

## 瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes

SMBJ Series



## 概述 Description

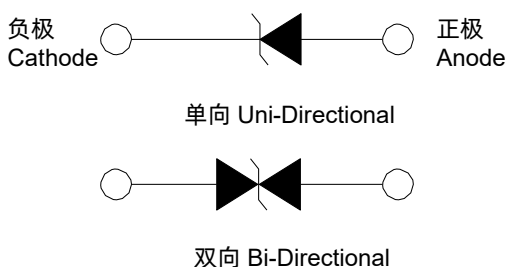
瞬态抑制二极管 (TVS) 是一种电路保护元件, 它可以削弱或过滤突增的瞬态电压(过压), 在浪涌到来瞬间几纳秒时间内发生雪崩击穿, 将浪涌电流引至接地端, 并将电压箝位在安全范围内, 从而实现了高效能的电压保护。

Transient Voltage Suppressor (TVS) is a circuit protection component that either attenuates (reduces) or filters a transient voltage spike (overvoltage), TVS diodes provide critical protection by going into avalanche breakdown within no more than a few nanoseconds after a strike, clamping the transient voltage, and routing its current to the ground.

## 应用 Applications

- 通信设备      Communication Equipment
- 安防            Security & Protection
- 工控设备      Industrial Control Equipment
- 电源            Power Supply
- 汽车电子      Automotive Electronics
- 新能源设备    New Energy
- 防雷保护      Lightning Protection

## 功能图 Functional Diagram



## 特性 Features

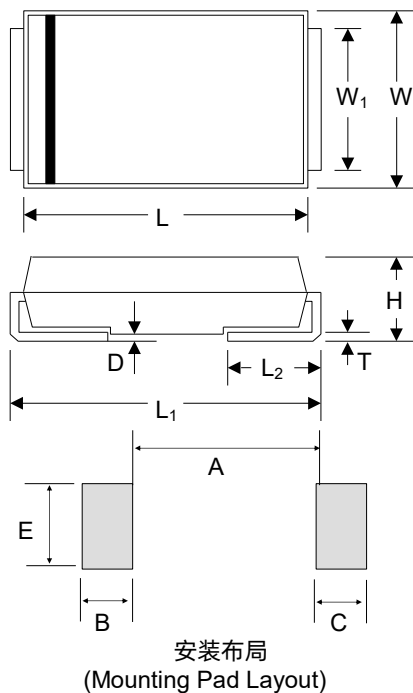
- 低浪涌电阻
- 优异的箝位性能
- 小型化紧凑封装, 内部结构去应力设计
- 12 V 以上电压规格对应漏电流典型值低于 1.0  $\mu$ A
- 重复率 0.01% 的 10/1000  $\mu$ S 波形对应峰值脉冲功率 600 W
- 表贴应用, 节约空间
- 典型的故障模式为电压或电流超过额定而导致的短路
- IEC 61000-4-2 ESD 30 kV (空气), 30 kV (接触)
- 数据线 EFT 保护符合 IEC 61000-4-4
- 快速响应时间
- 玻璃钝化保护
- 回流焊高温保证: 260  $^{\circ}$ C/30 s
- 温度系数典型值 0.1%
- 密封材料阻燃等级 V-0
- 湿度敏感等级符合 MSL 等级 1
- 引脚镀锡
- 无卤素, 符合 RoHS 要求
- 无铅 E3: 二级互连引线无铅, 端子镀锡 (Sn) (IPC/JEDEC J-STD-609A.01)
- Low incremental surge resistance
- Excellent clamping capability
- Low profile package with built-in strain relief for surface mounted applications
- Typical  $I_R$  less than 1.0  $\mu$ A above 12 V
- 600 W peak pulse power capability with a 10/1000  $\mu$ S Waveform, repetition rate (duty cycle): 0.01%
- For surface mounted applications to optimize board space
- Low profile package, Built-in strain relief
- Typical failure mode is short from over-specified voltage or current
- IEC 61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Very fast response time
- Glass passivated chip junction
- High temperature to reflow soldering guaranteed: 260  $^{\circ}$ C/30sec
- $V_{BR} @ T_J = V_{BR@25^{\circ}C} \times (1 + \alpha T \times (T_J - 25))$   
( $\alpha T$ : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level 1, per J-STD-020
- 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)

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## 封装尺寸 Package Outline Dimensions (DO-214AA)



符号 Symbol	公制(毫米) Millimeters		英制(英寸) Inches	
	Min.	Max.	Min.	Max.
L	4.060	4.750	0.160	0.187
W	3.300	3.940	0.130	0.155
W <sub>1</sub>	1.930	2.200	0.076	0.086
H	1.990	2.610	0.078	0.103
T	0.152	0.305	0.006	0.012
L <sub>1</sub>	5.210	5.590	0.205	0.220
L <sub>2</sub>	0.760	1.520	0.030	0.060
D	-	0.203	-	0.008
A	-	2.740	-	0.107
B	2.160	-	0.085	-
C	2.160	-	0.085	-
E	2.260	-	0.089	-

TVS

TVS

## 额定参数与特性 Maximum Ratings and Characteristics

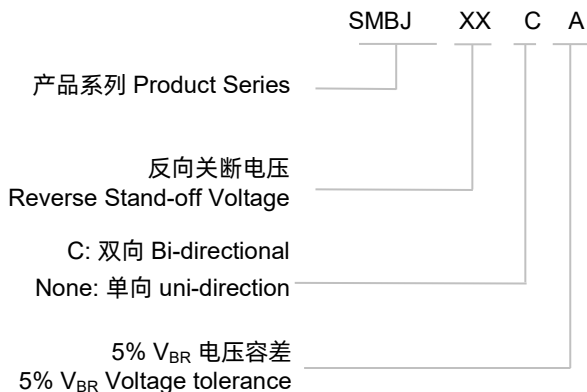
(除另有注释, 默认 $T_A=25\text{ }^\circ\text{C}$  Ratings at  $25\text{ }^\circ\text{C}$  ambient temperature unless otherwise specified.)

