RoHS Available

1500 Watt Low Capacitance Transient Voltage Suppressor

DESCRIPTION

This Transient Voltage Suppressor (TVS) product family includes a rectifier diode element in series and in an opposite direction. This allows it to achieve low capacitance performance below 100 pF (see figure 2). The low level of TVS capacitance may be used for protecting higher frequency applications in inductive switching environments or electrical systems involving secondary lightning effects per IEC61000-4-5 as well as RTCA/DO-160 or ARINC 429 for airborne avionics. With virtually instantaneous response, they also protect from ESD and EFT per IEC61000-4-2 and IEC61000-4-4. If bipolar transient capability is required, two of these low capacitance TVS devices may be used in parallel in opposite directions (anti-parallel) for complete ac protection as shown in figure 4.

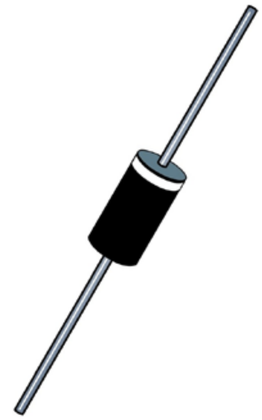
Important: For the latest information, visit our website http://www.microsemi.com.

FEATURES

- Unidirectional low-capacitance TVS series (for bidirectional see figure 4).
- Economical plastic encapsulated TVS series for thru-hole mounting.
- Suppresses transients up to 1500 watts @ 10/1000 µs (see figure 1)*.
- Clamps transient in less than 100 pico seconds.
- Working voltage (V_{WM}) range 6.5 V to 170 V.
- RoHS compliant versions available.

APPLICATIONS / BENEFITS

- Protection from switching transients and induced RF.
- Low capacitance for data line protection up to 1 MHz.
- Protection for aircraft fast data rate lines up to Level 5 Waveform 4 and Level 2 Waveform 5A in RTCA/DO-160D (also see MicroNote 130) & ARINC 429 with bit rates of 100 kb/s (per ARINC 429, Part 1, par 2.4.1.1).
- ESD & EFT protection per IEC 61000-4-2 and -4-4.
- Secondary lightning protection per IEC61000-4-5 with 42 ohms source impedance:
  - Class 1: LCE6.5 to LC170A
  - Class 2: LCE6.5 to LC150A
  - Class 3: LCE6.5 to LC70A
  - Class 4: LCE6.5 to LC36A
- Secondary lightning protection per IEC61000-4-5 with 12 ohms source impedance:
  - Class 1 : LCE6.5 to LC90A
  - Class 2: LCE6.5 to LC45A
  - Class 3: LCE6.5 to LC22A
  - Class 4: LCE6.5 to LC11A
- Secondary lightning protection per IEC61000-4-5 with 2 ohms source impedance:
  - Class 2: LCE6.5 to LC20A
  - Class 3: LCE6.5 to LC10A



Case 1 Package

Also available in:

HiRel Case 1 package
(axial-lead)
MLCE6.5 – MXLCE170A

DO-13 (metal) package
(axial-lead)
LC6.5 – LC170A

DO-215AB and DO-214AB package
(surface mounts)
SMCG(J)LCE6.5 – SMCG(J)LCE170A

MSC – Lawrence
6 Lake Street,
Lawrence, MA 01841
Tel: 1-800-446-1158 or (978) 620-2600
Fax: (978) 689-0803

MSC – Ireland
Gort Road Business Park,
Ennis, Co. Clare, Ireland
Tel: +353 (0) 65 6840044
Fax: +353 (0) 65 6822298

Website:
www.microsemi.com

MAXIMUM RATINGS

Parameters/Test Conditions	Symbol	Value	Unit
Junction and Storage Temperature	T_J and T_{STG}	-65 to +150	ºC
Thermal Resistance, Junction to Lead @ 0.375 inch (10 mm) from body	$R_{\Theta JL}$	22	ºC/W
Thermal Resistance, Junction to Ambient (1)	$R_{\Theta JA}$	82	ºC/W
Peak Pulse Power @ T_L = +25 ºC (2)	P_{PP}	1500	W
Rated Average Power Dissipation (3) @ T_L = +40 ºC @ T_A = +25 ºC	$P_{M(AV)}$	5 1.52	W
Solder Temperature @ 10 s	T_{SP}	260	ºC

Notes:
1. When mounted on FR4 PC board with 4 mm^2 copper pads (1 oz) and track width 1 mm, length 25 mm.
2. At 10/1000 µs with repetition rate of 0.01% or less (see figure 1).
3. At 3/8 inch (10 mm) from body. TVS devices are not typically used for dc power dissipation and are instead operated at or less than their rated standoff voltage (V_{WM}) except for transients that briefly drive the device into avalanche breakdown (V_{BR} to V_C region). Also see figure 4 for further protection details in rated peak pulse power for unidirectional and bidirectional configurations respectively.

