LC6.5 thru LC170A, e3

1500 WATT LOW CAPACITANCE TRANSIENT VOLTAGE SUPPRESSOR

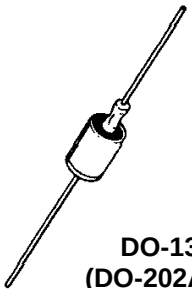
Microsemi
SCOTTSDALE DIVISION

DESCRIPTION

This hermetically sealed Transient Voltage Suppressor (TVS) product family includes a rectifier diode element in series and opposite direction 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-160D 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 most current data, consult *MICROSEMI's* website: http://www.microsemi.com

APPEARANCE



DO-13
(DO-202AA)

FEATURES

- Unidirectional low-capacitance TVS series for flexible thru-hole mounting (for bidirectional see Figure 4)
- 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
- Hermetic sealed DO-13 metal package
- Options for screening in accordance with MIL-PRF-19500 for JAN, JANTX, JANTXV, and JANS are also available by adding MQ, MX, MV, MSP prefixes respectively to part numbers, e.g. MXLC6.5A, etc.
- Surface mount equivalent packages also available as SMCJLCE6.5 - SMCJLCE170A or SMCGLCE6.5 - SMCGLCE170A in separate data sheet (consult factory for other surface mount options)
- Plastic axial-leaded equivalents available in the LCE6.5 - LCE170A series in separate data sheet
- RoHS Compliant devices available by adding "e3" suffix

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: LC6.5 to LC170A
  Class 2: LC6.5 to LC150A
  Class 3: LC6.5 to LC70A
  Class 4: LC6.5 to LC36A
- Secondary lightning protection per IEC61000-4-5 with 12 Ohms source impedance:
  Class 1 : LC6.5 to LC90A
  Class 2: LC6.5 to LC45 A
  Class 3: LC6.5 to LC22A
  Class 4: LC6.5 to LC11A
- Secondary lightning protection per IEC61000-4-5 with 2 Ohms source impedance:
  Class 2: LC6.5 to LC20A
  Class 3: LC6.5 to LC10A
- Inherently radiation hard per Microsemi MicroNote 050

MAXIMUM RATINGS

- 1500 Watts at 10/1000 µs with repetition rate of 0.01% or less* at lead temperature (T_L) 25°C (see Figs. 1, 2, & 4)
- Operating & Storage Temperatures: -65° to +175°C
- THERMAL RESISTANCE: 50°C/W (Typical) junction to lead at 0.375 inches (10 mm) from body or 110 °C/W junction to ambient when mounted on FR4 PC board with 4 mm^2 copper pads (1 oz) and track width 1 mm, length 25 mm
- DC Power Dissipation*: 1 Watt at $T_L \leq +125°C$ 3/8" (10 mm) from body (see derating in Fig 3 and note below)
- Solder Temperatures: 260 ° C for 10 s (maximum)

MECHANICAL AND PACKAGING

- CASE: DO-13 (DO-202AA), welded, hermetically sealed metal and glass
- FINISH: All external metal surfaces are Tin-Lead plated and solderable per MIL-STD-750 method 2026
- POLARITY: Cathode connected to case as shown by diode symbol (cathode positive for normal operation)
- MARKING: Part number and polarity diode symbol
- WEIGHT: 1.4 grams. (Approx)
- TAPE & REEL option: Standard per EIA-296 (add "TR" suffix to part number)
- See package dimension on last page

* TVS devices are not typically used for dc power dissipation and are instead operated $\leq V_{WM}$ (rated standoff voltage) except for transients that briefly drive the device into avalanche breakdown (V_{BR} to V_C region) of the TVS element. Also see Figures 3 and 4 for further protection details in rated peak pulse power for unidirectional and bidirectional configurations respectively.

