500 Watt Low Capacitance Transient Voltage Suppressors

MSMBJSAC5.0 – MSMBJSAC75(e3)

Product Overview

This high-reliability surface mount 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. They are available in DO-214AA (J-bend) package and RoHS compliant versions. They feature working stand-off voltages from 5.0 to 75 volts. 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-160D or ARINC 429 for airborne avionics. They also protect from ESD and EFT per IEC61000-4-2 and IEC61000-4-4.

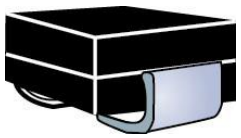
Features

- Unidirectional low-capacitance device (30 pF). For bidirectional applications, see Figure 6-3.
- 3σ lot norm screening performed on standby current I_D for all M prefix devices
- All devices are 100% surge tested.
- Suppresses transients up to 500W peak pulse power (P_{PP}) at 10/1000 µs
- Available in working stand-off voltage range of 5.0 to 75V
- Enhanced reliability options with M prefix are available in reference to MIL-PRF-19500. Refer to Hi-Rel 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.
- Moisture classification is Level 1 with no dry pack required per IPC/JEDEC J-STD-020F for all M prefix devices. RoHS compliant versions available.

Applications/Benefits

- Suppress transients up to 500W at 10/1000 µs (see Figure 4-1)
- Low capacitance for data-line protection to 10 MHz
- Available in working stand-off voltage (V_{WM}) range 5.0 to 170V
- Protection for fast data rate lines in aircraft up to:
  - RTCA/DO-160G – Waveform 4 and 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: MSMBJSAC5.0 to MSMBJSAC75
  Class 2: MSMBJSAC5.0 to MSMBJSAC45
  Class 3: MSMBJSAC5.0 to MSMBJSAC22
  Class 4: MSMBJSAC5.0 to MSMBJSAC10
- Secondary lightning protection per IEC 61000-4-5 with 12 ohms source impedance:
  Class 1: MSMBJSAC5.0 to MSMBJSAC26
  Class 2: MSMBJSAC5.0 to MSMBJSAC15
  Class 3: MSMBJSAC5.0 to MSMBJSAC7.0
- T1/E1 kine cards
- Base stations, WAN and XDSL interfaces
- CSU/DSU equipment

Figure 1. DO-214AA J-bend Package



All SMB series are equivalent to prior SMS package identifications.

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1. Maximum Ratings

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

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
Clamping speed (0 volts to $V_{(BR)}$ min, theoretical)	$t_{clamping}$	< 5	ns
Solder temperature at 10 s	—	260	°C

Notes:

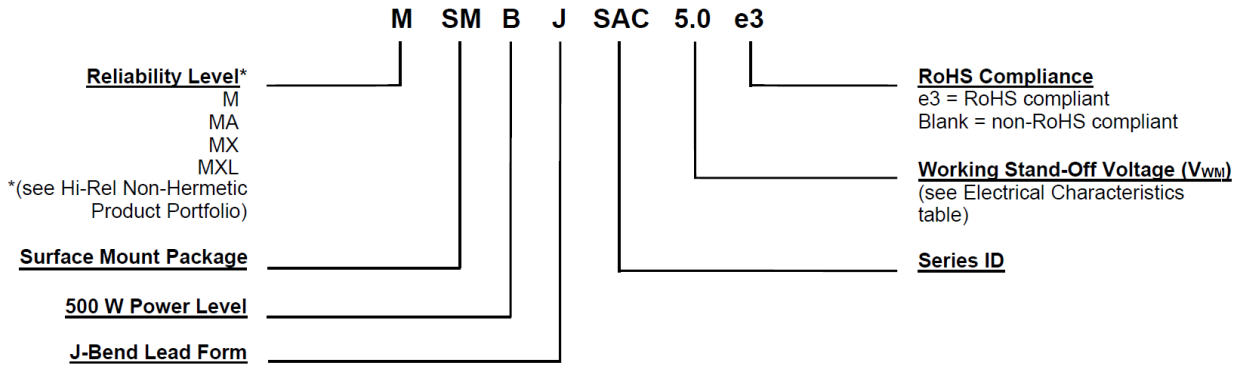
1. With impulse repetition rate (duty factor) of 0.01 % max. TVS devices are not typically used for DC power dissipation and are instead operated ≤ V_{WM} (rated stand-off voltage) except for transients that briefly drive the device into avalanche breakdown ($V_{(BR)}$ to V_C region) of the TVS element. Also see Figure 6-2 and Figure 6-3 for further protection details in rated peak pulse power for unidirectional and bidirectional configurations respectively.
2. At 3/8 (10 mm) lead length from body

