



## 概述 Description

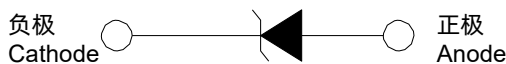
瞬态抑制二极管 (TVS) 是一种电路保护元件, 它可以削弱或过滤突增的瞬态电压(过压), 在浪涌到来瞬间几纳秒时间内发生雪崩击穿, 将浪涌电流引至接地端, 并将电压箝位在安全范围内, 从而实现了高效能的电压保护。

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

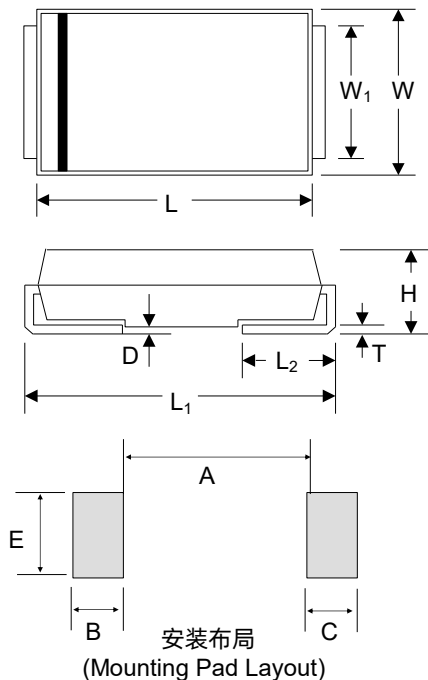
## 特性 Features

- 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400 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
- 玻璃钝化保护或平面芯片(< 10 V )
- 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
- 400 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 or Planar chip (< 10 V )
- High temperature to reflow soldering guaranteed: 260 °C/40sec
- $V_{BR} @ T_J = V_{BR@25^\circ C} \times (1 + \alpha T \times (T_J - 25))$   
( $\alpha T$ : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL 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)

TVS

TVS

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



符号 Symbol	公制(毫米) Millimeters		英制(英寸) Inches	
	Min.	Max.	Min.	Max.
L	3.99	4.60	0.157	0.181
W	2.30	2.79	0.095	0.110
W <sub>1</sub>	1.25	1.65	0.049	0.065
H	1.90	2.44	0.075	0.096
T	0.152	0.305	0.006	0.012
L <sub>1</sub>	4.80	5.28	0.189	0.208
L <sub>2</sub>	0.78	1.52	0.030	0.060
D	-	0.203	-	0.008
A	-	2.30	-	0.090
B	2.10	-	0.082	-
C	2.10	-	0.082	-
E	1.80	-	0.070	-

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

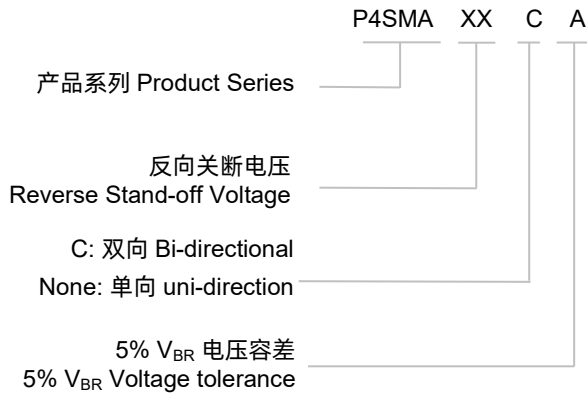
(除另有注释, 默认 $T_A=25\text{ }^\circ\text{C}$  Ratings at  $25\text{ }^\circ\text{C}$  ambient temperature unless otherwise specified.)

参数 Parameter	符号 Symbol	值 Value	单位 Unit
10/1000 $\mu\text{S}$ 波形下的峰值功耗 (图 2) <sup>(1)(2)</sup> (图 4)-单芯片器件 Peak Power Dissipation (Fig2) with a 10/1000 $\mu\text{S}$ waveform <sup>(1)(2)</sup> (Fig4)-Single Die Parts	$P_{PPM}$	400	W
10/1000 $\mu\text{S}$ 波形下的峰值功耗 (图 2)(1)(2)(图 4)-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>	$P_{PPM}$	600	W
峰值功耗,无限散热, $T_L=50\text{ }^\circ\text{C}$ Peak Power Dissipation on Infinite Heat Sink at $T_L=50\text{ }^\circ\text{C}$	$P_D$	3.3	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,8.3 ms single half sine wave superimposed on rated load (JEDEC Method) <sup>(3)</sup>	$I_{FSM}$	60	A
正向瞬态峰值电压@ $I_F=25\text{ A}$ , 仅适用于单向产品 Maximum Instantaneous Forward Voltage at $25\text{ A}$ 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	$T_{STG}$	-65 to 175	$^\circ\text{C}$
热阻(结至引线) Typical Thermal Resistance Junction to Lead	$R_{\theta JL}$	30	$^\circ\text{C/W}$
热阻(结至环境) Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	120	$^\circ\text{C/W}$

