

TVS

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## 概述 Description

SPCL6系列高功率TVS二极管是专门为满足交直流线路保护应用的浪涌试验环境而设计的。与传统的金属氧化物(MOV)解决方案相比，它具有非常快的响应和超低箝位性能。将其串并联进行使用可作为超高浪涌的保护方案。

The SPCL6 series of high power TVS diode is specially designed for meeting severe surge test environment of both AC and DC line protection applications. It features a very fast response and ultra low clamping characteristics over traditional metal oxide varistor ( MOV ) solutions. They can be connected in series and / or parallel to create a very high surge current protection solution.

## 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

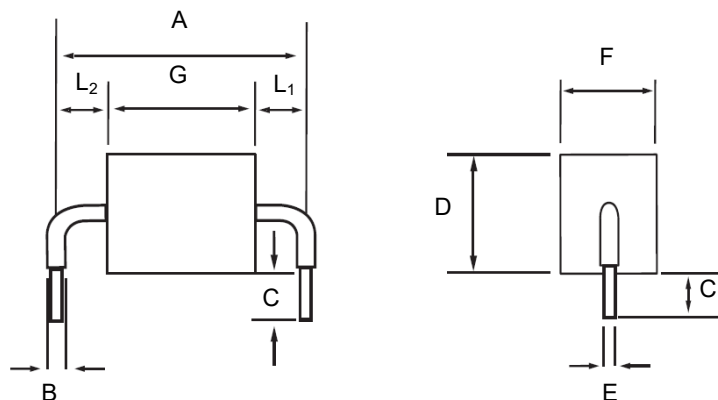


双向 Bi-Directional

## 特性 Features

- 极低的箝位电压
- 急速击穿响应
- 低斜率电阻
- 双向
- 采用叠层技术具有优异的箝位因子
- 引脚宽度对称，便于组装焊接
- IEC 61000-4-2 防静电：30 kV (空气放电), 30 kV (接触放电)
- 符合IEC 61000-4-2标准的数据线路的ESD保护
- 符合IEC 61000-4-4标准的数据线路的EFT保护
- 无卤素
- 符合RoHS指令
- 玻璃钝化保护工艺
- 无铅E4：二级互连引线无铅，端子镀银
- Very low clamping voltage
- Sharp breakdown voltage
- Low slope resistance
- Bi-directional
- Snapback technology for superior clamping factor
- Symmetric in leads width for easier soldering during assembly
- IEC-61000-4-2 ESD 30 kV ( Air ), 30 kV ( Contact )
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Halogen-free
- RoHS compliant
- Glass passivated junction
- Pb-free E4 means 2nd level interconnect is Pb-free and the terminal finish material is Silver

## 封装尺寸 Package Outline Dimensions



| 符号<br>Symbol                    | 公制(毫米)<br>Millimeters  | 英制(英寸)<br>Inches |
|---------------------------------|--|------------------|
| A                               | 24.15 ± 1.00   | 0.951 ± 0.040    |
| B                               | 2.50 ± 0.70  | 0.100 ± 0.028    |
| C                               | 6.00 ± 1.00  | 0.236 ± 0.040    |
| D                               | 14.48 max.   | 0.570 max.       |
| E                               | 1.28 ± 0.05  | 0.051 ± 0.002    |
| F                               | 12.70 max.   | 0.500 max.       |
| G - 030C / -038C                | 4.10 ± 1.00  | 0.161 ± 0.040    |
| G - 058C / -066C / -076C        | 4.80 ± 1.00  | 0.189 ± 0.040    |
| G - 170C / 190C                 | 8.13 ± 1.00  | 0.320 ± 0.040    |
| G - 240C                        | 9.40 ± 1.00  | 0.370 ± 0.040    |
| G - 380C-Y / 430C               | 13.80 ± 1.00   | 0.543 ± 0.040    |
| L <sub>1</sub> / L <sub>2</sub> | L <sub>1</sub> = L <sub>2</sub> Tolerance ± 1.0 mm ( ± 0.04 inch ) |                  |

