Characteristics Curves

Maximum Clamping Voltage for 7mm Parts

V7E130(P)-V7E460(P)

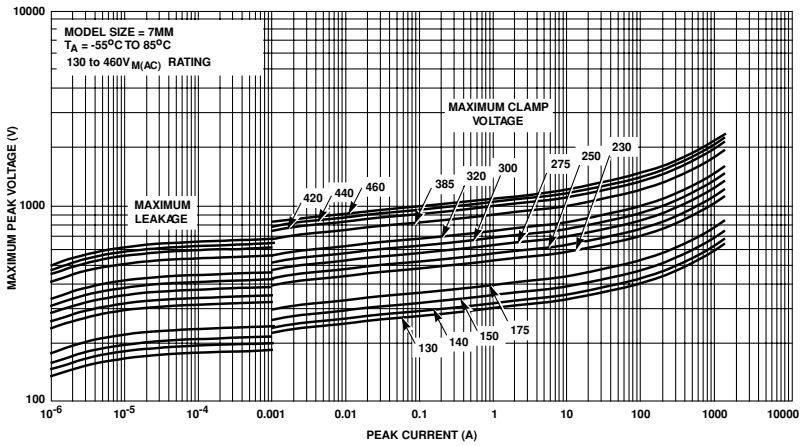

Figure 3

Maximum Clamping Voltage for 10mm Parts

V10E130(P)-V10E625(P)

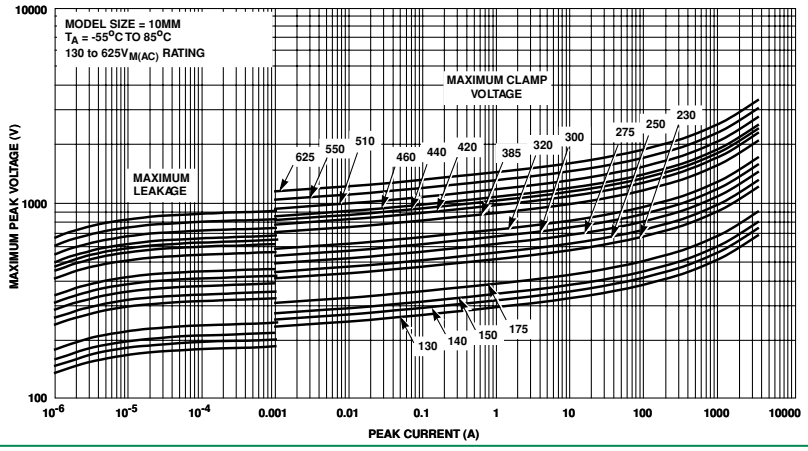

Figure 4

Maximum Clamping Voltage for 14mm Parts

V14E130(P) - V14E625(P)

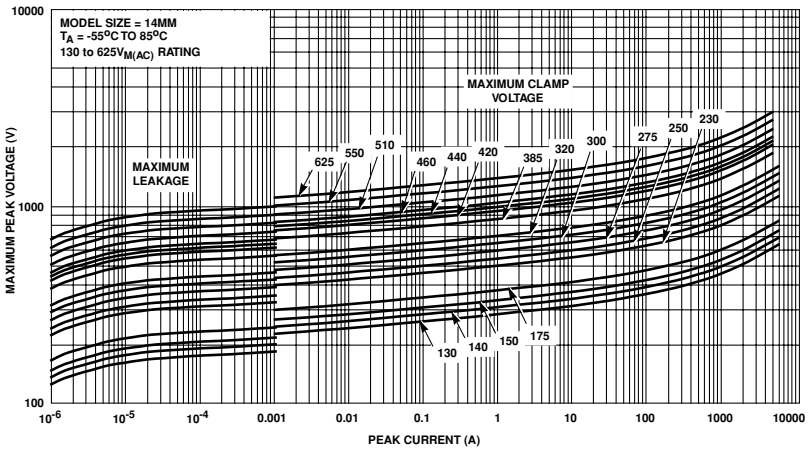

Figure 5

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Transient V-I Characteristics Curves

Maximum Clamping Voltage for 20mm Parts

V20E130(P) - V20E625(P)

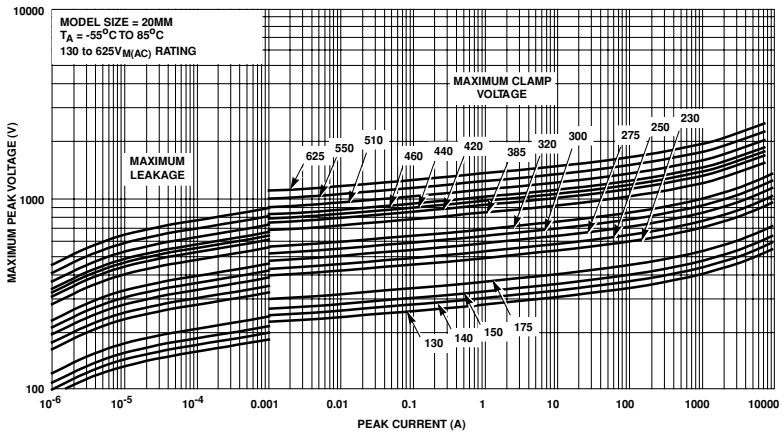

Figure 6

Pulse Rating Curves

Repetitive Surge Capability for 7mm Parts

V7E130(P) - V7E460(P)

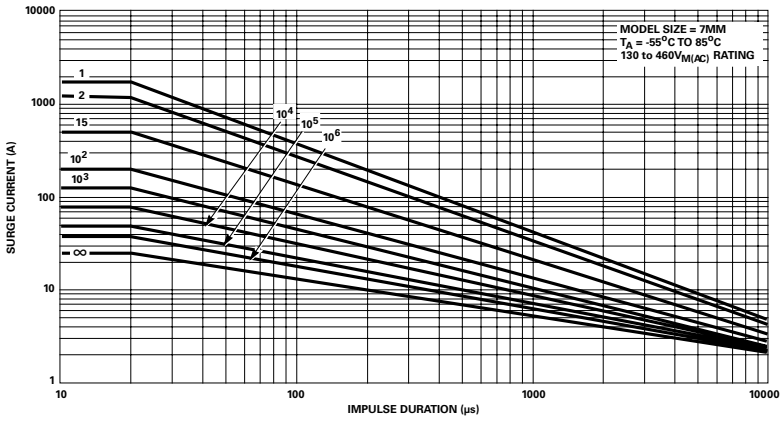

Figure 7

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Pulse Rating Curves

Repetitive Surge Capability for 10mm Parts

V10E130(P) - VIOE625(P)

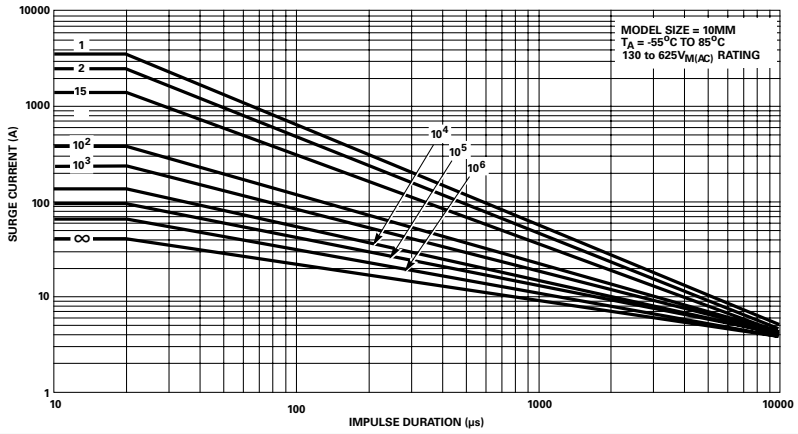

Figure 8

Repetitive Surge Capability for 14mm Parts

V14E130(P) -V14E625(P)

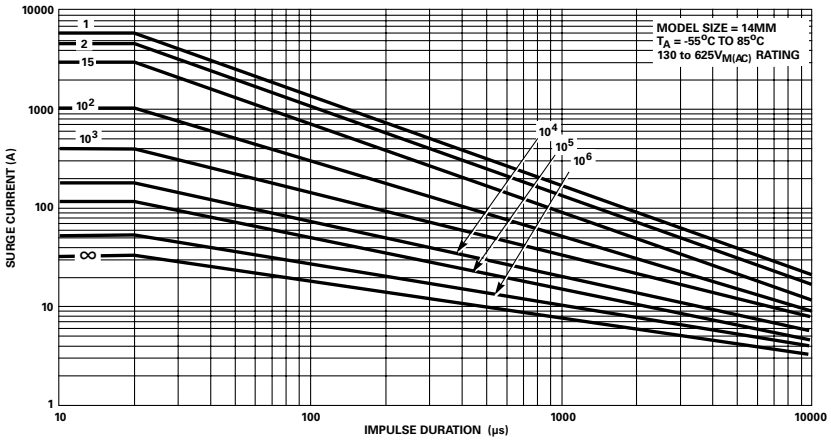

Figure 9

Repetitive Surge Capability for 20mm Parts

V20E130(P) -V20E625(P)

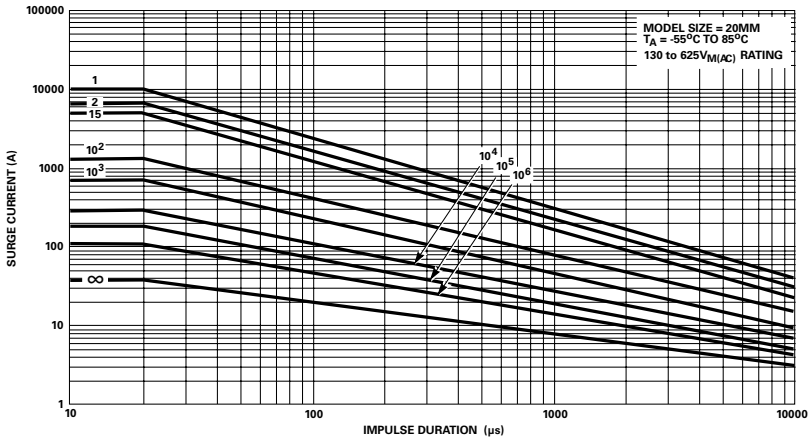

Figure 10

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Wave Solder Profile

Non Lead–free Profile

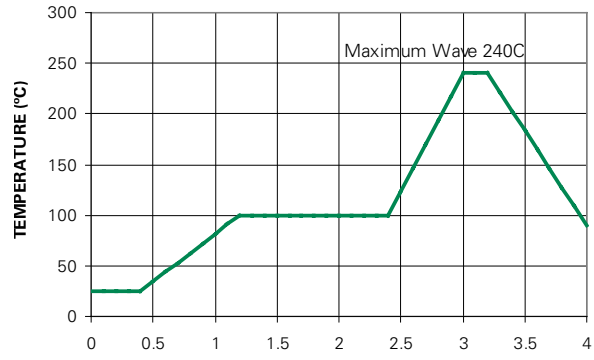


Figure 11

Lead–free Profile

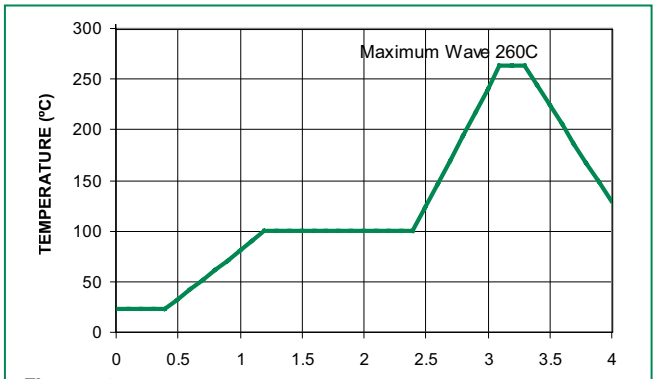


Figure 12

Physical Specifications

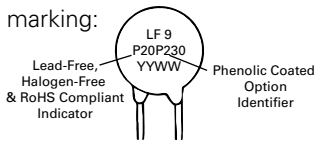
Lead Material	Copper Clad Steel Wire
Soldering Characteristics	Solderability per MIL–STD–202, Method 208
Insulating Material	Cured, flame retardant epoxy polymer meets UL94V–0 requirements
Device Labeling	Marked with LF, voltage, UL/CSA logos, and date code

Environmental Specifications

Operating Temperature	-55°C to +85°C
Storage Temperature	-55°C to +125°C
Humidity Aging	+85°C, 85% RH, 1000 hours +/-10% typical voltage change
Thermal Shock	+85°C to -40°C 5 times +/-10% typical voltage change
Solvent Resistance	MIL–STD–202, Method 215
Moisture Sensitivity	Level 1, J-STD-020

Phenolic Coating Option -- UltraMOV™ Varistor Series for Hi-Temperature Operating Conditions:

- Phenolic Coated UltraMOV™ Varistor Series devices are available with improved maximum operating 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) = 800V.
- Phenolic Coating is HALOGEN FREE. To order: change 'E' (Epoxy coating) in part number to 'P' (Phenolic coating; e.g. V20P230)
- See Part Numbering System section of this series for more information.
- Contact factory for further details.
- Product marking:



NOTE: 1. 10mm, 14mm and 20mm devices are UL recognized with 800V isolation voltage rating.