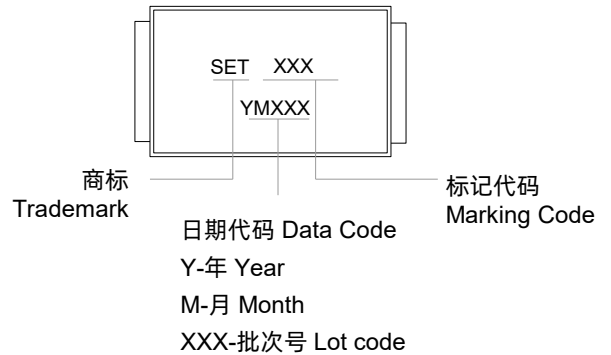
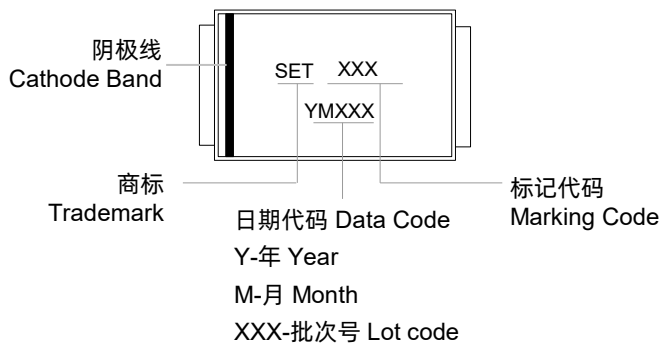
### 注释 Notes

- 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 frequency and voltage.

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

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

Transient Voltage Suppression Diodes

P4SMA Series

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 $V_C@I_{PP}$
Uni	Bi	Uni	Bi	Min	Max					
				(V)		(mA)	(V)	( $\mu\text{A}$ )	(A)	(V)
P4SMA6.8A	P4SMA6.8CA	6V8A	6V8C	6.45	7.14	10	5.8	1000	39	10.5
P4SMA7.5A	P4SMA7.5CA	7V5A	7V5C	7.13	7.88	10	6.4	500	36.3	11.3
P4SMA8.2A	P4SMA8.2CA	8V2A	8V2C	7.79	8.61	10	7.02	200	33.9	12.1
P4SMA9.1A	P4SMA9.1CA	9V1A	9V1C	8.65	9.55	1	7.78	50	30.6	13.4
P4SMA10A	P4SMA10CA	10A	10C	9.5	10.5	1	8.55	10	28.3	14.5
P4SMA11A	P4SMA11CA	11A	11C	10.5	11.6	1	9.4	5	26.3	15.6
P4SMA12A	P4SMA12CA	12A	12C	11.4	12.6	1	10.2	5	24.6	16.7
P4SMA13A	P4SMA13CA	13A	13C	12.4	13.7	1	11.1	1	22.5	18.2
P4SMA15A	P4SMA15CA	15A	15C	14.3	15.8	1	12.8	1	19.3	21.2
P4SMA16A	P4SMA16CA	16A	16C	15.2	16.8	1	13.6	1	18.2	22.5
P4SMA18A	P4SMA18CA	18A	18C	17.1	18.9	1	15.3	1	16.1	25.5
P4SMA20A	P4SMA20CA	20A	20C	19	21	1	17.1	1	14.8	27.7
P4SMA22A	P4SMA22CA	22A	22C	20.9	23.1	1	18.8	1	13.4	30.6
P4SMA24A	P4SMA24CA	24A	24C	22.8	25.2	1	20.5	1	12.3	33.2
P4SMA27A	P4SMA27CA	27A	27C	25.7	28.4	1	23.1	1	10.9	37.5
P4SMA30A	P4SMA30CA	30A	30C	28.5	31.5	1	25.6	1	9.9	41.4
P4SMA33A	P4SMA33CA	33A	33C	31.4	34.7	1	28.2	1	9	45.7
P4SMA36A	P4SMA36CA	36A	36C	34.2	37.8	1	30.8	1	8.2	49.9
P4SMA39A	P4SMA39CA	39A	39C	37.1	41	1	33.3	1	7.6	53.9
P4SMA43A	P4SMA43CA	43A	43C	40.9	45.2	1	36.8	1	6.9	59.3
P4SMA47A	P4SMA47CA	47A	47C	44.7	49.4	1	40.2	1	6.3	64.8
P4SMA51A	P4SMA51CA	51A	51C	48.5	53.6	1	43.6	1	5.8	70.1
P4SMA56A	P4SMA56CA	56A	56C	53.2	58.8	1	47.8	1	5.3	77
P4SMA62A	P4SMA62CA	62A	62C	58.9	65.1	1	53	1	4.8	85
P4SMA68A	P4SMA68CA	68A	68C	64.6	71.4	1	58.1	1	4.5	92
P4SMA75A	P4SMA75CA	75A	75C	71.3	78.8	1	64.1	1	4	103
P4SMA82A	P4SMA82CA	82A	82C	77.9	86.1	1	70.1	1	3.6	113
P4SMA91A	P4SMA91CA	91A	91C	86.5	95.5	1	77.8	1	3.3	125
P4SMA100A	P4SMA100CA	100A	100C	95	105	1	85.5	1	3	137