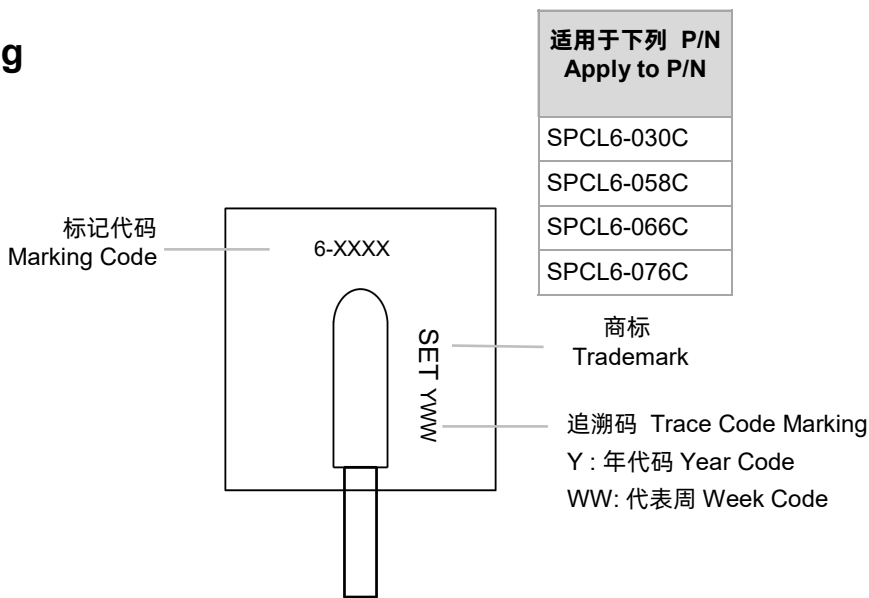
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TVS

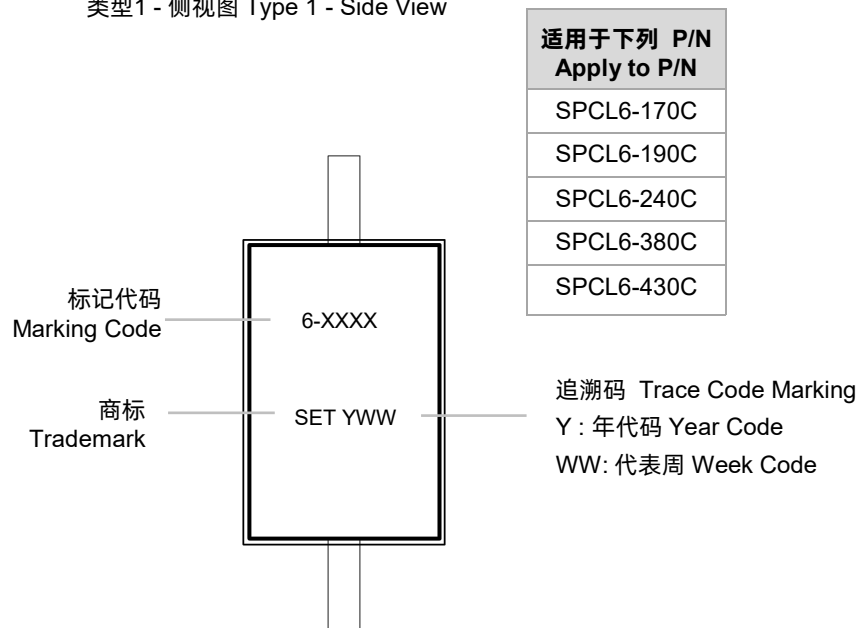
### 型号规则 Part Numbering System



### 标记 Marking



类型1 - 侧视图 Type 1 - Side View



类型2 - 俯视图 Type 2 - Top View

## 术语 Glossary

| 项目<br>Item  | 描述<br>Description   |
|-------------|---|
| $V_C$       | <b>箝位电压 Clamping Voltage</b><br>TVS在低差阻区域内的电压，用于限制设备两端的电压。<br>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><br>TVS 在没有导通状态下最高电压。<br>Maximum voltage that can be applied to the TVS without operation.<br>注：也用 $V_{WM}$ （最高直流工作电压）表示，也称为截止电压( $V_{SO}$ )。<br>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><br>量测 $V_R$ 的电流。<br>Current measured at $V_R$ .<br>注：也用 $I_D$ 待机电流表示。<br>NOTE : Also shown as $I_D$ for stand-by current.  |
| $V_{BR}$    | <b>击穿电压 Breakdown Voltage</b><br>在击穿区以指定电流 $I_T$ (测试电流)通过TVS的电压。<br>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><br>施加在设备上的随机重复峰值脉冲电流的最大额定值。<br>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><br>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。<br>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><br>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。<br>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><br>在规定的频率和电压下所测量的TVS电容。<br>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