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ELECTRICAL CHARACTERISTICS @25°C

MICROSEMI PART NUMBER	REVERSE STANDOFF VOLTAGE V_{WM} VOLTS	BREAKDOWN VOLTAGE $V_{(BR)}$ VOLTS MIN	BREAKDOWN VOLTAGE $V_{(BR)}$ VOLTS MAX	@ $I_{(BR)}$ mA	MAXIMUM STANDBY CURRENT I_D @V_{WM} µA	MAXIMUM CLAMPING VOLTAGE V_C @ I_{PP} VOLTS	MAXIMUM PEAK PULSE CURRENT I_{PP} @ 10/1000 µs AMPS	MAXIMUM CAPACITANCE @ 0 Volts, f = 1 MHz 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
LC6.5	6.5	7.22	8.82	10	1000	12.3	100	100	75	10	100
LC6.5A	6.5	7.22	7.98	10	1000	11.2	100	100	75	10	100
LC7.0	7.0	7.78	9.51	10	500	13.3	100	100	75	10	100
LC7.0A	7.0	7.78	8.60	10	500	12.0	100	100	75	10	100
LC7.5	7.5	8.33	10.2	10	250	14.3	100	100	75	10	100
LC7.5A	7.5	8.33	9.21	10	250	12.9	100	100	75	10	100
LC8.0	8.0	8.89	10.9	1	100	15.0	100	100	75	10	100
LC8.0A	8.0	8.89	9.83	1	100	13.6	100	100	75	10	100
LC8.5	8.5	9.44	11.5	1	50	15.9	94	100	75	10	100
LC8.5A	8.5	9.44	10.4	1	50	14.4	100	100	75	10	100
LC9.0	9.0	10.0	12.2	1	10	16.9	89	100	75	10	100
LC9.0A	9.0	10.0	11.1	1	10	15.4	97	100	75	10	100
LC10	10	11.1	13.6	1	5	18.8	80	100	75	10	100
LC10A	10	11.1	12.3	1	5	17.0	88	100	75	10	100
LC11	11	12.2	14.9	1	5	20.1	74	100	75	10	100
LC11A	11	12.2	13.5	1	5	18.2	82	100	75	10	100
LC12	12	13.3	16.3	1	5	22.0	68	100	75	10	100
LC12A	12	13.3	14.7	1	5	19.9	75	100	75	10	100
LC13	13	14.4	17.6	1	5	23.8	63	100	75	10	100
LC13A	13	14.4	15.9	1	5	21.5	70	100	75	10	100
LC14	14	15.6	19.1	1	5	25.8	58	100	75	10	100
LC14A	14	15.6	17.2	1	5	23.2	65	100	75	10	100
LC15	15	16.7	20.4	1	5	26.9	56	100	75	10	100
LC15A	15	16.7	18.5	1	5	24.4	61	100	75	10	100
LC16	16	17.8	21.8	1	5	28.8	52	100	75	10	100
LC16A	16	17.8	19.7	1	5	26.0	57	100	75	10	100
LC17	17	18.9	23.1	1	5	30.5	49	100	75	10	100
LC17A	17	18.9	20.9	1	5	27.6	54	100	75	10	100
LC18	18	20.0	24.4	1	5	32.2	46	100	75	10	100
LC18A	18	20.0	22.1	1	5	29.2	51	100	75	10	100
LC20	20	22.2	27.1	1	5	35.8	42	100	75	10	100
LC20A	20	22.2	24.5	1	5	32.4	46	100	75	10	100
LC22	22	24.4	29.8	1	5	39.4	38	100	75	10	100
LC22A	22	24.4	26.9	1	5	35.5	42	100	75	10	100
LC24	24	26.7	32.6	1	5	43.0	35	100	75	10	100
LC24A	24	26.7	29.5	1	5	38.9	39	100	75	10	100
LC26	26	28.9	35.3	1	5	46.6	32	100	75	10	100
LC26A	26	28.9	31.9	1	5	42.1	36	100	75	10	100
LC28	28	31.1	38.0	1	5	50.1	30	100	75	10	100
LC28A	28	31.1	34.4	1	5	45.4	33	100	75	10	100
LC30	30	33.3	40.7	1	5	53.5	28	100	75	10	100
LC30A	30	33.3	36.8	1	5	48.4	31	100	75	10	100
LC33	33	36.7	44.9	1	5	58.0	25.4	100	75	10	100
LC33A	33	36.7	40.6	1	5	53.3	28.1	100	75	10	100
LC36	36	40.0	48.9	1	5	64.3	23.3	100	75	10	100
LC36A	36	40.0	44.2	1	5	58.1	25.8	100	75	10	100
LC40	40	44.4	54.3	1	5	71.4	21.0	100	75	10	100
LC40A	40	44.4	49.1	1	5	64.5	23.3	100	75	10	100
LC43	43	47.8	58.4	1	5	76.7	19.5	100	150	10	200
LC43A	43	47.8	52.8	1	5	69.4	21.6	100	150	10	200
LC45	45	50.0	61.1	1	5	80.3	18.7	100	150	10	200
LC45A	45	50.0	55.3	1	5	72.7	20.6	100	150	10	200
LC48	48	53.3	65.1	1	5	85.5	17.5	100	150	10	200
LC48A	48	53.3	58.9	1	5	77.4	19.4	100	150	10	200
LC51	51	56.7	69.3	1	5	91.1	16.5	100	150	10	200
LC51A	51	56.7	62.7	1	5	82.4	18.2	100	150	10	200