1.1 Mechanical and Packaging

- Case: Void-free transfer molded thermosetting epoxy body meeting UL94V-0 requirements
- 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. No cathode band on bidirectional devices
- Tape and reel option: Standard per EIA-481-1-A (add “TR” suffix to part number). Consult factory for quantities.
- Weight: Approximately 0.1 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
C_T	Total capacitance: The total small signal capacitance between the diode terminals of a complete device.
I_{IB}	Inverse blocking leakage current: The current through a unidirectional-blocking low capacitance device at working inverse blacking voltage (V_{WIB}).
$I_{(BR)}$	Breakdown current: The current used for measuring breakdown voltage $V_{(BR)}$.
I_D	Standby current: The current through the device at rated stand-off voltage.
I_{PP}	Peak impulse current: The peak current during the impulse.
P_{PP}	Peak pulse power: The peak power that can be applied for a specific pulse width and waveform. The product of V_C and I_{PP}.
$V_{(BR)}$	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. Above this rated voltage, the diode is not to be surge or impulse tested for any reason.
V_{WM}	Working stand-off 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

Microchip Part Number	Working Stand-Off Voltage[1] V_{WM}	Breakdown Voltage V_{BR} at I_{BR} 1.0 mA $V_{(BR)}$	Maximum Standby Current I_D at V_{WM}	Maximum Clamping Voltage V_C at I_P = 5.0A	Maximum Peak Pulse Current[2, 3] at 10/1000 µs I_{PP}	Maximum Capacitance at 0 Volts f = 1 MHz C_T	Working Inverse Blocking Voltage V_{WIB}	Inverse Blocking Leakage Current at V_{WIB} I_{IB}	Peak Inverse Blocking Voltage V_{PIB}
	Volts	Volts (Min)	µA	Volts	Amps	pF	Volts	µA	Volts
MSMBJSAC5.0	5.0	7.60	300	10.0	44	30	75	10	100
MSMBJSAC6.0	6.0	7.90	300	11.2	41	30	75	10	100
MSMBJSAC7.0	7.0	8.33	300	12.6	38	30	75	10	100
MSMBJSAC8.0	8.0	8.89	100	13.4	36	30	75	10	100
MSMBJSAC8.5	8.5	9.44	50	14.0	34	30	75	10	100
MSMBJSAC10	10	11.10	5.0	16.3	29	30	75	10	100
MSMBJSAC12	12	13.30	5.0	19.0	25	30	75	10	100
MSMBJSAC15	15	16.70	5.0	23.6	20	30	75	10	100
MSMBJSAC18	18	20.00	5.0	28.8	15	30	75	10	100
MSMBJSAC22	22	24.40	5.0	35.4	14	30	75	10	100
MSMBJSAC26	26	28.90	5.0	42.3	11.1	30	75	10	100
MSMBJSAC36	36	40.0	5.0	60.0	8.6	30	75	10	100
MSMBJSAC45	45	50.00	5.0	77.0	6.8	30	150	10	200
MSMBJSAC50	50	55.50	5.0	88.0	5.8	30	150	10	200
MSMBJSAC75	75	83.3	5.0	121	4.1	30	150	10	200

Notes:

1. A transient voltage suppressor is normally selected according to voltage (V_{WM}), which should be equal to or greater than the DC or continuous peak operating voltage level.
2. See Figure 4-3. For the MSMBJSAC75, the maximum clamping voltage V_C is at the maximum rated peak pulse current (I_{PP}) of 4.1 amps.
   Clamping Factor: The ratio of the numerical value of V_C to $V_{(BR)}$ is typically 1.4 at full rated power and 1.20 at 50% rated power. Also see MicroNote 108.
3. Test in TVS avalanche direction. Do not pulse in “forward” direction. See section for Application Schematics herein.