MECHANICAL and 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: Part number and polarity band.
- POLARITY: Cathode indicated by band.
- TAPE & REEL option: Standard per EIA-296 (add “TR” suffix to part number). Consult factory for quantities.
- WEIGHT: Approx 1.5 grams.
- See Package Dimensions on last page.

PART NOMENCLATURE

LC E 6.5 A (e3)

- **LC** – **Low Capacitance Rated**
- **E** – **Encapsulated Plastic Package**
- **6.5** – **Reverse Standoff Voltage (V_{WM})** (See Electrical Characteristics table)
- **A** – **+/- 5% Tolerance Level**
- **(e3)** – **RoHS Compliance**
  e3 = RoHS compliant
  Blank = non-RoHS compliant

SYMBOLS & DEFINITIONS

Symbol	Definition
$I_{(BR)}$	Breakdown Current: The current used for measuring breakdown voltage $V_{(BR)}$.
$V_{(BR)}$	Breakdown Voltage: This is the breakdown voltage the device will exhibit at 25 ºC.
V_{WM}	Rated Working Standoff Voltage: The maximum peak voltage that can be applied over the operating temperature range.
V_C	Maximum Clamping Voltage: The maximum peak voltage appearing across the TVS when subjected to the peak pulse current in a one millisecond time interval. The peak pulse voltage is the combination of voltage rise due to both the series resistance and thermal rise and positive temperature coefficient $\alpha_{V(BR)}$.
I_{PP}	Peak Impulse Current: The peak current during the impulse.
P_{PP}	Peak Pulse Power: The pulse power as determined by the product of V_C and I_{PP}.
I_D	Standby Current: The current at the standoff voltage V_{WM}.

