

## 瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes

SMCJ Series



## 概述 Description

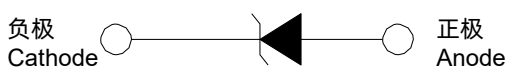
瞬态抑制二极管 (TVS) 是一种电路保护元件, 它可以削弱或过滤突增的瞬态电压(过压), 在浪涌到来瞬间几纳秒时间内发生雪崩击穿, 将浪涌电流引至接地端, 并将电压箝位在安全范围内, 从而实现了高效能的电压保护。

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



单向 Uni-Directional

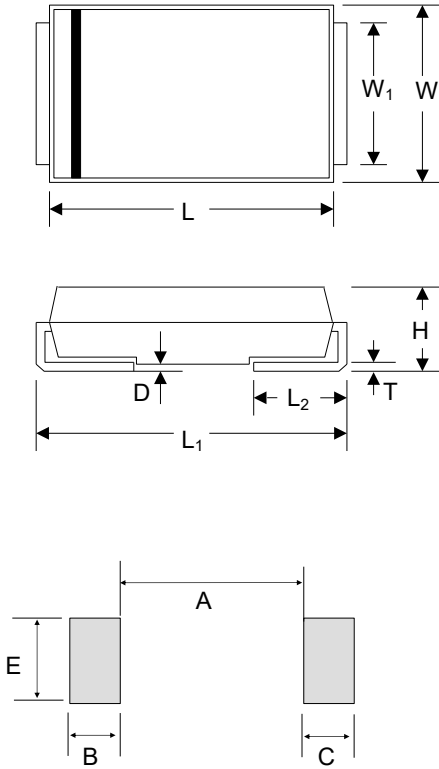


双向 Bi-Directional

## 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1500 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 °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
- 引脚镀雾锡
- 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
- Typical  $I_R$  less than 1.0  $\mu$ A above 12 V
- 1500 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
- 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 °C/30sec
- $V_{BR} @ T_J = V_{BR}@25\text{ °C} \times (1 + \alpha T \times (T_J - 25))$   
( $\alpha T$ : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level1, 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)

封装尺寸 Package Outline Dimensions (DO-214AB)



焊盘布局  
Mounting Pad Layout

符号 Symbol	公制(毫米) Millimeters		英制(英寸) Inches	
	Min.	Max.	Min.	Max.
L	6.600	7.110	0.260	0.280
W	5.590	6.220	0.220	0.245
W <sub>1</sub>	2.900	3.200	0.114	0.126
H	2.060	2.620	0.079	0.103
T	0.1520	0.305	0.006	0.012
L <sub>1</sub>	7.750	8.130	0.305	0.320
L <sub>2</sub>	0.760	1.520	0.030	0.060
D	-	0.203	-	0.008
A	-	4.200	-	0.165
B	2.400	-	0.094	-
C	2.400	-	0.094	-
E	3.300	-	0.129	-

TVS

TVS

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

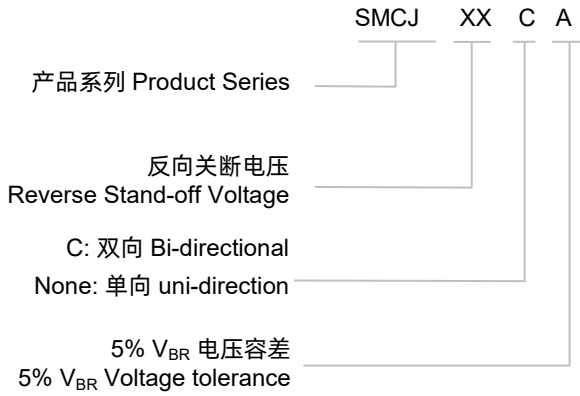
(除另有注释, 默认 $T_A=25\text{ }^\circ\text{C}$  Ratings at  $25\text{ }^\circ\text{C}$  ambient temperature unless otherwise specified.)

