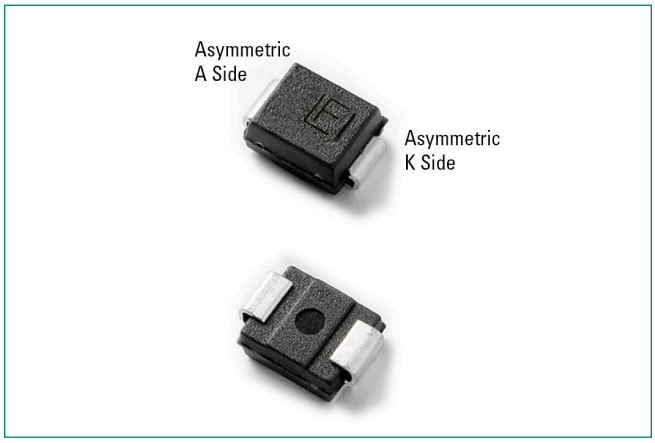
TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

AUTOMOTIVE GRADE HF RoHS Pb e3



Description

The TPSMB Asymmetrical TPSMBxx05 TVS Diodes protect automotive SiC MOSFET gate driver from overvoltage events. These devices feature asymmetrical reverse standoff voltages, protecting against positive and negative transients with different clamping in a single component. They are ideal for safeguarding driving circuits of on-board charger (OBC) and traction inverters in Electric Vehicles (EVs).

Features & Benefits

- High-reliability application and automotive grade AEC-Q101 qualified
- 600 W P_{PPM} peak pulse power capability at 10/1000 µs waveform, repetition rate (duty cycles):0.01 %
- Surface mount component to optimize board space
- Low profile package
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per tables 4a and 4c
- ESD protection of data lines in accordance with IEC 61000-4-2, 30 kV(Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Glass passivated chip junction
- Fast response time: typically less than 1.0 ns from 0 V to V_{BR} min
- Excellent clamping capability
- Low incremental surge resistance
- UL Recognized compound meeting flammability rating V-0
- Meets MSL Level 1 per J-STD-020, high temperature soldering guaranteed: 260 °C/10 seconds at terminals
- Matte tin lead–free plated
- Halogen-free and RoHS-compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

Maximum Ratings and Thermal Characteristics

(T_A = 25 °C unless otherwise noted)

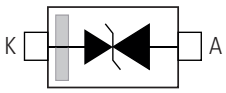
Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation (I_{PP} x V_C) by 10/1000 µs waveform (Fig.1)(Note 1), (Note 2)	P_{PPM1}	600	W
	P_{PPM2}		
Power Dissipation on infinite heat sink at T_L = 50 °C	$P_{M(AV)}$	5.0	W
Operating Junction Temperature Range	T_J	-65 to 175	°C
Storage Temperature Range	T_{STG}	-65 to 175	°C

Notes:
1. Non-repetitive current pulse, per Fig.4 and derated above T_A = 25 °C per Fig. 3.
2. Mounted on copper pad area of 0.2x0.2" (5.0 x 5.0 mm) to each terminal.

Applications

- Gate driver protection of SiC MOSFET
- On-board charger (OBC)
- Traction inverters

Functional Diagram



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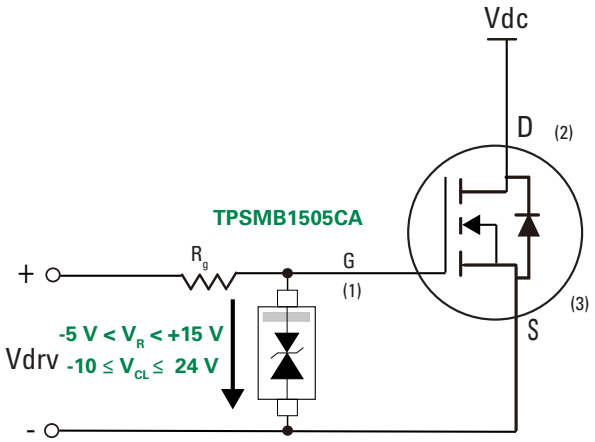
Electrical Characteristics @ Asymmetric Product (T_A = 25 °C unless otherwise noted)

