500 Watt Low Capacitance Transient Voltage Suppressors

MSAC5.0A – MXLSAC50A(e3)

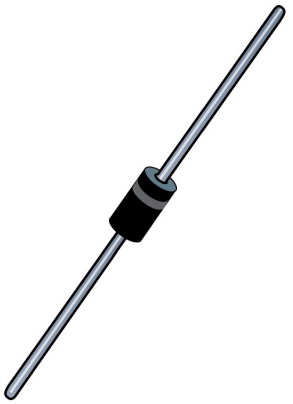
Product Overview

This high-reliability axial lead family of MSAC5.0A through MSAC50A Transient Voltage Suppressor (TVS) product family includes a rectifier diode in series with and in the opposite direction to the primary TVS protection diode. The circuit being protected sees only the rectifier diode's low 30 pF capacitance and are available in RoHS compliant versions. They feature working standoff voltages V_{WM} from 5.0 to 50 volts. These are available with a variety of upscreening options for enhanced reliability. The low capacitance of these TVS devices allows them to be applied to the protection of high-frequency signal and communication lines in inductive switching environments or systems exposed to the secondary effects of lightning per IEC61000-4-5 as well as RTCA/DO-160G or ARINC 429 for airborne avionics. They also protect from ESD and EFT per IEC61000-4-2 and IEC61000-4-4.

Features

- Unidirectional low-capacitance device (< 30 pF). For bidirectional applications, see Figure 5-3.
- 3σ lot norm screening performed on standby current I_D for all M prefix devices
- High reliability controlled devices with wafer fabrication and assembly lot traceability for all M prefix devices
- 100% surge testing of all devices
- Suppresses transients up to 500 watts at 10/1000 µs
- 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.)
- 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

Figure 1. DO-41 (DO-204AL) Package



Applications/Benefits

- Available in working standoff voltage (V_{WM}) range from 5 to 50V.
- Low capacitance for data-line protection to 10 MHz
- Economical axial-lead plastic encapsulated TVS series for thru-hole mounting
- Protection for fast data rate lines in aircraft up to:
  RTCA/DO-160G - Level 3 Waveform 4 and Level 1 Waveform 5A (also see MicroNote 130)
  ARINC 429, Part 1, paragraph 2.4.1.1 up to bit rates of 100 kb/s
- ESD and EFT protection per IEC61000-4-2 and IEC61000-4-4 respectively.
- Secondary lightning protection per IEC 61000-4-5 with 42 ohms source impedance:
  Class 1: MSAC5.0A to MXLSAC50A
  Class 2: MSAC5.0A to MXLSAC45A
  Class 3: MSAC5.0A to MXLSAC22A
  Class 4: MSAC5.0A to MXLSAC10A
- Secondary lightning protection per IEC 61000-4-5 with 12 ohms source impedance:
  Class 1: MSAC5.0A to MXLSAC26A
  Class 2: MSAC5.0A to MXLSAC15A
  Class 3: MSAC5.0A to MXLSAC7.0A

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1. Maximum Ratings

Table 1-1. Maximum Ratings at 25 °C Unless Otherwise Noted

Parameters/Test Conditions	Symbol	Value	Unit
Junction and storage temperature	T_J and T_{STG}	–65 to +150	°C
Peak pulse power dissipation at 10/1000 µs[1]	P_{PP}	500	W
Average power dissipation at T_L = +75 °C[2]	$P_{M(AV)}$	2.5	W
$T_{clamping}$ (0 volts to $V_{(BR)}$ min)	—	< 5	ns
Solder temperature at 10 seconds	—	260	°C

Notes:

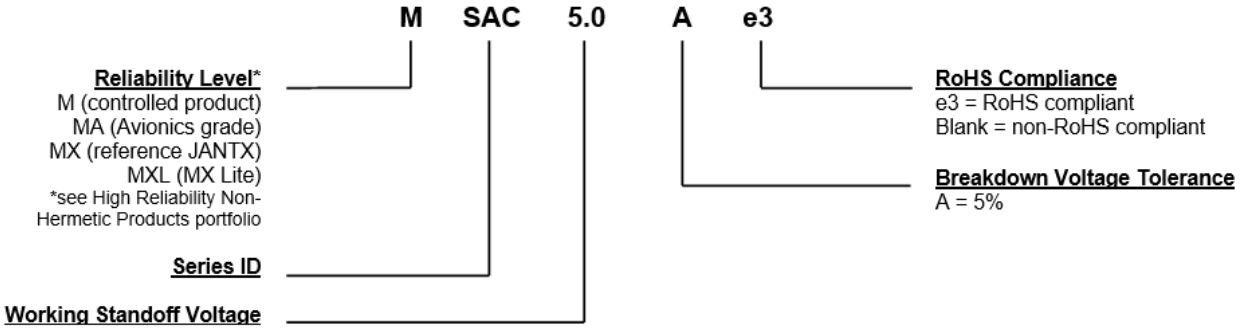
1. With impulse repetition rate (duty factor) of 0.01 % max. TVS devices are not typically used for DC power dissipation and are instead operated ≤ V_{WM} (working standoff voltage) except for transients that briefly drive the device into avalanche breakdown ($V_{(BR)}$ to V_C region) of the TVS element.
2. At 3/8 (10 mm) lead length from body

