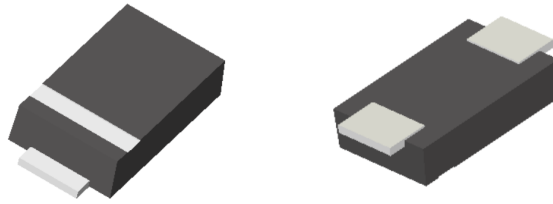


瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes



概述 Description

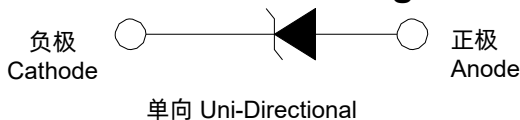
SMA6L系列是专为保护敏感电子设备免受雷电和其他瞬变电压事件引起的电压瞬变。SMA6L小型封装与SMB封装相比具有相同的功能，但高度是行业中最底的器材（1.1毫米）。

The SMA6L series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events. The SMA6L low profile package has the same power performance as the SMB package but with lowest height profiles (1.1 mm) in the industry.

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



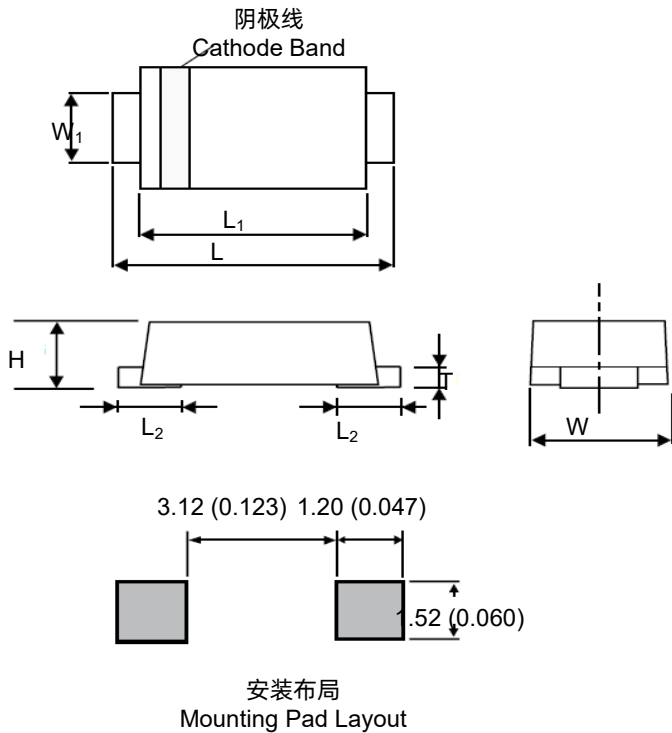
特性 Features

- 与标准SMB器件功率相同(600 W)
- SMA 小型封装:厚度小于1.1 毫米
- 引脚与标准SMA和SMB产品的兼容（易于布局）
- 典型的故障模式为电压或电流超过额定而导致的短路
- 锡须测试依据JEDEC JESD201A表4a和4c进行
- 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
- 低电感, 优异的箝位性能
- 快速响应时间: 从0 V到击穿电压时间小于1.0 ns
- 消除内部应力
- 玻璃钝化保护或平面芯片(< 10 V)
- 当击穿电压大于12 V时, 典型反向漏电流小于1 μA
- 回流焊高温保证:260 °C /40 s
- 温度系数典型值0.1%
- UL认证的塑封料符合可燃性等级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)
- Same power as standard SMB devices (600 W)
- SMA low profile package: less than 1.1 mm
- Footprint compatibility with standard SMA and SMB products (easy to layout)
- Typical failure mode is a short circuit condition for current events exceeding component rating
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC 61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Low inductance, excellent clamping capability
- Fast response time: typically less than 1.0 ns from 0 Volts to $V_{BR\ min}$
- Built-in strain relief
- Glass passivated chip junction or Planar chip (< 10 V)
- Typical $I_R < 1\ \mu A$ when $V_{BR\ min} > 12\ V$
- High temperature reflow soldering guaranteed: 260 °C / 40 sec
- $V_{BR} @ T_J = V_{BR}@25\ ^\circ C \times (1 + \alpha T \times (T_J - 25))$
(αT : Temperature Coefficient, typical value is 0.1%)
- UL Recognized compound meeting flammability rating V-0
- 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-221AC)



