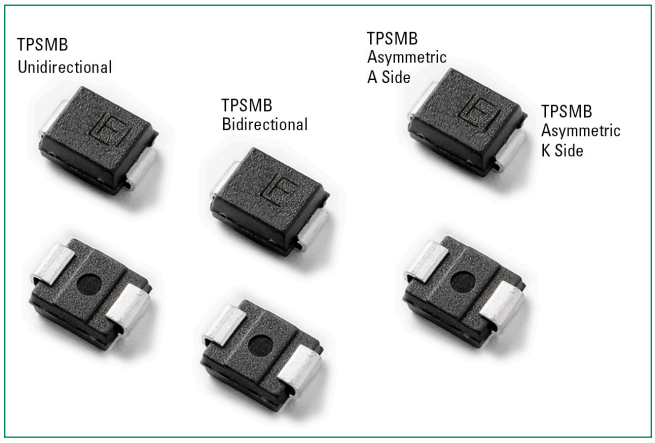
TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

AUTOMOTIVE GRADE HF RoHS



Agency Approvals

Agency	Agency Number
	E230531

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} P_{PPM2}	600	W
Power Dissipation on infinite heat sink at T_L = 50 °C	$P_{M(AV)}$	5.0	W
Peak Forward Surge Current, 8.3 ms Single Half Sine Wave (Note 3)	I_{FSM}	100	A
Maximum Instantaneous Forward Voltage at 50 A for Unidirectional only (Note 4)	V_F	3.5/5	V
Operating Junction Temperature Range (V_{BR}≤ 91 V and Asymmetric)	T_J	-65 to 175	°C
Operating Junction Temperature Range (V_{BR} > 91 V)	T_J	-65 to 150	°C
Storage Temperature Range	T_{STG}	-65 to 175	°C
Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	20	°C/W
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	100	°C/W

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.
3. Measured on 8.3 ms single half sine wave or equivalent square wave for unidirectional component only,duty cycle = 4 per minute maximum.
4. V_F < 3.5 V for part number with V_{BR} < 300 V, V_F < 5.0 V for part number with V_{BR} > = 300 V.

Applications

TPSMB Series are ideal for the protection of I/O interfaces, V_{CC} bus, on-board charging (OBC) driving circuits, traction inverter and other battery related vulnerable circuits used in automotive applications.

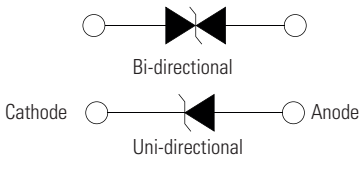
Description

The TPSMB and TPSMB Asymmetric Series specifically protects sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

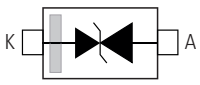
Features & Benefits

- 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)
- High voltage TPSMB supports active clamping. (Please see *Using High Voltage TVS Diodes in IGBT active Clamp Applications* for futher details)
- The TPSMB Asymmetric Series TVS products feature asymmetrical reverse stand-off voltages, protecting against positive and negative transients with different clamping in a single device. For the working range, please see product details in the characteristic table