SPCL6 Series (6 kA)

| 项目<br>Item       | 描述<br>Description   |
|------------------|---|
| $V_{FS}$         | <p><b>正向浪涌峰值电压 Peak Forward Surge Voltage</b><br/>                     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。<br/>                     Peak voltage across TVS for a specified forward surge current (<math>I_{FS}</math>) and time duration.<br/>                     注: 也用<math>V_F</math>表示。<br/>                     NOTE : Also shown as <math>V_F</math>.</p>   |
| $I_{FS}$         | <p><b>正向浪涌电流 Forward Surge Current</b><br/>                     在正向导通区域通过TVS的脉冲电流。<br/>                     Pulsed current through TVS in the forward conducting region.<br/>                     注: 也用<math>I_F</math>表示。<br/>                     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><br/>                     击穿电压的变化与温度变化的比值。<br/>                     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><br/>                     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。<br/>                     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><br/>                     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。<br/>                     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.<br/>                     注: 也用<math>I_{BR}</math>表示。<br/>                     NOTE : Also shown as <math>I_{BR}</math>.</p> |

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

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## 电气特性 (除另有注释, 默认 $T_A=25^\circ\text{C}$ )

### Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted) Table 1

| 型号<br>Part Number | 标记代码<br>Device<br>Marking<br>Code | 击穿电压<br>Breakdown<br>Voltage<br>$V_{BR@I_T}$ |      | 测试电流<br>Test<br>Current<br>$I_T$ | 反向关断电<br>压<br>Stand-off<br>Voltage<br>$V_R$ | 最大反向漏电流<br>Max.<br>Reverse<br>Leakage<br>$I_R@V_R$ | 典型漏电流<br>Typical<br>$I_R@85^\circ\text{C}$ | 最大箝位电压<br>Max. Clamping<br>Voltage<br>$V_{CL}@I_{PP}$ Peak<br>Pulse Current<br>( $I_{PP}$ )<br>(Note 1) |              | 最大 $V_{BR}$ 温度<br>系数<br>Max.<br>Temp<br>Coefficient<br>OF $V_{BR}$ | 最大电容值<br>Max.<br>Capacitance<br>0 Bias 10kHz |
|-------------------|-----------------------------------|--|------|----------------------------------|---|--|--|---|--------------|--|--|
|                   |                                   | Min  | Max  |                                  |   |  |  | $I_{PP}$ (A)  | $V_{CL}$ (V) |  |  |
|                   |                                   | (V)  |      |                                  |   |  |  |   |              |  |  |
| SPCL6-030C        | 6-030C                            | 32   | 37   | 10                               | 30  | 10   | 15   | 6000  | 58           | 0.1  | 11.0   |
| SPCL6-038C        | 6-038C                            | 42.6   | 47.6 | 10                               | 38  | 10   | 15   | 6000  | 73.4         | 0.1  | 11.0   |
| SPCL6-058C        | 6-058C                            | 64   | 70   | 10                               | 58  | 10   | 15   | 6000  | 110          | 0.1  | 8.0  |
| SPCL6-066C        | 6-066C                            | 72   | 80   | 10                               | 66  | 10   | 15   | 6000  | 120          | 0.1  | 6.0  |
| SPCL6-076C        | 6-076C                            | 85   | 95   | 10                               | 76  | 10   | 15   | 6000  | 140          | 0.1  | 6.5  |
| SPCL6-170C        | 6-170C                            | 180  | 220  | 10                               | 170   | 10   | 15   | 6000  | 260          | 0.1  | 2.8  |
| SPCL6-190C        | 6-190C                            | 200  | 245  | 10                               | 190   | 10   | 15   | 6000  | 290          | 0.1  | 2.5  |
| SPCL6-240C        | 6-240C                            | 250  | 285  | 10                               | 240   | 10   | 15   | 6000  | 340          | 0.1  | 2.0  |
| SPCL6-380C        | 6-380C                            | 401  | 443  | 10                               | 380   | 10   | 15   | 6000  | 520          | 0.1  | 1.4  |
| SPCL6-430C        | 6-430C                            | 440  | 490  | 10                               | 430   | 10   | 15   | 6000  | 625          | 0.1  | 1.0  |

注释 Note:

1. 采用 IEC 61000-4-5 定义的 8/20  $\mu\text{S}$  波形。  
Using 8/20  $\mu\text{S}$  wave shape as defined in IEC 61000-4-5.