ELECTRICAL CHARACTERISTICS @ 25 °C

MICROSEMI PART NUMBER	RATED WORKING STANDOFF VOLTAGE V_{WM} Volts	BREAKDOWN VOLTAGE $V_{(BR)}$ Volts		@ $I_{(BR)}$ mA	MAXIMUM STANDBY CURRENT I_D @ V_{WM} µA	MAXIMUM CLAMPING VOLTAGE V_C @ I_{PP} Volts	MAXIMUM PEAK IMPULSE CURRENT I_{PP} @ 10/1000 µs Amps	CAPACI-TANCE @ 0 Volts f = 1 MHz C pF	WORKING INVERSE BLOCKING VOLTAGE V_{WIB} Volts	INVERSE BLOCKING LEAKAGE CURRENT I_{IB} @ V_{WIB} µA	PEAK INVERSE BLOCKING VOLTAGE VOLTS V_{PIB} Volts
		MIN	MAX								
LCE6.5	6.5	7.22	8.82	10	1000	12.3	100	100	75	10	100
LCE6.5A	6.5	7.22	7.98	10	1000	11.2	100	100	75	10	100
LCE7.0	7.0	7.78	9.51	10	500	13.3	100	100	75	10	100
LCE7.0A	7.0	7.78	8.60	10	500	12.0	100	100	75	10	100
LCE7.5	7.5	8.33	10.2	10	250	14.3	100	100	75	10	100
LCE7.5A	7.5	8.33	9.21	10	250	12.9	100	100	75	10	100
LCE8.0	8.0	8.89	10.9	1	100	15.0	100	100	75	10	100
LCE8.0A	8.0	8.89	9.83	1	100	13.6	100	100	75	10	100
LCE8.5	8.5	9.44	11.5	1	50	15.9	94	100	75	10	100
LCE8.5A	8.5	9.44	10.4	1	50	14.4	100	100	75	10	100
LCE9.0	9.0	10.0	12.2	1	10	16.9	89	100	75	10	100
LCE9.0A	9.0	10.0	11.1	1	10	15.4	97	100	75	10	100
LCE10	10	11.1	13.6	1	5	18.8	80	100	75	10	100
LCE10A	10	11.1	12.3	1	5	17.0	88	100	75	10	100
LCE11	11	12.2	14.9	1	5	20.1	74	100	75	10	100
LCE11A	11	12.2	13.5	1	5	18.2	82	100	75	10	100
LCE12	12	13.3	16.3	1	5	22.0	68	100	75	10	100
LCE12A	12	13.3	14.7	1	5	19.9	75	100	75	10	100
LCE13	13	14.4	17.6	1	5	23.8	63	100	75	10	100
LCE13A	13	14.4	15.9	1	5	21.5	70	100	75	10	100
LCE14	14	15.6	19.1	1	5	25.8	58	100	75	10	100
LCE14A	14	15.6	17.2	1	5	23.2	65	100	75	10	100
LCE15	15	16.7	20.4	1	5	26.9	56	100	75	10	100
LCE15A	15	16.7	18.5	1	5	24.4	61	100	75	10	100
LCE16	16	17.8	21.8	1	5	28.8	52	100	75	10	100
LCE16A	16	17.8	19.7	1	5	26.0	57	100	75	10	100
LCE17	17	18.9	23.1	1	5	30.5	49	100	75	10	100
LCE17A	17	18.9	20.9	1	5	27.6	54	100	75	10	100
LCE18	18	20.0	24.4	1	5	32.2	46	100	75	10	100
LCE18A	18	20.0	22.1	1	5	29.2	51	100	75	10	100
LCE20	20	22.2	27.1	1	5	35.8	42	100	75	10	100
LCE20A	20	22.2	24.5	1	5	32.4	46	100	75	10	100
LCE22	22	24.4	29.8	1	5	39.4	38	100	75	10	100
LCE22A	22	24.4	26.9	1	5	35.5	42	100	75	10	100
LCE24	24	26.7	32.6	1	5	43.0	35	100	75	10	100
LCE24A	24	26.7	29.5	1	5	38.9	39	100	75	10	100
LCE26	26	28.9	35.3	1	5	46.6	32	100	75	10	100
LCE26A	26	28.9	31.9	1	5	42.1	36	100	75	10	100
LCE28	28	31.1	38.0	1	5	50.1	30	100	75	10	100
LCE28A	28	31.1	34.4	1	5	45.4	33	100	75	10	100
LCE30	30	33.3	40.7	1	5	53.5	28	100	75	10	100
LCE30A	30	33.3	36.8	1	5	48.4	31	100	75	10	100
LCE33	33	36.7	44.9	1	5	58.0	25.4	100	75	10	100
LCE33A	33	36.7	40.6	1	5	53.3	28.1	100	75	10	100
LCE36	36	40.0	48.9	1	5	64.3	23.3	100	75	10	100
LCE36A	36	40.0	44.2	1	5	58.1	25.8	100	75	10	100
LCE40	40	44.4	54.3	1	5	71.4	21.0	100	75	10	100
LCE40A	40	44.4	49.1	1	5	64.5	23.3	100	75	10	100
LCE43	43	47.8	58.4	1	5	76.7	19.5	100	150	10	200
LCE43A	43	47.8	52.8	1	5	69.4	21.6	100	150	10	200
LCE45	45	50.0	61.1	1	5	80.3	18.7	100	150	10	200
LCE45A	45	50.0	55.3	1	5	72.7	20.6	100	150	10	200
LCE48	48	53.3	65.1	1	5	85.5	17.5	100	150	10	200
LCE48A	48	53.3	58.9	1	5	77.4	19.4	100	150	10	200
LCE51	51	56.7	69.3	1	5	91.1	16.5	100	150	10	200
LCE51A	51	56.7	62.7	1	5	82.4	18.2	100	150	10	200

Continued.

ELECTRICAL CHARACTERISTICS @ 25 °C (continued)