Functional Diagram



TPSMB Series



TPSMB Asymmetric Series

Revised: FW.10/14/24 V1

TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

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

Part Number (Uni)	Part Number (Bi)	Marking		Typical I_R @ 150 °C (µA)	Reverse Stand off Voltage V_R (Volts)	Breakdown Voltage V_{BR} (Volts) @ I_T		Test Current I_T (mA)	Maximum Clamping Voltage V_C @ I_{pp} (V)	Maximum Peak Pulse Current I_{pp} (A)	Maximum Reverse Leakage I_R @ V_R (µA)	Maximum Temperature coefficient of V_{BR} (%/C)	Agency Approval
		Uni	Bi			Min	Max						
TPSMB7.5A	-	7V5AA	-	500	6.40	7.13	7.88	10	11.3	54.0	500	0.052	√
TPSMB8.2A	-	8V2AA	-	200	7.02	7.79	8.61	10	12.1	50.4	200	0.058	√
TPSMB9.1A	-	9V1AA	-	50	7.78	8.65	9.55	1	13.4	45.5	50	0.063	√
TPSMB10A	TPSMB10CA	10AA	10CA	20	8.55	9.50	10.50	1	14.5	42.1	10	0.066	√
TPSMB11A	TPSMB11CA	11AA	11CA	8	9.40	10.50	11.60	1	15.6	39.1	5	0.069	√
TPSMB12A	TPSMB12CA	12AA	12CA	8	10.20	11.40	12.60	1	16.7	36.5	5	0.071	√
TPSMB13A	TPSMB13CA	13AA	13CA	8	11.10	12.40	13.70	1	18.2	33.5	1	0.074	√
TPSMB15A	TPSMB15CA	15AA	15CA	8	12.80	14.30	15.80	1	21.2	28.8	1	0.076	√
TPSMB16A	TPSMB16CA	16AA	16CA	8	13.60	15.20	16.80	1	22.5	27.1	1	0.080	√
TPSMB18A	TPSMB18CA	18AA	18CA	8	15.30	17.10	18.90	1	25.5	24.2	1	0.083	√
TPSMB20A	TPSMB20CA	20AA	20CA	8	17.10	19.00	21.00	1	27.7	22.0	1	0.085	√
TPSMB22A	TPSMB22CA	22AA	22CA	8	18.80	20.90	23.10	1	30.6	19.9	1	0.088	√
TPSMB24A	TPSMB24CA	24AA	24CA	8	20.50	22.80	25.20	1	33.2	18.4	1	0.091	√
TPSMB27A	TPSMB27CA	27AA	27CA	8	23.10	25.70	28.40	1	37.5	16.3	1	0.092	√
TPSMB30A	TPSMB30CA	30AA	30CA	8	25.60	28.50	31.50	1	41.4	14.7	1	0.093	√
TPSMB33A	TPSMB33CA	33AA	33CA	8	28.20	31.40	34.70	1	45.7	13.3	1	0.094	√
TPSMB36A	TPSMB36CA	36AA	36CA	8	30.80	34.20	37.80	1	49.9	12.2	1	0.096	√
TPSMB39A	TPSMB39CA	39AA	39CA	8	33.30	37.10	41.00	1	53.9	11.3	1	0.097	√
TPSMB43A	TPSMB43CA	43AA	43CA	8	36.80	40.90	45.20	1	59.3	10.3	1	0.098	√
TPSMB47A	TPSMB47CA	47AA	47CA	8	40.20	44.70	49.40	1	64.8	9.4	1	0.099	√
TPSMB51A	TPSMB51CA	51AA	51CA	8	43.60	48.50	53.60	1	70.1	8.7	1	0.100	√
TPSMB56A	TPSMB56CA	56AA	56CA	8	47.80	53.20	58.80	1	77.0	7.9	1	0.101	√
TPSMB58A	TPSMB58CA	58AA	58CA	8	52.78	55.10	60.90	1	79.8	7.7	1	0.101	√
TPSMB62A	TPSMB62CA	62AA	62CA	8	53.00	58.90	65.10	1	85.0	7.2	1	0.102	√
TPSMB64A	TPSMB64CA	64AA	64CA	8	54.40	60.80	67.20	1	86.90	7.0	1	0.102	√
TPSMB68A	TPSMB68CA	68AA	68CA	8	58.10	64.60	71.40	1	92.0	6.6	1	0.103	√
TPSMB75A	TPSMB75CA	75AA	75CA	8	64.10	71.30	78.80	1	103.0	5.9	1	0.104	√
TPSMB82A	TPSMB82CA	82AA	82CA	8	70.10	77.90	86.10	1	113.0	5.4	1	0.105	√
TPSMB91A	TPSMB91CA	91AA	91CA	8	77.80	86.50	95.50	1	125.0	4.9	1	0.106	√
TPSMB100A	TPSMB100CA	100A	100C	-	85.50	95.00	105.00	1	137.0	4.5	1	0.106	√
TPSMB110A	TPSMB110CA	110A	110C	-	94.00	105.00	116.00	1	152.0	4.0	1	0.107	√
TPSMB120A	TPSMB120CA	120A	120C	-	102.00	114.00	126.00	1	165.0	3.7	1	0.107	√
TPSMB130A	TPSMB130CA	130A	130C	-	111.00	124.00	137.00	1	179.0	3.4	1	0.107	√
TPSMB150A	TPSMB150CA	150A	150C	-	128.00	143.00	158.00	1	207.0	2.9	1	0.108	√
TPSMB160A	TPSMB160CA	160A	160C	-	136.00	152.00	168.00	1	219.0	2.8	1	0.108	√
TPSMB170A	TPSMB170CA	170A	170C	-	145.00	162.00	179.00	1	234.0	2.6	1	0.108	√
TPSMB180A	TPSMB180CA	180A	180C	-	154.00	171.00	189.00	1	246.0	2.5	1	0.108	√
TPSMB200A	TPSMB200CA	200A	200C	-	171.00	193.00	207.00	1	274.0	2.2	1	0.108	√
TPSMB210A	TPSMB210CA	210A	210C	-	179.60	202.65	217.35	1	288.0	2.1	1	0.110	√
TPSMB219A	-	219A	-	23	187.00	211.34	226.67	1	300.0	2.0	1	0.110	√
TPSMB220A	TPSMB220CA	220A	220C	-	185.00	212.30	227.70	1	328.0	1.9	1	0.110	√
TPSMB250A	TPSMB250CA	250A	250C	-	214.00	241.25	258.75	1	344.0	1.8	1	0.110	√
TPSMB300A-A	TPSMB300CA-A	300A	300C	-	256.00	291.00	309.00	1	414.0	1.5	1	0.110	√
TPSMB350A-A	TPSMB350CA-A	350A	350C	-	300.00	339.50	360.50	1	482.0	1.3	1	0.112	√
TPSMB400A-A	TPSMB400CA-A	400A	400C	-	342.00	388.00	412.00	1	548.0	1.1	1	0.112	√
TPSMB440A-A	TPSMB440CA-A	440A	440C	-	376.00	426.80	453.20	1	602.0	1.0	1	0.112	√
TPSMB480A-A	TPSMB480CA-A	480A	480C	-	408.00	465.60	494.40	1	658.0	0.9	1	0.112	√
TPSMB510A-A	TPSMB510CA-A	510A	510C	-	434.00	494.70	525.30	1	698.0	0.9	1	0.112	√
TPSMB520A-A	TPSMB520CA-A	520A	520C	-	443.00	504.40	535.60	1	718.0	0.9	1	0.112	√
TPSMB530A-A	TPSMB530CA-A	530A	530C	-	451.00	514.10	545.90	1	725.0	0.8	1	0.112	√
TPSMB540A-A	TPSMB540CA-A	540A	540C	-	460.00	523.80	556.20	1	740.0	0.8	1	0.112	√
TPSMB550A-A	TPSMB550CA-A	550A	550C	-	468.00	533.50	566.50	1	760.0	0.8	1	0.112	√
-	TPSMB600CA-A	-	600C	-	511.00	582.00	618.00	1	828.0	0.8	1	0.112	-
-	TPSMB650CA-A	-	650C	-	553.00	630.50	669.50	1	897.0	0.8	1	0.112	-