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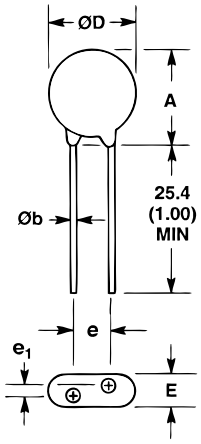
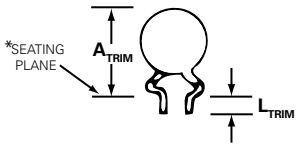
Product Dimensions (mm)

Lead form options L1 and L3
(refer to table below)



Lead form options L2 and L4
(refer to table below)



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

Dimension	V_{RMS} Voltage Model	7mm Size		10mm Size		14mm Size		20mm Size	
		Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)	Min. mm (in)	Max. mm (in)
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)
	385-510	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)	-	7.3 (0.287)
	550-625	-	8.3 (0.327)	-	8.3 (0.327)	-	8.3 (0.327)	-	-8.3 (0.327)
Ø b	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)
A_{TRIM}	All	-	15 (0.591)	-	19.5 (0.768)	-	22.5 (0.886)	-	29.0 (1.142)
L (L2)	All	25.4 (1.00)	-	25.4 (1.00)	-	25.4 (1.00)	-	25.4 (1.00)	-
***L (L4)**	All	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)

NOTES:
1. Measurements displayed in Millimeters (Inches in parentheses).
2. Standard lead space.
3. For in-line lead option L3, dimension e_1 is "zero". Straight lead form option L1 shown.

For information about bulk packaging quantities, please refer to the Ordering Notes section at the end of this document.

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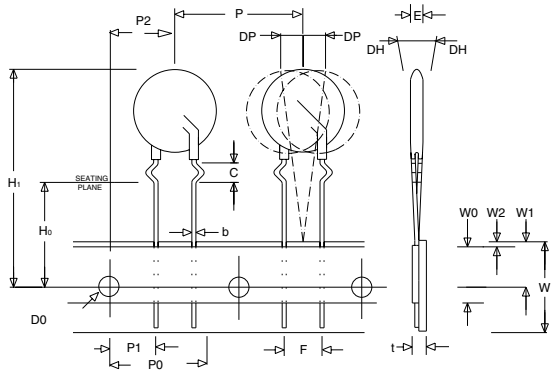
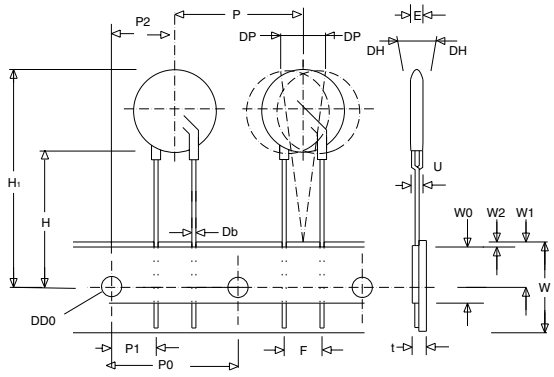
Tape Specifications for Reel and Ammo Pack Items (Refer to dimensions on following page)

7mm Devices

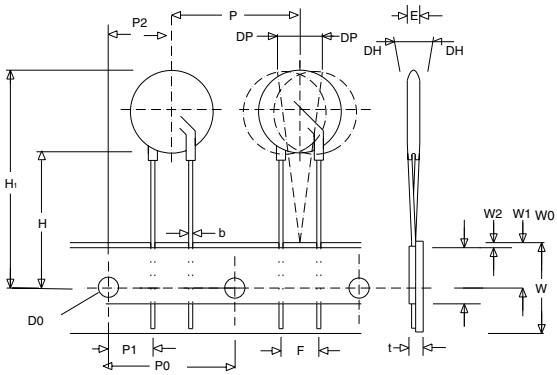
CRIMPED LEADS "L2"



INLINE LEADS "L3"

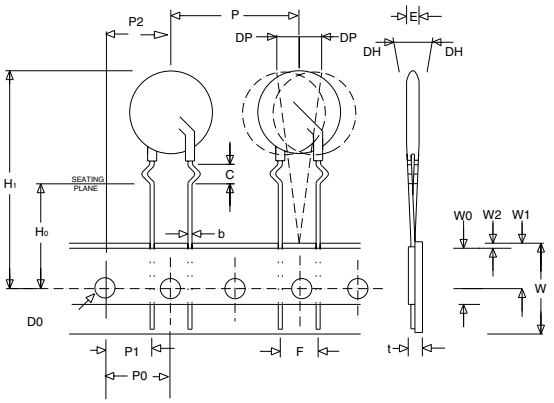


STRAIGHT LEADS "L1"

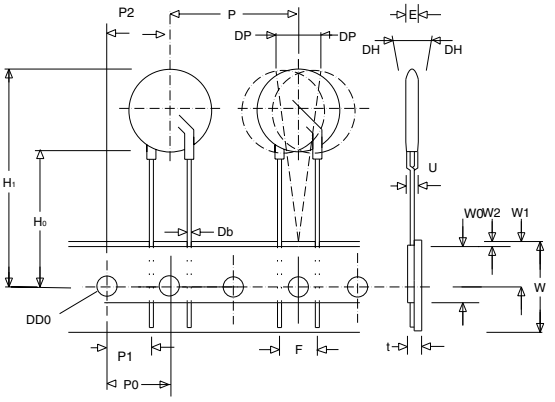


10, 14 and 20mm Devices

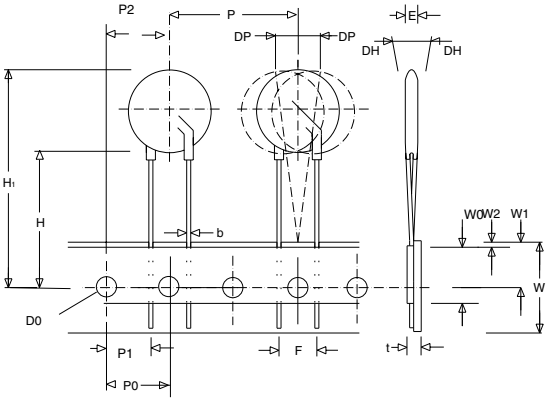
CRIMPED LEADS "L2"



INLINE LEADS "L3"



STRAIGHT LEADS "L1"



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Tape Specifications for Reel and Ammo Pack Items (Refer to drawings on previous page)

- 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 12.7mm when 'F' (lead space) is 5mm.
- 7mm parts are available on tape and reel up to 460 VAC only
- 10mm parts are available on tape and reel up to 510 VAC only
- 14mm and 20mm parts are available on tape and reel up to 550 VAC only
- 7mm devices with 7.5mm lead spacing option will be taped at 25.4mm component pitch and 500 pieces per reel
- 10mm devices with 5.0mm lead spacing option will be taped at 12.7mm component pitch and 1000 pieces per reel

Symbol	Description	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 / -0.5	18.0 +1.0 / -0.52	18.0 +1.0 / -0.5	18.0 +1.0 / -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 / -0.50	9.0 +0.75 / - 0.50	9.0 +0.75 / 0.50	9.0 +0.75 / -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 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -0.0	18.0 +2.0 / -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° Max, 1.00mm	3° Max, 1.00mm	3° Max, 1.00mm	3° Max, 1.00mm

For information on tape and reel packaging quantities, please refer to the Ordering Notes section at the end of this document.

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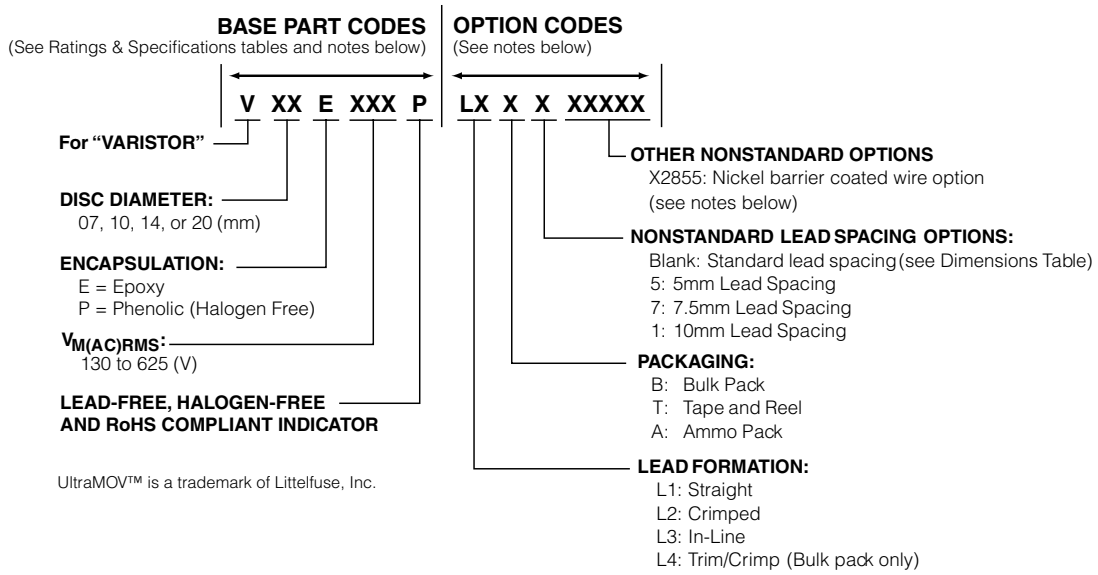
Part Numbering System



UltraMOV™ is a trademark of Littelfuse, Inc.

Ordering Notes:

For standard parts, use the **BASE PART** designator only.

For parts with non-standard options (such as additional form, packaging and lead space options) use, **BASE PART** + **OPTION CODE**.

OPTION CODE items are subject to availability and minimum order requirements. Please contact a Littelfuse representative if you require additional information

OPTION CODES:

X2855: Nickel Barrier COATED WIRE OPTION

All standard parts use tinned copper clad steel wire. Nickel Barrier Coated Wire is available as an option, consisting of Copper Wire with a flashing of Nickel followed by a top coating of Tin.

To order: append standard model **BASE PART** number with "X2855." Example:

Standard Model	Order As
V18ZA40P	V18ZA40P**X2855**

PACKAGING:

Littelfuse UltraMOV™ varistors are shipped standard in bulk pack with straight leads and lead spacing outlined in the dimensions sections of this document. Contact a Littelfuse representative to discuss non-standard options.

Standard Part Default Conditions

Device Size	Part #	Lead Space	Packaging
7mm	V07E–	5.0-/+1	Bulk
10mm	V10E–	7.5-/+1	Bulk
14mm	V14E–	7.5-/+1	Bulk
20mm	V20E–	10.0-/+1	Bulk

Standard Bulk Pack Quantity

Varistor Voltage	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

Tape & Reel Quantity

Varistor Voltage	Shipping Quantity Per Reel			
	7mm	10mm	14mm	20mm
130 – 275	1000	500	500	500
300 – 625	1000	500	400	400

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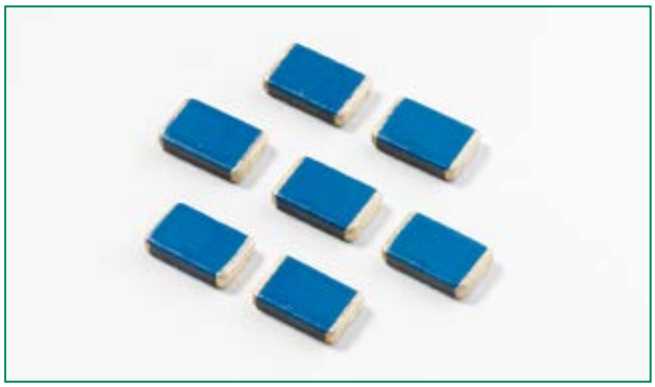
CH Varistor Series

RoHS



Agency Approvals

Recognized under the components program of Underwriters Laboratories.

Agency	Agency Approval	Agency File Number
	UL1449	E320116

Description

CH Series transient surge suppressors are small, metal-oxide varistors (MOVs) manufactured in leadless chip form. They are intended for use in a variety of applications from low voltage DC to off-line board-level protection. These devices, which have significantly lower profiles than traditional radial lead varistors, permit designers to reduce the size and weight and increase the reliability of their equipment designs.

CH Series varistors are available in a voltage range from 14V to 275V ($V_{M(AC)RMS}$), and energy ratings up to 8J.

See the Littelfuse Multilayer Suppressor Series also.