参数 Parameter	符号 Symbol	值 Value	单位 Unit
10/1000 $\mu\text{S}$ 脉冲波形 <sup>(1)(2)</sup> (Fig.1)下, 峰值脉冲功率耗-单芯片器件 Peak Power Dissipation with a 10/1000 $\mu\text{S}$ waveform <sup>(1)(2)</sup> (Fig.1)-Single Die Parts	$P_{\text{PPM}}$	1500	W
10/1000 $\mu\text{S}$ 脉冲波形 <sup>(1)(2)</sup> (Fig.4)下, 峰值脉冲功率耗 (Fig.2)- 双芯片器件 Peak Pulse Power Dissipation(Fig.2) by 10/1000 $\mu\text{S}$ Test Waveform <sup>(1)(2)</sup> (Fig.4) - Stacked Die Parts <sup>(5)</sup>	$P_{\text{PPM}}$	2000	W
峰值功耗,无限散热, $T_L=50\text{ }^\circ\text{C}$ Peak Power Dissipation on Infinite Heat Sink at $T_L=50\text{ }^\circ\text{C}$	$P_D$	6.5	W
正向脉冲电流峰值,额定负载叠加8.3 ms 单半正弦波测得(JEDEC方法) Peak Forward Surge Current,8.3 ms single half sinewave superimposed on rated load (JEDEC Method) <sup>(3)</sup>	$I_{\text{FSM}}$	200	A
正向瞬态峰值电压 @ $I_F=100\text{ A}$ , 仅适用于单向产品 <sup>(4)</sup> Maximum Instantaneous Forward Voltage at 100 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	$^\circ\text{C}$
典型热阻(结至引线) Typical Thermal Resistance Junction to Lead	$R_{\theta\text{JL}}$	15	$^\circ\text{C}/\text{W}$
典型热阻(结至环境) Typical Thermal Resistance Junction to Ambient	$R_{\theta\text{JA}}$	75	$^\circ\text{C}/\text{W}$

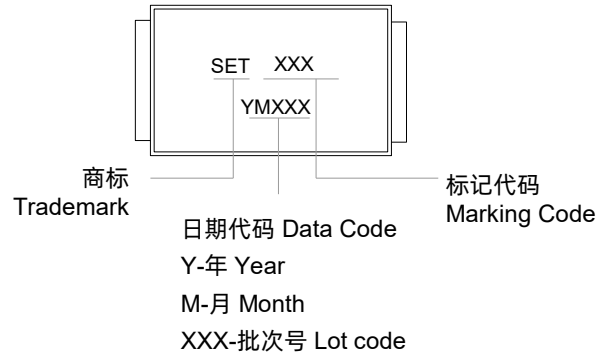
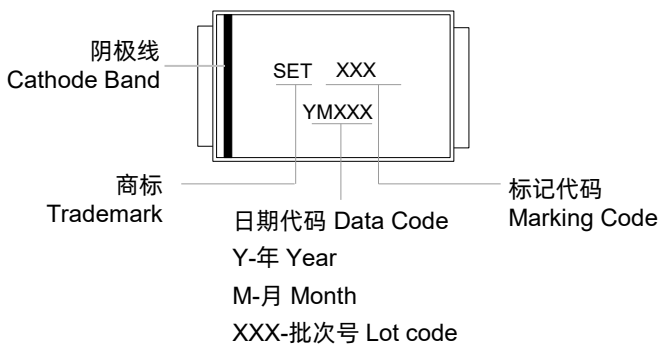
## 注释 Notes

- 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 $8.0\text{ mm}^2$ 焊盘。  
Mounted on  $8.0\text{ mm}^2$  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.

## 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 frequency 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.</p> <p>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.</p> <p>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.</p> <p>注: 也用<math>I_{BR}</math>表示。 NOTE : Also shown as <math>I_{BR}</math>.</p>