Note:

1. For bidirectional type having V_R of 10 volts and less, the I_R limit is double.

2. V_{BR} @T_J= V_{BR}@25°C x (1+αT x (T_J - 25)) (αT:Temperature Coefficient).

3: The CTI (Comparative Tracking Index) of TPSMB600CA-A and TPSMB650CA-A is 600 and other parts is 550

Littelfuse

Revised: FW.10/14/24 V1

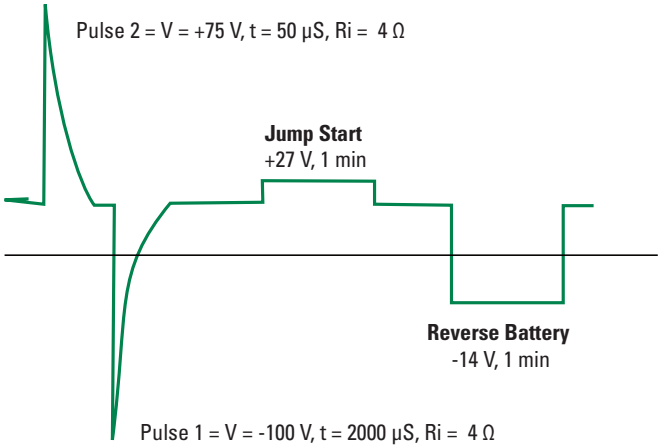
TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

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

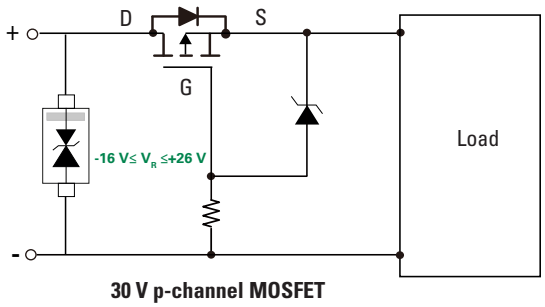
Part Number	Marking	K to A							A to K							Agency Approval
		Maximum Reverse Leakage I_{R1} @ V_{R1} (µA)	Stand off Voltage V_{R1} (V)	Breakdown Voltage V_{BR} @ I_{T1} (V)		Maximum Clamping Voltage V_{C1} @ I_{PP} (V)	Maximum Peak Pulse Current I_{PP1} (A)	Test Current I_{T1} (mA)	Maximum Reverse 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} (V)	Maximum Peak Pulse Current I_{PP2} (A)	Test Current I_{T2} (mA)	
				Min	Max						Min	Max				
TPSMB2412CA	2412	1	24	26.6	29.4	38.9	15.5	1	1	12	13.3	14.7	19.9	30.2	1	-
TPSMB2616CA	2616	1	26	28.9	31.9	39.5	14.3	1	1	16	17.8	19.7	26.0	23.1	1	-
TPSMB2818CA	2818	1	28	31.1	34.4	42.5	13.3	1	1	18	20.0	22.1	29.2	20.6	1	-

