1500 Watt Transient Voltage Suppressor

M1.5KE6.8A – MXL1.5KE400CA(e3)

Product Overview

The M1.5KE6.8A - MXL1.5KE200CA series of axial lead 1,500 watt transient voltage suppressors provide a selection of standoff voltages (V_{WM}) from 5.8 to 324V, with nominal breakdown voltages of 6.8 to 400V. These high-reliability devices are available in either unidirectional or bidirectional versions. RoHS compliant versions are available. These are available with a variety of upscreening options for enhanced reliability. They can protect against the secondary effects of lightning per IEC61000-4-5 and against voltage pulses from inductive switching environments and induced by RF radiation. Since their response time is virtually instantaneous, they can also be used in protection from ESD and EFT per IEC61000-4-2 and IEC61000-4-4.

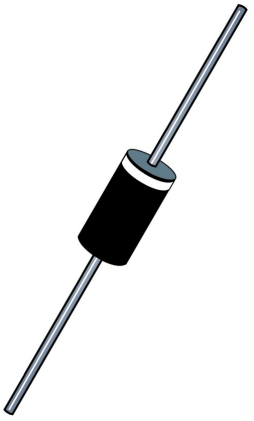
Features

- Available in both unidirectional and bidirectional configurations
- 3σ lot norm screening performed on standby current I_D for all M prefix devices
- 100% surge tested devices
- Suppress transients up to 1,500 watts at 10/1000 µs (see Figure 4-1)
- Enhanced reliability screening in reference to MIL-PRF-19500 are available. Refer to High Reliability Non-Hermetic Product Portfolio for more details on the screening options.
  (See Part Nomenclature for all options.)
- High reliability controlled devices have wafer fabrication and assembly lot traceability for all M prefix devices
- Moisture classification is level 1 with no dry pack required per IPC/JEDEC J-STD-020F for all M prefix devices
- RoHS compliant versions are available
- Surface mount equivalent packages for PCB mounting are available as MSMCJ5.0A - MXLSMCG170Ae3 (contact Microchip for other options).

Applications/Benefits

- Available in working standoff voltage (V_{WM}) range 5.8 to 324 volts, with nominal breakdown voltage $V_{(BR)}$ 6.8 to 400 volts.
- Economical axial-lead plastic encapsulated TVS series for thru-hole mounting
- Protects sensitive components such as IC's, CMOS, Bipolar, BiCMOS, ECL, DTL, T2L, etc
- Protection from switching transients and induced RFI
- Compliant to IEC 61000-4-2 and IEC 61000-4-4 for ESD and EFT protection respectively.
- Secondary lightning protection per IEC-4-5 with 42 ohms source impedance:
  Class 1: M1.5KE6.8A to MXL1.5KE200CA
  Class 2: M1.5KE6.8A to MXL1.5KE180CA
  Class 3: M1.5KE6.8A to MXL1.5KE91CA
  Class 4: M1.5KE6.8A to MXL1.5KE43CA
- Secondary lightning protection per IEC61000-4-5 with 12 ohms source impedance:
  Class 1: M1.5KE6.8A to MXL1.5KE110CA
  Class 2: M1.5KE6.8A to MXL1.5KE56CA
  Class 3: M1.5KE6.8A to MXL1.5KE27CA
  Class 4: M1.5KE6.8A to MXL1.5KE13CA
- Secondary lightning protection per IEC61000-4-5 with 2 ohms source impedance:
  Class 2: M1.5KE6.8A to MXL1.5KE24CA
  Class 3: M1.5KE6.8A to MXL1.5KE12CA

Figure 1. Case 1 Package



Also available in:

J-bend Package
(surface mount)
MSMCJ5.0A – MXLSMCJ170CA

Gull-wing Package
(surface mount)
MSMCG5.0A – MXLSMCG170CA

Table of Contents

1. Maximum Ratings

Table 1-1. Maximum Ratings

Parameters/Test Conditions		Symbol	Value	Unit
Junction and storage temperature		T_J and T_{STG}	–65 to +150	°C
Thermal resistance, junction to lead[1]		$R_{\Theta JL}$	22	°C/W
Thermal resistance, junction to ambient[2]		$R_{\Theta JA}$	82	°C/W
Peak pulse power at T_L = +25 °C[3]		P_{PP}	1500	W
Average power dissipation	at T_L = +40 °C[1] at T_A = +25 °C[2]	$P_{M(AV)}$	5 1.52	W
$T_{clamping}$ (0 volts to $V_{(BR)}$ min)	Unidirectional Bidirectional		< 100 < 5	ps ns
Surge peak forward current[4]		I_{FSM}	200	A
Solder temperature at 10 seconds		T_{SP}	260	°C

Notes:

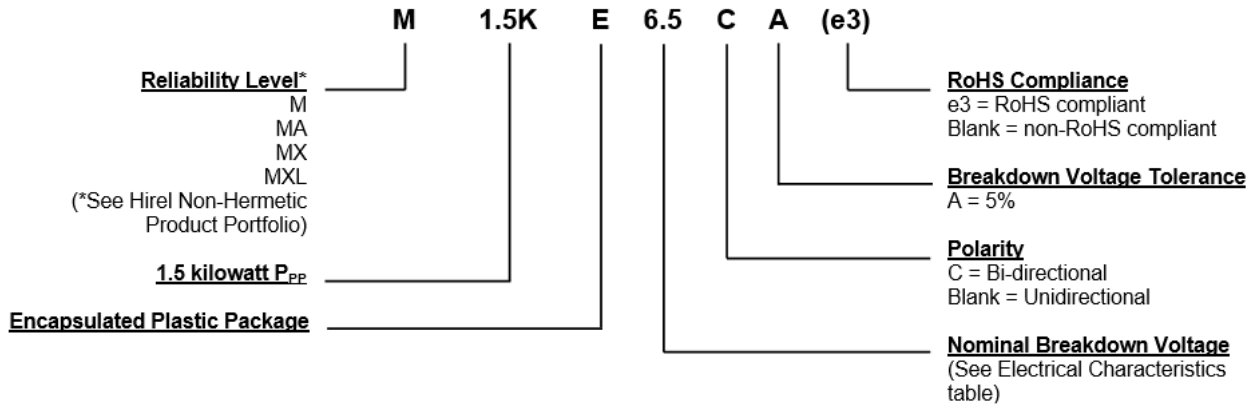
1. At 0.375 inch (10 mm) from body
2. Mounted on FR4 PC board with 4 mm^2 copper pads (1 oz) and track width 1 mm, length 25 mm
3. At 10/1000 µs with repetition rate of 0.01% or less (see Figure 4-1)
4. At 8.3 ms half-sine wave for unidirectional devices only

1.1 Mechanical Packaging

- Case: Void-free transfer molded thermosetting epoxy body meeting UL94V-0
- Terminals: Tin-lead or RoHS compliant annealed matte-tin plating readily solderable per MIL-STD-750 method 2026
- Marking: Reliability level, part number, date code
- Polarity: Cathode indicated by band. Bidirectional not marked.
- Tape and Reel option: Standard per EIA-296 (add “TR” suffix to part number). Consult factory for quantities.
- Weight: Approximately 1.5 grams
- See Package Dimensions

2. Part Nomenclature

Figure 2-1. Part Nomenclature



2.1 Symbols and Definitions

Table 2-1. Symbols and Definitions

Symbol	Definition
$\alpha_{V(BR)}$	Temperature coefficient of breakdown voltage: The change in breakdown voltage divided by the change in temperature that caused it expressed in %/°C or mV/°C.
C_T	Total capacitance: The total small signal capacitance between the diode terminals of a complete device.
$I_{(BR)}$	Breakdown current: The current used for measuring breakdown voltage $V_{(BR)}$.
I_D	Standby current: The current through the device at working standoff voltage.
I_{PP}	Peak impulse current: The peak current during an impulse.
P_{PP}	Peak pulse power: The peak power that can be applied for a specific pulse width and waveform. The product of I_{PP} and V_C.
$V_{(BR)}$	Breakdown voltage: The voltage across the device at a specified current $I_{(BR)}$ in the breakdown region.
V_C	Clamping voltage: The voltage across the device in a region of low differential resistance during the application of an impulse current (I_{PP}) for a specified waveform.
V_{WM}	Working standoff voltage: The maximum-rated value of DC or repetitive peak positive cathode-to-anode voltage that may be continuously applied over the standard operating temperature.