参数 Parameter	符号 Symbol	值 Value	单位 Unit
10/1000 $\mu\text{S}$ 脉冲波形 <sup>(1)(2)</sup> (图4)下, 峰值脉冲功耗 (图2)-单芯片器件 Peak Power Dissipation (Fig.2)- with a 10/1000 $\mu\text{S}$ waveform <sup>(1)(2)</sup> (Fig.4)-Single Die Parts	$P_{\text{PPM}}$	600	W
10/1000 $\mu\text{S}$ 波形 <sup>(1)(2)</sup> (图4)的峰值脉冲功耗(图2)(注1)、(注2)-双芯片器件 <sup>(5)</sup> Peak Power Dissipation (Fig2) with a 10/1000 $\mu\text{S}$ waveform <sup>(1)(2)</sup> (Fig.4)-Stacked Die Parts <sup>(5)</sup>	$P_{\text{PPM}}$	800	W
峰值功耗,无限散热, $T_L=50\text{ }^\circ\text{C}$ Peak Power Dissipation on Infinite Heat Sink at $T_L=50\text{ }^\circ\text{C}$	$P_D$	5.0	W
正向脉冲电流峰值 <sup>(3)</sup> ,额定负载叠加8.3 ms 单半正弦波测得(JEDEC方法) Peak Forward Surge Current,8.3ms single half sinewave superimposed on rated load (JEDEC Method) <sup>(3)</sup>	$I_{\text{FSM}}$	100	A
正向瞬态峰值电压 @ $I_F=50\text{ A}$ , 仅适用于单向产品 Maximum Instantaneous Forward Voltage at 50 A for Unidirectional Only <sup>(4)</sup>	$V_F$	3.5/5.0	V
工作温度范围 Operating Temperature Range	$T_J$	-65 to 150	$^\circ\text{C}$
存储温度范围 Storage Temperature Range	$T_{\text{STG}}$	-65 to 175	$^\circ\text{C}$
热阻(结至引线) Typical Thermal Resistance Junction to Lead	$R_{\theta\text{JL}}$	20	$^\circ\text{C/W}$
热阻(结至环境) Typical Thermal Resistance Junction to Ambient	$R_{\theta\text{JA}}$	100	$^\circ\text{C/W}$

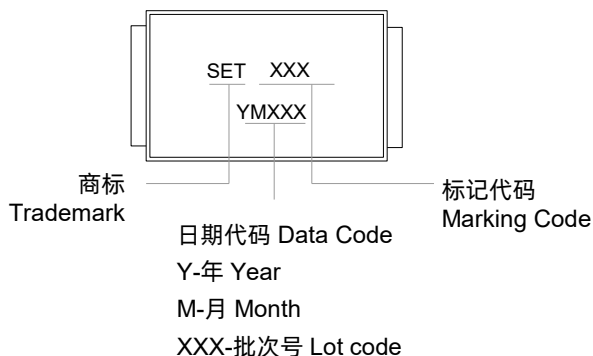
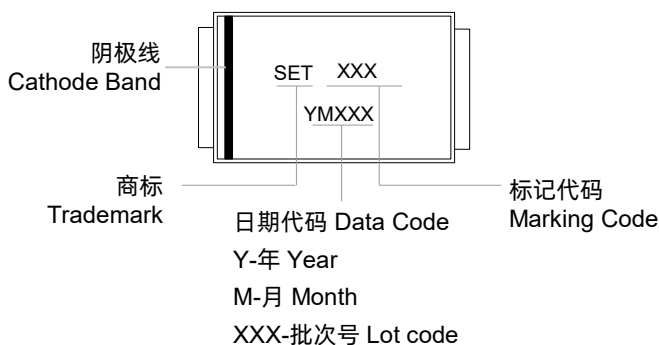
## 注释 Notes

- 参照图4非重复性脉冲电流波形, 初始结温 $25\text{ }^\circ\text{C}$ 以图3所示曲线降额(环境温度 $T_A=25\text{ }^\circ\text{C}$ )。  
Non-repetitive current pulse, per Fig. 4 and derated above  $T_J(\text{initial})=25\text{ }^\circ\text{C}$  per Fig. 3.
- 测试安装于 $5.0\text{ mm}^2$ 焊盘。  
Mounted on  $5.0\text{ mm}^2$  land areas.
- 叠加波形为8.3 ms单个半周期正弦波或等幅方波, 最长周期4次/min。  
Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
- 单芯片 $V_F < 3.5\text{ V}$ , 叠层芯片 $V_F < 5.0\text{ V}$ 。  
 $V_F < 3.5\text{ V}$  for single die parts and  $V_F < 5.0\text{ V}$  for stacked-die parts.
- 双芯片产品的详细信息, 请参阅电气特性中以\*标示的部件编号。  
For stacked die component details, please refer to models marked with \* in electrical characteristics table.