Technical application example of reverse-battery protection (using TPSMB2616CA)



If connected to the 12 V Battery，Applications can survive following requirements:

Reverse Polarity	-14 V	
Jump Start	+26V	
Test pulse 2	ISO 7637-2	+75 V / 50 µs
Test Pulse 1	ISO 7637-2	-150 V / 2 ms



30 V p-channel MOSFET

As the above diagram shows, symmetrical TVS is used widely in anti-reverse protection circuits. In this diagram, the asymmetrical TPSMB2616 can clamp the voltage to lower than 40 V to protect the following load when positive pulse(such as Pulse 2) is applied. Meanwhile it can ensure that V_SD of the P-MOS is clamping to 26V which is lower than its rated voltage (30 V) when the negative test pulses of ISO7637-2 (such as pulse 1) are applied. Hence the customer can employ 30 V P-MOS instead of a high-voltage one to reduce costs. What's more, one asymmetrical TVS solution can replace 2 pcs of TVS diodes in series to save the PCB space.

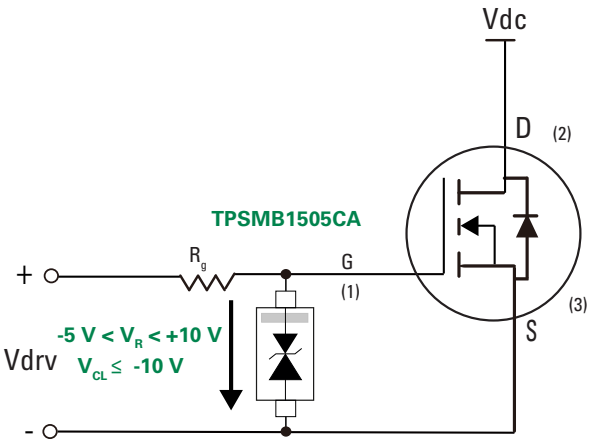
TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

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)

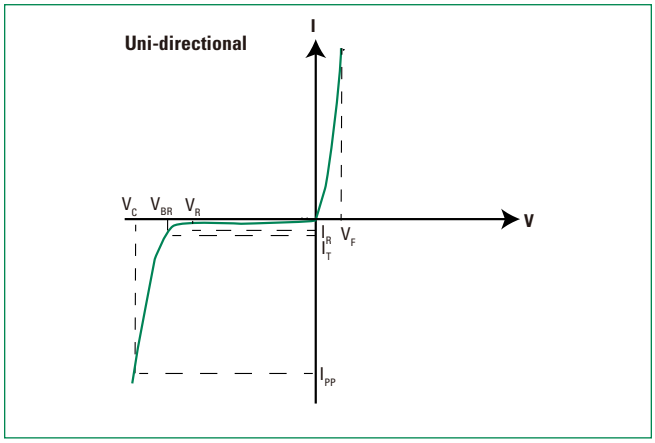


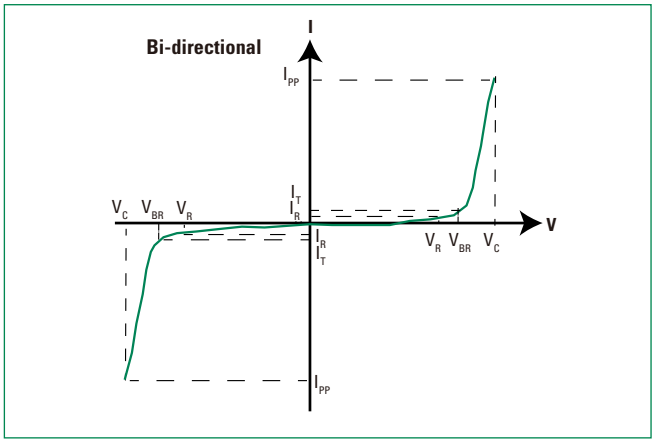
Asymmetrical TVS is used widely in the driving circuit of SiC MOS or IGBT in OBC and Traction inverter as the right diagram shown. In this diagram, the asymmetrical TPSMB1505CA can ensure that Vgs is clamped to below V_{CL} = 24.4 V while forward surge current is applied and the Vgs is lower than V_{CL} = -10 V @ I_{PP} = 30 A while reverse surge current is applied. By employing the TVS, the power components can be better protected whose clamping voltages are not allowed to exceed its maximum limiting voltage (-10/+25 V) of SiC MOS, the reliability of system also be enhanced.

TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

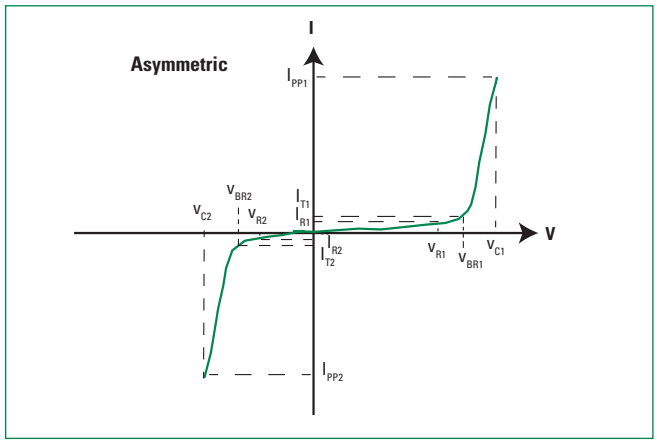
I-V Curve Characteristics @ Standard Product





P_{PPM} Peak Pulse Power Dissipation (I_{PP} x V_C) – Max power dissipation
V_R Stand-off Voltage – Maximum voltage that can be applied to the TVS without operation
V_{BR} Breakdown Voltage – Maximum voltage that flows though the TVS at a specified test current (I_T)
V_C Clamping Voltage – Peak voltage measured across the TVS at a specified Ippm (peak impulse current)
I_R Reverse Leakage Current -- Current measured at V_R
V_F Forward Voltage Drop for Unidirectional