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Transient Voltage Suppression Diodes

P4SMA Series

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)	( $\mu$ A)	(A)	(V)
P4SMA110A	P4SMA110CA	110A	110C	105	116	1	94	1	2.7	152
P4SMA120A	P4SMA120CA	120A	120C	114	126	1	102	1	2.5	165
P4SMA130A	P4SMA130CA	130A	130C	124	137	1	111	1	2.3	179
P4SMA150A	P4SMA150CA	150A	150C	143	158	1	128	1	2	207
P4SMA160A	P4SMA160CA	160A	160C	152	168	1	136	1	1.9	219
P4SMA170A	P4SMA170CA	170A	170C	162	179	1	145	1	1.8	234
P4SMA180A	P4SMA180CA	180A	180C	171	189	1	154	1	1.7	246
P4SMA200A	P4SMA200CA	200A	200C	190	210	1	171	1	1.5	274
P4SMA220A	P4SMA220CA	220A	220C	209	231	1	185	1	1.3	328
P4SMA250A	-	250A		237	263	1	214	1	1.2	344
-	P4SMA250CA*		250C	237	263	1	214	1	1.2	344
P4SMA300A	-	300A		285	315	1	256	1	1	414
-	P4SMA300CA*		300C	285	315	1	256	1	1	414
P4SMA350A*	P4SMA350CA*	350A	350C	332	368	1	300	1	0.9	482
P4SMA400A*	P4SMA400CA*	400A	400C	380	420	1	342	1	0.8	548
P4SMA440A*	P4SMA440CA*	440A	440C	418	462	1	376	1	0.7	602
P4SMA480A*	P4SMA480CA*	480A	480C	456	504	1	408	1	0.61	658
P4SMA510A*	P4SMA510CA*	510A	510C	485	535	1	434	1	0.57	698
P4SMA530A*	P4SMA530CA*	530A	530C	503.5	556.5	1	451	1	0.55	725
P4SMA540A*	P4SMA540CA*	540A	540C	513	567	1	460	1	0.54	740
P4SMA550A*	P4SMA550CA*	550A	550C	522.5	577.5	1	468	1	0.53	760

注释 Notes:

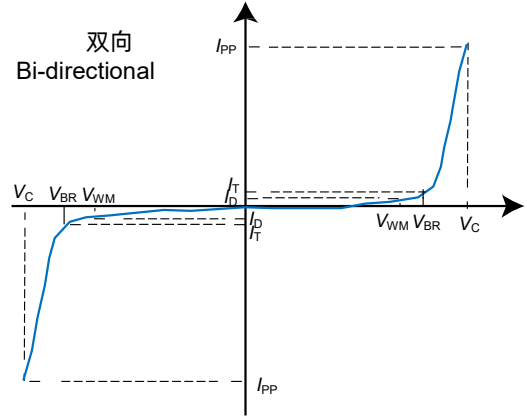
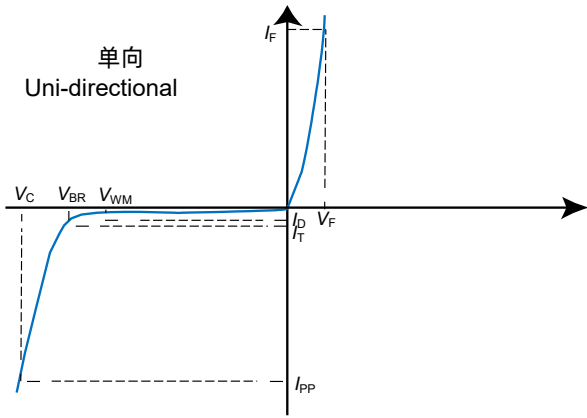
1.对于 $V_R$ 为10 V及更低的双向产品,  $I_R$ 值需乘以两倍。For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  should be doubled.2.对于没有A的产品,  $V_{BR}$ 范围为 $\pm 10\%$ 且 $V_C$ 也比有A的产品高5%, 当前不推荐没有A的产品用于新设计, 带A的产品推荐优先选用。For parts without A in the PN, the  $V_{BR}$  tolerance is  $\pm 10\%$  and  $V_C$  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.

3.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.



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)