Features

- Lead–free
- Leadless, surface mount chip in 5 x 8mm Size
- Voltage ratings $V_{M(AC)RMS}$ 14V to 275V
- Supplied in tape and reel or bulk pack
- No derating up to 125°C ambient
- High surge rated up to 400A for low voltage devices

Absolute Maximum Ratings

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

Continuous		CH Series	Units
Steady State Applied Voltage:			
	AC Voltage Range ($V_{M(AC)RMS}$)	14 to 275	V
	DC Voltage Range ($V_{M(DC)}$)	18 to 369	V
Transient:			
	Peak Pulse Current (I_{TM})		
	For 8/20μs Current (See Figure 2)	100 to 400	A
	Single Pulse Energy Range		
	For 10/1000μs Current Wave (W_{TM})	1.0 to 8.0	J
Operating Ambient Temperature Range (T_A)		-55 to +125	°C
Storage Temperature Range (T_{STG})		-55 to +150	°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.

Additional Information

Datasheet | **Resources** | **Samples**

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Device Ratings and Specifications

Part Number	Maximum Ratings (125°C)				Specifications (25°C)					
	Continuous		Transient		Varistor Voltage at 1 mA DC Test Current			Max Clamping Volt V_C at Test Current (8/20μs)		Typical Capacitance
	V_{RMS}	V_{DC}	Energy (10/1000μ s)	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)
V22CH8	14	18 (Note 3)	1.0 (Note2)	100	18.7	22.0	26.0	47	5	1600
V27CH8	17	22	1.0	100	23.0	27.0	31.1	57	5	1300
V33CH8	20	26	1.0	100*	29.5	33.0	36.5	68	5	750
V39CH8	25	31	1.0	100*	35.0	39.0	43.0	79	5	700
V47CH8	30	38	1.2	100*	42.0	47.0	52.0	92	5	650
V56CH8	35	45	1.4	100*	50.0	56.0	62.0	107	5	600
V68CH8	40	56	1.5	100*	61.0	68.0	75.0	127	10	500
V120CH8	75	102	2.0	250	108.0	120.0	132.0	200	10	300
V150CH8	95	127	3.0	250	135.0	150.0	165.0	250	10	250
V180CH8	115	153	4.0	250	162.0	180.0	198.0	295	10	120
V200CH8	130	175	4.0	250	184.0	200.0	228.0	340	10	110
V220CH8	140	180	5.0	250	198.0	220.0	242.0	360	10	105
V240CH8	150	200	5.0	250	212.0	240.0	268.0	395	10	100
V360CH8	230	300	6.0	250	324.0	360.0	396.0	595	10	70
V390CH8	250	330	7.0	250	354.0	390.0	429.0	650	10	60
V430CH8	275	369	8.0	250	389.0	430.0	473.0	710	10	50

NOTES:
1. Power dissipation of transients not to exceed 0.25W.
2. Energy rating for impulse duration of 30ms minimum to one half of peak current value.
3. Also rated to withstand 24V for 5 minutes.
4. The Typical Capacitance is for reference only
5. *High Surge Option (up to 400A) available for relevant voltage ratings.

Current, Energy and Power Derating Curve

Continuous power dissipation capability is not an applicable design requirement for a suppressor, unless transients occur in rapid succession. Under this condition, 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 tempera tures as shown in this diagram. 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.

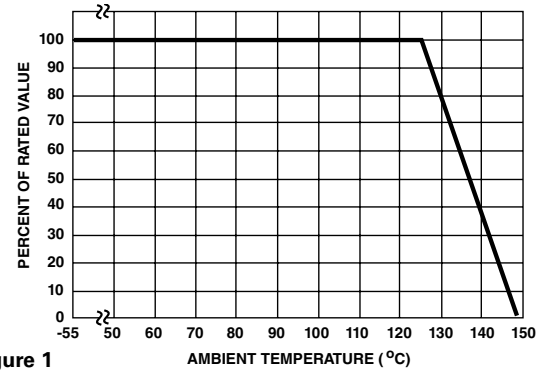

Figure 1

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Peak Pulse Current Test Waveform

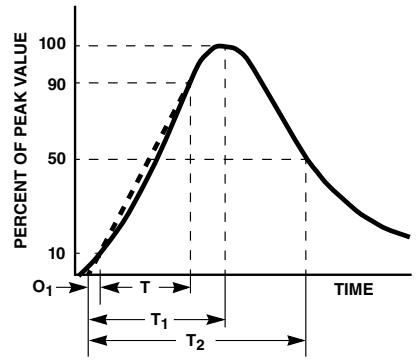

Figure 2

0_1 = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
T_1 = Rise Time = 1.25 x T
T_2 = Decay Time

Example:
For an 8/20 μs Current Waveform:
8μs = T_1 = Rise Time
20μs = T_2 = Decay Time

Clamping Voltage for V22CH8 – V68CH8

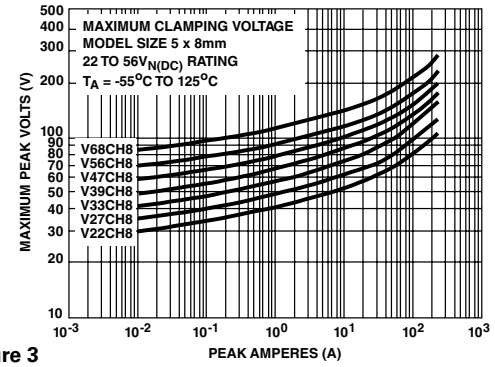

Figure 3

Clamping Voltage for V120CH8 – V430CH8

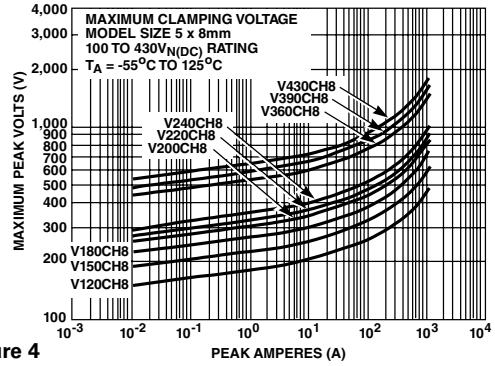

Figure 4

Pulse Rating Curves

Surge Current Rating Curves for V22CH8 - V56CH8

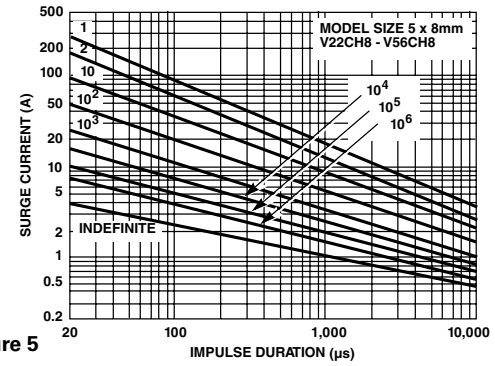

Figure 5

Surge Current Rating Curves for V120CH8 - V430CH8

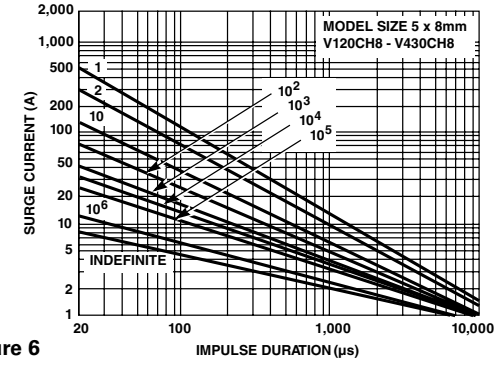

Figure 6

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.

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Lead (Pb) Soldering Recommendations

The principal techniques used for the soldering of components in surface mount technology are IR Re-flow and Wave soldering. Typical profiles are shown on the right.

CH series devices have silver-platinum terminals (Ag/Pt), and the recommended solder is 62/36/2 (Sn/Pb/Ag), 60/40 (Sn/Pb) or 63/37 (Sn/Pb). Littelfuse also recommends an RMA solder flux.

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

When using a reflow process, care should be taken to ensure that the CH chip is not subjected to a thermal gradient steeper than 4 degrees per second; the ideal gradient being 2 degrees per second. During the soldering process, preheating to within 100 degrees of the solder's peak temperature is essential to minimize thermal shock.

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

Reflow Solder Profile

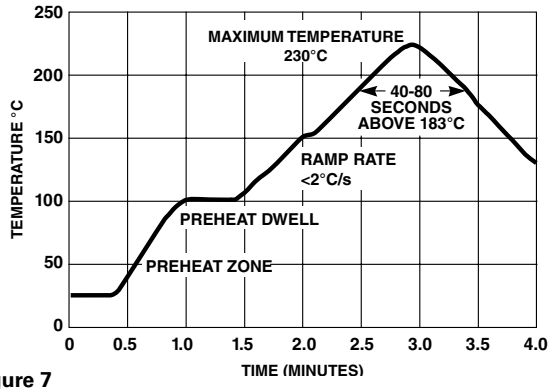

Figure 7

Wave Solder Profile

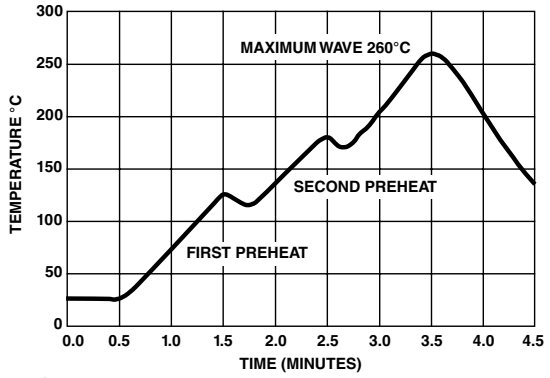

Figure 8

Lead–free (Pb-free) Soldering Recommendations

CH series devices have silver-platinum terminals (Ag/Pt), and the recommended Lead-free solder is 96.5/3.0/0.5 (SnAgCu) with an RMA flux, though there is a wide selection of pastes and fluxes available that should be compatible.

The reflow profile must be constrained by the maximums in the Lead–free Reflow Profile. For Lead–free Wave soldering, the Wave Solder Profile still applies.

Note: the Lead–free paste, flux and profile were used for evaluation purposes by Littelfuse, based upon industry standards and practices. There are multiple choices of all three available, it is advised that the customer explores the optimum combination for their process as processes vary considerably from site to site.

Lead–free Re-flow Solder Profile

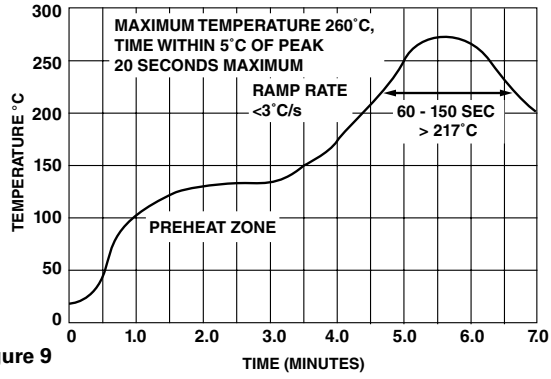

Figure 9

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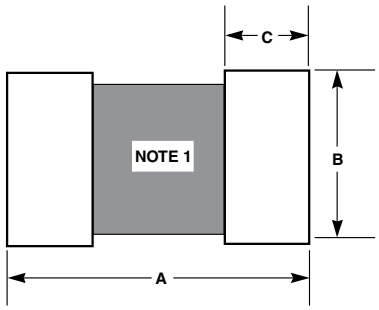
Part Numbering System

V 220 CH 8 X

- V — LITTELFUSE VARISTOR
- 220 — NOMINAL VARISTOR VOLTAGE
- CH — SERIES DESIGNATOR
- 8 — RELATIVE SIZE INDICATOR
- X — PACKAGING OPTIONS
  - No Letter: Standard 13 Inch Reel
  - T: 7 Inch Reel
  - S: Bulk Pack

Dimensions

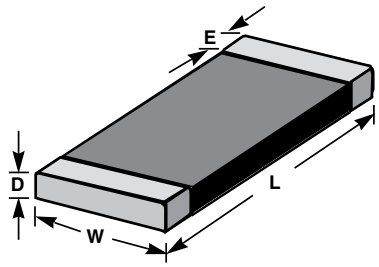
PAD LAYOUT DIMENSIONS



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A	0.402		10.210	
B	0.216		5.500	
C	0.087		2.210	
D	-	0.080	-	2.00
E	0.016	0.050	0.41	1.27
L	0.311	0.335	7.90	8.51
W	0.185	0.207	4.70	5.26

NOTE: Avoid metal runs in this area. Soldering recommendations: Material - 62/36/2 Sn/Pb/Ag or equivalent.Temperature – 230°C Max., 5s. Max. Flux - R.M.A.