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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 Current $I_R@V_R$	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)
SMCJ5.0A	SMCJ5.0CA	GDE	BDE	6.4	7.0	10	5	800	163	9.2
SMCJ6.0A	SMCJ6.0CA	GDG	BDG	6.67	7.37	10	6	800	145.7	10.3
SMCJ6.5A	SMCJ6.5CA	GDK	BDK	7.22	7.98	10	6.5	500	134	11.2
SMCJ7.0A	SMCJ7.0CA	GDM	BDM	7.78	8.6	10	7	200	125	12
SMCJ7.5A	SMCJ7.5CA	GDP	BDP	8.33	9.21	1	7.5	100	116.3	12.9
SMCJ8.0A	SMCJ8.0CA	GDR	BDR	8.89	9.83	1	8	50	110.3	13.6
SMCJ8.5A	SMCJ8.5CA	GDT	BDT	9.44	10.4	1	8.5	20	104.2	14.4
SMCJ9.0A	SMCJ9.0CA	GDV	BDV	10	11.1	1	9	10	97.4	15.4
SMCJ10A	SMCJ10CA	GDX	BDX	11.1	12.3	1	10	5	88.3	17
SMCJ11A	SMCJ11CA	GDZ	BDZ	12.2	13.5	1	11	1	82.5	18.2
SMCJ12A	SMCJ12CA	GEE	BEE	13.3	14.7	1	12	1	75.4	19.9
SMCJ13A	SMCJ13CA	GEG	BEG	14.4	15.9	1	13	1	69.8	21.5
SMCJ14A	SMCJ14CA	GEK	BEK	15.6	17.2	1	14	1	64.7	23.2
SMCJ15A	SMCJ15CA	GEM	BEM	16.7	18.5	1	15	1	61.5	24.4
SMCJ16A	SMCJ16CA	GEP	BEP	17.8	19.7	1	16	1	57.7	26
SMCJ17A	SMCJ17CA	GER	BER	18.9	20.9	1	17	1	54.4	27.6
SMCJ18A	SMCJ18CA	GET	BET	20	22.1	1	18	1	51.4	29.2
SMCJ20A	SMCJ20CA	GEV	BEV	22.2	24.5	1	20	1	46.3	32.4
SMCJ22A	SMCJ22CA	GEX	BEX	24.4	26.9	1	22	1	42.3	35.5
SMCJ24A	SMCJ24CA	GEZ	BEZ	26.7	29.5	1	24	1	38.6	38.9
SMCJ26A	SMCJ26CA	GFE	BFE	28.9	31.9	1	26	1	35.7	42.1

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				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	( $\mu$ A)	(A)	(V)
SMCJ28A	SMCJ28CA	GFG	BFG	31.1	34.4	1	28	1	33.1	45.4
SMCJ30A	SMCJ30CA	GFK	BFK	33.3	36.8	1	30	1	31	48.4
SMCJ33A	SMCJ33CA	GFM	BFM	36.7	40.6	1	33	1	28.2	53.3
SMCJ36A	SMCJ36CA	GFP	BFP	40	44.2	1	36	1	25.9	58.1
SMCJ40A	SMCJ40CA	GFR	BFR	44.4	49.1	1	40	1	23.3	64.5
SMCJ43A	SMCJ43CA	GFT	BFT	47.8	52.8	1	43	1	21.7	69.4
SMCJ45A	SMCJ45CA	GFV	BFV	50	55.3	1	45	1	20.6	72.7
SMCJ48A	SMCJ48CA	GFX	BFX	53.3	58.9	1	48	1	19.4	77.4
SMCJ51A	SMCJ51CA	GFZ	BFZ	56.7	62.7	1	51	1	18.2	82.4
SMCJ54A	SMCJ54CA	GGE	BGE	60	66.3	1	54	1	17.3	87.1
SMCJ58A	SMCJ58CA	GGG	BGG	64.4	71.2	1	58	1	16.1	93.6
SMCJ60A	SMCJ60CA	GGK	BGK	66.7	73.7	1	60	1	15.5	96.8
SMCJ64A	SMCJ64CA	GGM	BGM	71.1	78.6	1	64	1	14.6	103
SMCJ70A	SMCJ70CA	GGP	BGP	77.8	86	1	70	1	13.3	113
SMCJ75A	SMCJ75CA	GGR	BGR	83.3	92.1	1	75	1	12.4	121
SMCJ78A	SMCJ78CA	GGT	BGT	86.7	95.8	1	78	1	11.9	126
SMCJ85A	SMCJ85CA	GGV	BGV	94.4	104	1	85	1	11	137
SMCJ90A	SMCJ90CA	GGX	BGX	100	111	1	90	1	10.3	146
SMCJ100A	SMCJ100CA	GGZ	BGZ	111	123	1	100	1	9.3	162
SMCJ110A	SMCJ110CA	GHE	BHE	122	135	1	110	1	8.5	177
SMCJ120A	SMCJ120CA	GHG	BHG	133	147	1	120	1	7.8	193
SMCJ130A	SMCJ130CA	GHK	BHK	144	159	1	130	1	7.2	209
SMCJ150A	SMCJ150CA	GHM	BHM	167	185	1	150	1	6.2	243