符号 Symbol	公制(毫米) Millimeters		英制(英寸) Inches	
	Min.	Max.	Min.	Max.
L ₁	3.950	4.600	0.156	0.181
L	4.800	5.600	0.189	0.220
W ₁	1.250	1.750	0.049	0.069
W	2.250	2.950	0.088	0.116
L ₂	0.750	1.500	0.030	0.059
T	0.125	0.250	0.005	0.010
H	0.900	1.100	0.035	0.043

TVS

TVS

额定参数与特性 Maximum Ratings and Characteristics

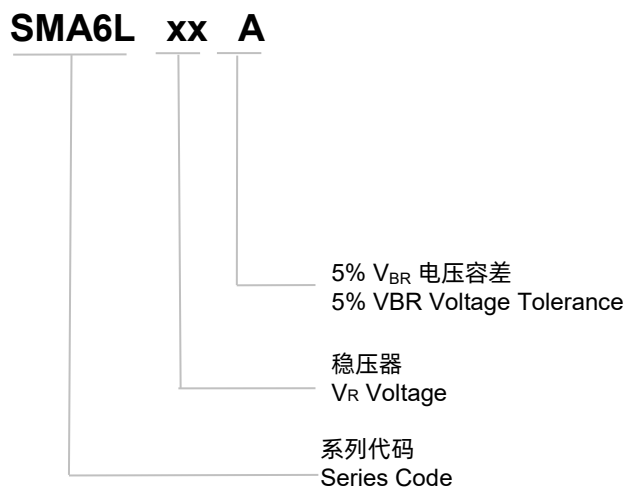
(除另有注释, 默认 $T_A=25\text{ }^\circ\text{C}$ Ratings at $25\text{ }^\circ\text{C}$ ambient temperature unless otherwise specified.)

参数 Parameter	符号 Symbol	值 Value	单位 Unit
$T_A = 25\text{ }^\circ\text{C}$ 时在10/1000 μS 波形的峰值脉冲功耗 (图2) ^(1,2,3) Peak Pulse Power Dissipation at $T_A=25\text{ }^\circ\text{C}$ by 10/1000 μs Waveform (Fig.2) (Note 1,2,3)	P_{PPM}	600	W
峰值功耗,无限散热, $T_L=50\text{ }^\circ\text{C}$ Power Dissipation on Infinite Heat Sink at $T_L=50\text{ }^\circ\text{C}$	P_D	3	W
峰值正向浪涌电流, 8.3 ms单正弦半波 ⁽⁴⁾ Peak Forward Surge Current, 8.3 ms Single Half Sine Wave (Note 4)	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 A for Unidirectional Only	V_F	3.5	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	$R_{\theta JL}$	35	$^\circ\text{C/W}$
热阻(结至环境) Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C/W}$

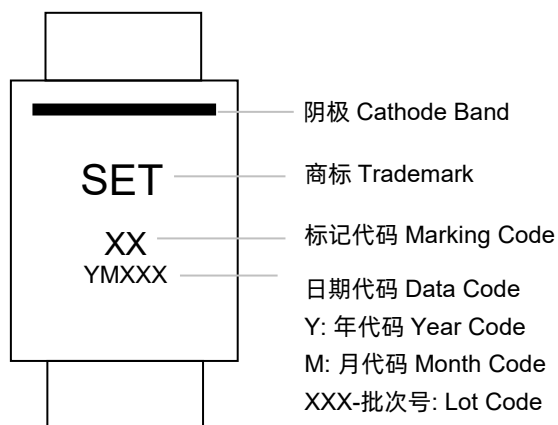
注释 Notes

- 参照图4为非重复性脉冲电流波形, 初始结温 $25\text{ }^\circ\text{C}$ 以上的所示曲线降额峰值功耗参考图3。
Non-repetitive current pulse, per Fig. 4 and derated above $T_J(\text{initial})=25\text{ }^\circ\text{C}$ per Fig. 3.
- 安装在每个端子的 $5.0 \times 5.0\text{ mm}$ 铜垫上。
Mounted on $5.0 \times 5.0\text{ mm}$ copper pad to each terminal.
- SMA6L150A~SMA6L250A通过10/1000 μS 波形 (P_{PPM}) 产生的峰值脉冲功率消耗为400 W。
SMA6L150A~SMA6L250A Peak Pulse Power Dissipation by 10/1000 μs Waveform (P_{PPM}) is 400 W.
- 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 on 8.3 ms single half sine wave or equivalent square wave for unidirectional device only.