CHIP LAYOUT DIMENSIONS



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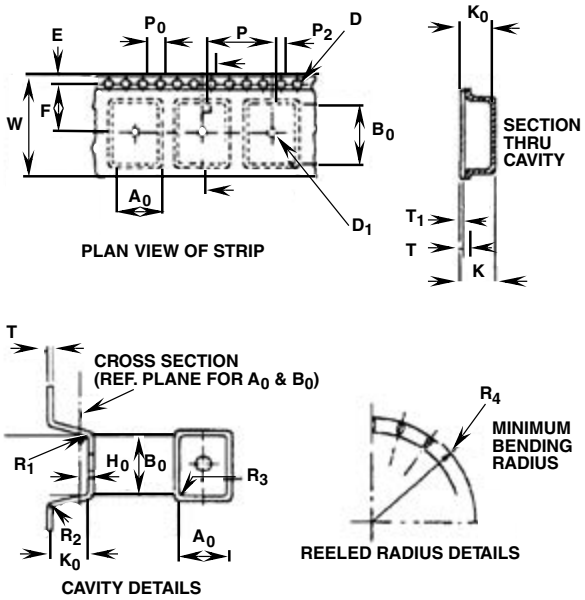
Revised: 09/30/15

Tape and Reel Specifications



Symbol	Parameter	Size (mm)
B_0	Cavity Length	8.8 -/+ 0.1
A_0	Cavity Width	5.5 -/+ 0.1
K_0	Cavity Depth	2.0 Min.
H_0	Ref. Plane for A0 and B0	+ 0.10 0.3 - 0.05
R_1, R_2, R_3	Tape Cavity Radii	0.5 Max.
T	Carrier Tape Thickness	1.0 Max.
T_1	Cover Tape Thickness	0.1 Max.
E	Sprocket Hole from Edge	1.75 -/+ 0.1
P_0	Sprocket Hole Pitch	4.0 -/+ 0.1
D	Sprocket Hole Diameter	+ 0.1 1.5 - 0.0
P_2	Hole Centre to Component Centre	2.0 -/+ 0.15
R_4	Min. Bending Radius	30.5 Min.
D_1	Ejection Hole Diameter	1.5 Min.
K	Overall Thickness	3.0 Min.
P	Pitch Of Component	8.0 -/+ 0.1
F	Sprocket Hole to Ejection Hole	7.5 -/+ 0.1
W	Carrier Tape Width	16.0 -/+ 0.3

Notes :
- Conforms to EIA-481-1, Revision A
- Can be supplied to IEC P ublication 286-3

Standard Packaging*

CH Series varistors are always shipped in tape and reel. The standard 13-inch reel utilized contains 4000 pieces.

Note also that the CH Series receives no branding on the chip itself.

*NOTE: It is recommended that parts be kept in the sealed bag provided and that parts be used as soon as possible when removed from bags.

Special Packaging

Option 1 7-inch reels containing 1000 pieces are available. To order 7-inch reels add a 'T' suffix to the part number; e.g., V47CH8T.

Option 2 For small quantities (less than 100 pieces) the units are shipped bulk pack. To order, add a 'S' suffix to the part number; e.g., V47CH8S.

Ordering Notes:

X3313: HIGH SURGE RATING OPTION --

Low voltage (V22~V68) standard parts high surge rating to 100A, to order high surge rated up to 400A with suffix X3313. Example:

Standard Model	Order As
V33CH8	V33CH8X3313

Revised: 09/30/15

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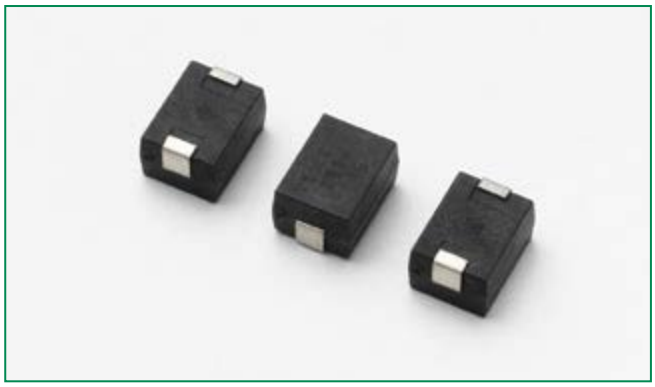
Littelfuse
Expertise Applied | Answers Delivered

SM7 Varistor Series



Agency Approvals

Agency	Agency File Number
UL	E320116

Description

The Littelfuse SM7 Series is a plastic-encapsulated surface-mount metal oxide varistor (MOV) transient voltage surge suppressor that is designed to be operated continuously across AC power lines.

The series comprises a Nylon molded package with tin plated lead frame for soldering to board. The surface mount SM7 Series is based on radial 7mm internal varistor element with similar characteristics to the Littelfuse LA / ZA series of varistor.

Features

- Electrical equivalent to leaded types LA/ZA series
- AC Voltage Rating 115 to 510VAC rms
- No De-Rating up to 85°C ambient
- Good solderability
- Available in tape and reel
- Application of AC power meters

Absolute Maximum Ratings

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

Continuous	SM7 Series	Units
Steady State Applied Voltage:		
AC Voltage Range ($V_{M(AC)RMS}$)	115 to 510	V
DC Voltage Range ($V_{M(DC)}$)	153 to 675	V
Transients:		
Peak Pulse Current (I_{TM})		
For 8/20μs Current Wave (See Figure 2)	1200	A
Single Pulse Energy Range		
For 10/1000μs Current Wave (W_{TM})	10 to 40	J
Operating Ambient Temperature Range (T_A)	-40 to +85	°C
Storage Temperature Range (T_{STG})	-55 to +125	°C
Temperature Coefficient (a^V) of Clamping Voltage (V_C) at Specified Test Current	<0.01	%/°C
Hi-Pot Encapsulation (COATING Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301)	2500	V
COATING 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.

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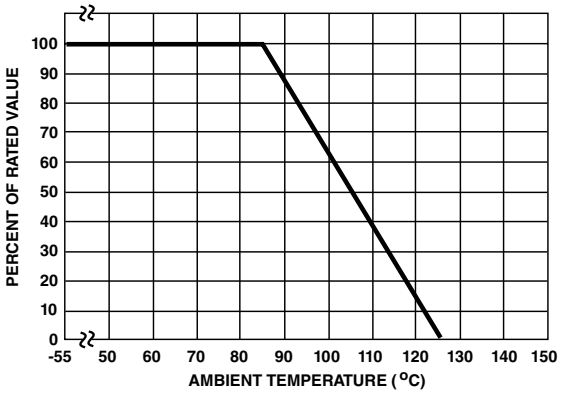
SM7 Series Ratings & Specifications

	Maximum Rating (85°C)				Specifications (25°C)				
	Continuous		Transient		Varistor Voltage at 1mA DC Test Current		Maximum Clamping Voltage 8 x 20 μs		Typical Capacitance f = 1MHz
	V_{RMS}	V_{DC}	Energy 10 x 1000μs	Peak Current 8 x 20μs					
Part Number	$V_{M(AC)}$	$V_{M(DC)}$	W_{TM}	I_{TM}	V_{NOM} Min	V_{NOM} Max	V_C	I_{PK}	C
	(V)	(V)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
V115SM7	115	153	10	1200	162	198	300	10	200
V130SM7	130	175	11	1200	184	228	340	10	180
V140SM7	140	180	12	1200	198	242	360	10	160
V150SM7	150	200	13	1200	212	268	395	10	150
V175SM7	175	225	15	1200	247	303	455	10	130
V230SM7	230	300	20	1200	324	396	595	10	100
V250SM7	250	330	21	1200	354	429	650	10	90
V275SM7	275	369	23	1200	389	473	710	10	80
V300SM7	300	405	25	1200	420	517	775	10	70
V320SM7	320	420	25	1200	462	565	850	10	65
V385SM7	385	505	27	1200	558	682	1025	10	60
V420SM7	420	560	30	1200	610	748	1120	10	55
V460SM7	460	615	37	1200	640	790	1190	10	55
V480SM7	480	640	35	1200	670	825	1240	10	50
V510SM7	510	675	40	1200	735	910	1200	10	45

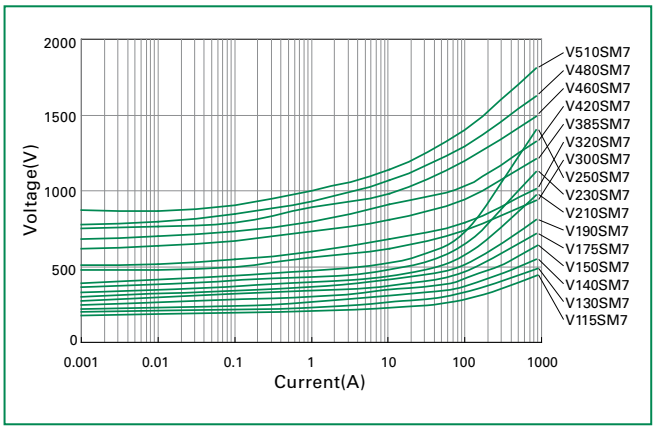
NOTE: SM7 series devices are recognized under UL file # E320116

Peak Current, Energy and Power Derating Curve

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

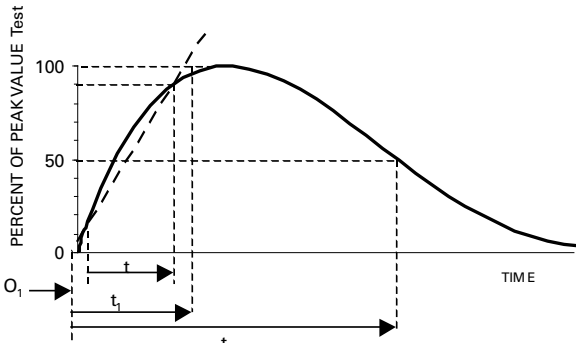


V-I Limit Curves



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.

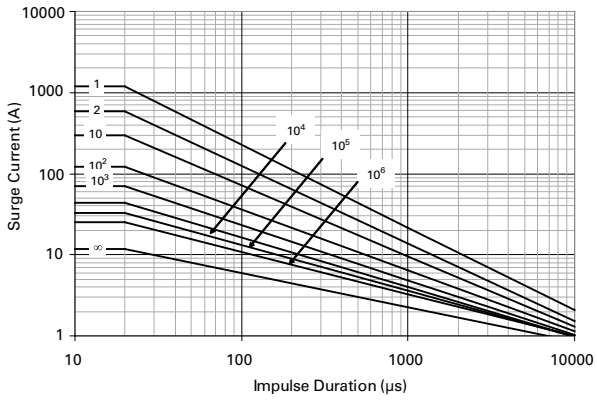
Peak Pulse Current Test Waveform for Clamping Voltage



0_1 = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
T_1 = Rise Time = 1.25 x T
T_2 = Decay Time

Example - For an 8/20 μs Current Waveform:
8μs = T_1 = Rise Time
20μs = T_2 = Decay Time

Pulse Rating Curves



SM7 Series

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Lead (Pb) Soldering Recommendations

The principal techniques used for the soldering of components in surface mount technology are IR Re-flow and Wave soldering. Typical profiles are shown on the right.

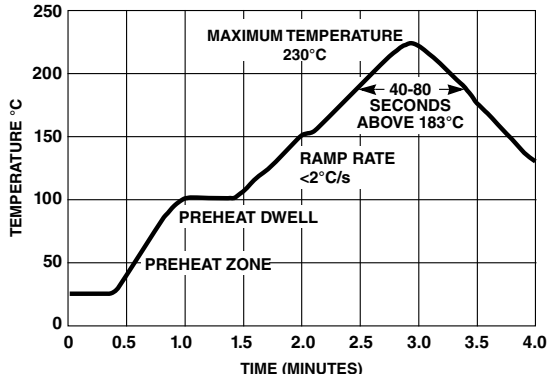
The terminals of SM7 series devices are tin plated copper, and the recommended solder is 62/36/2 (Sn/Pb/Ag), 60/40 (Sn/Pb) or 63/37 (Sn/Pb). Littelfuse also recommends an RMA solder flux.

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

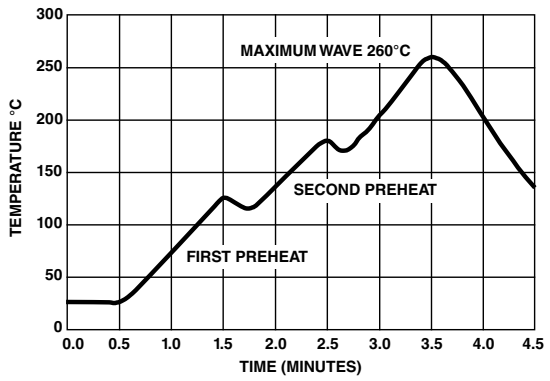
When using a reflow process, care should be taken to ensure that the SM7 chip is not subjected to a thermal gradient steeper than 4 degrees per second; the ideal gradient being 2 degrees per second. During the soldering process, preheating to within 100 degrees of the solder's peak temperature is essential to minimize thermal shock.

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

Reflow Solder Profile



Wave Solder Profile



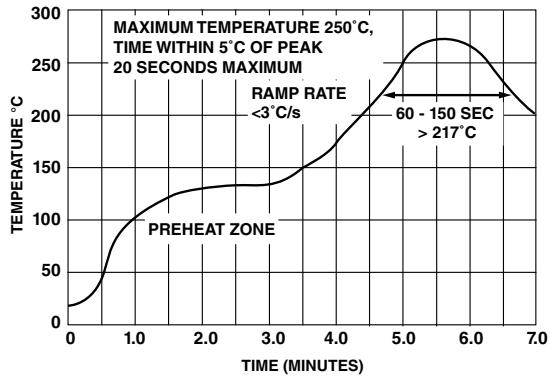
Lead–free (Pb-free) Soldering Recommendations

The terminals of SM7 series devices are tin plated copper, and the recommended Lead-free solder is 96.5/3.0/0.5 (SnAgCu) with an RMA flux, though there is a wide selection of pastes and fluxes available that should be compatible.