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				Min	Max					
Uni	Bi	Uni	Bi	(V)		(mA)	(V)	( $\mu$ A)	(A)	(V)
SMCJ160A	SMCJ160CA	GHP	BHP	178	197	1	160	1	5.8	259
SMCJ170A	SMCJ170CA	GHR	BHR	189	209	1	170	1	5.5	275
SMCJ180A	SMCJ180CA	GHT	BHT	201	222	1	180	1	5.1	292
SMCJ200A	SMCJ200CA	GHV	BHV	224	247	1	200	1	4.6	324
SMCJ220A	SMCJ220CA	GHX	BHX	246	272	1	220	1	4.2	356
SMCJ250A	SMCJ250CA	GHZ	BHZ	279	309	1	250	1	3.7	405
SMCJ300A	SMCJ300CA	GJE	BJE	335	371	1	300	1	3.1	486
SMCJ350A	SMCJ350CA	GJG	BJG	391	432	1	350	1	2.6	567
SMCJ400A	SMCJ400CA	GJK	BJK	447	494	1	400	1	2.3	648
SMCJ440A	SMCJ440CA	GJM	BJM	492	543	1	440	1	2.1	713

## 注释 Notes:

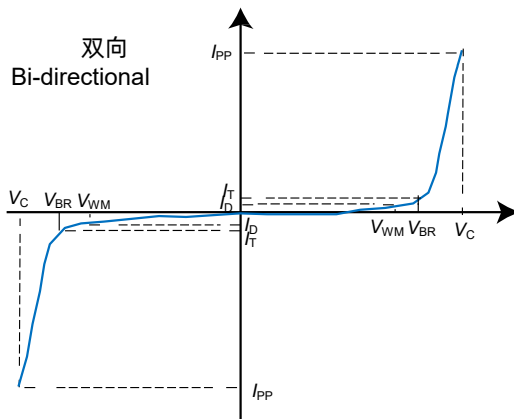
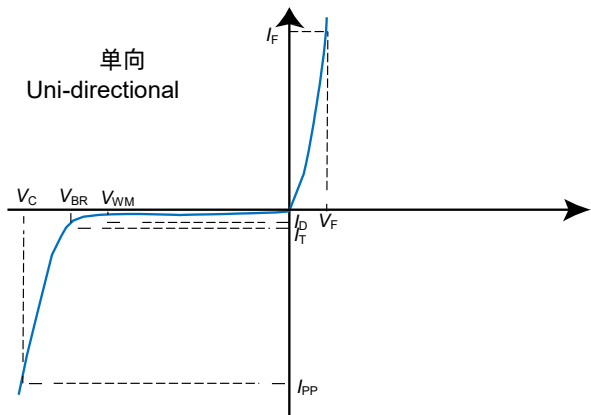
1. 对于 $V_R$ 为10 V及更低的双向产品， $I_R$ 值需乘以两倍。

For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  should be doubled.

2. 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.