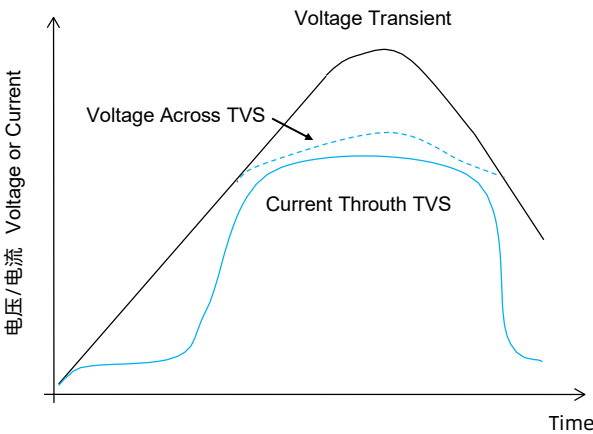


FIGURE 1 TVS瞬态箝位波形  
TVS Transients Clamping Waveform

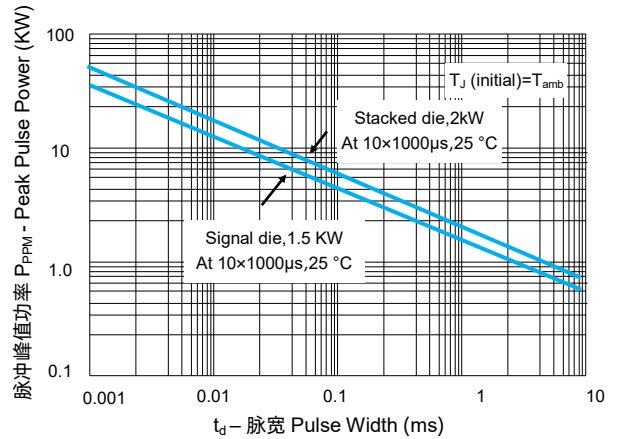


FIGURE 2 峰值脉冲功率额定曲线  
Peak Pulse Power Rating Curve

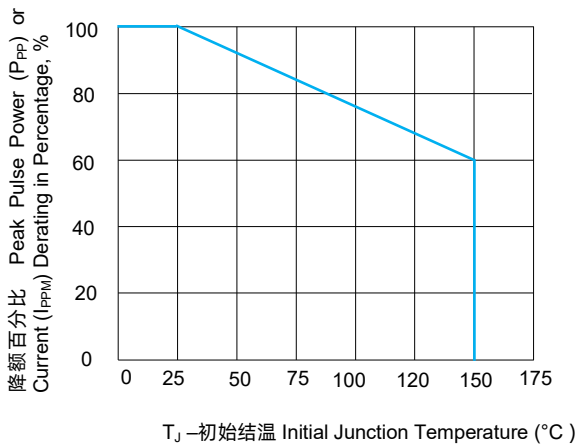


FIGURE 3 峰值脉冲功率降额曲线  
Peak Pulse Power Derating Curve

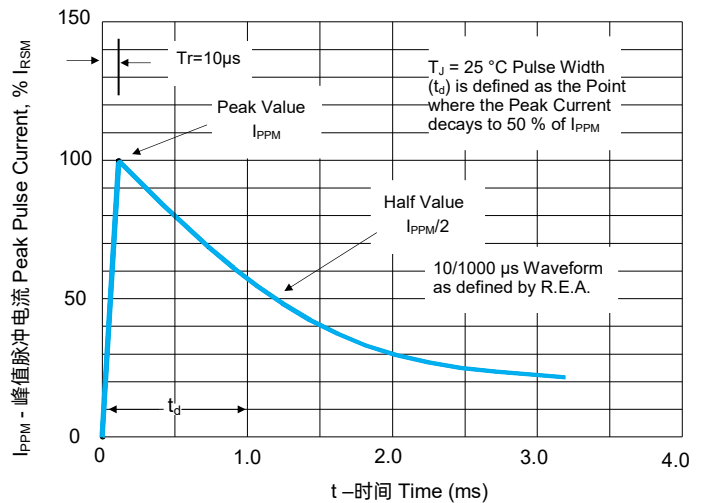


FIGURE 4 脉冲波形 Pulse Waveform

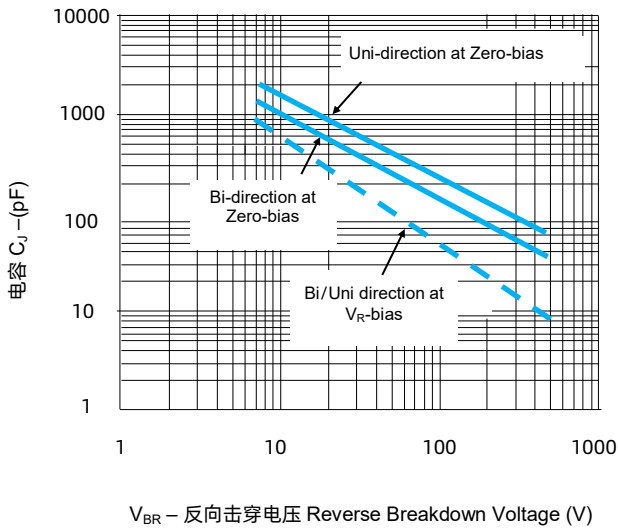


FIGURE 5 典型结电容 Typical Junction Capacitance

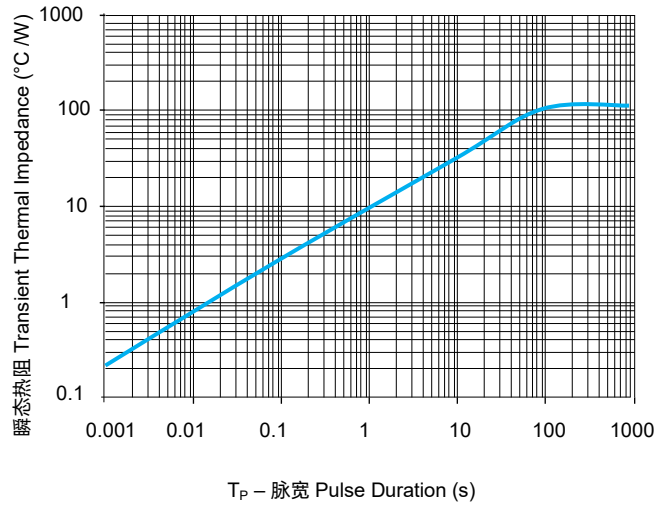


FIGURE 6 典型瞬态热阻 Typical Transient Thermal Impedance

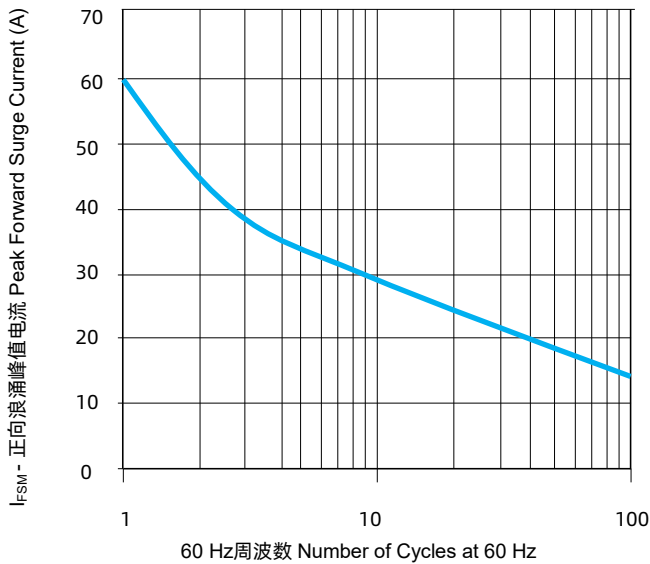


FIGURE 7 最大非重复正向浪涌电流(单向型)  
Maximum Non-Repetitive Forward Surge Current  
Uni-Directional only