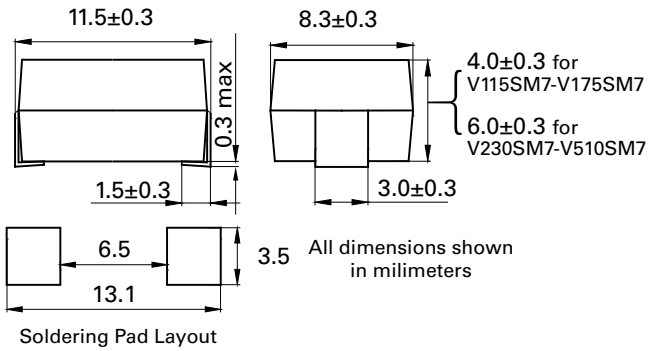
The reflow profile must be constrained by the maximums in the Lead–free Reflow Profile. For Lead–free Wave soldering, the Wave Solder Profile still applies.

Note: the Lead–free paste, flux and profile were used for evaluation purposes by Littelfuse, based upon industry standards and practices. There are multiple choices of all three available, it is advised that the customer explores the optimum combination for their process as processes vary considerably from site to site.

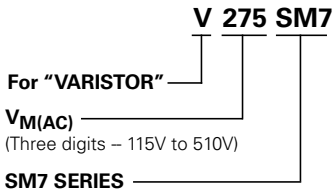
Lead–free Re-flow Solder Profile



Product Dimensions

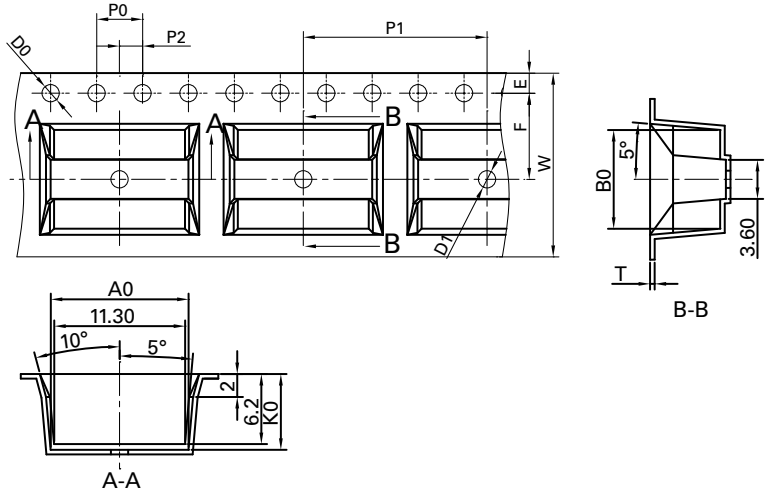


Part Numbering System



Tape & Reel Specifications

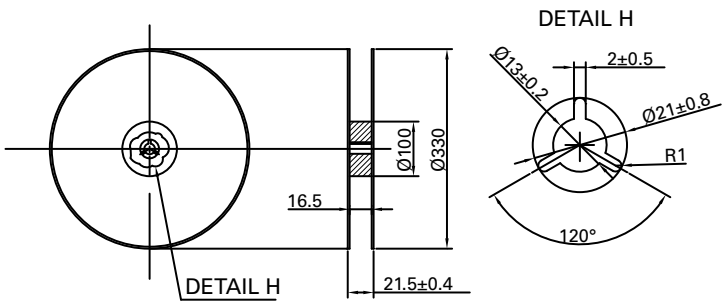
Carrier Tape



	mm
W	16.00±0.30
T	0.40±0.05
A0	11.80±0.10
B0	8.60±0.10
K0	6.80±0.10
E	1.75±0.10
F	7.50±0.10
P0	4.00±0.10
P1	16.00±0.10
P2	2.00±0.10
D0	ø1.50 +0.10/-0
D1	ø1.50 +0.10/-0

NOTES:
1) All dimensions per EIA-481-c
2) 10 pitches cumulative tolerance on tape ±0.20mm
3) Quantity per 13 inch (330 mm) reel: 600 pcs

Plastic Reel



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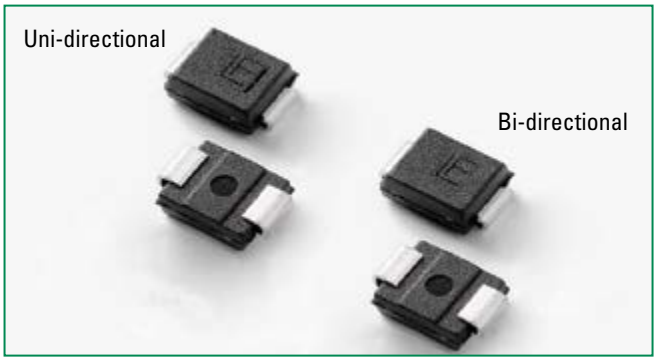
SMBJ Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
®	E128662/E230531

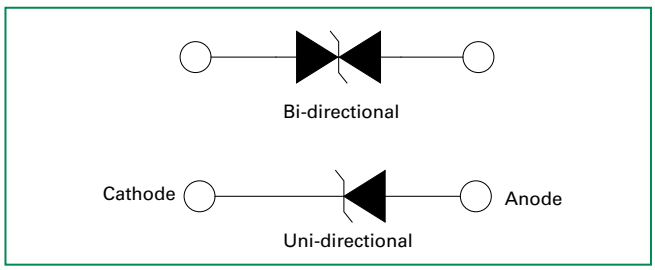
Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation at T_A=25°C by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2)	P_{PPM}	600	W
Power Dissipation on Infinite Heat Sink at T_A=50°C	$P_{M(AV)}$	5.0	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	I_{FSM}	100	A
Maximum Instantaneous Forward Voltage at 50A for Unidirectional Only (Note 4)	V_F	3.5V/5.0	V
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	°C
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	20	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	100	°C/W

Notes:

1. Non-repetitive current pulse , per Fig. 4 and derated above T_A = 25°C per Fig. 3.
2. Mounted on copper pad area of 0.2x0.2" (5.0 x 5.0mm) to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only, duty cycle=4 per minute maximum.
4. V_F<3.5V for $V_{BR} \leq$ 200V and V_F<5.0V for $V_{BR} \geq$ 201V.

Functional Diagram



Description

The SMBJ series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

Features

- Excellent clamping capability
- Low incremental surge resistance
- Typical I_R less than 1µA above 12V
- For surface mounted applications to optimize board space
- Low profile package
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2)
- EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)
- Built-in strain relief
- Fast response time: typically less than 1.0ps from 0V to BV min
- 600W peak pulse power capability at 10/1000µs waveform, repetition rate (duty cycles):0.01%
- V_{BR} @T_J= V_{BR}@25°C x (1+αT x (T_J - 25))
  (αT:Temperature Coefficient)
- Glass passivated chip junction
- High temperature soldering guaranteed: 260°C/40 seconds at terminals
- Plastic package has underwriters laboratory flammability 94V-O
- Meet MSL level1, per J-STD-020, LF maximun peak of 260°C
- Matte tin lead–free plated
- Halogen free and RoHS compliant
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

Applications

TVS devices are ideal for the protection of I/O Interfaces, V_{CC} bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

Revised: 10/09/14

TVS Diodes

Surface Mount – 600W > SMBJ series

Electrical Characteristics (T_A=25°C unless otherwise noted)

Part Number (Uni)	Part Number (Bi)	Marking		Reverse Stand off Voltage V_R (Volts)	Breakdown Voltage V_{BR} (Volts) @ I_T		Test Current I_T (mA)	Maximum Clamping Voltage V_C @ I_{pp} (V)	Maximum Peak Pulse Current I_{pp} (A)	Maximum Reverse Leakage I_R @ V_R (µA)	Agency Approval
		UNI	BI		MIN	MAX					
SMBJ5.0A	SMBJ5.0CA	KE	AE	5.0	6.40	7.00	10	9.2	65.3	800	X
SMBJ6.0A	SMBJ6.0CA	KG	AG	6.0	6.67	7.37	10	10.3	58.3	800	X
SMBJ6.5A	SMBJ6.5CA	KK	AK	6.5	7.22	7.98	10	11.2	53.6	500	X
SMBJ7.0A	SMBJ7.0CA	KM	AM	7.0	7.78	8.60	10	12.0	50.0	200	X
SMBJ7.5A	SMBJ7.5CA	KP	AP	7.5	8.33	9.21	1	12.9	46.6	100	X
SMBJ8.0A	SMBJ8.0CA	KR	AR	8.0	8.89	9.83	1	13.6	44.2	50	X
SMBJ8.5A	SMBJ8.5CA	KT	AT	8.5	9.44	10.40	1	14.4	41.7	20	X
SMBJ9.0A	SMBJ9.0CA	KV	AV	9.0	10.00	11.10	1	15.4	39.0	10	X
SMBJ10A	SMBJ10CA	KX	AX	10.0	11.10	12.30	1	17.0	35.3	5	X
SMBJ11A	SMBJ11CA	KZ	AZ	11.0	12.20	13.50	1	18.2	33.0	1	X
SMBJ12A	SMBJ12CA	LE	BE	12.0	13.30	14.70	1	19.9	30.2	1	X
SMBJ13A	SMBJ13CA	LG	BG	13.0	14.40	15.90	1	21.5	28.0	1	X
SMBJ14A	SMBJ14CA	LK	BK	14.0	15.60	17.20	1	23.2	25.9	1	X
SMBJ15A	SMBJ15CA	LM	BM	15.0	16.70	18.50	1	24.4	24.6	1	X
SMBJ16A	SMBJ16CA	LP	BP	16.0	17.80	19.70	1	26.0	23.1	1	X
SMBJ17A	SMBJ17CA	LR	BR	17.0	18.90	20.90	1	27.6	21.8	1	X
SMBJ18A	SMBJ18CA	LT	BT	18.0	20.00	22.10	1	29.2	20.6	1	X
SMBJ20A	SMBJ20CA	LV	BV	20.0	22.20	24.50	1	32.4	18.6	1	X
SMBJ22A	SMBJ22CA	LX	BX	22.0	24.40	26.90	1	35.5	16.9	1	X
SMBJ24A	SMBJ24CA	LZ	BZ	24.0	26.70	29.50	1	38.9	15.5	1	X
SMBJ26A	SMBJ26CA	ME	CE	26.0	28.90	31.90	1	42.1	14.3	1	X
SMBJ28A	SMBJ28CA	MG	CG	28.0	31.10	34.40	1	45.4	13.3	1	X
SMBJ30A	SMBJ30CA	MK	CK	30.0	33.30	36.80	1	48.4	12.4	1	X
SMBJ33A	SMBJ33CA	MM	CM	33.0	36.70	40.60	1	53.3	11.3	1	X
SMBJ36A	SMBJ36CA	MP	CP	36.0	40.00	44.20	1	58.1	10.4	1	X
SMBJ40A	SMBJ40CA	MR	CR	40.0	44.40	49.10	1	64.5	9.3	1	X
SMBJ43A	SMBJ43CA	MT	CT	43.0	47.80	52.80	1	69.4	8.7	1	X
SMBJ45A	SMBJ45CA	MV	CV	45.0	50.00	55.30	1	72.7	8.3	1	X
SMBJ48A	SMBJ48CA	MX	CX	48.0	53.30	58.90	1	77.4	7.8	1	X
SMBJ51A	SMBJ51CA	MZ	CZ	51.0	56.70	62.70	1	82.4	7.3	1	X
SMBJ54A	SMBJ54CA	NE	DE	54.0	60.00	66.30	1	87.1	6.9	1	X
SMBJ58A	SMBJ58CA	NG	DG	58.0	64.40	71.20	1	93.6	6.5	1	X
SMBJ60A	SMBJ60CA	NK	DK	60.0	66.70	73.70	1	96.8	6.2	1	X
SMBJ64A	SMBJ64CA	NM	DM	64.0	71.10	78.60	1	103.0	5.9	1	X
SMBJ70A	SMBJ70CA	NP	DP	70.0	77.80	86.00	1	113.0	5.3	1	X
SMBJ75A	SMBJ75CA	NR	DR	75.0	83.30	92.10	1	121.0	5.0	1	X
SMBJ78A	SMBJ78CA	NT	DT	78.0	86.70	95.80	1	126.0	4.8	1	X
SMBJ85A	SMBJ85CA	NV	DV	85.0	94.40	104.00	1	137.0	4.4	1	X
SMBJ90A	SMBJ90CA	NX	DX	90.0	100.00	111.00	1	146.0	4.1	1	X
SMBJ100A	SMBJ100CA	NZ	DZ	100.0	111.00	123.00	1	162.0	3.7	1	X
SMBJ110A	SMBJ110CA	PE	EE	110.0	122.00	135.00	1	177.0	3.4	1	X
SMBJ120A	SMBJ120CA	PG	EG	120.0	133.00	147.00	1	193.0	3.1	1	X
SMBJ130A	SMBJ130CA	PK	EK	130.0	144.00	159.00	1	209.0	2.9	1	X
SMBJ150A	SMBJ150CA	PM	EM	150.0	167.00	185.00	1	243.0	2.5	1	X
SMBJ160A	SMBJ160CA	PP	EP	160.0	178.00	197.00	1	259.0	2.3	1	X
SMBJ170A	SMBJ170CA	PR	ER	170.0	189.00	209.00	1	275.0	2.2	1	X
SMBJ180A	SMBJ180CA	PT	ET	180.0	201.00	222.00	1	292.0	2.1	1	X
SMBJ188A	SMBJ188CA	PB	EB	188.0	209.00	231.00	1	304.0	2.0	1	X
SMBJ200A	SMBJ200CA	PV	EV	200.0	224.00	247.00	1	324.0	1.9	1	X
SMBJ220A	SMBJ220CA	PX	EX	220.0	246.00	272.00	1	356.0	1.7	1	X
SMBJ250A	SMBJ250CA	PZ	EZ	250.0	279.00	309.00	1	405.0	1.5	1	X
SMBJ300A	SMBJ300CA	QE	FE	300.0	335.00	371.00	1	486.0	1.3	1	
SMBJ350A	SMBJ350CA	QG	FG	350.0	391.00	432.00	1	567.0	1.1	1	
SMBJ400A	SMBJ400CA	QK	FK	400.0	447.00	494.00	1	648.0	0.9	1	
SMBJ440A	SMBJ440CA	QM	FM	440.0	492.00	543.00	1	713.0	0.9	1	

For bidirectional type having V_R of 10 volts and less, the I_R limit is double.
For parts without A , the V_{BR} is +10% and Vc is 5% higher than with A parts.