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. Solderable per MIL-STD-750, method 2026.
- Marking: Reliability level, part number, date code
- Polarity: Cathode indicated by band
- Tape and Reel option: Standard per EIA-296 (add “TR” suffix to part number). Consult factory for quantities.
- Weight: Approximately 0.7 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_{IB}	Inverse blocking leakage current: The current through a unidirectional-blocking low capacitance device at working inverse blacking voltage (V_{WIB}).
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_{PIB}	Peak inverse blocking voltage: Minimum breakdown voltage of the series low capacitance rectifier.
V_{WIB}	Working inverse blocking voltage: The maximum-rated value of DC or peak blocking voltage that may be applied to a unidirectional-blocking low-capacitance diode in the inverse direction. Note: Above this rated voltage, the diode is not to be surge or impulse tested for any reason.
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

Part Number	Working Standoff Voltage[1] V_{WM}	Minimum Breakdown Voltage V_{BR} at I_{BR} 1.0mA $V_{(BR)}$	Maximum Standby Current I_D at V_{WM}	Maximum Clamping Voltage V_C at I_P = 5.0A	Maximum Peak pulse Current[2] at 10/1000 µs I_{PP}	Working Inverse Blocking Voltage[3] V_{WIB}	Peak Inverse Blocking Voltage V_{PIB}
	Volts	Volts	µA	Volts	Amps	Volts	Volts
MSAC5.0A	5.0	7.60	300	10.0	44	75	100
MSAC6.0A	6.0	7.90	300	11.2	41	75	100
MSAC7.0A	7.0	8.33	300	12.6	38	75	100
MSAC8.0A	8.0	8.89	100	13.4	36	75	100
MSAC8.5A	8.5	9.44	50	14.0	34	75	100
MSAC10A	10	11.10	5.0	16.3	29	75	100
MSAC12A	12	13.30	5.0	19.0	25	75	100
MSAC15A	15	16.70	5.0	23.6	20	75	100
MSAC18A	18	20.00	5.0	28.8	15	75	100
MSAC22A	22	24.40	5.0	35.4	14	75	100
MSAC26A	26	28.90	5.0	42.3	11.1	75	100
MSAC36A	36	40.0	5.0	60.0	8.6	75	100
MSAC45A	45	50.00	5.0	77.0	6.8	150	200
MSAC50A	50	55.50	5.0	88.0	5.8	150	200

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. Test in TVS avalanche direction. Do not pulse in “forward” direction. See section for Application Schematics.
3. Maximum capacitance of MSAC series at 0 volts is 30 pF.
4. V_{WIB} at Inverse Blocking Leakage Current (I_{IB}) is 10 µA.