MICROSEMI PART NUMBER	RATED WORKING STANDOFF VOLTAGE V_{WM} Volts	BREAKDOWN VOLTAGE $V_{(BR)}$ Volts MIN	MAX	@ $I_{(BR)}$ mA	MAXIMUM STANDBY CURRENT I_D @ V_{WM} µA	MAXIMUM CLAMPING VOLTAGE V_C @ I_{PP} Volts	MAXIMUM PEAK IMPULSE CURRENT I_{PP} @ 10/1000 µs Amps	CAPACITANCE @ 0 Volts f = 1 MHz C pF	WORKING INVERSE BLOCKING VOLTAGE V_{WIB} Volts	INVERSE BLOCKING LEAKAGE CURRENT I_{IB} @ V_{WIB} µA	PEAK INVERSE BLOCKING VOLTAGE VOLTS V_{PIB} Volts
LCE54	54	60.0	73.3	1	5	96.3	15.6	100	150	10	200
LCE54A	54	60.0	66.3	1	5	87.1	17.2	100	150	10	200
LCE58	58	64.4	78.7	1	5	103.0	14.6	100	150	10	200
LCE58A	58	64.4	71.2	1	5	93.6	16.0	100	150	10	200
LCE60	60	66.7	81.5	1	5	107.0	14.0	90	150	10	200
LCE60A	60	66.7	73.7	1	5	96.8	15.5	90	150	10	200
LCE64	64	71.1	86.9	1	5	114.0	13.2	90	150	10	200
LCE64A	64	71.1	78.6	1	5	103.0	14.6	90	150	10	200
LCE70	70	77.8	95.1	1	5	125	12.0	90	150	10	200
LCE70A	70	77.8	86.0	1	5	113	13.3	90	150	10	200
LCE75	75	83.3	102.0	1	5	134	11.2	90	150	10	200
LCE75A	75	83.3	92.1	1	5	121	12.4	90	150	10	200
LCE80	80	88.7	108	1	5	142	10.6	90	150	10	200
LCE80A	80	88.7	98.0	1	5	129	11.6	90	150	10	200
LCE90	90	100	122	1	5	160	9.4	90	300	10	200
LCE90A	90	100	111	1	5	146	10.3	90	300	10	200
LCE100	100	111	136	1	5	179	8.4	90	300	10	200
LCE100A	100	111	123	1	5	162	9.3	90	300	10	200
LCE110	110	122	149	1	5	196	7.7	90	300	10	400
LCE110A	110	122	135	1	5	178	8.4	90	300	10	400
LCE120	120	133	163	1	5	214	7.0	90	300	10	400
LCE120A	120	133	147	1	5	193	7.8	90	300	10	400
LCE130	130	144	176	1	5	231	6.5	90	300	10	400
LCE130A	130	144	159	1	5	209	7.2	90	300	10	400
LCE150	150	167	204	1	5	268	5.6	90	300	10	400
LCE150A	150	167	185	1	5	243	6.2	90	300	10	400
LCE160	160	178	218	1	5	287	5.2	90	300	10	400
LCE160A	160	178	197	1	5	259	5.8	90	300	10	400
LCE170	170	189	231	1	5	304	4.9	90	300	10	400
LCE170A	170	189	209	1	5	275	5.4	90	300	10	400

NOTE 1: TVS devices are normally selected according to the reverse standoff voltage (V_{WM}) which should be equal to or greater than the DC or continuous peak operating voltage level.