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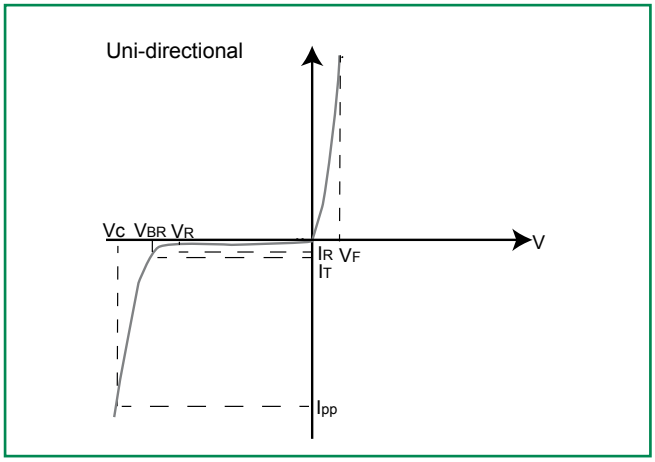
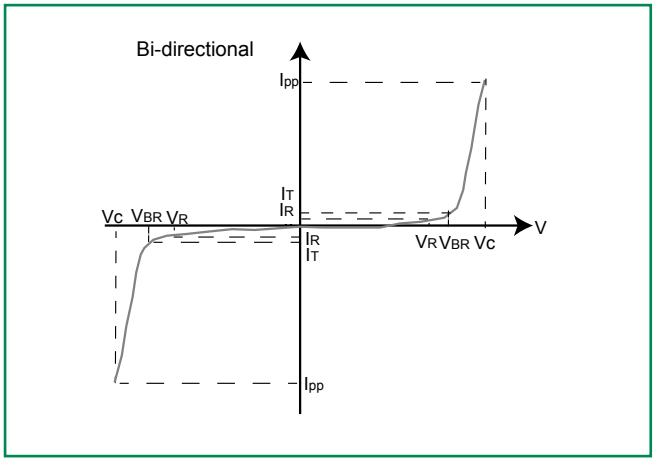
I-V Curve Characteristics





P_{PPM} Peak Pulse Power Dissipation – Max power dissipation
V_R Stand-off Voltage – Maximum voltage that can be applied to the TVS without operation
V_{BR} Breakdown Voltage – Maximum voltage that flows though the TVS at a specified test current (I_T)
V_C Clamping Voltage – Peak voltage measured across the suppressor at a specified Ippm (peak impulse current)
I_R Reverse Leakage Current – Current measured at V_R
V_F Forward Voltage Drop for Uni-directional

Ratings and Characteristic Curves (T_A=25°C unless otherwise noted)

Figure 1 - TVS Transients Clamping Waveform

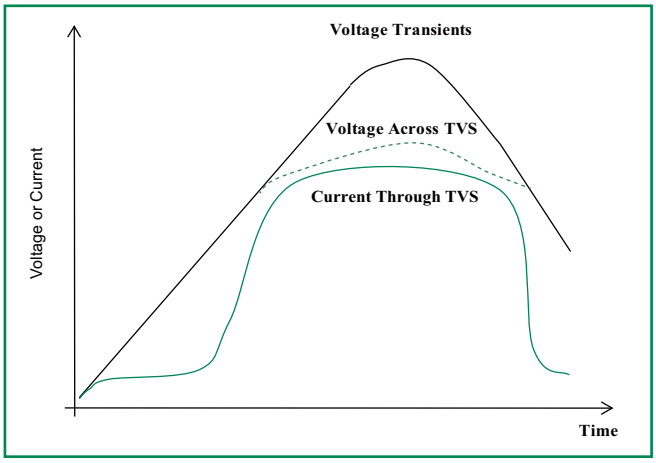
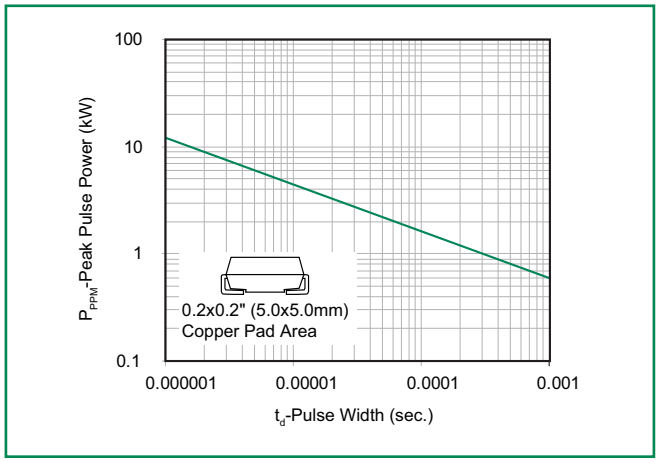


Figure 2 - Peak Pulse Power Rating



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Ratings and Characteristic Curves (T_A=25°C unless otherwise noted) (Continued)

Figure 3 - Pulse Derating Curve

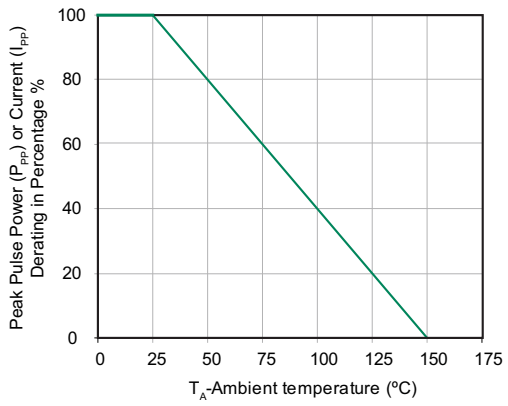


Figure 4 - Pulse Waveform

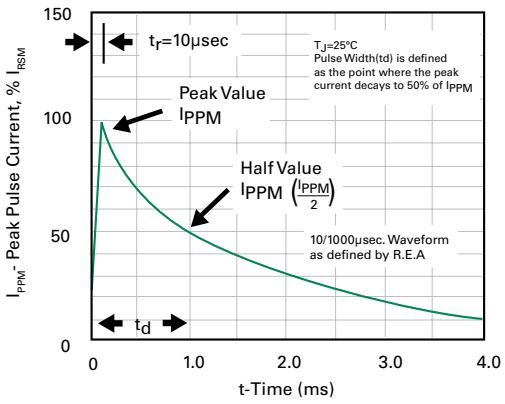


Figure 5 - Typical Junction Capacitance

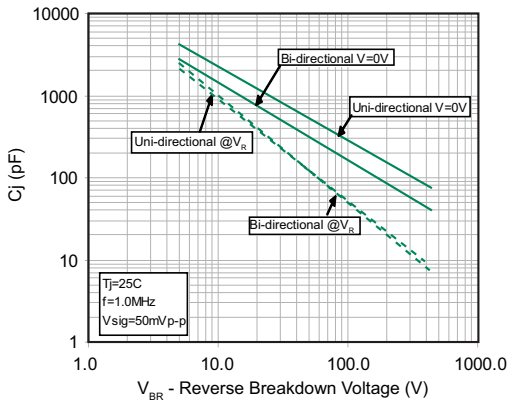


Figure 6 - Steady State Power Dissipation Derating Curve

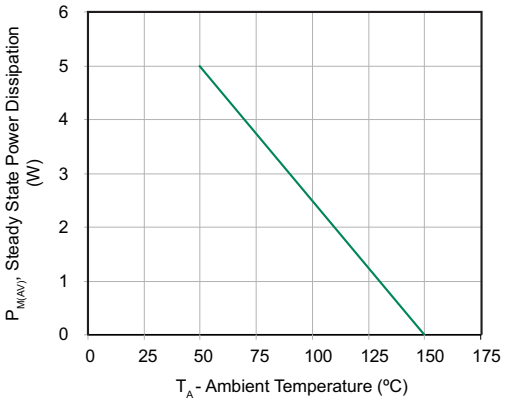
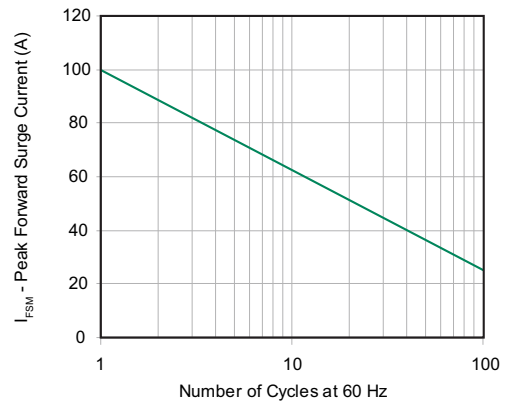
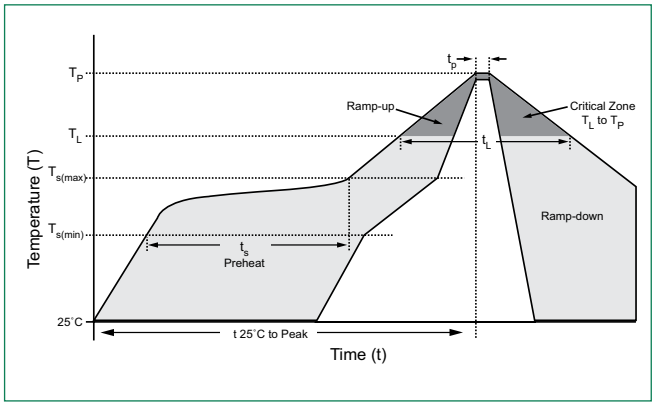


Figure 7 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional Only



Soldering Parameters

Reflow Condition		Lead–free assembly
Pre Heat	- Temperature Min ($T_{s(min)}$)	150°C
	- Temperature Max ($T_{s(max)}$)	200°C
	- Time (min to max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		3°C/second max
Reflow	- Temperature (T_L) (Liquidus)	217°C
	- Time (min to max) (t_s)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		280°C



Physical Specifications

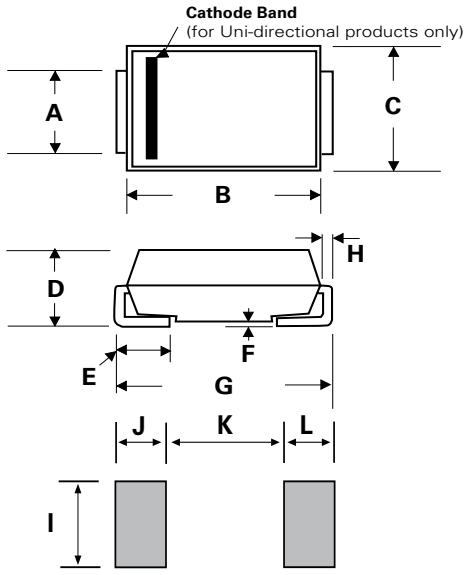
Weight	0.003 ounce, 0.093 grams
Case	JEDEC DO214AA. Molded plastic body over glass passivated junction
Polarity	Color band denotes cathode except Bidirectional
Terminal	Matte Tin-plated leads, Solderable per JESD22-B102

Environmental Specifications

High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-B106

Dimensions

DO-214AA (SMB J-Bend)



Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.077	0.086	1.950	2.200
B	0.160	0.180	4.060	4.570
C	0.130	0.155	3.300	3.940
D	0.084	0.096	2.130	2.440
E	0.030	0.060	0.760	1.520
F	-	0.008	-	0.203
G	0.205	0.220	5.210	5.590
H	0.006	0.012	0.152	0.305
I	0.089	-	2.260	-
J	0.085	-	2.160	-
K	-	0.107	-	2.740
L	0.085	-	2.160	-