## 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)

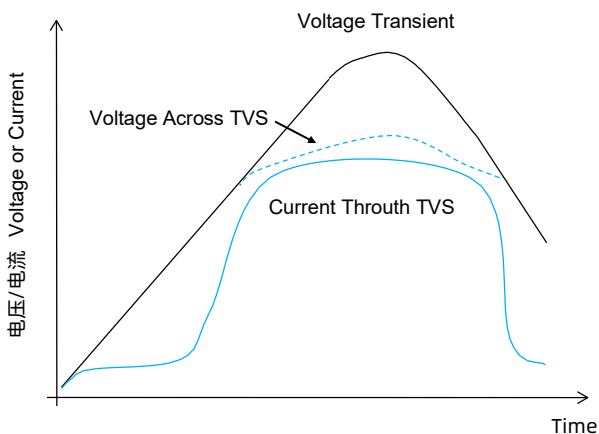


FIGURE 1 TVS瞬态箝位波形  
TVS Transients Clamping Waveform

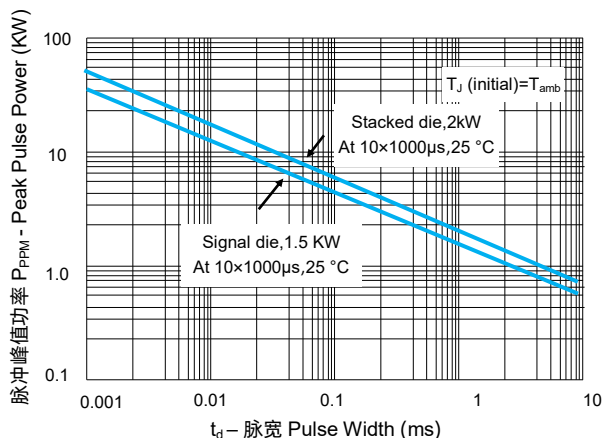


FIGURE 2 峰值脉冲功率额定曲线  
Peak Pulse Power Rating Curve

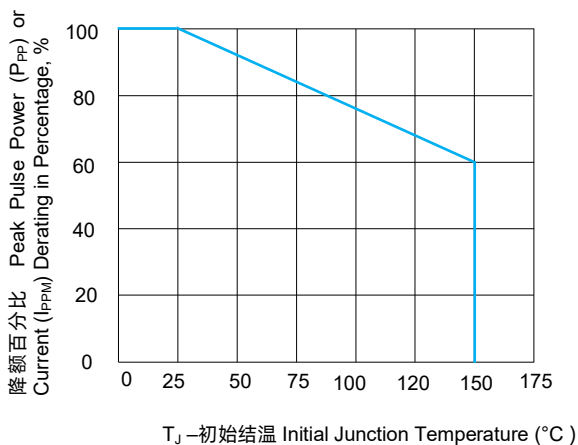


FIGURE 3 峰值脉冲功率降额曲线  
Peak Pulse Power Derating Curve

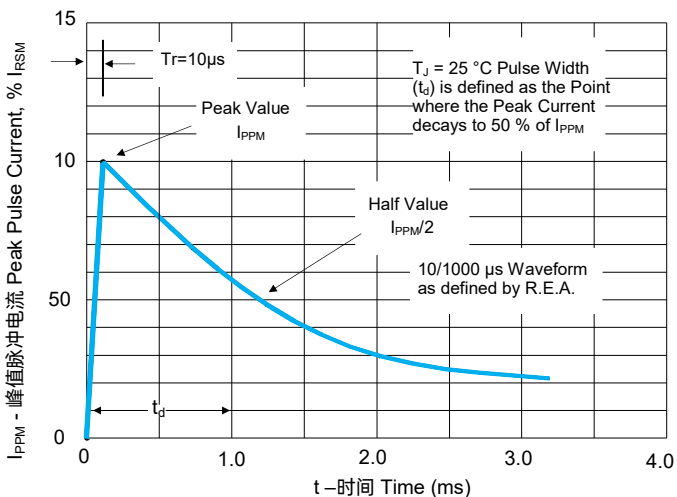