4. Graphs

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

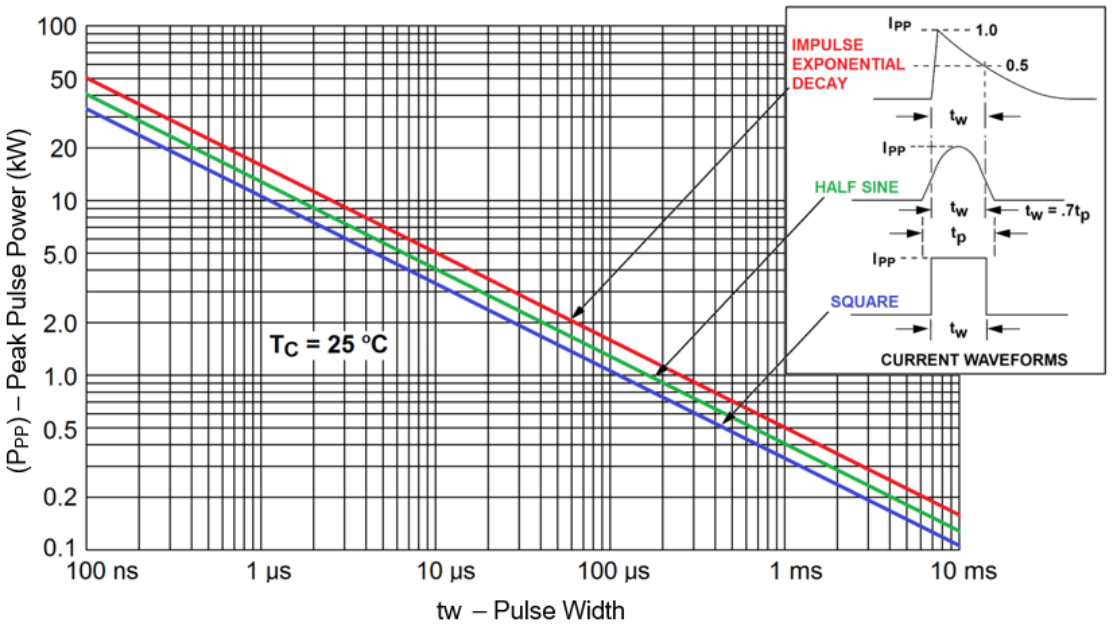


Figure 4-2. Rated Power Vs. Lead Temperature (at Lead Length = 3/8”)

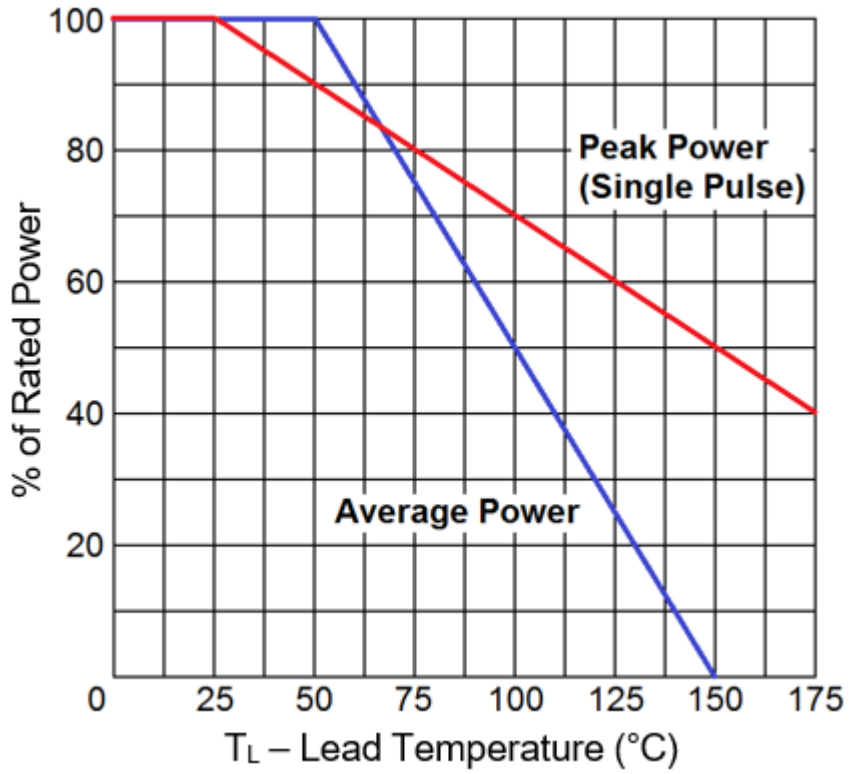
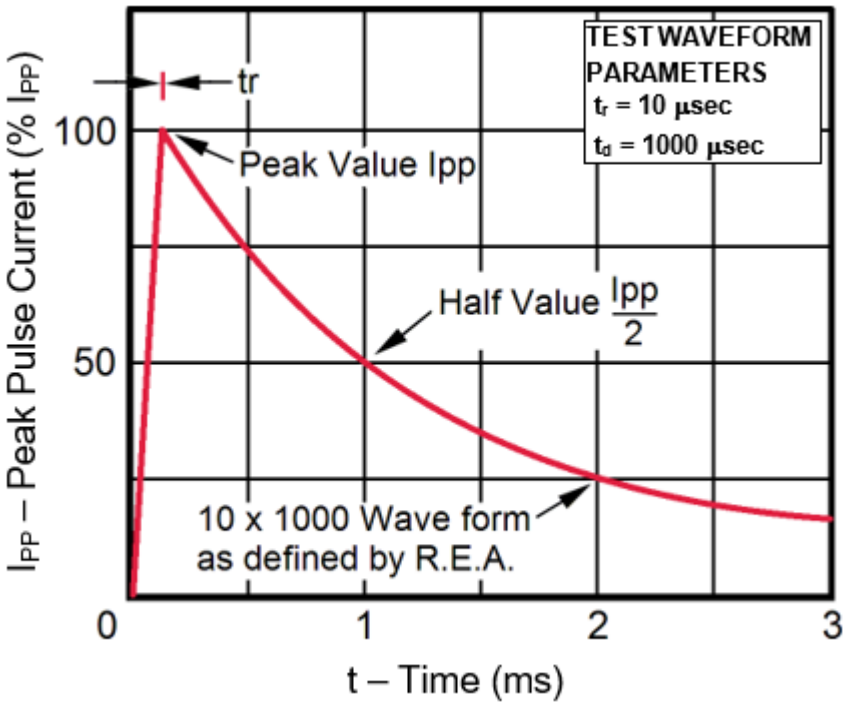
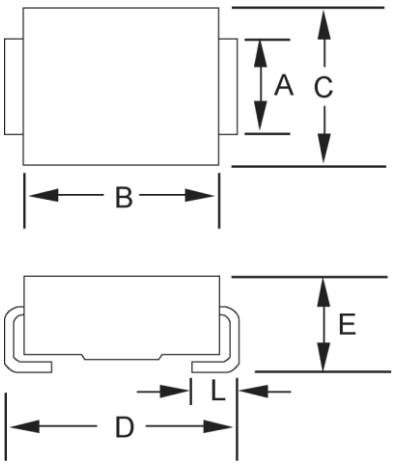