## 型号规则 Part Numbering System



## 标记 Marking



## 术语 Glossary

项目 Item	描述 Description
$V_C$	<b>箝位电压 Clamping Voltage</b> TVS在低差阻区域内的电压，用于限制设备两端的电压。 Voltage across TVS in a region of low differential resistance that serves to limit the voltage across the device terminals.
$V_R$	<b>反向关断电压 Reverse Stand-off Voltage</b> TVS 在没有导通状态下最高电压。 Maximum voltage that can be applied to the TVS without operation. 注：也用 $V_{WM}$ （最高直流工作电压）表示，也称为截止电压( $V_{so}$ )。 NOTE : It is also shown as $V_{WM}$ (maximum working voltage (maximum d.c. voltage)) and known as rated stand-off voltage ( $V_{so}$ ).
$I_R$	<b>反向漏电流 Reverse Leakage Current</b> 量测 $V_R$ 的电流。 Current measured at $V_R$ . 注：也用 $I_D$ 待机电流表示。 NOTE : Also shown as $I_D$ for stand-by current.
$V_{BR}$	<b>击穿电压 Breakdown Voltage</b> 在击穿区以指定电流 $I_T$ (测试电流)通过TVS的电压。 Voltage across TVS at a specified current $I_T$ (test current) in the breakdown region.
$I_{PPM}$	<b>额定随机重复峰值脉冲电流 Rated Random Recurring Peak Impulse Current</b> 施加在设备上的随机重复峰值脉冲电流的最大额定值。 Maximum-rated value of random recurring peak impulse current that may be applied to a device.
$P_{M(AV)}$	<b>额定平均功率 Rated Average Power Dissipation</b> 所有电源(包括瞬态电流和待机电流)在短时间内平均产生的最大额定功耗。 Maximum-rated value of power dissipation resulting from all sources, including transients and standby current, averaged over a short period of time.
$P_{PPM}$	<b>额定随机重复峰值脉冲功率 Rated Random Recurring Peak Impulse Power Dissipation</b> 额定随机重复峰值脉冲电流( $I_{PPM}$ )和规定的最大箝位电压( $V_C$ )乘积的最大额定值。 Maximum-rated value of the product of rated random recurring peak impulse current ( $I_{PPM}$ ) multiplies by specified maximum clamping voltage ( $V_C$ ).
$C_J$	<b>电容 Capacitance</b> 在规定的频率和电压下所测量的TVS电容。 Capacitance across the TVS measured at a specified frequencyx and voltage.

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)

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项目 Item	描述 Description
$V_{FS}$	<p><b>正向浪涌峰值电压 Peak Forward Surge Voltage</b></p> <p>在指定的正向浪涌电流(<math>I_{FS}</math>)和持续时间下, 通过TVS的峰值电压。 Peak voltage across TVS for a specified forward surge current (<math>I_{FS}</math>) and time duration. 注: 也用<math>V_F</math>表示。 NOTE : Also shown as <math>V_F</math>.</p>
$I_{FS}$	<p><b>正向浪涌电流 Forward Surge Current</b></p> <p>在正向导通区域通过TVS的脉冲电流。 Pulsed current through TVS in the forward conducting region. 注: 也用<math>I_F</math>表示。 NOTE : Also shown as <math>I_F</math>.</p>
$\alpha_{V(BR)}$	<p><b>击穿电压温度系数 Temperature Coefficient of Breakdown Voltage</b></p> <p>击穿电压的变化与温度变化的比值。 The change of breakdown voltage divided by the change of temperature.</p>
$I_{PP}$	<p><b>峰值脉冲电流 Peak pulse Current</b></p> <p>施加在TVS上的峰值脉冲电流, 以确定箝位电压<math>V_C</math>的特定波形。 Peak pulse current value applied across the TVS to determine the clamping voltage <math>V_C</math> for a specified wave shape.</p>
$I_T$	<p><b>脉冲直流测试电流 Pulsed D.C. Test Current</b></p> <p>测量击穿电压<math>V_{BR}</math>的测试电流。该电流值由制造商确定, 通常以脉冲持续时间小于40 ms的毫安级电流给出。 Test current for measurement of the breakdown voltage <math>V_{BR}</math>. This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms. 注: 也用<math>I_{BR}</math>表示。 NOTE : Also shown as <math>I_{BR}</math>.</p>

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)

## 瞬态抑制二极管 TVS Diodes

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电气特性 (除另有注释, 默认 $T_A=25\text{ }^\circ\text{C}$ )Electrical Characteristics ( $T_A=25\text{ }^\circ\text{C}$  unless otherwise noted) Table 1