I-V Curve Characteristics @ Asymmetric Product



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

TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

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

Figure 1:TVS Transients Clamping Waveform

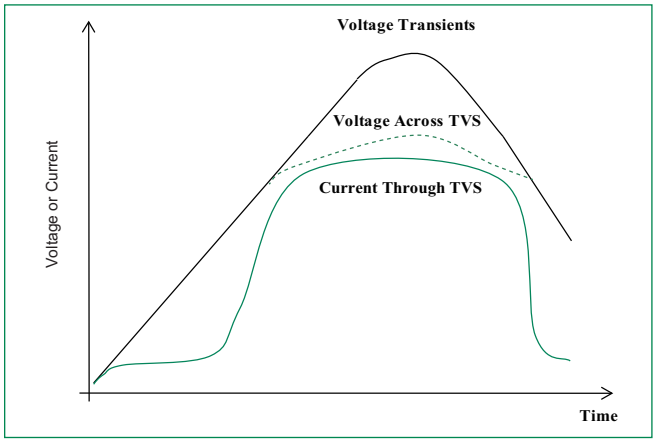


Figure 2: Peak Pulse Power Rating Curve

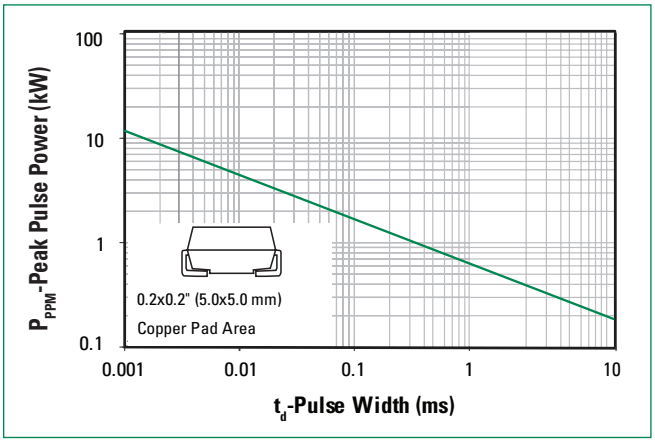


Figure 3: Peak Pulse Power Derating Curve @Standard Product

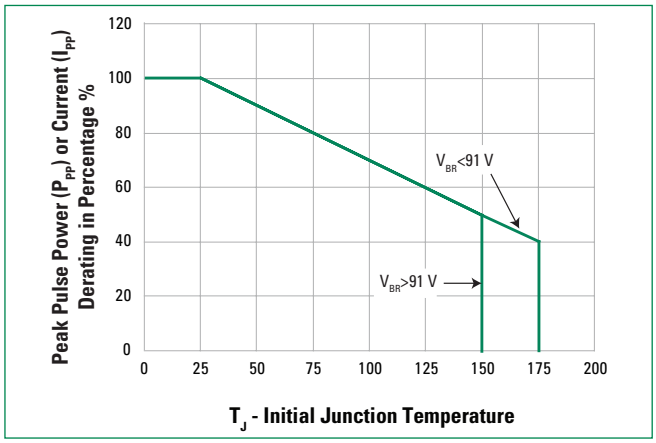


Figure 4: Peak Pulse Power Derating Curve @Asymmetric Product

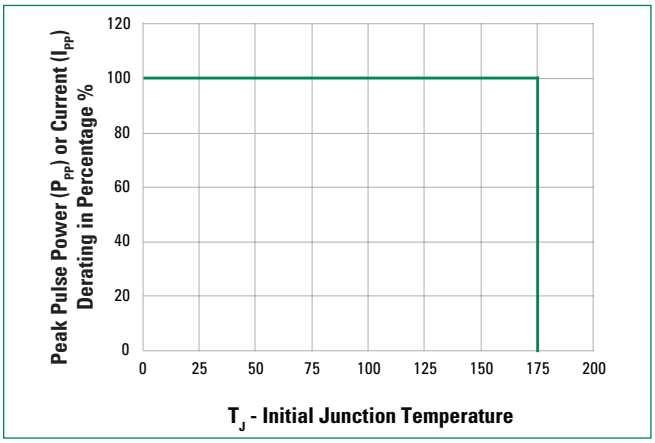


Figure 5: Pulse Waveform

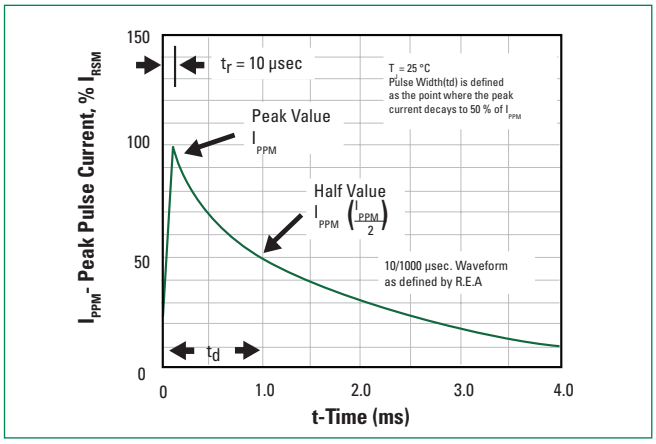


Figure 6 - Typical Junction Capacitance @Standard Product

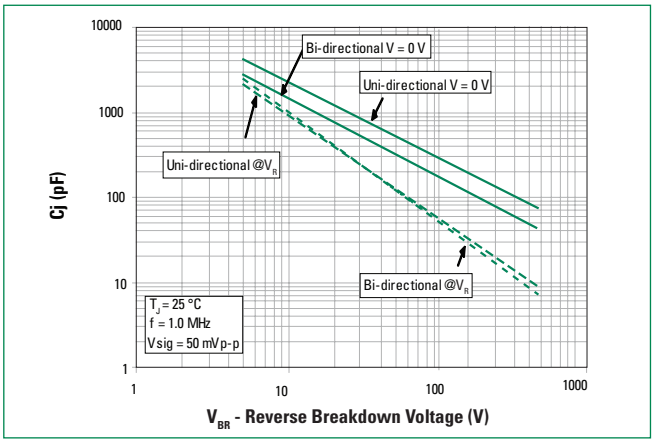


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Figure 7 - Maximum Non-Repetitive Peak Forward Surge Current Unidirectional Only @Standard Product