GRAPHS

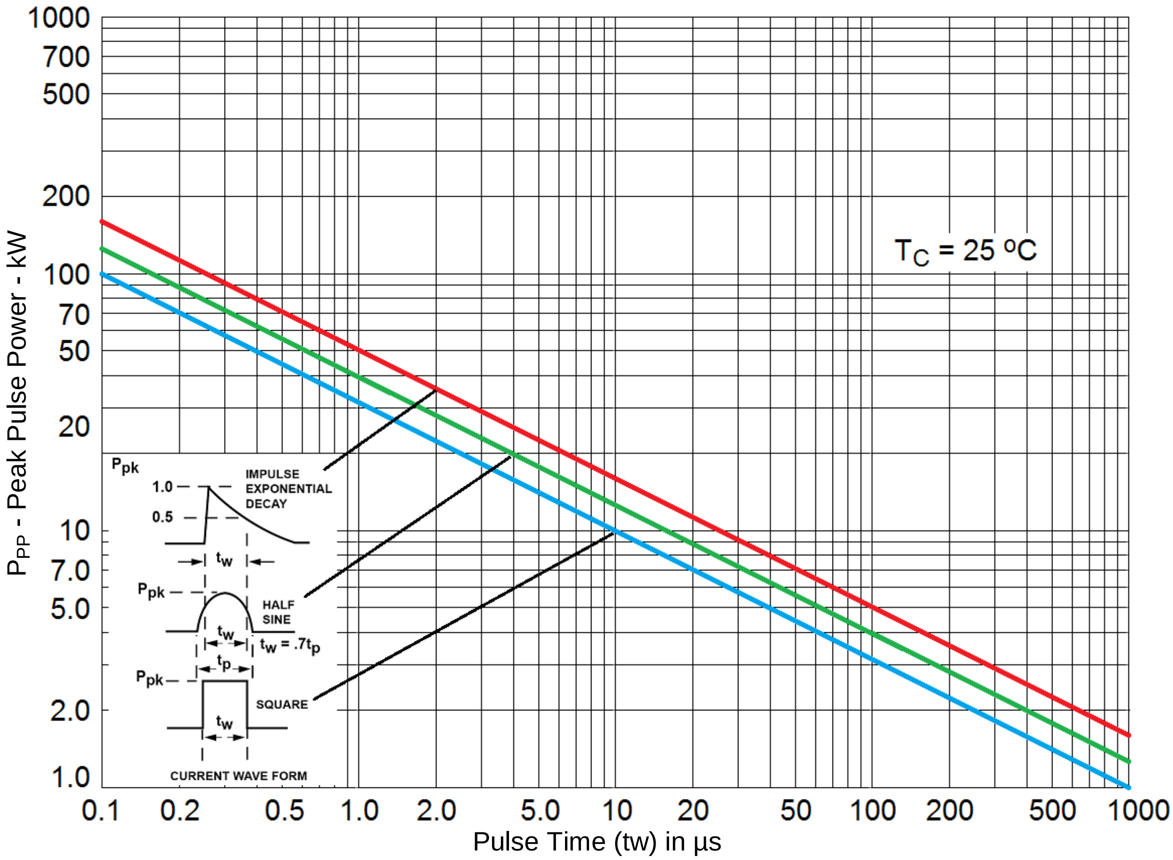
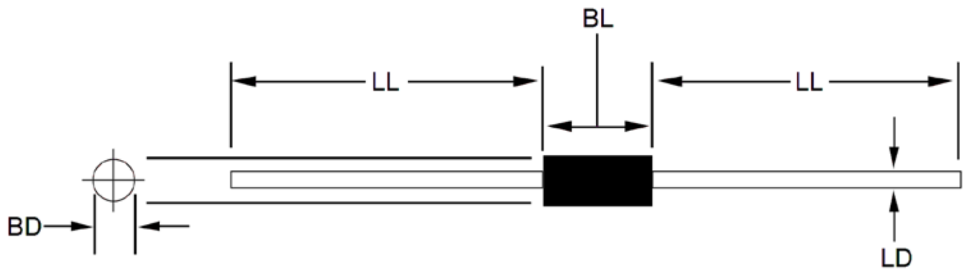


FIGURE 1
Peak Pulse Power vs Pulse Time (tw) in µs

PACKAGE DIMENSIONS



NOTES:
1 Dimensions are in inches.
2 Millimeter equivalents are given for general 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

SCHEMATIC APPLICATIONS

The TVS low capacitance device configuration is shown in figure 2. As a further option for unidirectional applications, an additional low capacitance rectifier diode may be used in parallel in the same polarity direction as the TVS as shown in figure 3. In applications where random high voltage transients occur, this will prevent reverse transients from damaging the internal low capacitance rectifier diode and also provide a low voltage conducting direction. The added rectifier diode should be of similar low capacitance and also have a higher reverse voltage rating than the TVS clamping voltage V_C. The Microsemi recommended rectifier part number is the "ELCR80" for the application in figure 3. If using two (2) low capacitance TVS devices in anti-parallel for bidirectional applications, this added protective feature for both directions (including the reverse of each rectifier diode) is also provided. The unidirectional and bidirectional configurations in figure 3 and 4 will both result in twice the capacitance of figure 2.

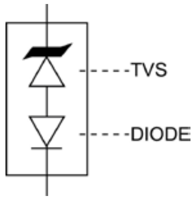


FIGURE 2
TVS with internal Low Capacitance Diode

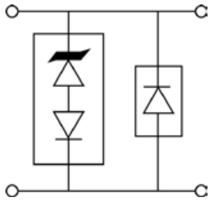


FIGURE 3
Optional Unidirectional configuration (TVS and separate rectifier diode in parallel)

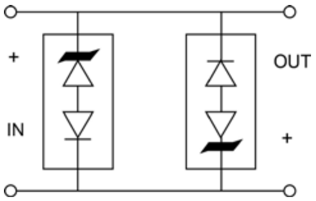


FIGURE 4
Optional Bidirectional configuration (two TVS devices in anti-parallel)