型号 Part Number		标记代码 Device Marking Code		击穿电压 Breakdown Voltage $V_{BR}@I_T$		测试 电流 Test Current $I_T$	反向关断 电压 Reverse Stand-off Voltage $V_R$	最大反向 漏电流 Max. Reverse Leakage $I_R@V_R$	最大峰值 脉冲电流 Max. Peak Pulse Current $I_{PP}$	最大箝位 电压 Max. Clamping Voltage $V_C@I_{PP}$
				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	( $\mu\text{A}$ )	(A)	(V)
SMBJ5.0A	SMBJ5.0CA	KE	AE	6.4	7	10	5	800	65.3	9.2
SMBJ6.0A	SMBJ6.0CA	KG	AG	6.67	7.37	10	6	800	58.3	10.3
SMBJ6.5A	SMBJ6.5CA	KK	AK	7.22	7.98	10	6.5	500	53.6	11.2
SMBJ7.0A	SMBJ7.0CA	KM	AM	7.78	8.6	10	7	200	50	12
SMBJ7.5A	SMBJ7.5CA	KP	AP	8.33	9.21	1	7.5	100	46.6	12.9
SMBJ8.0A	SMBJ8.0CA	KR	AR	8.89	9.83	1	8	50	44.2	13.6
SMBJ8.5A	SMBJ8.5CA	KT	AT	9.44	10.4	1	8.5	20	41.7	14.4
SMBJ9.0A	SMBJ9.0CA	KV	AV	10	11.1	1	9	10	39	15.4
SMBJ10A	SMBJ10CA	KX	AX	11.1	12.3	1	10	5	35.3	17
SMBJ11A	SMBJ11CA	KZ	AZ	12.2	13.5	1	11	1	33	18.2
SMBJ12A	SMBJ12CA	LE	BE	13.3	14.7	1	12	1	30.2	19.9
SMBJ13A	SMBJ13CA	LG	BG	14.4	15.9	1	13	1	28	21.5
SMBJ14A	SMBJ14CA	LK	BK	15.6	17.2	1	14	1	25.9	23.2
SMBJ15A	SMBJ15CA	LM	BM	16.7	18.5	1	15	1	24.6	24.4
SMBJ16A	SMBJ16CA	LP	BP	17.8	19.7	1	16	1	23.1	26
SMBJ17A	SMBJ17CA	LR	BR	18.9	20.9	1	17	1	21.8	27.6
SMBJ18A	SMBJ18CA	LT	BT	20	22.1	1	18	1	20.6	29.2
SMBJ20A	SMBJ20CA	LV	BV	22.2	24.5	1	20	1	18.6	32.4
SMBJ22A	SMBJ22CA	LX	BX	24.4	26.9	1	22	1	16.9	35.5
SMBJ24A	SMBJ24CA	LZ	BZ	26.7	29.5	1	24	1	15.5	38.9
SMBJ26A	SMBJ26CA	ME	CE	28.9	31.9	1	26	1	14.3	42.1
SMBJ28A	SMBJ28CA	MG	CG	31.1	34.4	1	28	1	13.3	45.4
SMBJ30A	SMBJ30CA	MK	CK	33.3	36.8	1	30	1	12.4	48.4
SMBJ33A	SMBJ33CA	MM	CM	36.7	40.6	1	33	1	11.3	53.3
SMBJ36A	SMBJ36CA	MP	CP	40	44.2	1	36	1	10.4	58.1
SMBJ40A	SMBJ40CA	MR	CR	44.4	49.1	1	40	1	9.3	64.5
SMBJ43A	SMBJ43CA	MT	CT	47.8	52.8	1	43	1	8.7	69.4
SMBJ45A	SMBJ45CA	MV	CV	50	55.3	1	45	1	8.3	72.7
SMBJ48A	SMBJ48CA	MX	CX	53.3	58.9	1	48	1	7.8	77.4

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				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	( $\mu$ A)	(A)	(V)
SMBJ51A	SMBJ51CA	MZ	CZ	56.7	62.7	1	51	1	7.3	82.4
SMBJ54A	SMBJ54CA	NE	DE	60	66.3	1	54	1	6.9	87.1
SMBJ58A	SMBJ58CA	NG	DG	64.4	71.2	1	58	1	6.5	93.6
SMBJ60A	SMBJ60CA	NK	DK	66.7	73.7	1	60	1	6.2	96.8
SMBJ64A	SMBJ64CA	NM	DM	71.1	78.6	1	64	1	5.9	103
SMBJ70A	SMBJ70CA	NP	DP	77.8	86	1	70	1	5.3	113
SMBJ75A	SMBJ75CA	NR	DR	83.3	92.1	1	75	1	5	121
SMBJ78A	SMBJ78CA	NT	DT	86.7	95.8	1	78	1	4.8	126
SMBJ85A	SMBJ85CA	NV	DV	94.4	104	1	85	1	4.4	137
SMBJ90A	SMBJ90CA	NX	DX	100	111	1	90	1	4.1	146
SMBJ100A	SMBJ100CA	NZ	DZ	111	123	1	100	1	3.7	162
SMBJ110A	SMBJ110CA	PE	EE	122	135	1	110	1	3.4	177
SMBJ120A	SMBJ120CA	PG	EG	133	147	1	120	1	3.1	193
SMBJ130A	SMBJ130CA	PK	EK	144	159	1	130	1	2.9	209
SMBJ150A	SMBJ150CA	PM	EM	167	185	1	150	1	2.5	243
SMBJ160A	SMBJ160CA	PP	EP	178	197	1	160	1	2.3	259
SMBJ170A	SMBJ170CA	PR	ER	189	209	1	170	1	2.2	275
SMBJ180A	SMBJ180CA	PT	ET	201	222	1	180	1	2.1	292
SMBJ188A	SMBJ188CA	PB	EB	209	231	1	188	1	2	304
SMBJ200A	SMBJ200CA	PV	EV	224	247	1	200	1	1.9	324
SMBJ220A	SMBJ220CA	PX	EX	246	272	1	220	1	1.7	356
SMBJ250A	SMBJ250CA	PZ	EZ	279	309	1	250	1	1.5	405
SMBJ300A*	SMBJ300CA*	QE	FE	335	371	1	300	1	1.7	486
SMBJ350A*	SMBJ350CA*	QG	FG	391	432	1	350	1	1.5	567
SMBJ400A*	SMBJ400CA*	QK	FK	447	494	1	400	1	1.3	648
SMBJ440A*	SMBJ440CA*	QM	FM	492	543	1	440	1	1.1	713