Part Number	Marking	K to A							A to K								Agency Approval
		Maximum Reverse Leakage I_{R1} @ V_{R1} (µA)	Stand off Voltage V_{R1} (V)	Breakdown Voltage V_{BR} @ I_{T1} (V)		Maximum Clamping Voltage V_{C1} @ I_{PP} 10/1000 µs (V)	Maximum Peak Pulse Current I_{PP1} 10/1000 µs(A)	Test Current I_{T1} (mA)	Maximum Reverse Leakage I_{R2} @ V_{R2} (µA)	Stand off Voltage V_{R2} (V)	Breakdown Voltage V_{BR} (V) @ I_{T2}		Maximum Clamping Voltage V_{C2} @ I_{PP} 10/1000 µs (V)	Maximum Peak Pulse Current I_{PP2} 10/1000 µs (A)	Maximum Clamping Voltage V_{C2} @ I_{PP} = 30 A 8/20 µs (V)	Test Current I_{T2} (mA)	
				Min	Max						Min	Max					
TPSMB1505CA	1505	1	15	16.7	18.5	24.4	24.6	1	500	5	6.8	7.4	11.5	60	10	10	-
TPSMB1805CA	1805	1	18	20.0	22.1	29.2	20.6	1	500	5	6.8	7.4	11.5	60	10	10	-
TPSMB2005CA	2005	1	20	22.2	24.5	32.4	18.6	1	500	5	6.8	7.4	11.5	60	10	10	-

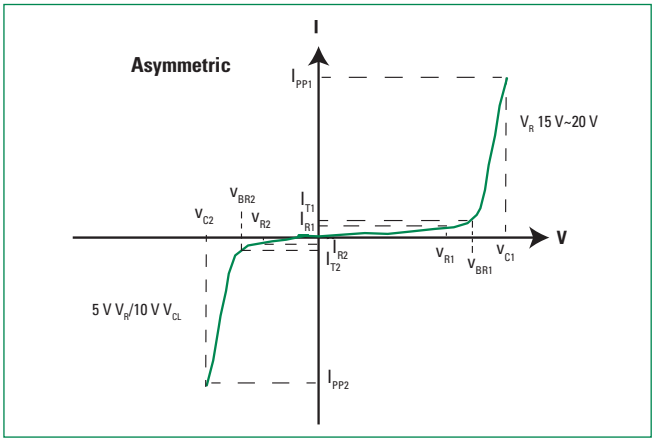
Technical application example for OBC / inverter protection (using TPSMB1505CA)



The asymmetrical TVS Diode is used widely in the driving circuit of SiC MOSFET or IGBT in OBC and traction inverters.

In this diagram, the asymmetrical TPSMB1505CA can ensure that Vgs is clamped to below V_{CL} = 24.4 V while forward surge current is applied and the Vgs is lower than V_{CL} = -10 V @ I_{PP} = 30 A while reverse surge current is applied. The power components can be better protected by employing this TVS, and its max. clamping voltages range are not allowed to exceed its maximum limiting voltage (-10/+25 V) of SiC MOSFET. This design approach also enhances the system's reliability.

I-V Curve Characteristics



P_{PPM} Peak Pulse Power Dissipation (I_{PP} x V_C) - Max power dissipation

V_{R1}/V_{R2} Stand-off Voltage - Maximum voltage that can be applied to the TVS without operation

V_{BR1}/V_{BR2} Breakdown Voltage - Maximum voltage that flows though the TVS at a specified test current (I_T)

V_{C1}/V_{C2} Clamping Voltage - Peak voltage measured across the TVS at a specified I_{PPM} (peak impulse current)

I_{R1}/I_{R2} Reverse Leakage Current - Current measured at V_R

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Ratings and Characteristic Curves (T_A = 25 °C unless otherwise noted)