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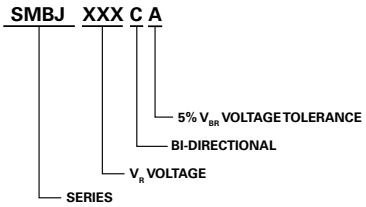
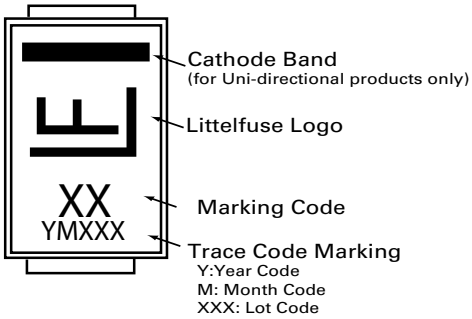
Part Numbering System



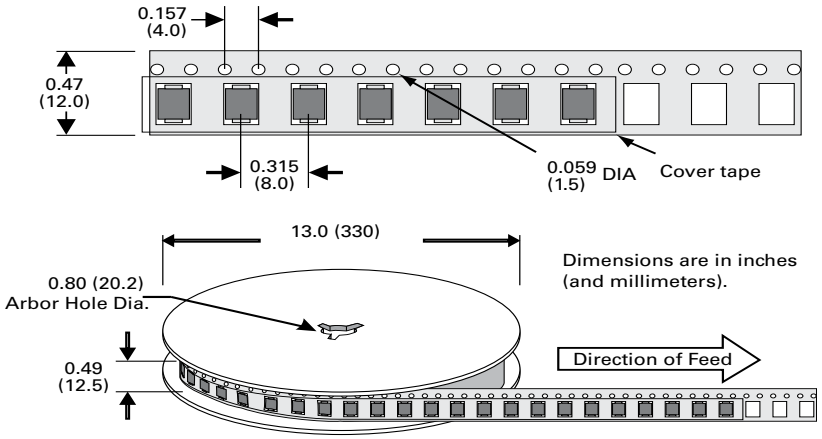
Part Marking System

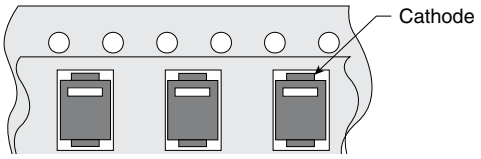


Packaging

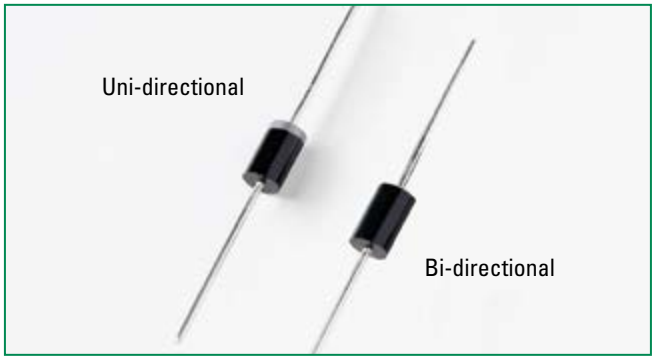
Part number	Component Package	Quantity	Packaging Option	Packaging Specification
SMBJxxxXX	DO-214AA	3000	Tape & Reel - 12mm tape/13" reel	EIA STD RS-481

Tape and Reel Specification





1.5KE Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
®	E128662/E230531

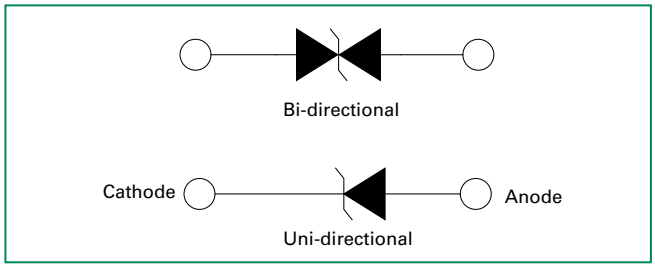
Maximum Ratings and Thermal Characteristics (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation by 10/1000µs Test Waveform (Fig.2) (Note 1)	P_{PPM}	1500	W
Steady State Power Dissipation on Inifinite Heat Sink at T_L=75°C (Fig. 6)	P_D	6.5	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave Unidirectional Only (Note 2)	I_{FSM}	200	A
Maximum Instantaneous Forward Voltage at 100A for Unidirectional Only (Note 3)	V_F	3.5/5.0	V
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 175	°C
Typical Thermal Resistance Junction to Lead	R_{uJL}	15	°C/W
Typical Thermal Resistance Junction to Ambient	R_{uJA}	75	°C/W

Notes:

1. Non-repetitive current pulse , per Fig. 4 and derated above T_A = 25°C per Fig. 3.
2. Measured on 8.3ms single half sine wave or equivalent square wave, duty cycle=4 per minute maximum.
3. V_F<3.5V for devices of $V_{BR} \leq$ 200V and V_F<5.0V for devices of $V_{BR} \geq$ 201V.

Functional Diagram



Description

The 1.5KE Series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

Features

- V_{BR} @T_J= V_{BR}@25°C x (1+αT x (T_J - 25))
  (αT:Temperature Coefficient)
- Glass passivated chip junction in DO-201 Package
- 1500W peak pulse capability at 10/1000µs waveform, repetition rate (duty cycles):0.01 %
- Fast response time: typically less than 1.0ps from 0 Volts to BV min
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2)
- EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)
- Low incremental surge resistance
- Typical I_R less than 1µA above 13V
- High temperature soldering guaranteed: 260°C/40 seconds / 0.375",(9.5mm) lead length, 5 lbs., (2.3kg) tension
- Plastic package has underwriters laboratory flammability classification 94V-O
- Matte tin lead–free plated
- Halogen free and RoHS compliant
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

Applications

TVS devices are ideal for the protection of I/O interfaces, V_{CC} bus and other vulnerable circuits used in telecom, computer, industrial and consumer electronic applications.

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TVS Diodes

Axial Leaded – 1500W > 1.5KE series

Electrical Characteristics (T_A=25°C unless otherwise noted)

Part Number (Uni)	Part Number (Bi)	Reverse Stand off Voltage V_R (Volts)	Breakdown Voltage V_{BR} (Volts) @ I_T		Test Current I_T (mA)	Maximum Clamping Voltage V_C @ I_{pp} (Volts)	Maximum Peak Pulse Current I_{pp} (A)	Maximum Reverse Leakage I_R @ V_R (µA)	Agency Approval
			MIN	MAX					
1.5KE6.8A	1.5KE6.8CA	5.80	6.45	7.14	10	10.5	144.8	1000	X
1.5KE7.5A	1.5KE7.5CA	6.40	7.13	7.88	10	11.3	134.5	500	X
1.5KE8.2A	1.5KE8.2CA	7.02	7.79	8.61	10	12.1	125.6	200	X
1.5KE9.1A	1.5KE9.1CA	7.78	8.65	9.50	1	13.4	113.4	50	X
1.5KE10A	1.5KE10CA	8.55	9.50	10.50	1	14.5	104.8	10	X
1.5KE11A	1.5KE11CA	9.40	10.50	11.60	1	15.6	97.4	5	X
1.5KE12A	1.5KE12CA	10.20	11.40	12.60	1	16.7	91.0	5	X
1.5KE13A	1.5KE13CA	11.10	12.40	13.70	1	18.2	83.5	1	X
1.5KE15A	1.5KE15CA	12.80	14.30	15.80	1	21.2	71.7	1	X
1.5KE16A	1.5KE16CA	13.60	15.20	16.80	1	22.5	67.6	1	X
1.5KE18A	1.5KE18CA	15.30	17.10	18.90	1	25.2	60.3	1	X
1.5KE20A	1.5KE20CA	17.10	19.00	21.00	1	27.7	54.9	1	X
1.5KE22A	1.5KE22CA	18.80	20.90	23.10	1	30.6	49.7	1	X
1.5KE24A	1.5KE24CA	20.50	22.80	25.20	1	33.2	45.8	1	X
1.5KE27A	1.5KE27CA	23.10	25.70	28.40	1	37.5	40.5	1	X
1.5KE30A	1.5KE30CA	25.60	28.50	31.50	1	41.4	36.7	1	X
1.5KE33A	1.5KE33CA	28.20	31.40	34.70	1	45.7	33.3	1	X
1.5KE36A	1.5KE36CA	30.80	34.20	37.80	1	49.9	30.5	1	X
1.5KE39A	1.5KE39CA	33.30	37.10	41.00	1	53.9	28.2	1	X
1.5KE43A	1.5KE43CA	36.80	40.90	45.20	1	59.3	25.6	1	X
1.5KE47A	1.5KE47CA	40.20	44.70	49.40	1	64.8	23.5	1	X
1.5KE51A	1.5KE51CA	43.60	48.50	53.60	1	70.1	21.7	1	X
1.5KE56A	1.5KE56CA	47.80	53.20	58.80	1	77.0	19.7	1	X
1.5KE62A	1.5KE62CA	53.00	58.90	65.10	1	85.0	17.9	1	X
1.5KE68A	1.5KE68CA	58.10	64.60	71.40	1	92.0	16.5	1	X
1.5KE75A	1.5KE75CA	64.10	71.30	78.80	1	103.0	14.8	1	X
1.5KE82A	1.5KE82CA	70.10	77.90	86.10	1	113.0	13.5	1	X
1.5KE91A	1.5KE91CA	77.80	86.50	95.50	1	125.0	12.2	1	X
1.5KE100A	1.5KE100CA	85.50	95.00	105.00	1	137.0	11.1	1	X
1.5KE110A	1.5KE110CA	94.00	105.00	116.00	1	152.0	10.0	1	X
1.5KE120A	1.5KE120CA	102.00	114.00	126.00	1	165.0	9.2	1	X
1.5KE130A	1.5KE130CA	111.00	124.00	137.00	1	179.0	8.5	1	X
1.5KE150A	1.5KE150CA	128.00	143.00	158.00	1	207.0	7.3	1	X
1.5KE160A	1.5KE160CA	136.00	152.00	168.00	1	219.0	6.9	1	X
1.5KE170A	1.5KE170CA	145.00	162.00	179.00	1	234.0	6.5	1	X
1.5KE180A	1.5KE180CA	154.00	171.00	189.00	1	246.0	6.2	1	X
1.5KE200A	1.5KE200CA	171.00	190.00	210.00	1	274.0	5.5	1	X
1.5KE220A	1.5KE220CA	185.00	209.00	231.00	1	328.0	4.6	1	X
1.5KE250A	1.5KE250CA	214.00	237.00	263.00	1	344.0	4.4	1	X
1.5KE300A	1.5KE300CA	256.00	285.00	315.00	1	414.0	3.7	1	X
1.5KE320A	1.5KE320CA	273.00	304.00	336.00	1	441.0	3.5	1	X
1.5KE350A	1.5KE350CA	300.00	332.00	368.00	1	482.0	3.2	1	X
1.5KE400A	1.5KE400CA	342.00	380.00	420.00	1	548.0	2.8	1	X
1.5KE440A	1.5KE440CA	376.00	418.00	462.00	1	602.0	2.5	1	X
1.5KE480A	1.5KE480CA	408.00	456.00	504.00	1	658.0	2.3	1	X
1.5KE510A	1.5KE510CA	434.00	485.00	535.00	1	698.0	2.1	1	X
1.5KE530A	1.5KE530CA	451.00	503.50	556.50	1	725.0	2.1	1	X
1.5KE540A	1.5KE540CA	460.00	513.00	567.00	1	740.0	2.0	1	X
1.5KE550A	1.5KE550CA	468.00	522.50	577.50	1	760.0	2.0	1	X
1.5KE600A	1.5KE600CA	512.00	570.00	630.00	1	828.0	1.8	1	

For bidirectional type having V_R of 10 volts and less, the I_R limit is double.

For parts without A, the V_{BR} is ±10% and V_C is 5% higher than with A parts.