## 注释 Notes:

- 对于 $V_R$ 为10 V及更低的双向产品,  $I_R$ 值需乘以两倍。  
For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  should be doubled.
- 对于没有A的产品,  $V_{BR}$ 范围为 $\pm 10\%$ 且 $V_C$ 也比有A的产品高5%, 当前不推荐没有A的产品用于新设计, 带A的产品推荐优先选用。  
For parts without A in the PN, the  $V_{BR}$  tolerance is  $\pm 10\%$  and  $V_C$  is 5% higher than parts with A. The parts without A are currently available, but not recommended for new designs. The parts with A are preferred.
- 双芯片产品的详细信息, 请参阅电气特性中以\*标示的部件编号。  
For stacked die component details, please refer to models marked with \* in electrical characteristics table.

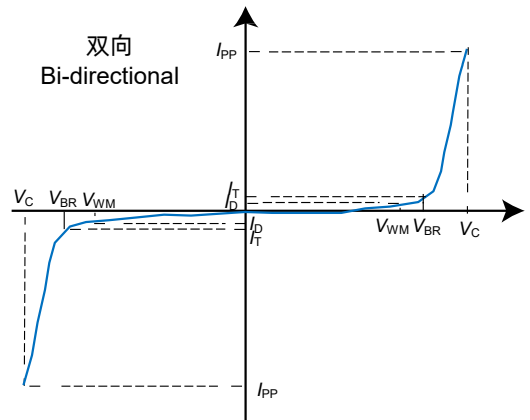
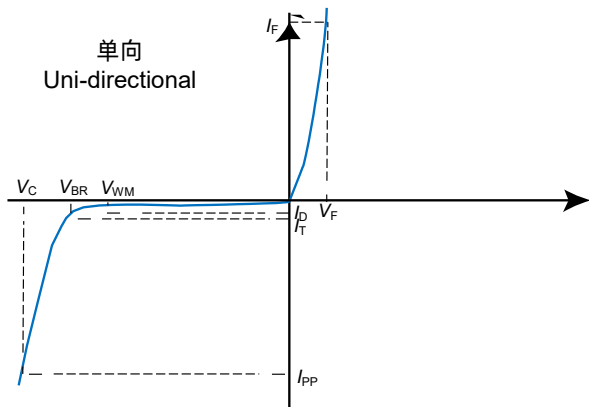


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## 伏安特性曲线 I-V Curve Characteristics



参考性能曲线(除有另外注释, 默认 $T_A=25^\circ\text{C}$ )

Performance Curve for Reference ( $T_A=25^\circ\text{C}$  unless otherwise noted)