## 额定参数与特性 (除有另外注释, 默认 $T_A=25^\circ\text{C}$ )

### Maximum Ratings and Thermal Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| 参数<br>Parameter                                | 符号<br>Symbol | 值<br>Value | 单位<br>Unit       |
|--|--------------|------------|------------------|
| 储存温度范围<br>Operating Storage Temperature Range  | $T_{STG}$    | -55 to 150 | $^\circ\text{C}$ |
| 工作结温范围<br>Operating Junction Temperature Range | $T_J$        | -55 to 125 | $^\circ\text{C}$ |
| 额定电流(注释1)<br>Current Rating (Note 1)           | $I_{PP}$     | 6          | kA               |

注释 Note

1. 额定 $I_{PP}$ 值采用 8/20  $\mu\text{S}$  进行测量。  
Rated  $I_{PP}$  measured with 8/20  $\mu\text{S}$  pulse.

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

Ratings and Characteristic Curves ( $T_A = 25\text{ }^\circ\text{C}$  unless otherwise noted)

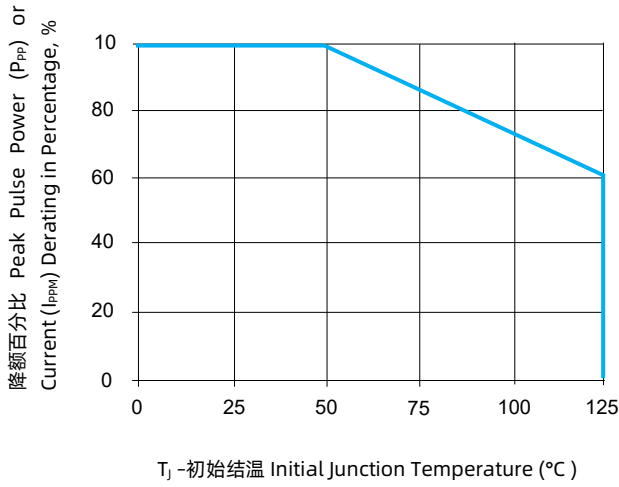


FIGURE 1 峰值脉冲功率降额曲线  
Peak Power Derating

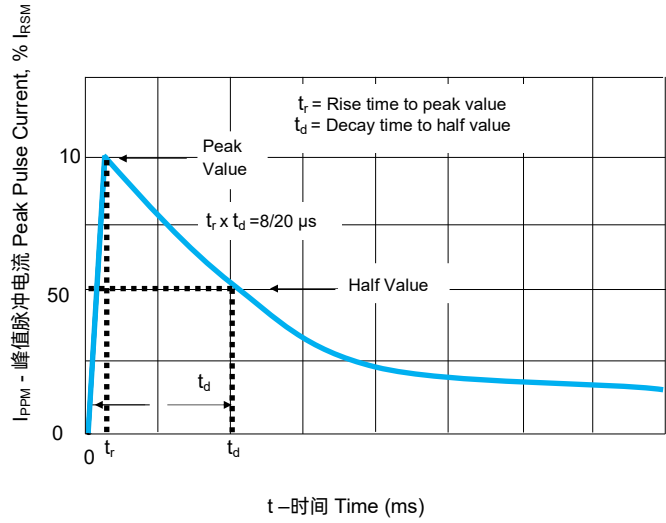


FIGURE 2 脉冲波形  
Pulse Waveform

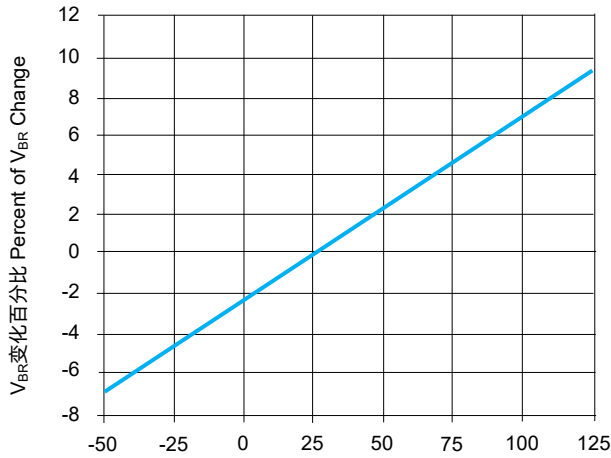
TVS

TVS

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$T_J$  - 结点温度 Junction Temperature ( °C )