3. Electrical Characteristics

Table 3-1. Electrical Characteristics at 25 °C Unless Otherwise Stated[1-4]

Part Number	Working Standoff Voltage V_{WM} (Note 1)	Breakdown Voltage $V_{(BR)}$ at $I_{(BR)}$		Maximum Clamping Voltage V_C at I_{PP}	Maximum Standby Current I_D at V_{WM}	Peak Pulse Current at 10/1000 µs I_{PP} (Figure 4-2)	Temperature Coefficient of $V_{(BR)}$ $\alpha V_{(BR)}$
	Volts	Volts Min. Max.	mA	Volts	µA	A	%/°C
M1.5KE6.8A	5.80	6.45 – 7.14	10	10.5	1000	143.0	0.057
M1.5KE7.5A	6.40	7.13 – 7.88	10	11.3	500	132.0	0.061
M1.5KE8.2A	7.02	7.79 – 8.61	10	12.1	200	124.0	0.065
M1.5KE9.1A	7.78	8.65 – 9.55	1	13.4	50	112.0	0.068
M1.5KE10A	8.55	9.50 – 10.50	1	14.5	10	103.0	0.073
M1.5KE11A	9.40	10.50 – 11.60	1	15.6	5	96.0	0.075
M1.5KE12A	10.22	11.40 – 12.60	1	16.7	5	90.0	0.078
M1.5KE13A	11.10	12.40 – 13.70	1	18.2	5	82.0	0.081
M1.5KE15A	12.80	14.30 – 15.80	1	21.2	1	71.0	0.084
M1.5KE16A	13.60	15.20 – 16.80	1	22.5	1	67.0	0.086
M1.5KE18A	15.30	17.10 – 18.90	1	25.2	1	59.5	0.088
M1.5KE20A	17.10	19.00 – 21.00	1	27.7	1	54.0	0.090
M1.5KE22A	18.80	20.90 – 23.10	1	30.6	1	49.0	0.092
M1.5KE24A	20.50	22.80 – 25.20	1	33.2	1	45.0	0.094
M1.5KE27A	23.10	25.70 – 28.40	1	37.5	1	40.0	0.096
M1.5KE30A	25.60	28.50 – 31.50	1	41.4	1	36.0	0.097
M1.5KE33A	28.20	31.40 – 34.70	1	45.7	1	33.0	0.098
M1.5KE36A	30.80	34.20 – 37.80	1	49.9	1	30.0	0.099
M1.5KE39A	33.30	37.10 – 41.00	1	53.9	1	28.0	0.100
M1.5KE43A	36.80	40.90 – 45.20	1	59.3	1	25.3	0.101
M1.5KE47A	40.20	44.70 – 49.40	1	64.8	1	23.2	0.101
M1.5KE51A	43.60	48.50 – 53.60	1	70.1	1	21.4	0.102
M1.5KE56A	47.80	53.20 – 58.80	1	77.0	1	19.5	0.103
M1.5KE62A	53.00	58.90 – 65.10	1	85.0	1	17.7	0.104
M1.5KE68A	58.10	64.60 – 71.40	1	92.0	1	16.3	0.104
M1.5KE75A	64.10	71.30 – 78.80	1	103.0	1	14.6	0.105
M1.5KE82A	70.10	77.90 – 86.10	1	113.0	1	13.3	0.105
M1.5KE91A	77.80	86.50 – 95.50	1	125.0	1	12.0	0.106
M1.5KE100A	85.50	95.00 – 105.00	1	137.0	1	11.0	0.106
M1.5KE110A	94.00	105.00 – 116.00	1	152.0	1	9.9	0.107
M1.5KE120A	102.00	114.00 – 126.00	1	165.0	1	9.1	0.107
M1.5KE130A	111.00	124.00 – 137.00	1	179.0	1	8.4	0.107
M1.5KE150A	128.00	143.00 – 158.00	1	207.0	1	7.2	0.108
M1.5KE160A	136.00	152.00 – 168.00	1	219.0	1	6.8	0.108