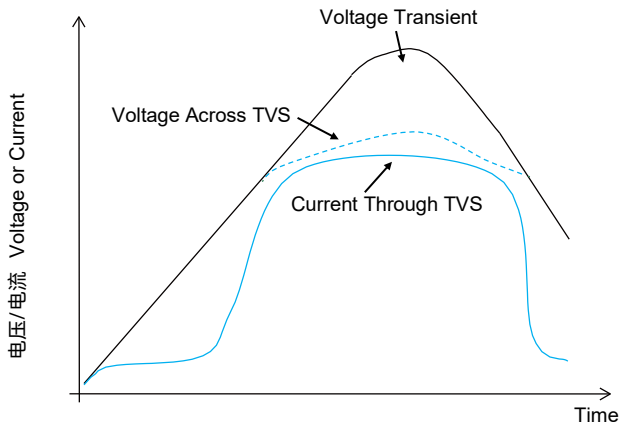


FIGURE 1 TVS瞬态箝位波形  
TVS Transients Clamping Waveform

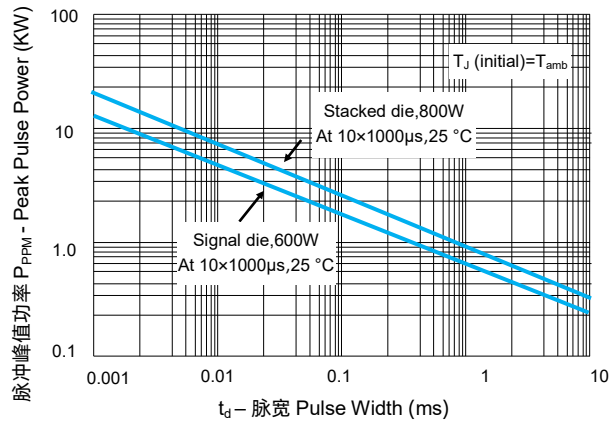


FIGURE 2 峰值脉冲功率额定曲线  
Peak Pulse Power Rating Curve

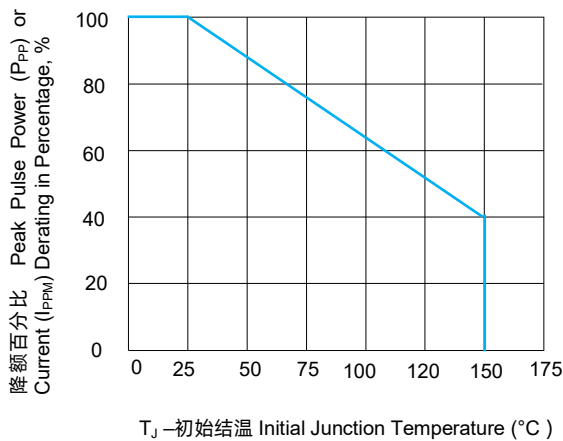


FIGURE 3 峰值脉冲功率降额曲线  
Peak Pulse Power Derating Curve

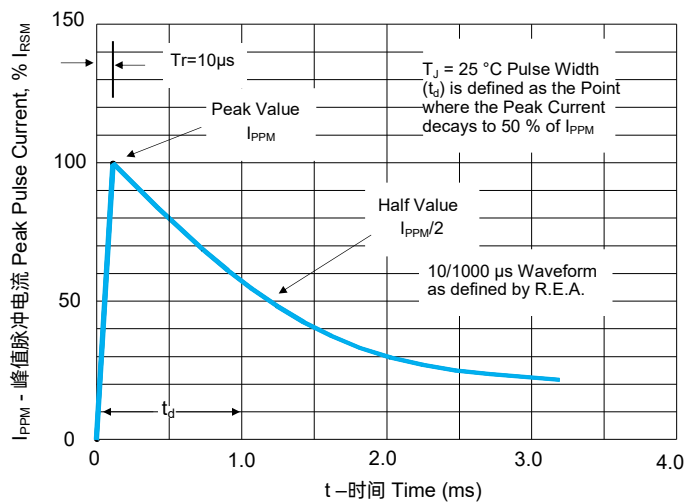


FIGURE 4 脉冲波形 Pulse Waveform

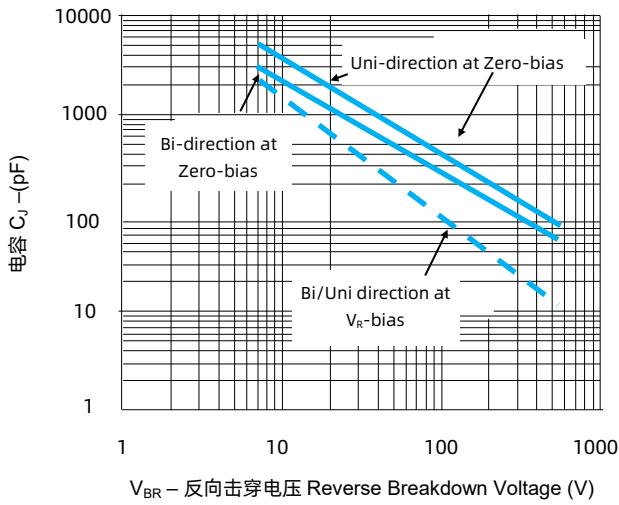


FIGURE 5 典型结电容 Typical Junction Capacitance

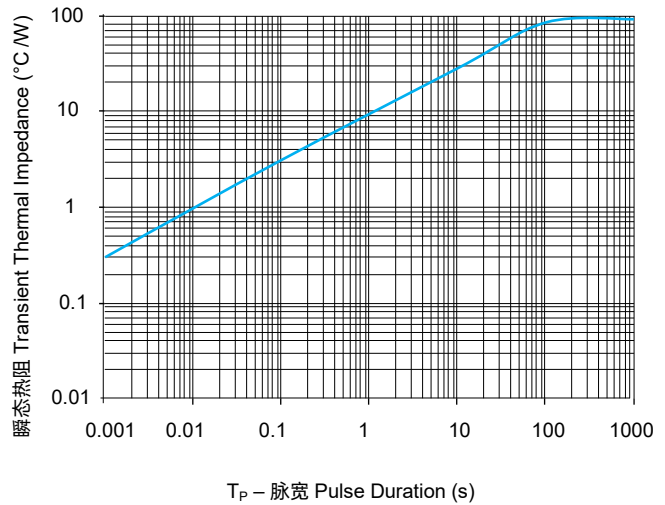


FIGURE 6 典型瞬态热阻 Typical Transient Thermal Impedance