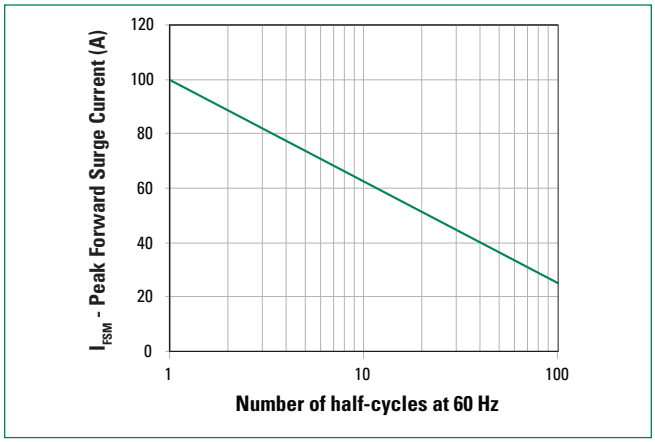


Figure 8 - Typical Junction Capacitance @TPSMBxx05CA(K to A)

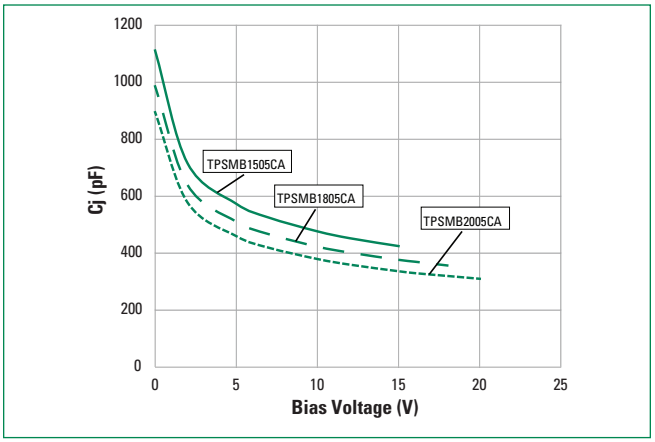


Figure 9 - Typical Junction Capacitance @ TPSMB2412/2616/2818CA(K to A)

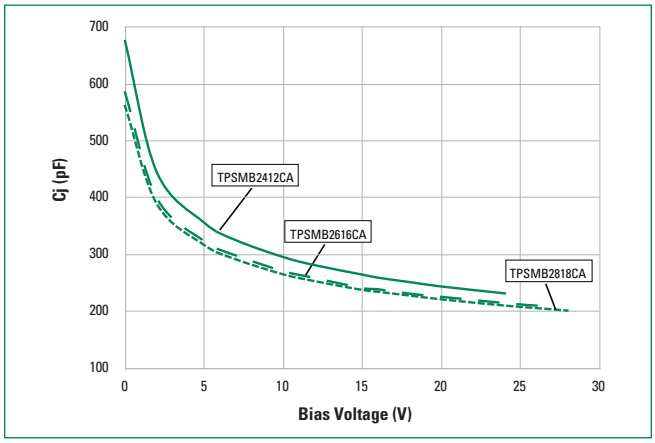
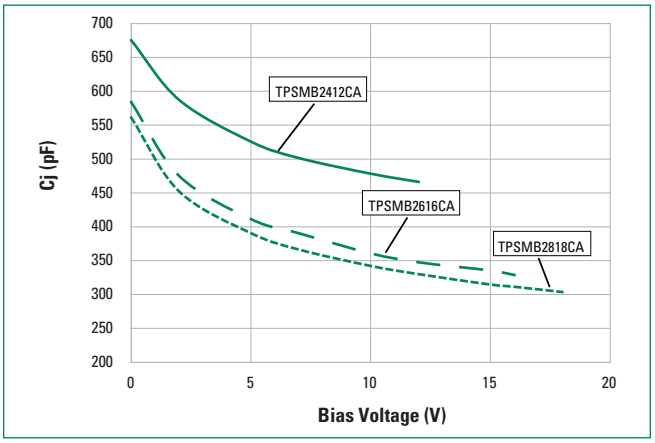


Figure 10 - Typical Junction Capacitance@ TPSMB2412/2616/2818CA(A to K)



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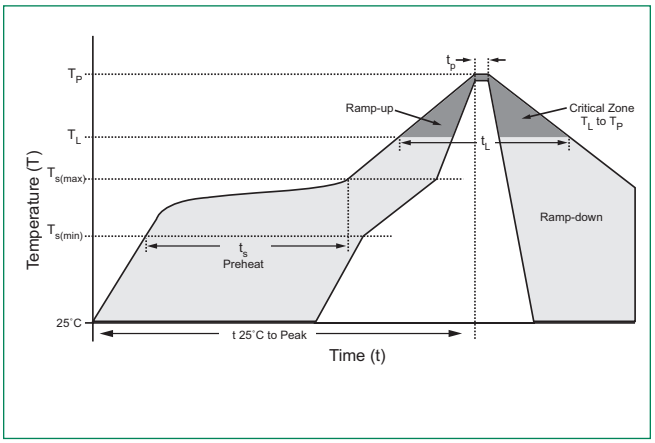
TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