Figure 4-3. Peak Pulse Current Vs. Time



5. Package Dimensions

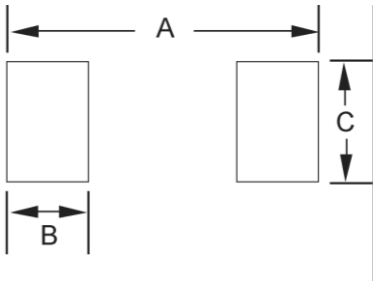
Figure 5-1. SMBJ (DO-214AA)



Ltr	Dimensions			
	Inch		Millimeters	
	Min.	Max.	Min.	Max.
A	0.077	0.083	1.96	2.10
B	0.160	0.180	4.06	4.57
C	0.130	0.155	3.30	3.94
D	0.205	0.220	5.21	5.59
E	0.077	0.104	1.95	2.65
L	0.030	0.060	0.76	1.52

5.1 Pad Layout

Figure 5-2. SMBJ (DO-214AA)



Dimensions		
Ltr	Inch	Millimeters
A	0.260	6.60
B	0.085	2.16
C	0.110	2.79

6. Application Schematics

The TVS low capacitance device configuration is shown in Figure 6-1. 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 6-2. 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 "SMBJLCR60" for the application in Figure 6-2. If using two 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 6-2 and Figure 6-3 will both result in twice the capacitance of Figure 6-1.

Figure 6-1. TVS With Internal Low Capacitance Diode

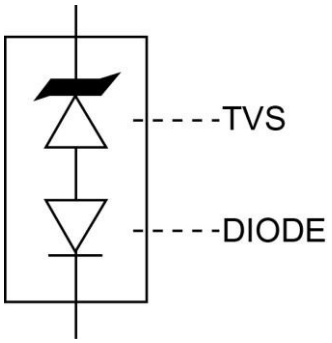


Figure 6-2. Optional Unidirectional Configuration (TVS and Separate Rectifier Diode in Parallel)

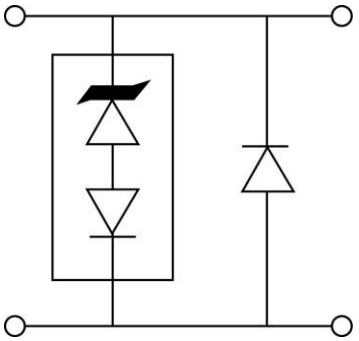
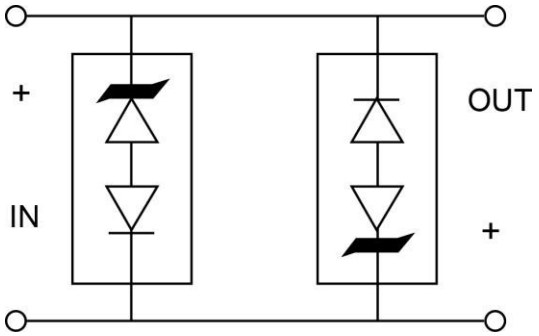


Figure 6-3. Optional Bidirectional Configuration (Two TVS Devices in Anti-Parallel)



7. 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	10/2023	Initial revision.

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