型号规则 Part Numbering System



标记 Marking



术语 Glossary

项目 Item	描述 Description
V_C	箝位电压 Clamping Voltage 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	反向关断电压 Reverse Stand-off Voltage 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	反向漏电流 Reverse Leakage Current 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}	击穿电压 Breakdown Voltage 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}	额定随机重复峰值脉冲电流 Rated Random Recurring Peak Impulse Current 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.
$P_{M(AV)}$	额定平均功率 Rated Average Power Dissipation 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}	额定随机重复峰值脉冲功率 Rated Random Recurring Peak Impulse Power Dissipation 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	电容 Capacitance 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)

瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes

SMA6L Series

项目 Item	描述 Description
V_{FS}	<p>正向浪涌峰值电压 Peak Forward Surge Voltage</p> <p>在指定的正向浪涌电流(I_{FS})和持续时间下, 通过TVS的峰值电压。 Peak voltage across TVS for a specified forward surge current (I_{FS}) and time duration. 注: 也用V_F表示。 NOTE : Also shown as V_F.</p>
I_{FS}	<p>正向浪涌电流 Forward Surge Current</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I_F表示。 NOTE : Also shown as I_F.</p>
$\alpha_{V(BR)}$	<p>击穿电压温度系数 Temperature Coefficient of Breakdown Voltage</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>峰值脉冲电流 Peak pulse Current</p> <p>施加在TVS上的峰值脉冲电流, 以确定箝位电压V_C的特定波形。 Peak pulse current value applied across the TVS to determine the clamping voltage V_C for a specified wave shape.</p>
I_T	<p>脉冲直流测试电流 Pulsed D.C. Test Current</p> <p>测量击穿电压V_{BR}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 V_{BR}. This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms. 注: 也用I_{BR}表示。 NOTE : Also shown as I_{BR}.</p>

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

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	Uni	(V)		(mA)	(V)	(μA)	(A)	(V)
SMA6L5.0A	AE	6.40	7.00	10	5.0	800	65.3	9.2
SMA6L6.0A	AG	6.67	7.37	10	6.0	800	58.3	10.3
SMA6L6.5A	AK	7.22	7.98	10	6.5	500	53.6	11.2
SMA6L7.0A	AM	7.78	8.60	10	7.0	200	50.0	12.0
SMA6L7.5A	AP	8.33	9.21	1	7.5	100	46.6	12.9
SMA6L8.0A	AR	8.89	9.83	1	8.0	50	44.2	13.6
SMA6L8.5A	AT	9.44	10.40	1	8.5	20	41.7	14.4
SMA6L9.0A	AV	10.00	11.10	1	9.0	10	39.0	15.4
SMA6L10A	AX	11.10	12.30	1	10.0	5	35.3	17.0
SMA6L11A	AZ	12.20	13.50	1	11.0	1	33.0	18.2
SMA6L12A	BE	13.30	14.70	1	12.0	1	30.2	19.9
SMA6L13A	BG	14.40	15.90	1	13.0	1	28.0	21.5
SMA6L14A	BK	15.60	17.20	1	14.0	1	25.9	23.2
SMA6L15A	BM	16.70	18.50	1	15.0	1	24.6	24.4
SMA6L16A	BP	17.80	19.70	1	16.0	1	23.1	26.0
SMA6L17A	BR	18.90	20.90	1	17.0	1	21.8	27.6
SMA6L18A	BT	20.00	22.10	1	18.0	1	20.6	29.2
SMA6L20A	BV	22.20	24.50	1	20.0	1	18.6	32.4
SMA6L22A	BX	24.40	26.90	1	22.0	1	16.9	35.5
SMA6L24A	BZ	26.70	29.50	1	24.0	1	15.5	38.9
SMA6L26A	CE	28.90	31.90	1	26.0	1	14.3	42.1
SMA6L28A	CG	31.10	34.40	1	28.0	1	13.3	45.4
SMA6L30A	CK	33.30	36.80	1	30.0	1	12.4	48.4
SMA6L33A	CM	36.70	40.60	1	33.0	1	11.3	53.3
SMA6L36A	CP	40.00	44.20	1	36.0	1	10.4	58.1