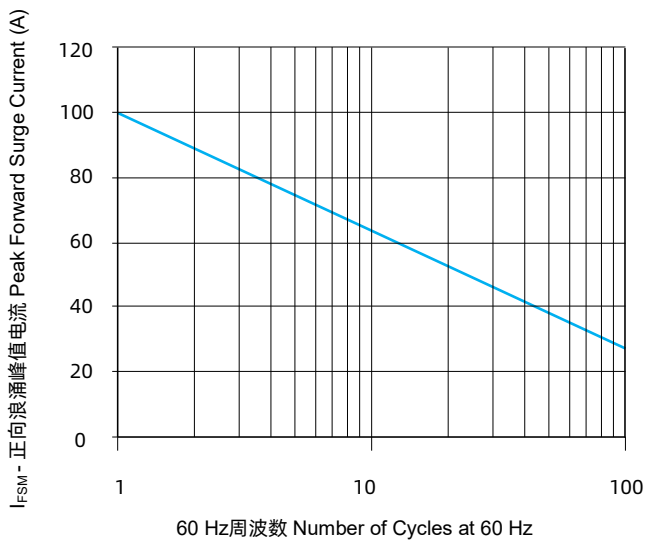


FIGURE 7 最大非重复正向浪涌电流(单向型)  
Maximum Non-Repetitive Forward Surge Current  
Uni-Directional only

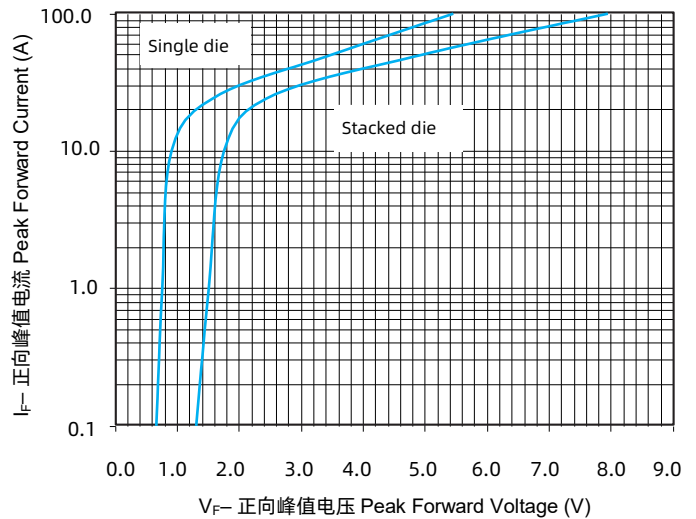


FIGURE 8 峰值正向电压及电流(典型值)  
Peak Forward Drop vs Peak Forward Current (Typical Values)

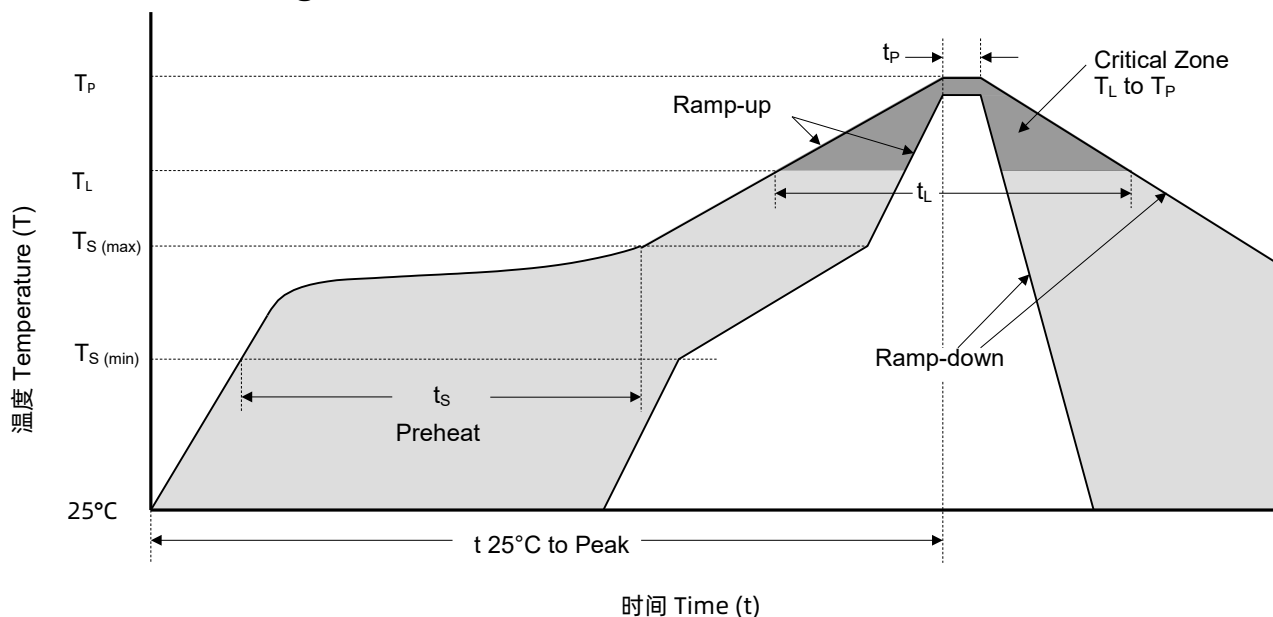
环境特性 Environmental Specifications

高温存储 High Temp. Storage	JESD22-A103
高温反偏 HTRB	JESD22-A108
温度循环 Temperature Cycling	JESD22-A104
湿度敏感性等级 MSL	JESDEC-J-STD-020, Level 1
高温高湿反偏 H3TRB	JESD22-A101
耐焊接热 RSH	JESD22-A111