4. Graphs

Figure 4-1. Peak Pulse Power Vs. Pulse Time

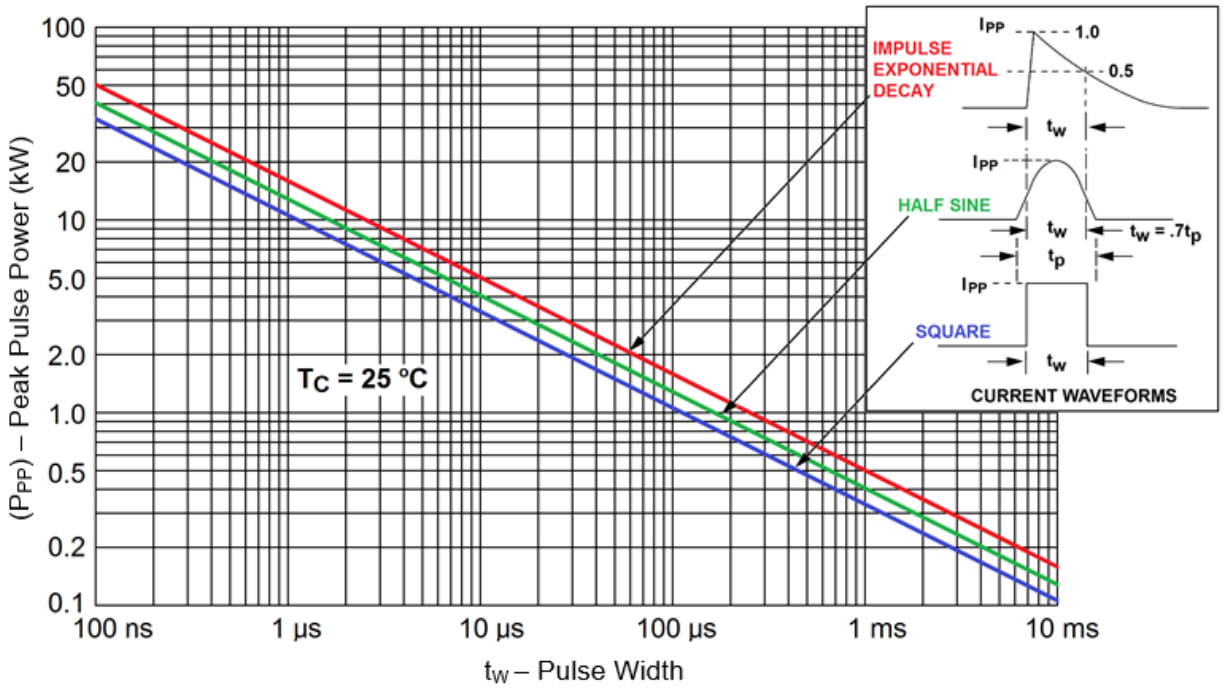


Figure 4-2. Rated Power Vs. Lead Temperature (at Lead Length = 3/8”)

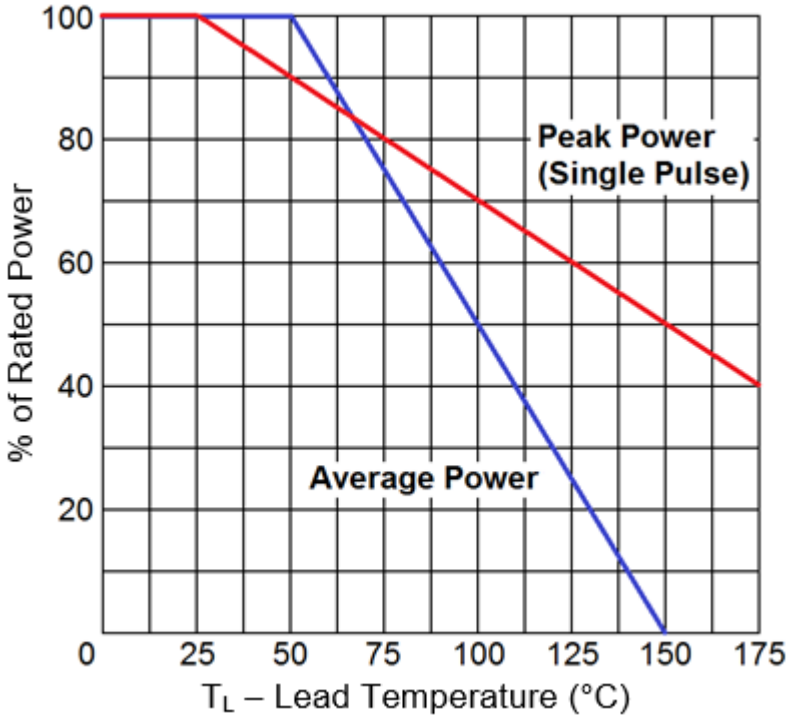
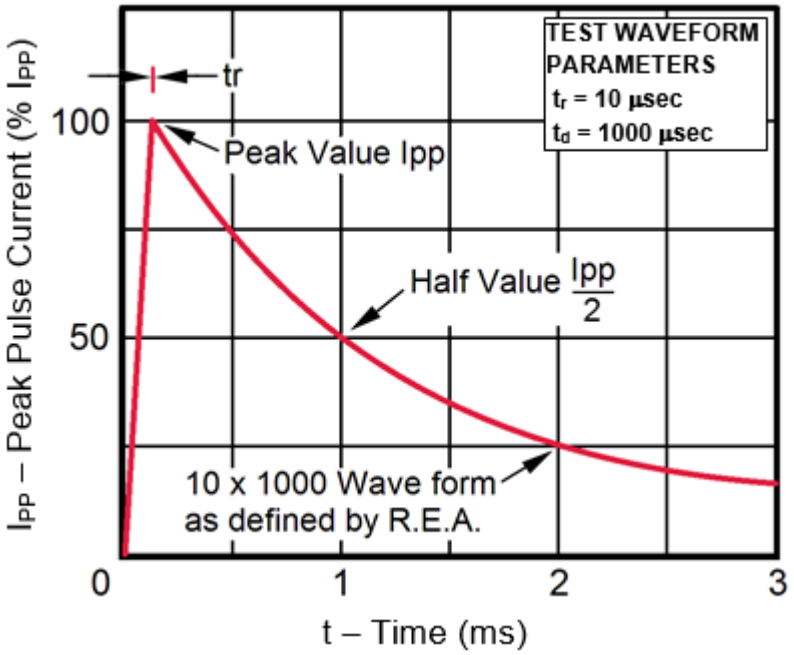
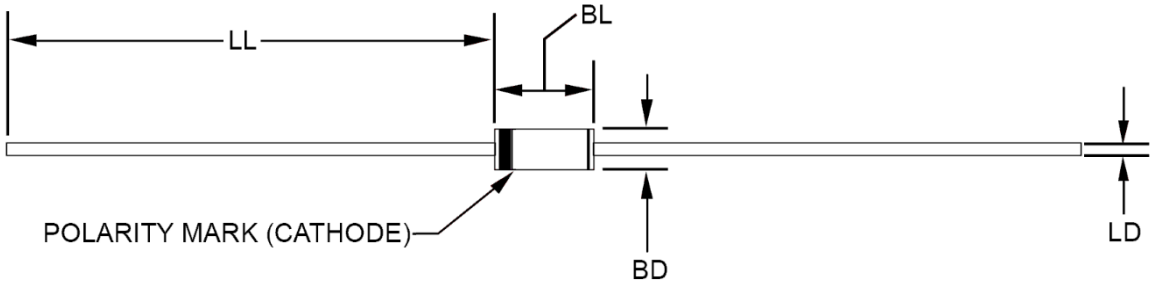