.....continued

Part Number	Working Standoff Voltage V_{WM} (Note 1)	Breakdown Voltage $V_{(BR)}$ at $I_{(BR)}$		Maximum Clamping Voltage V_C at I_{PP}	Maximum Standby Current I_D at V_{WM}	Peak Pulse Current at 10/1000 µs I_{PP} (Figure 4-2)	Temperature Coefficient of $V_{(BR)}$ $\alpha V_{(BR)}$
	Volts	Volts Min. Max.	mA	Volts	µA	A	%/°C
M1.5KE170A	145.00	162.00 – 179.00	1	234.0	1	6.4	0.108
M1.5KE180A	154.00	171.00 – 189.00	1	246.0	1	6.1	0.108
M1.5KE200A	171.00	190.00 – 210.00	1	274.0	1	5.5	0.108
M1.5KE220A	185.00	209.00 – 231.00	1	328.0	1	4.6	0.110
M1.5KE250A	214.00	237.00 – 263.00	1	344.0	1	5.0	0.110
M1.5KE300A	256.00	285.00 – 315.00	1	414.0	1	5.0	0.111
M1.5KE350A	300.00	332.00 – 368.00	1	482.0	1	4.0	0.111
M1.5KE400A	324.00	380.00 – 420.00	1	548.0	1	4.0	0.111

Notes:

1. Normal selection criteria for TVS devices is by working standoff voltage (V_{WM}) and should be equal or greater than DC or continuous peak operating voltage.
2. TVS devices are tested to maximum peak pulse current (I_{PP}) with clamping voltage monitored. This surge capability is one of the most significant electrical characteristics of the device and should be considered as part of customer quality inspections.
3. For bidirectional types having V_{WM} of 8 volts and under, the I_D leakage current is doubled. Also for bidirectional parts, the capacitance will be half that shown in Figure 4-2 for zero bias.
4. For unidirectional, the forward voltage (V_F) is 3.5 volts maximum at 100 Amps peak for 8.3 ms half-sine wave.