TVS

TVS

瞬态抑制二极管 TVS Diodes

Transient Voltage Suppression Diodes

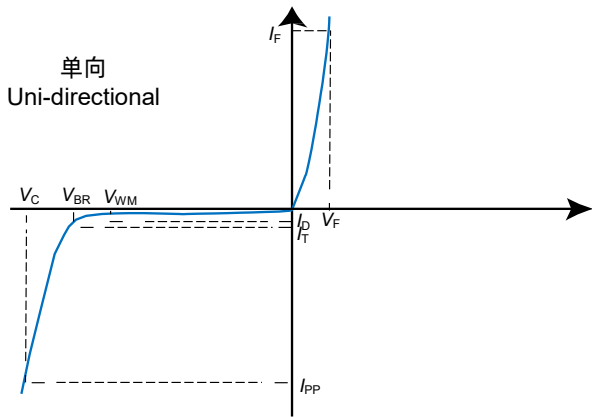
SMA6L Series

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	Uni	(V)		(mA)	(V)	(μ A)	(A)	(V)
SMA6L40A	CR	44.40	49.10	1	40.0	1	9.3	64.5
SMA6L43A	CT	47.80	52.80	1	43.0	1	8.7	69.4
SMA6L45A	CV	50.00	55.30	1	45.0	1	8.3	72.7
SMA6L48A	CX	53.30	58.90	1	48.0	1	7.8	77.4
SMA6L51A	CZ	56.70	62.70	1	51.0	1	7.3	82.4
SMA6L54A	RE	60.00	66.30	1	54.0	1	6.9	87.1
SMA6L58A	RG	64.40	71.20	1	58.0	1	6.5	93.6
SMA6L60A	RK	66.70	73.70	1	60.0	1	6.2	96.8
SMA6L64A	RM	71.10	78.60	1	64.0	1	5.9	103.0
SMA6L70A	RP	77.80	86.00	1	70.0	1	5.3	113.0
SMA6L75A	RR	83.30	92.10	1	75.0	1	5.0	121.0
SMA6L78A	RT	86.70	95.80	1	78.0	1	4.8	126.0
SMA6L85A	RV	94.40	104.00	1	85.0	1	4.4	137.0
SMA6L90A	RX	100.0	111.00	1	90.0	1	4.2	146.0
SMA6L100A	RZ	111.0	123.00	1	100.0	1	3.7	162.0
SMA6L 110A	SE	122.0	135.00	1	110.0	1	3.4	177.0
SMA6L120A	SG	133.0	147.00	1	120.0	1	3.2	193.0
SMA6L 130A	SK	144.0	159.00	1	130.0	1	2.9	209.0
SMA6L150A	SM	167.0	185.00	1	150.0	1	1.65	243.0
SMA6L160A	SP	178.0	197.00	1	160.0	1	1.55	259.0
SMA6L170A	SR	189.0	209.00	1	170.0	1	1.50	275.0
SMA6L180A	ST	201.0	222.00	1	180.0	1	1.40	292.0
SMA6L185A	SU	209.0	231.00	1	185.0	1	1.40	303.0
SMA6L200A	SV	224.0	247.00	1	200.0	1	1.25	324.0
SMA6L215A	SW	237.0	263.00	1	215.0	1	1.17	344.0
SMA6L220A	SX	246.0	272.00	1	220.0	1	1.13	356.0
SMA6L250A	SZ	279.0	309.00	1	250.0	1	0.95	405.0

TVS

TVS

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)