Figure 4-3. Peak Pulse Current Vs. Time



4.1 Package Dimensions

Figure 4-4. Package Dimensions[1]



Note:

1. Cathode indicated by band

Dim.	Dimensions			
	Inches		Millimeters	
	Min.	Max.	Min.	Max.
LL	1.00	—	25.4	—
BL	—	0.205	—	5.207
BD	—	0.107	—	2.72
LD	0.030	0.034	0.76	0.86

5. Application Schematics

The TVS low capacitance device configuration is shown in Figure 5-1. 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 5-2. 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 Microchip recommended rectifier part number is the "LCR60" for the application in Figure 5-2. 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 5-2 and Figure 5-3 will both result in twice the capacitance of Figure 5-1.

Figure 5-1. TVS With Internal Low Capacitance Diode

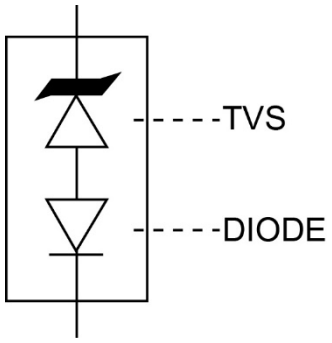


Figure 5-2. Optional Unidirectional Configuration (TVS and Separate Rectifier Diode in Parallel)

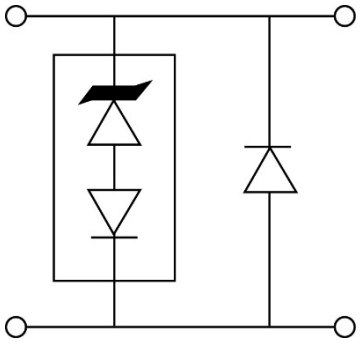
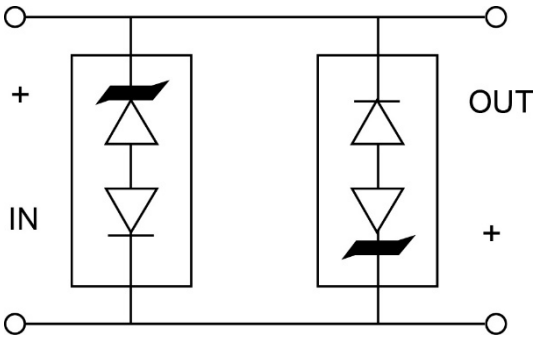


Figure 5-3. Optional Bidirectional Configuration (Two TVS Devices in Anti-Parallel)



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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