Figure 1:TVS Transients Clamping Waveform

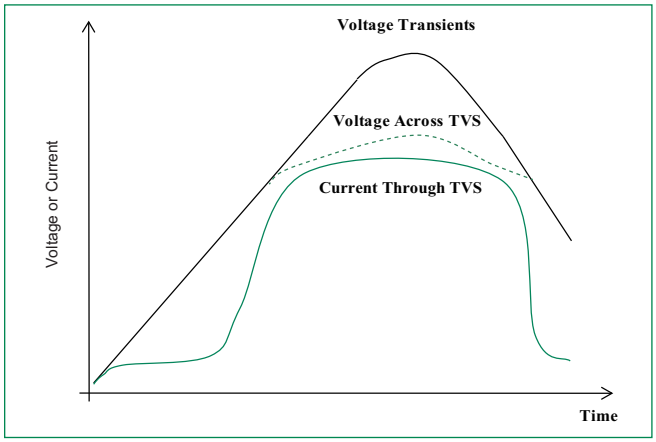


Figure 2: Peak Pulse Power Rating Curve

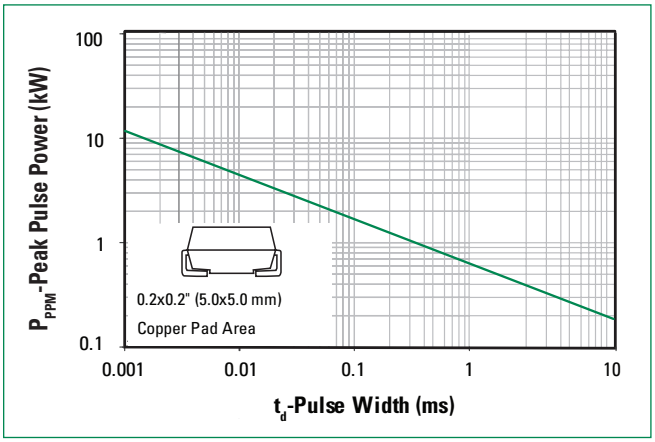


Figure 3: Pulse Waveform

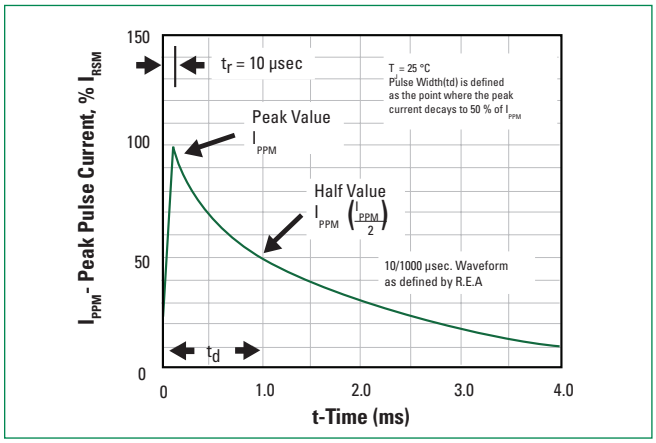


Figure 4: Peak Pulse Power Derating Curve

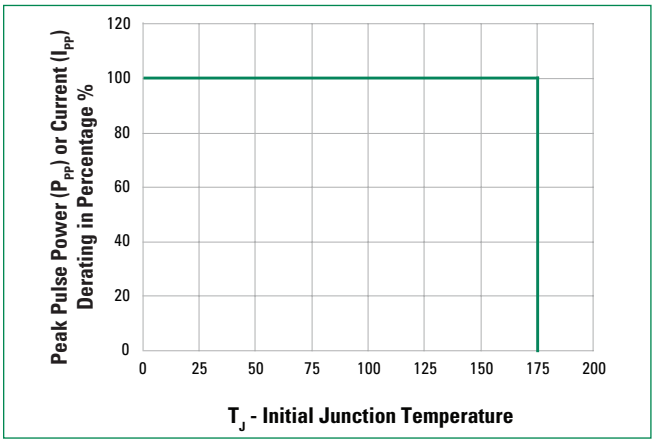
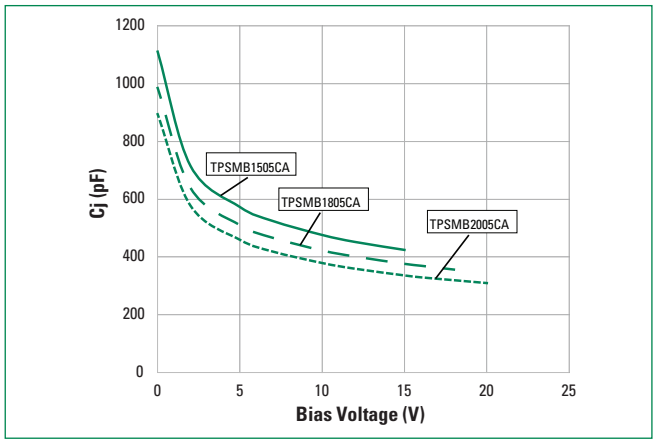


Figure 5 - Typical Junction Capacitance (K to A)