物理特性 Physical Specifications

重量 Weight	0.003 ounce, 0.093 grams
封装 Case	JESD22DO214AA. Molded plastic body over glass passivated junction
极性 Polarity	Color band denotes positive end (cathode) except Bidirectional
端子 Terminal	Matte Tin-plated leads, Solderability per JESD22-B102

焊接参数 Soldering Parameters



回流焊条件 Reflowing Condition

回流焊接参数 Reflow Soldering Parameters		无铅组装 Lead-Free Assembly
预热 Pre-heat	最低温( $T_{S(min)}$ ) Temperature Min ( $T_{S(min)}$ )	150 °C
	最高温( $T_{S(max)}$ ) Temperature Max ( $T_{S(max)}$ )	200 °C
	升温时长( $t_s$ ) Time (min to max) ( $t_s$ )	60 ~ 120 seconds
平均升温速率(液相温度( $T_L$ )至峰值温度( $T_P$ )) Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to Peak Temp ( $T_P$ ))		3 °C / second max.
$T_{S(max)}$ 到 $T_L$ 升温速率 $T_{S(max)}$ to $T_L$ Ramp-up Rate		3 °C / second max.
回流 Reflow	温度 Temperature ( $T_L$ ) (Liquidus)	217 °C
	时长 Time (min to max) ( $t_L$ )	60 ~ 150 seconds
峰值温度 Peak Temperature ( $T_P$ )		260 <sup>+0/-5</sup> °C
实际峰值温度 ( $t_p$ ) 5 °C 以内的时间 Time of within 5 °C of Actual Peak Temperature ( $t_p$ )		20 ~ 40 seconds
降温速率 Ramp-down Rate		6 °C / second max.
25 °C 至峰值温度时长 Time from 25 °C to Peak Temperature		8 Minutes max.
极限温度 Do Not Exceed		260 °C

包装信息 Packaging Information

符号 Symbol	尺寸 Dimension (mm)
W	12.00±0.30/-0.10
P <sub>0</sub>	4.00±0.10
P <sub>1</sub>	8.00±0.10
P <sub>2</sub>	2.00±0.05
D <sub>0</sub>	1.55±0.05
D <sub>1</sub>	1.55±0.05
E	1.75±0.1
F	5.50±0.05
A <sub>0</sub>	3.78±0.10
B <sub>0</sub>	5.65±0.15
K <sub>0</sub>	2.70±0.10
T	0.30±0.05

卷盘尺寸 Reel Size	13寸卷盘 13" Reel	
A	330 mm	
C	13.2 mm	
W <sub>1</sub>	12.5 mm	

型号 Part Number	封装 Package	卷盘数量QTY (Reel)	包装选项 Packaging Option	包装规格 Packaging Specification
SMBJxxx	DO-214AA	3000 PCS	Tape & Reel – 12 mm tape/13" reel	EIA STD RS-481



# 注意

## ATTENTION

### 使用方法 Usage

1. 请在规定的温度范围内使用TVS。  
TVS must be operated in the specified ambient temp.
2. 请勿使用强极性溶剂清洗TVS以免破坏封装层。  
Do not clean the TVS with strong polar solvent such as ketone, esters, benzene and halogenated hydrocarbon, to avoid damaging the encapsulating layer.
3. 请勿对TVS施加剧烈的振动，冲击或压力，以避免元件开裂。  
Please do not apply severe vibration, shock or pressure to TVS, to avoid element cracking.

### 更换 Replacement

1. 若TVS出现可视化损伤，请将其更换。  
If TVS is visually damaged, please replace it.
2. TVS为非修理型产品，安全起见，请更换同等规格的TVS。  
TVS is a non-repairable product. For safety sake, please use equivalent TVS for replacement.

### 存储 Storage

1. 存储温度范围。  
Storage Temp. Range: (-55 to 150) °C.
2. 请勿将TVS存放于高温高湿或腐蚀性气体环境中，已避免影响引脚的焊接性能，请于收货后一年内进行使用。  
Do not store the TVS at the high temp., high humidity or corrosive gas environment, to avoid influencing the solder-ability of the lead wires. The product shall be used up within 1 year after receiving the goods.

## 环境条件 Environmental Conditions

1. 请勿暴露于室外阳光直射环境。  
TVS should not be exposed to the open air, nor direct sunshine.
2. 请避免雨水，水汽等高温高湿环境。  
TVS should avoid rain, water vapor or other condition of high temp. and high humidity.
3. 请避免沙尘，盐雾等有害环境。  
TVS should avoid sand dust, salt mist, or other harmful gases.

## TVS最大典型结电容 Max. Typical Capacitance of TVS

高频线路应用中请参照规格书中所给出的典型电容曲线。

The typical capacitance of TVS is listed in the specifications. Designers may refer to it when designing TVS in high frequency circuit.

## 安装机械应力 Installation Mechanical Stress

1. 安装TVS时请避免敲击，防止物理损伤。  
Do not knock TVS when installing, to avoid mechanical damage.
2. 请不要对 TVS 施加剧烈的振动、冲击或压力，以免表面树脂或元件破裂。  
Please do not apply severe vibration, shock or pressure to TVS, to avoid surface resin or element cracking.

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