FIGURE 4 脉冲波形 Pulse Waveform

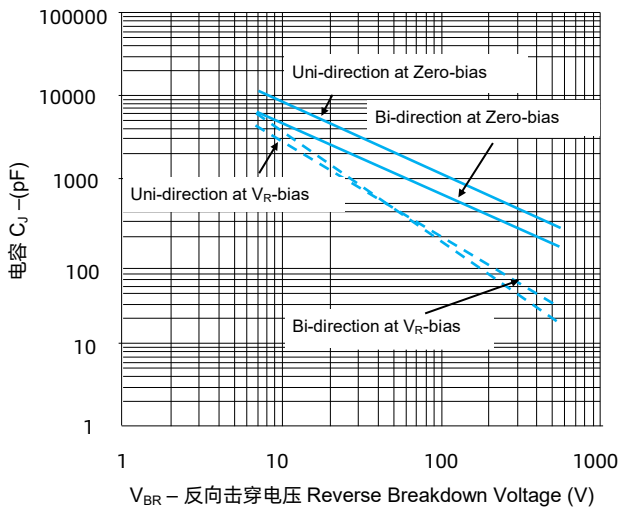


FIGURE 5 典型结电容 Typical Junction Capacitance

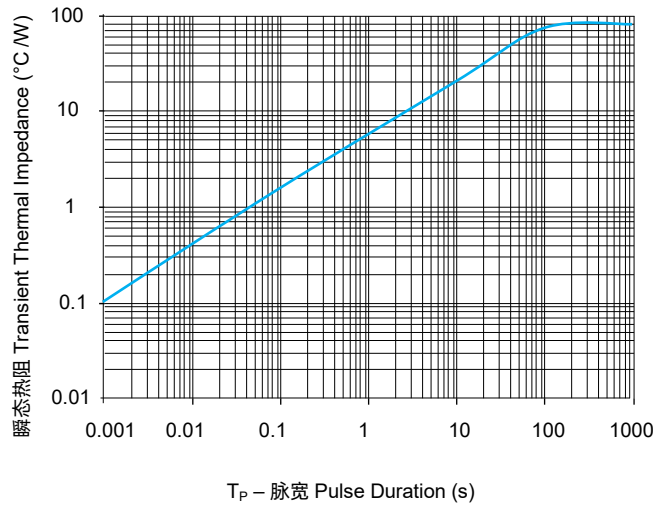


FIGURE 6 典型瞬态热阻 Typical Transient Thermal Impedance

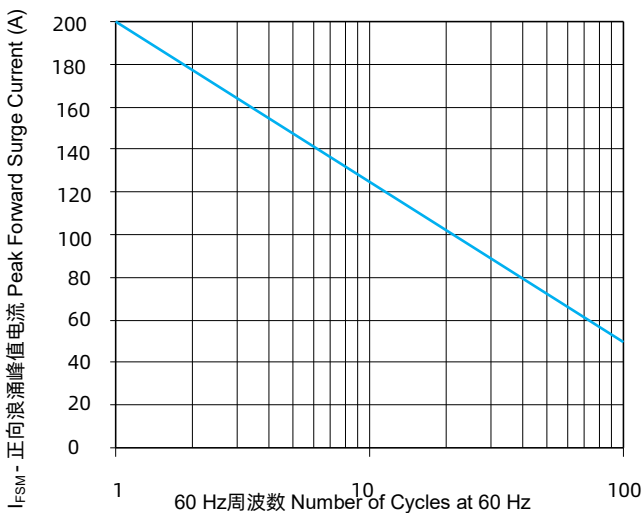


FIGURE 7 最大非重复正向浪涌电流(单向型)

Maximum Non-Repetitive Forward Surge Current  
Uni-Directional only

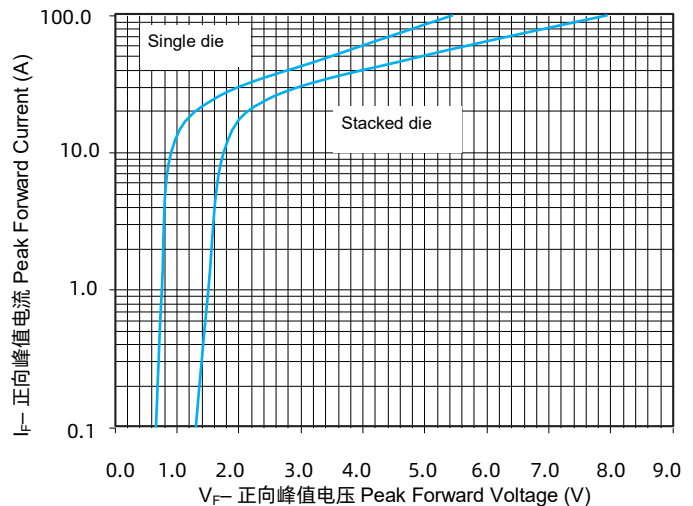


FIGURE 8 峰值正向电压及电流(典型值)