MICROSEMI PART NUMBER	REVERSE STANDOFF VOLTAGE V_{WM} VOLTS	BREAKDOWN VOLTAGE $V_{(BR)}$ VOLTS MIN	BREAKDOWN VOLTAGE $V_{(BR)}$ VOLTS MAX	@ $I_{(BR)}$ mA	MAXIMUM STANDBY CURRENT I_D @ V_{WM} µA	MAXIMUM CLAMPING VOLTAGE V_C @ I_{PP} VOLTS	MAXIMUM PEAK PULSE CURRENT I_{PP} @ 10/1000 µs AMPS	CAPACITANCE @ 0 Volts 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
LC54	54	60.0	73.3	1	5	96.3	15.6	100	150	10	200
LC54A	54	60.0	66.3	1	5	87.1	17.2	100	150	10	200
LC58	58	64.4	78.7	1	5	103.0	14.6	100	150	10	200
LC58A	58	64.4	71.2	1	5	93.6	16.0	100	150	10	200
LC60	60	66.7	81.5	1	5	107.0	14.0	90	150	10	200
LC60A	60	66.7	73.7	1	5	96.8	15.5	90	150	10	200
LC64	64	71.1	86.9	1	5	114.0	13.2	90	150	10	200
LC64A	64	71.1	78.6	1	5	103.0	14.6	90	150	10	200
LC70	70	77.8	95.1	1	5	125	12.0	90	150	10	200
LC70A	70	77.8	86.0	1	5	113	13.3	90	150	10	200
LC75	75	83.3	102.0	1	5	134	11.2	90	150	10	200
LC75A	75	83.3	92.1	1	5	121	12.4	90	150	10	200
LC80	80	88.7	108	1	5	142	10.6	90	150	10	200
LC80A	80	88.7	98.0	1	5	129	11.6	90	150	10	200
LC90	90	100	122	1	5	160	9.4	90	300	10	200
LC90A	90	100	111	1	5	146	10.3	90	300	10	200
LC100	100	111	136	1	5	179	8.4	90	300	10	200
LC100A	100	111	123	1	5	162	9.3	90	300	10	200
LC110	110	122	149	1	5	196	7.7	90	300	10	400
LC110A	110	122	135	1	5	178	8.4	90	300	10	400
LC120	120	133	163	1	5	214	7.0	90	300	10	400
LC120A	120	133	147	1	5	193	7.8	90	300	10	400
LC130	130	144	176	1	5	231	6.5	90	300	10	400
LC130A	130	144	159	1	5	209	7.2	90	300	10	400
LC150	150	167	204	1	5	268	5.6	90	300	10	400
LC150A	150	167	185	1	5	243	6.2	90	300	10	400
LC160	160	178	218	1	5	287	5.2	90	300	10	400
LC160A	160	178	197	1	5	259	5.8	90	300	10	400
LC170	170	189	231	1	5	304	4.9	90	300	10	400
LC170A	170	189	209	1	5	275	5.4	90	300	10	400

NOTE: TVS are normally selected according to the reverse "Standoff Voltage" (V_{WM}) that should be equal to or greater than the dc or continuous peak operating voltage level.