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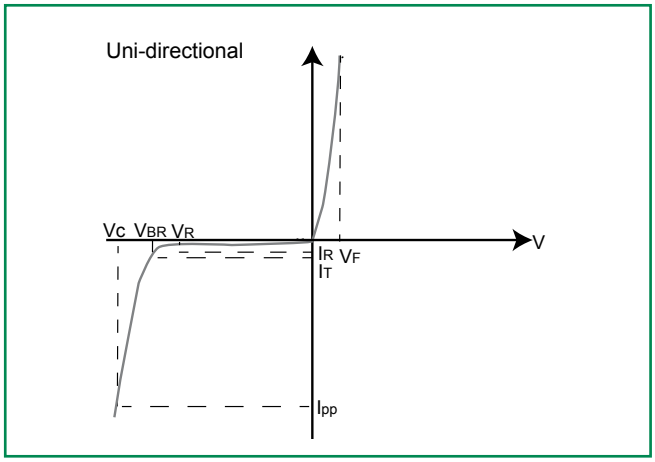
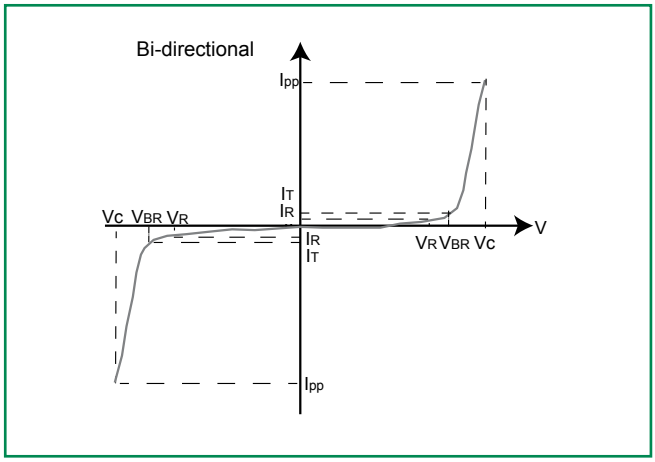
I-V Curve Characteristics





P_{PPM} Peak Pulse Power Dissipation – Max power dissipation
V_R Stand-off Voltage – Maximum voltage that can be applied to the TVS without operation
V_{BR} Breakdown Voltage – Maximum voltage that flows though the TVS at a specified test current (I_T)
V_C Clamping Voltage – Peak voltage measured across the suppressor at a specified Ippm (peak impulse current)
I_R Reverse Leakage Current – Current measured at V_R
V_F Forward Voltage Drop for Uni-directional

Ratings and Characteristic Curves (T_A=25°C unless otherwise noted)

Figure 1 - TVS Transients Clamping Waveform

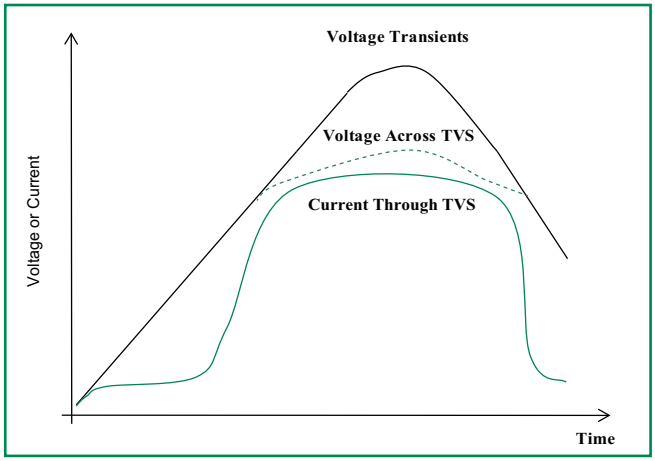
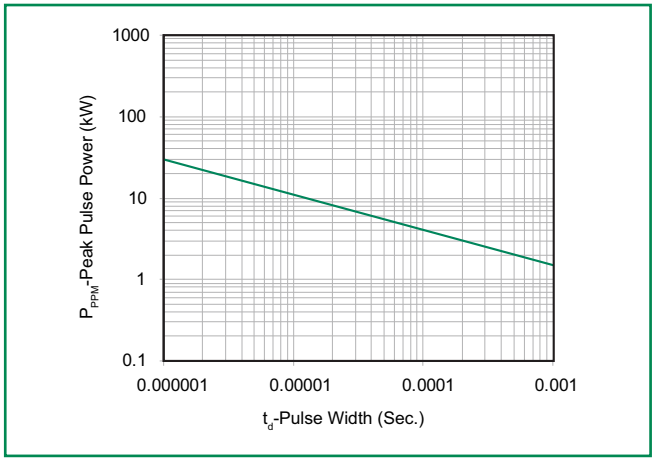


Figure 2 - Peak Pulse Power Rating



continues on next page.

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Ratings and Characteristic Curves (T_A=25°C unless otherwise noted) (Continued)

Figure 3 - Pulse Derating Curve

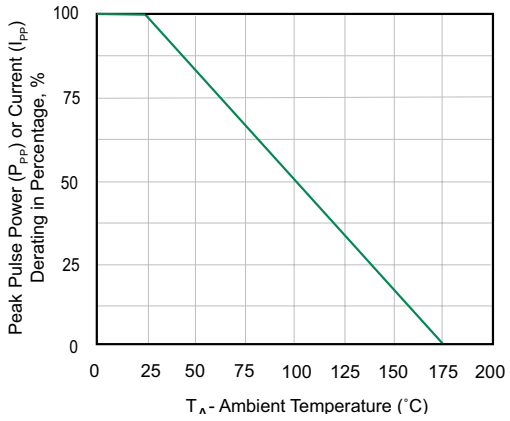


Figure 4 - Pulse Waveform

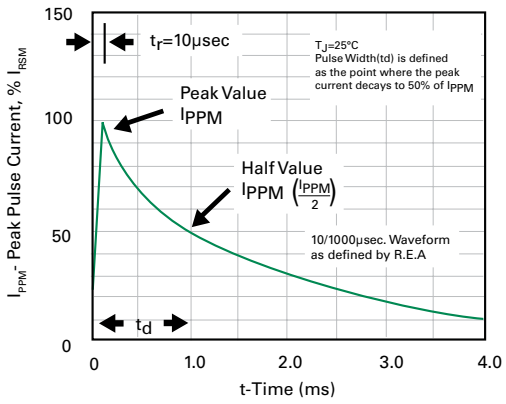


Figure 5 - Typical Junction Capacitance

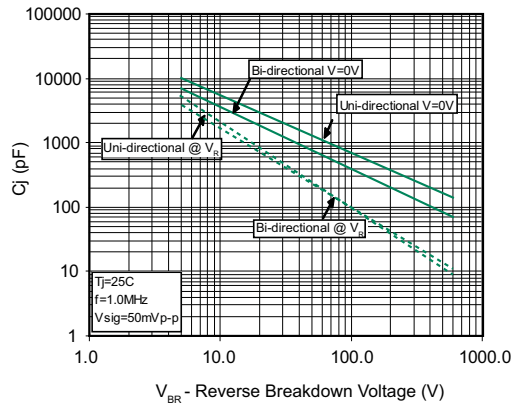


Figure 6 - Steady State Power Derating Curve

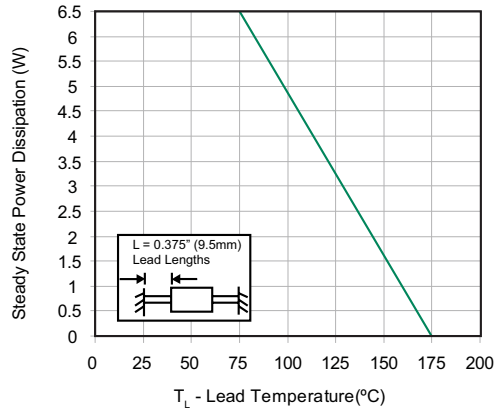
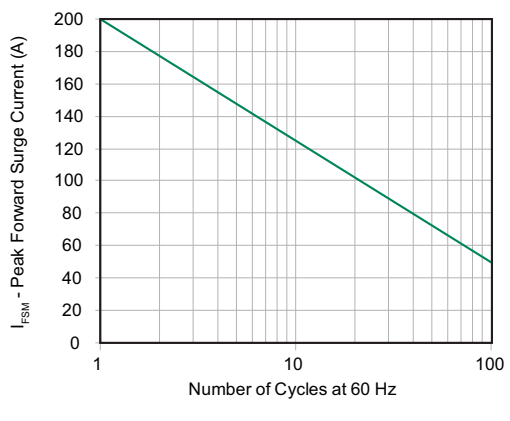
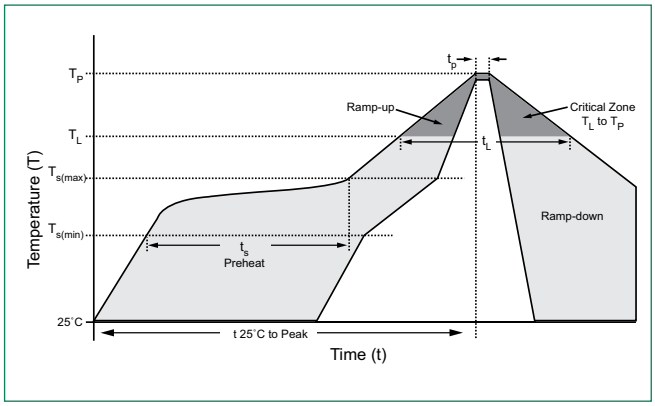


Figure 7 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional Only



Soldering Parameters

Reflow Condition		Lead–free assembly
Pre Heat	- Temperature Min ($T_{s(min)}$)	150°C
	- Temperature Max ($T_{s(max)}$)	200°C
	- Time (min to max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		3°C/second max
Reflow	- Temperature (T_L) (Liquidus)	217°C
	- Time (min to max) (t_s)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		280°C



Flow/Wave Soldering (Solder Dipping)

Peak Temperature :	265°C
Dipping Time :	10 seconds
Soldering :	1 time

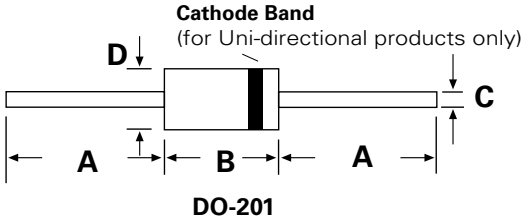
Physical Specifications

Weight	0.045oz., 1.2g
Case	JEDEC DO-201 molded plastic body over passivated junction.
Polarity	Color band denotes the cathode except Bipolar.
Terminal	Matte Tin axial leads, solderable per JESD22-B102.

Environmental Specifications

High Temp. Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
H3TRB	JESD22-A101
RSH	JESD22-B106

Dimensions



DO-201

Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	1.000	-	25.40	-
B	0.285	0.375	7.20	9.50
C	0.038	0.042	0.96	1.07
D	0.190	0.210	4.80	5.30

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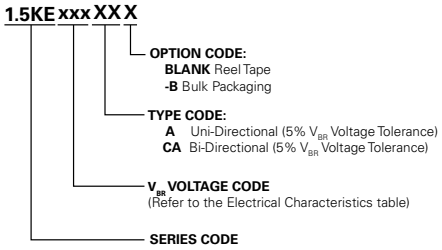
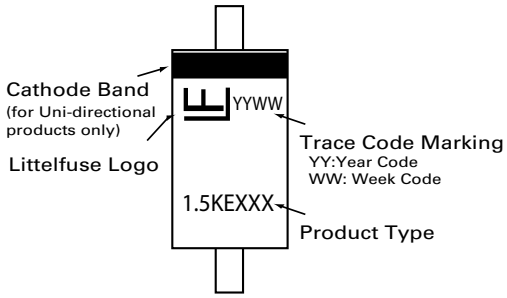
TVS Diodes
Axial Leaded – 1500W > 1.5KE series

Part Numbering System



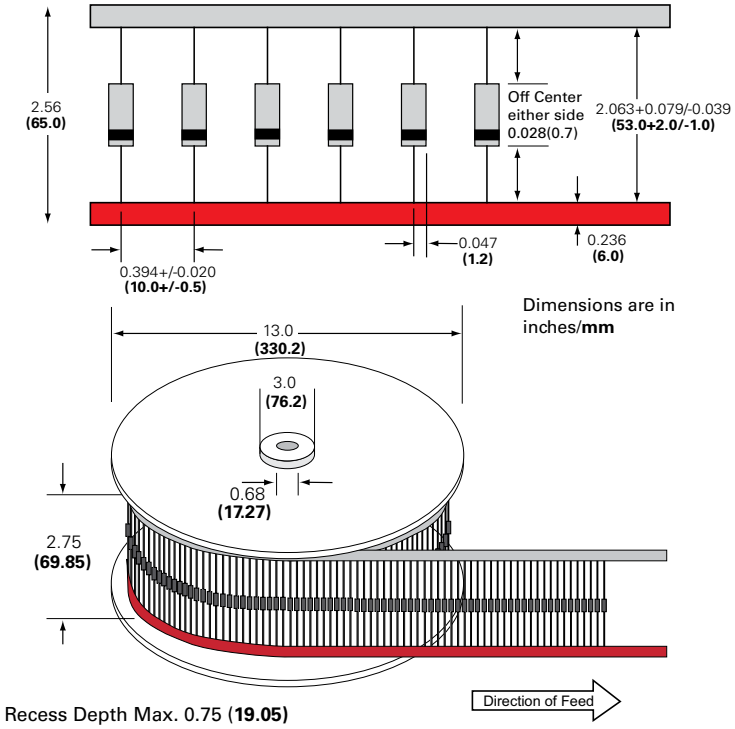
Part Marking System



Packaging

Part Number	Component Package	Quantity	Packaging Option	Packaging Specification
1.5KExxxXX	DO-201	1200	Tape & Reel	EIA STD RS-296
1.5KExxxXX-B	DO-201	500	BULK	Littelfuse Spec.

Tape and Reel Specification



Recess Depth Max. 0.75 (**19.05**)

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