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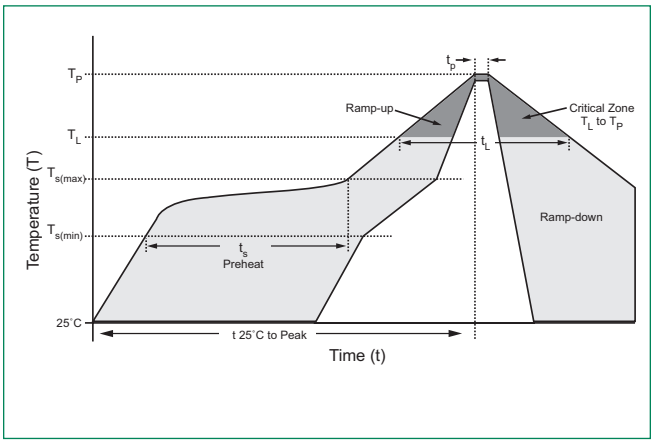
Soldering Parameters

Reflow Condition		Lead–free assembly
Pre Heat	**- Temperature Min ($T_{s(min)}$)**	150 °C
	- Temperature Max ($T_{s(max)}$)	200 °C
	- Time (min to max) (t_s)	60 – 120 seconds
Average Ramp up Rate (Liquidus Temp (T_L) to Peak		3 °C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		3 °C/second max
Reflow	**- Temperature (T_L) (Liquidus)**	217 °C
	- Time (min to max) (t_s)	60 – 150 seconds
Peak Temperature (T_p)		$260^{+0/-5}$ °C
Time Within 5°C of Actual Peak Temperature (t_p)		30 seconds max
Ramp-down Rate		6 °C/second max
Time 25°C to Peak Temperature (T_P)		8 minutes max
Do Not Exceed		260 °C



Physical Specifications

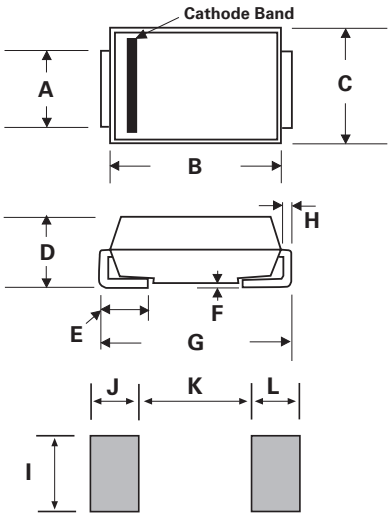
Weight	0.003 ounce, 0.093 grams
Case	JEDEC DO214AA. Molded plastic body over glass passivated junction
Polarity	Color band denotes cathode except bidirectional
Terminal	Matte Tin-plated leads, solderable per JESD22-B102

Environmental Specifications

High Temperature Storage	JESD22-A103
HTRB	JESD22-A108
Temperature Cycling	JESD22-A104
MSL	JEDEC-J-STD-020, Level 1
H3TRB	JESD22-A101
RSH	JESD22-A111

Dimensions

DO-214AA (SMB J-Bend)



Recommended Soldering Pad Layout

Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.077	0.086	1.950	2.200
B	0.160	0.180	4.060	4.570
C	0.130	0.155	3.300	3.940
D	0.084	0.096	2.130	2.440
E	0.030	0.060	0.760	1.520
F	-	0.008	-	0.203
G	0.205	0.220	5.210	5.590
H	0.006	0.012	0.152	0.305
I	0.089	-	2.260	-
J	0.085	-	2.160	-
K	-	0.107	-	2.740
L	0.085	-	2.160	-

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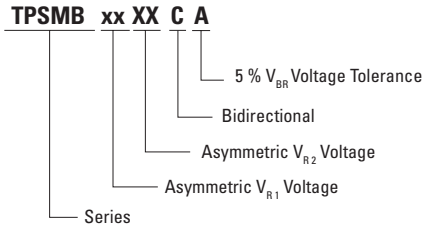
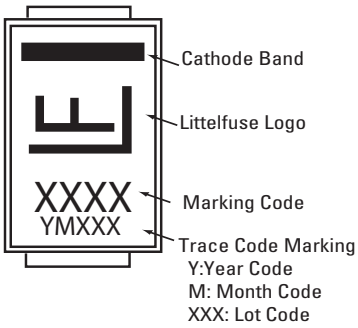
Part Numbering System



Part Marking System



Product Selector & Packaging Option

Part number	Product Type	Component Package	Quantity	Packaging Option	Packaging Specification
TPSMBxxXXCA	Asymmetric	DO-214AA	3000	Tape & Reel - 12 mm tape/13" reel	EIA-481

Tape and Reel Specification