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

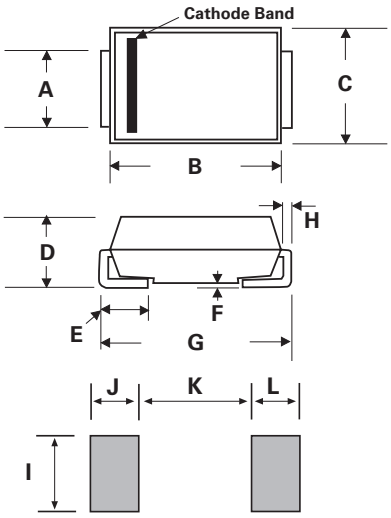
Weight	0.003 ounce, 0.093 grams
Case	JEDEC DO214AA. Molded plastic body over glass passivated junction
Polarity	Color band denotes cathode except bidirectional
Terminal	Matte Tin-plated leads, solderable per JESD22-B102

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)



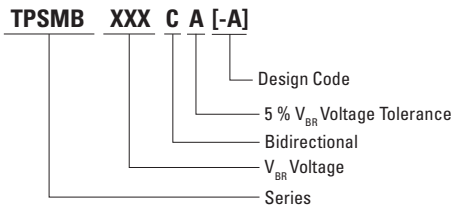
Recommended Soldering Pad Layout

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	-

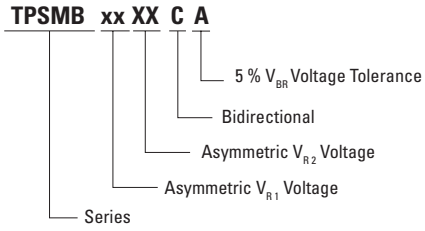
TPSMB and TPSMB Asymmetric Series

Automotive, Surface Mount 600 W in DO-214AA

Part Numbering System

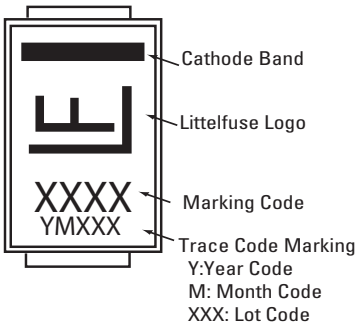


Standard Product



Asymmetric Product

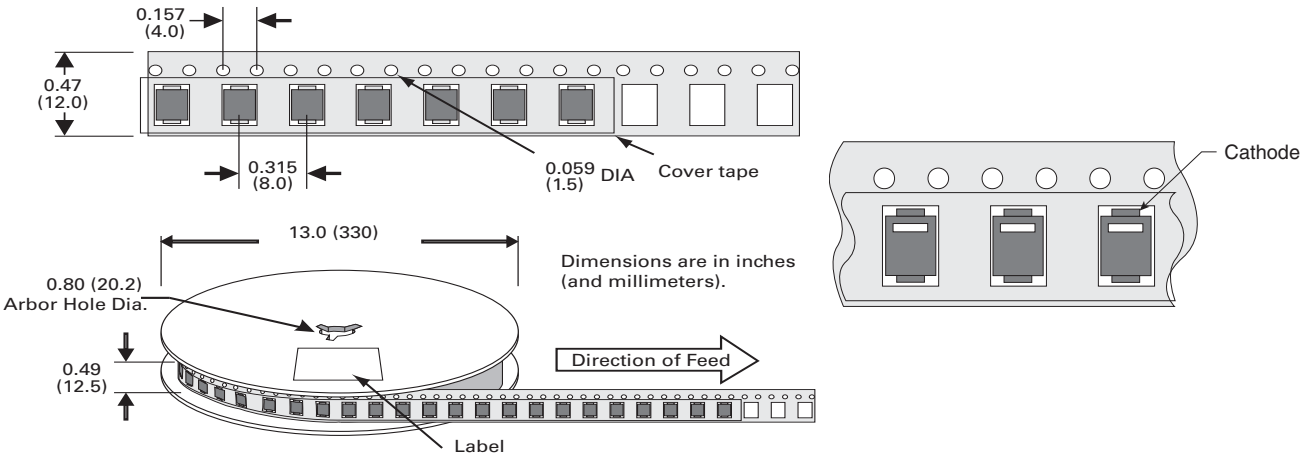
Part Marking System



Product Selector & Packaging Option

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

Tape and Reel Specification



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