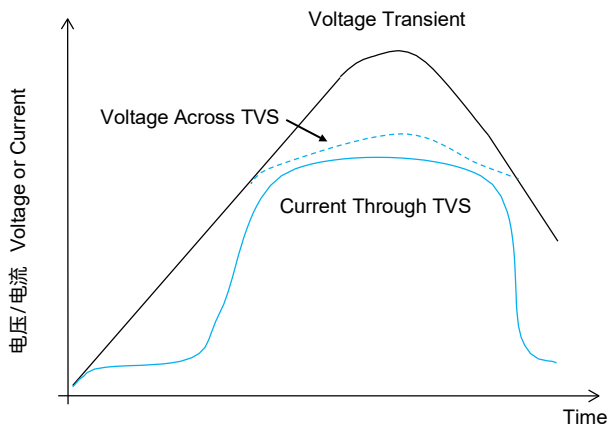


FIGURE 1 TVS瞬态箝位波形
FIGURE 1 TVS Transients Clamping Waveform

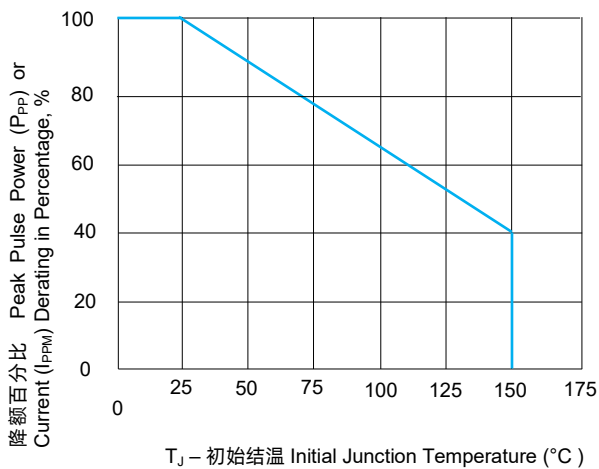


FIGURE 3 峰值脉冲功率降额曲线
Peak Pulse Power Derating Curve

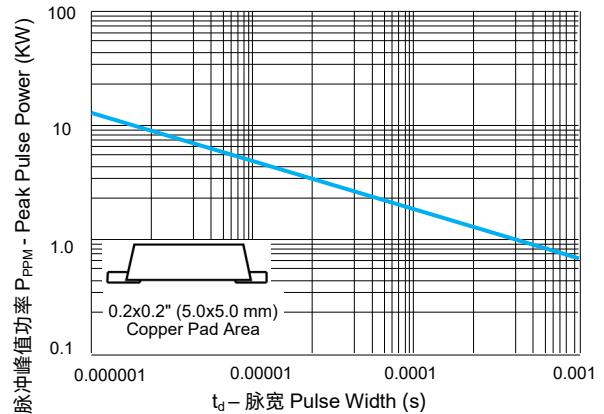


FIGURE 2 峰值脉冲功率额定曲线
FIGURE 2 Peak Pulse Power Rating Curve

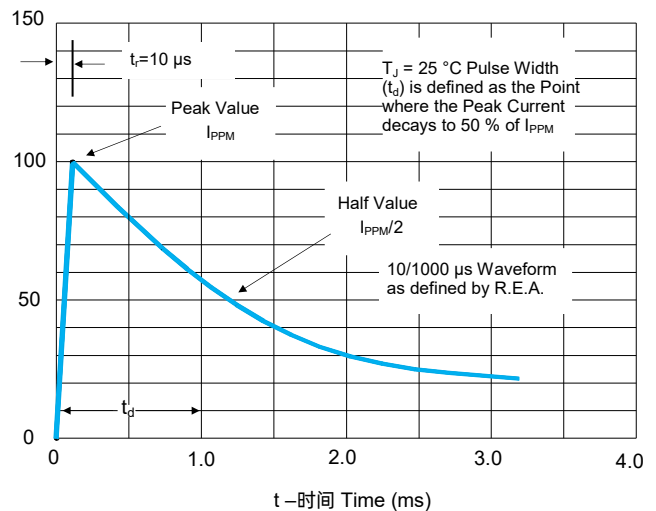


FIGURE 4 脉冲波形 Pulse Waveform - 10/1000 μs