Peak Forward Drop vs Peak Forward Current (Typical Values)

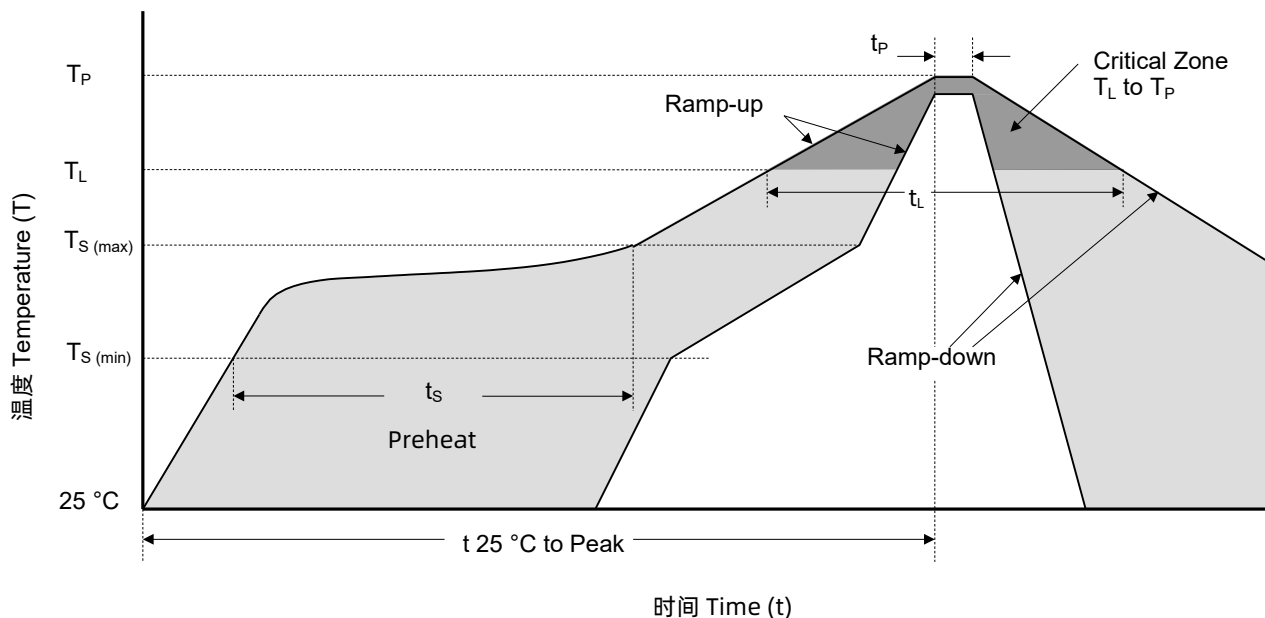
## 环境特性 Environmental Specifications

高温存储 High Temp. Storage	JESD22-A103
高温反偏 HTRB	JESD22-A108
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	0.007 ounce, 0.21 grams
封装 Case	JESD22DO214AB. 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

编带 Tape	符号 Symbol	尺寸 Dimension (mm)
	W	16.00+0.3/-0.10
	P <sub>0</sub>	4.00±0.10
	P <sub>1</sub>	8.00±0.10
	P <sub>2</sub>	2.00±0.10
	D <sub>0</sub>	1.55±0.05
	D <sub>1</sub>	1.55±0.05
	E	1.75±0.10
	F	7.50±0.10
	A <sub>0</sub>	6.15±0.10
	B <sub>0</sub>	8.30±0.10
	K <sub>0</sub>	2.48±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>	16.4 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
SMCJxxx	DO-214AB	3000 PCS	Tape & Reel – 16 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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