4. Graphs

Figure 4-1. Peak Pulse Power Vs. Pulse Time (t_W) in µs

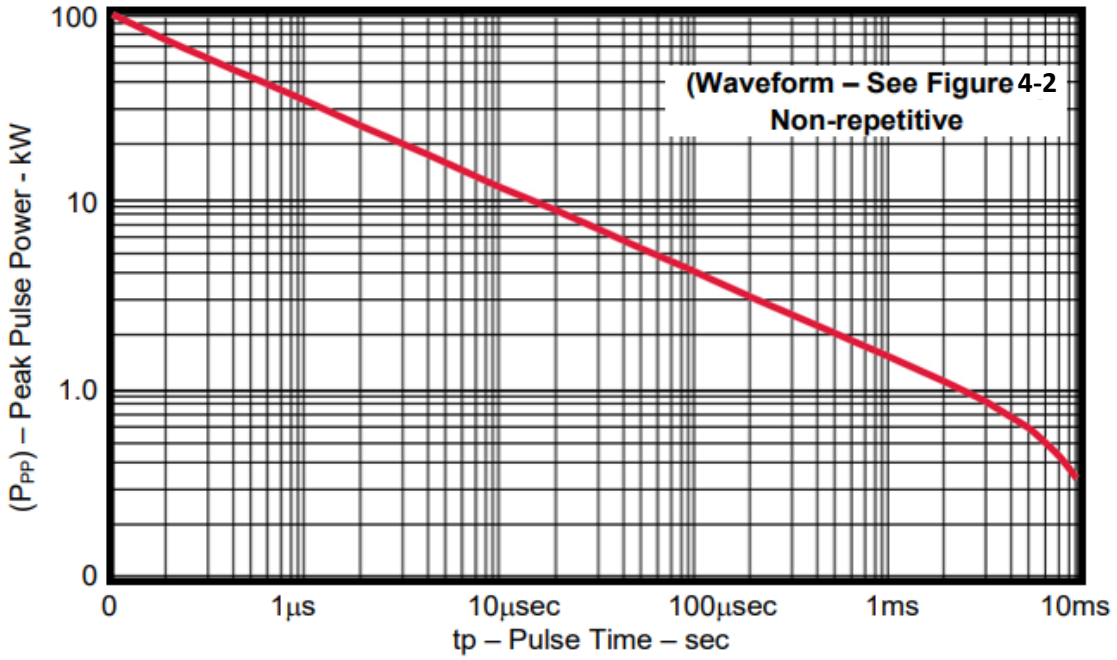


Figure 4-2. Pulse Waveform for 10/1000 Exponential Surge

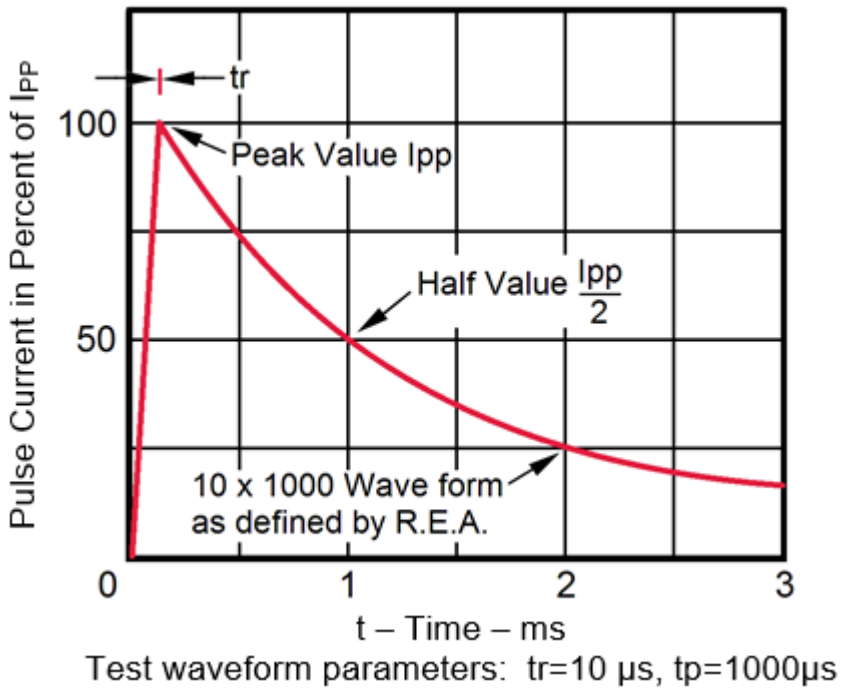


Figure 4-3. Derating Curve

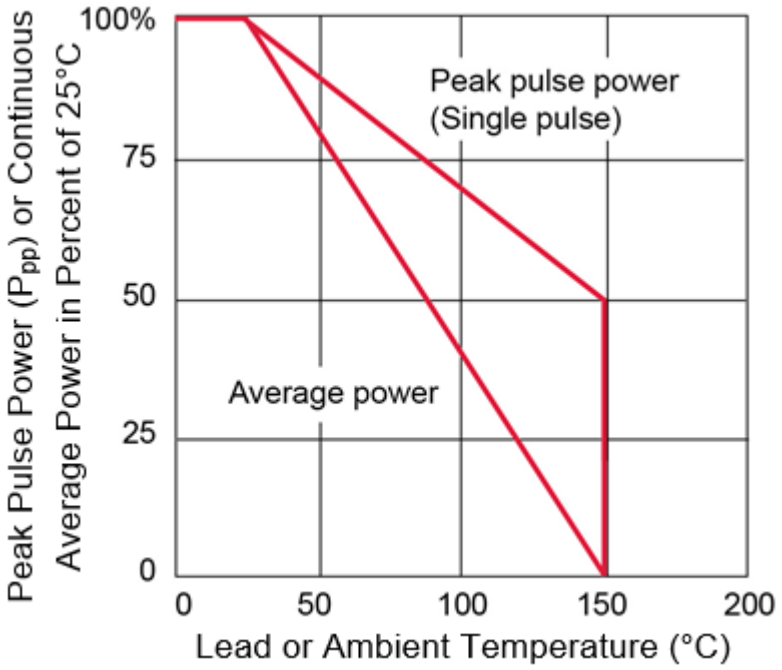
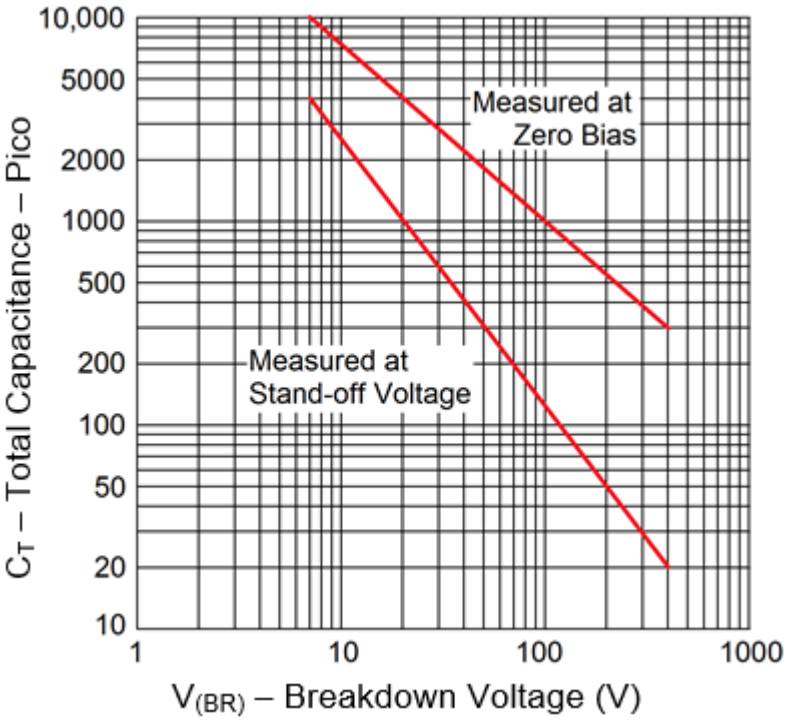


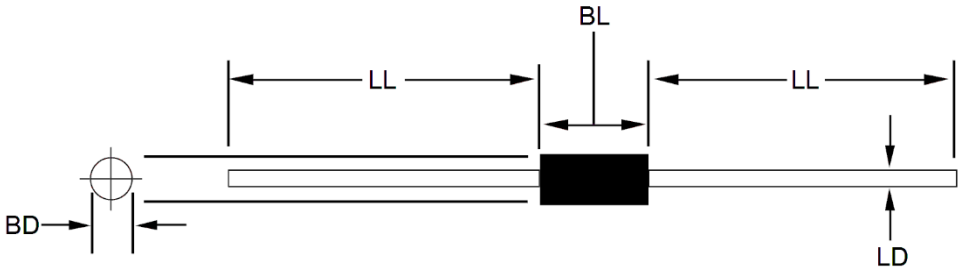
Figure 4-4. Typical Capacitance Vs. Breakdown Voltage



Bidirectional capacitance is half that shown.

5. Package Dimensions

Figure 5-1. Package Dimensions[1-4]



1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. The major diameter is essentially constant along its length.
4. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.

Symbol	Dimensions			
	Inches		Millimeters	
	Min.	Max.	Min.	Max.
BD	0.190	0.205	4.826	5.207
BL	0.360	0.375	9.146	9.527
LD	0.038	0.042	0.958	1.074
LL	1.10	1.625	27.9	41.28

6. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	01/2024	Initial revision.

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