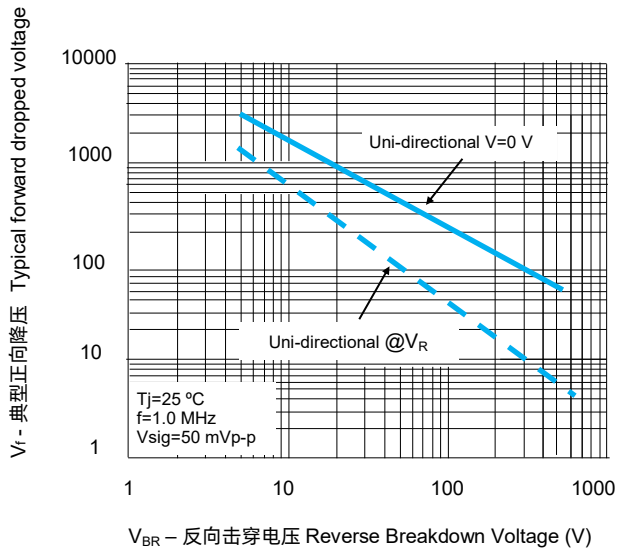


FIGURE 5 典型结电容 Typical Junction Capacitance

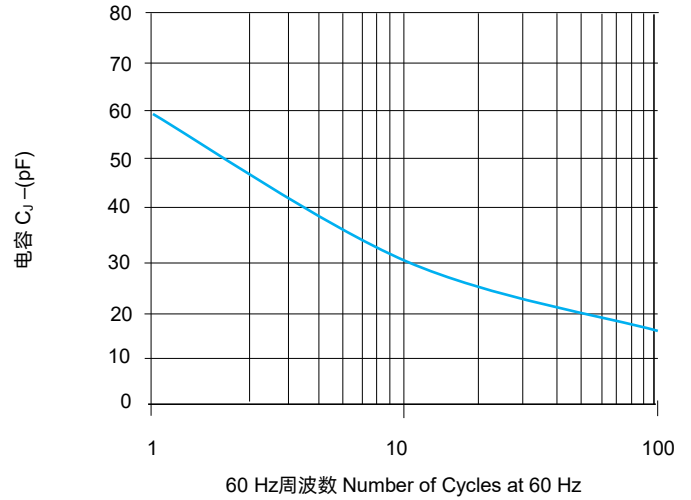


FIGURE 6 最大非重复正向浪涌电流(单向型)
Maximum Non-Repetitive Forward Surge Current
Uni-Directional only

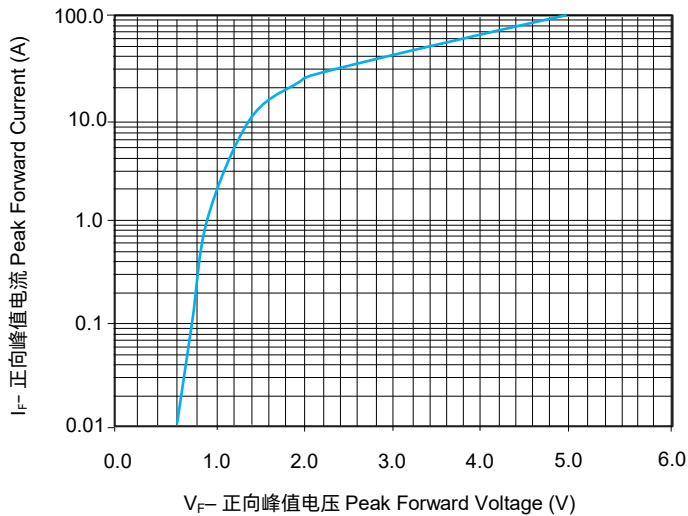


FIGURE 7 峰值正向电压及电流(典型值)
Peak Forward Drop vs Peak Forward Current (Typical Values)