FIGURE 3 典型  $V_{BR}$  随结温变化曲线  
Typical  $V_{BR}$  vs Junction Temperature

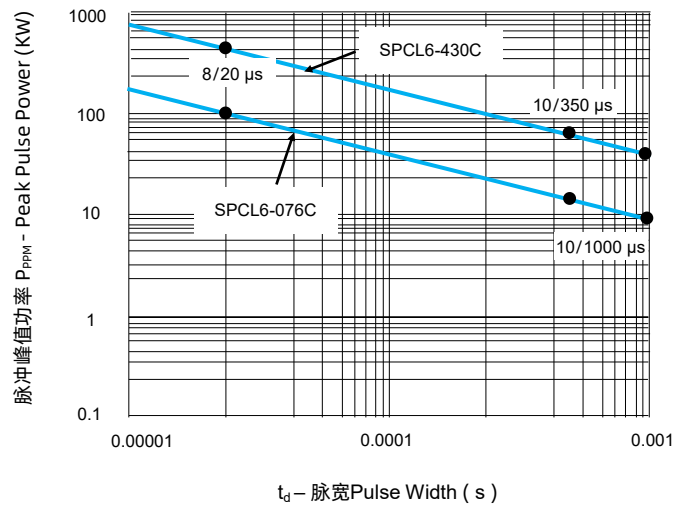


FIGURE 4 峰值脉冲功率额定曲线  
Peak Pulse Power Rating Curve

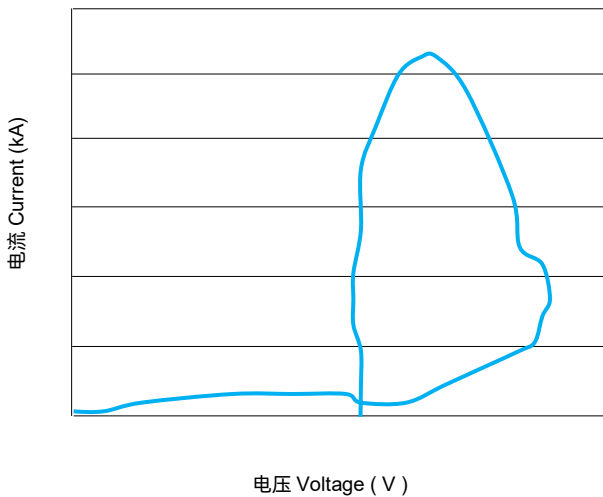
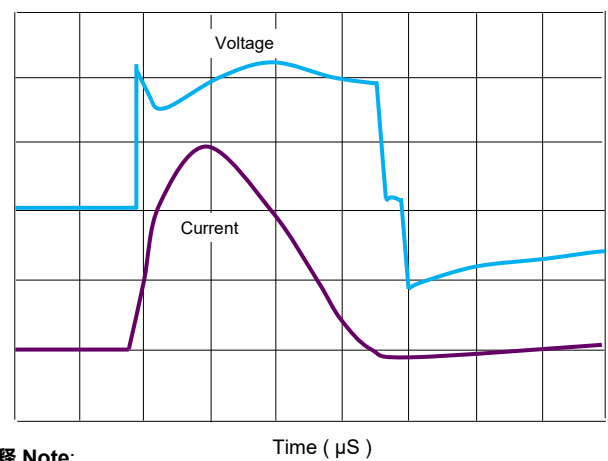


FIGURE 5 浪涌响应  
Surge Response



注释 Note:

浪涌时能量耗散导致会雪崩电压改变，但是浪涌过后雪崩电压又会恢复到初始值。

The power dissipation causes a change in avalanche voltage during the surge and the avalanche voltage eventually returns to the original value when the transient has passed.