GRAPHS

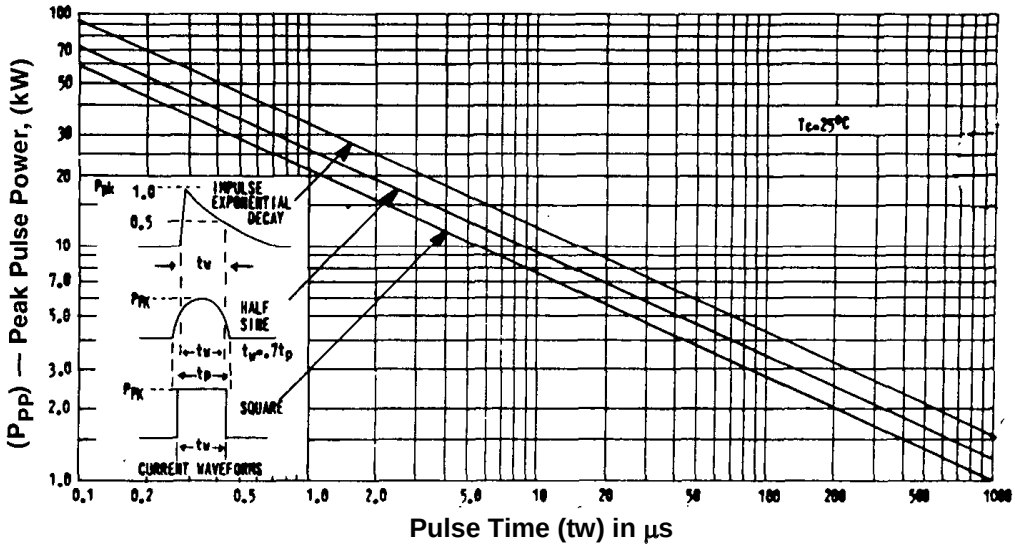


FIGURE 1
Peak Pulse Power vs.
Pulse Time (t_W) in µs

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 "LCR80" for the application in Figure 5. 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.

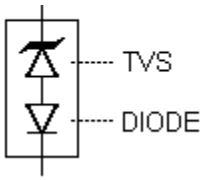


FIGURE 2
TVS with internal Low Capacitance Diode

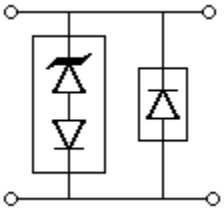


FIGURE 3
Optional Unidirectional configuration (TVS and separate rectifier diode) in parallel)

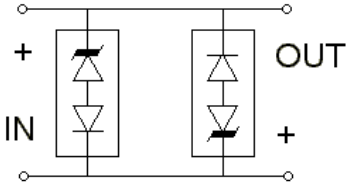
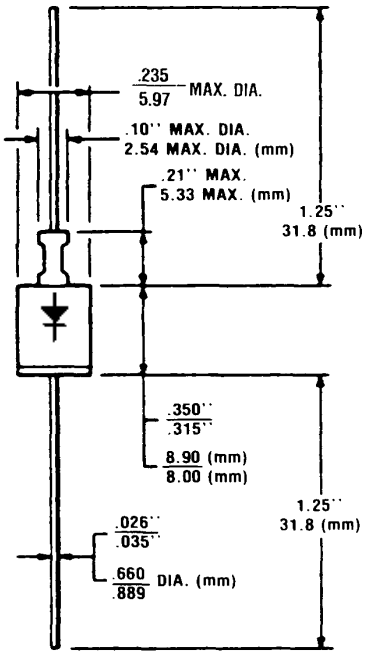


FIGURE 4
Optional Bidirectional configuration (two TVS devices in anti-parallel)

PACKAGE DIMENSIONS



DO-13 (or DO-202AA)