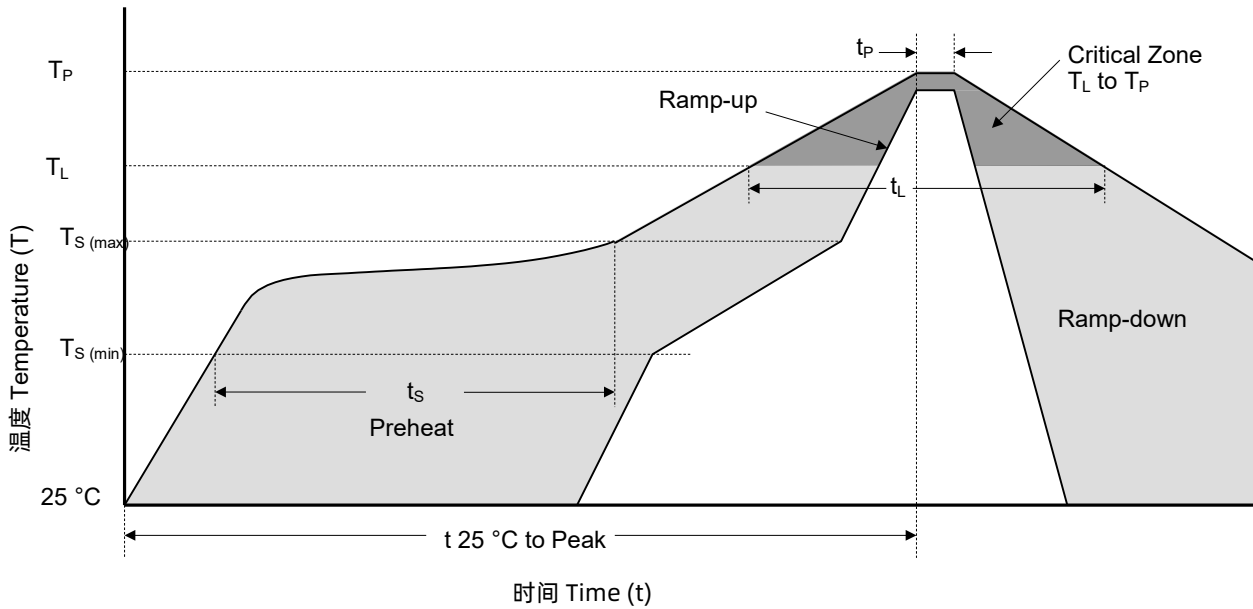
环境特性 Environmental Specifications

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	JEDEC-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	0.002 ounce, 0.032 gram
封装 Case	JEDEC DO-221AC Molded Plastic over glass passivated junction
极性 Polarity	Color band denotes cathode except Bipolar
端子 Terminal	Matte Tin-plated leads, Solderable per JESD22-B102

焊接参数 Soldering Parameters



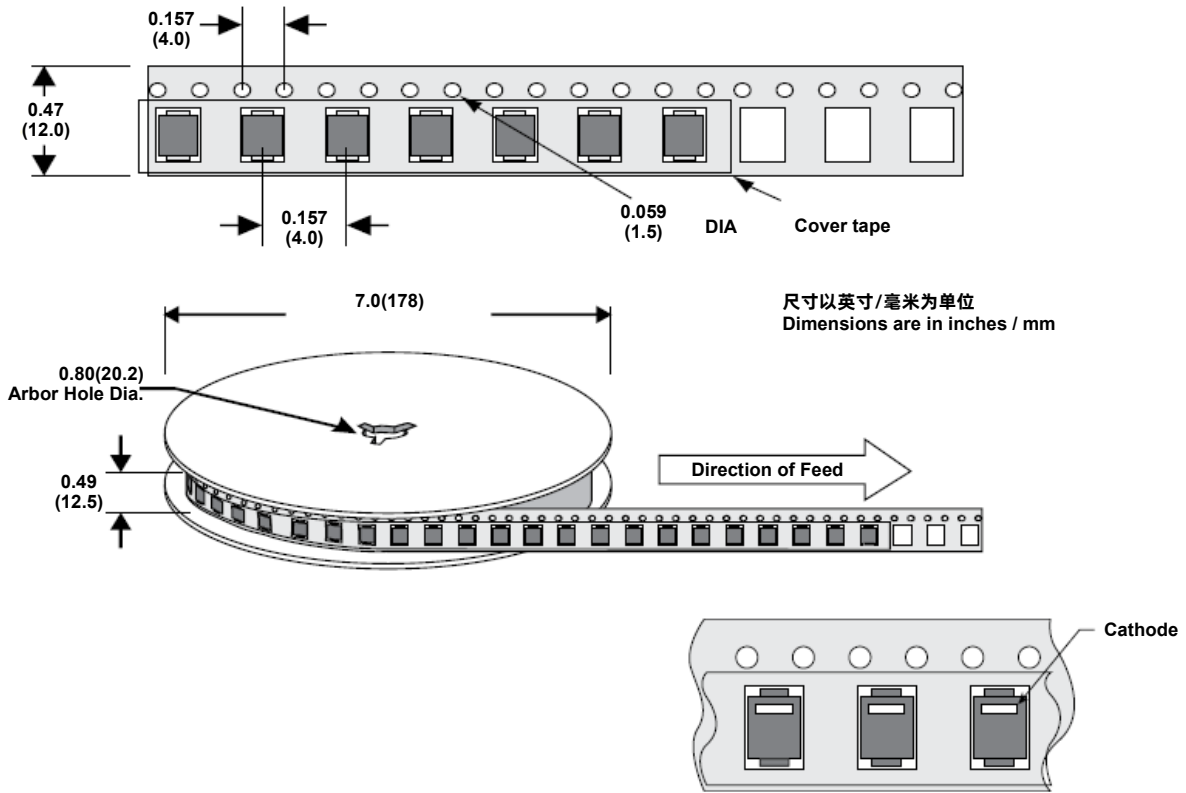
回流焊条件 Reflowing Condition

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 ^{+0/-5} °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

TVS

TVS

包装信息 Packaging Information



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
SMA6LxxA	DO-221AC	2000 PCS	Tape & Reel – 12 mm/7" tape	EIA 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.