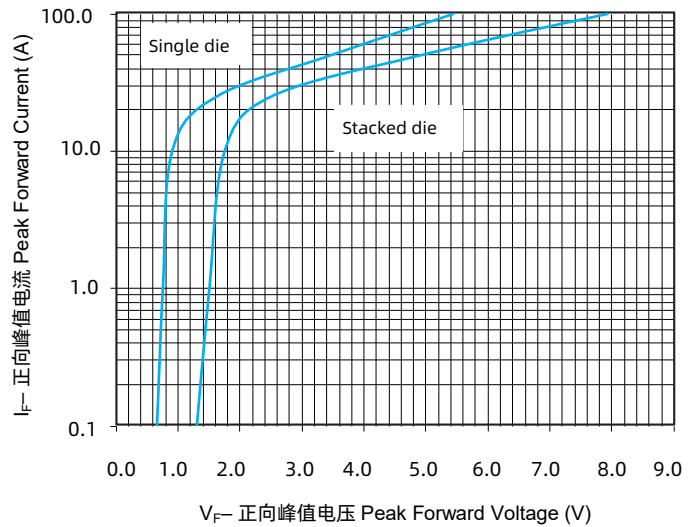


FIGURE 8 峰值正向电压及电流(典型值)  
Peak Forward Drop vs Peak Forward Current (Typical Values)

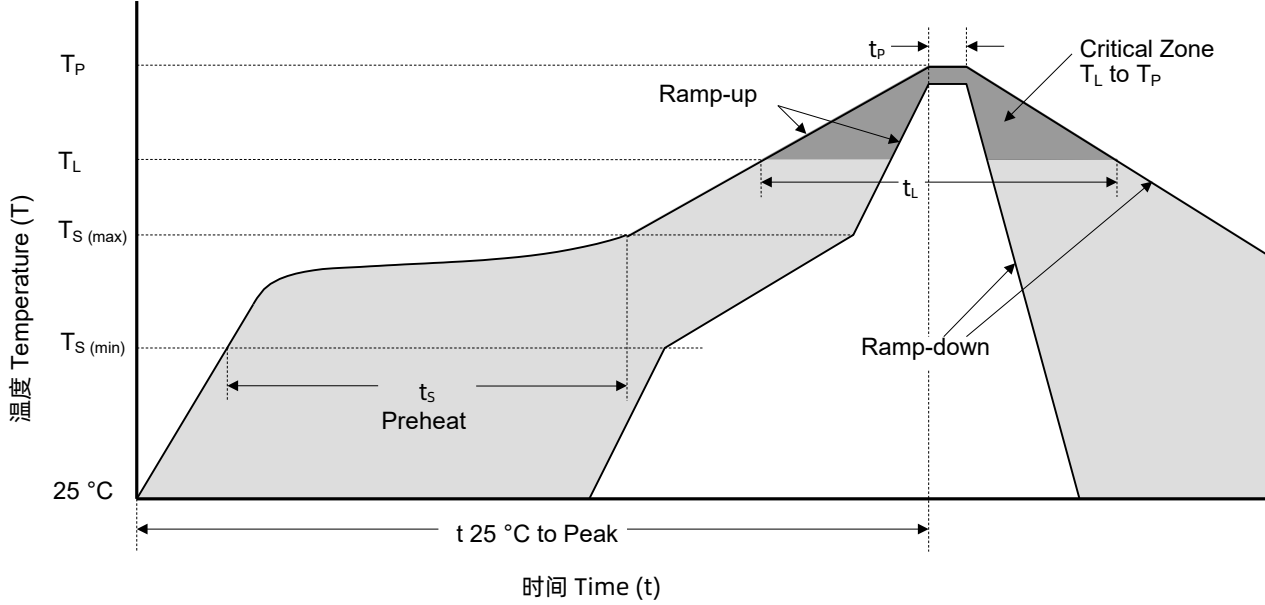
## 环境特性 Environmental Specifications

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	0.002ounce,0.061grams
封装 Case	JESD22DO214AC. 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

# 瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes

P4SMA Series

## 包装信息 Packaging Information

编带 Tape	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±0.10
	F	5.50±0.05
	A <sub>0</sub>	2.79±0.10
	B <sub>0</sub>	5.33±0.10
	K <sub>0</sub>	2.36±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
P4SMAxxx	DO-214AC	5000 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.