FIGURE 6 浪涌响应(8/20浪涌电流波形)  
Surge Response ( 8/20 Surge current waveform )

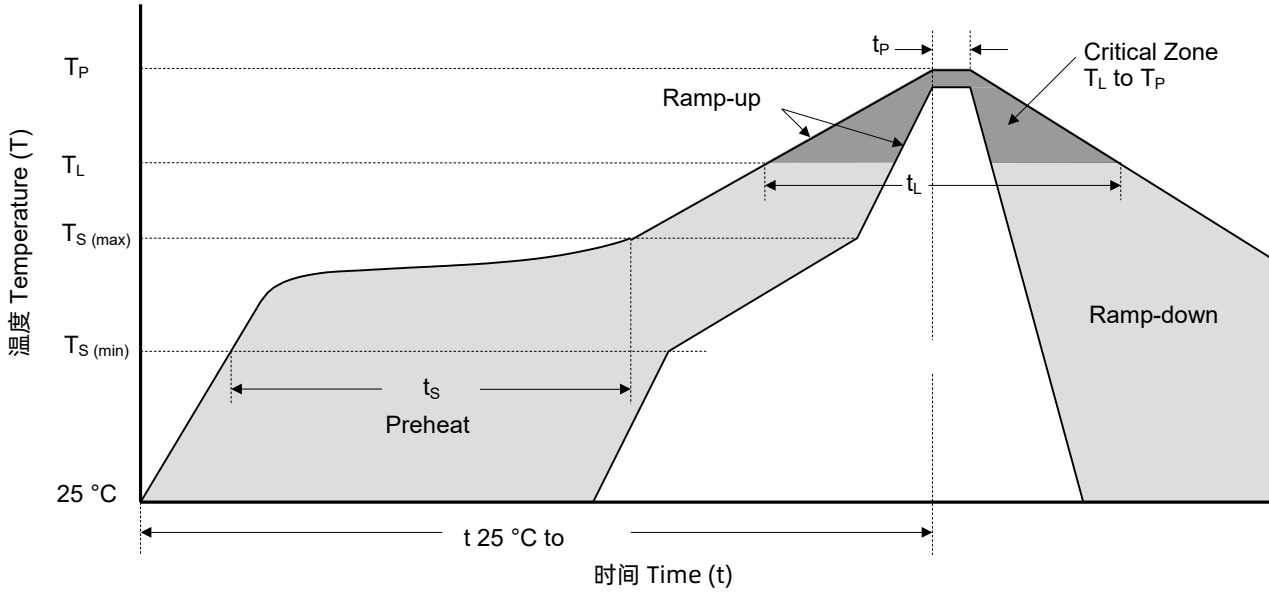
## 回流焊/波峰焊(浸焊) Flow/Wave Soldering (Solder Dipping)

|                          |                   |
|--------------------------|-------------------|
| 峰值温度<br>Peak Temperature | 260 °C +0 / -5 °C |
| 浸润时间<br>Dipping Time     | 10 seconds        |
| 焊接次数<br>Soldering Numbe  | 1 time            |

## 物理特性 Physical Specifications

|                |   |
|----------------|---|
| 重量<br>Weight   | Contact manufacturer  |
| 封装<br>Case     | Epoxy encapsulated  |
| 端子<br>Terminal | Silver plated leads, solderable per MIL-STD-750 Method 2026 |

焊接参数 Soldering Parameters



回流焊条件 Reflowing Condition

| 回流焊接参数<br>Reflow Soldering Parameters   |   | 无铅组装<br>Lead-Free Assembly |
|---|---|----------------------------|
| 预热 Pre-heat   | 最低温( $T_{S(min)}$ )<br>Temperature Min ( $T_{S(min)}$ ) | 150 °C                     |
|   | 最高温( $T_{S(max)}$ )<br>Temperature Max ( $T_{S(max)}$ ) | 200 °C                     |
|   | 升温时长( $t_s$ )<br>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( $T_P$ ))<br>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<br>$T_{S(max)}$ 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<br>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<br>Part Number | 封装<br>Package | 数量<br>Quantity     | 包装选项<br>Packaging Option |
|-------------------|---------------|--------------------|--------------------------|
| SPCL6-XXXX        | SPCL Package  | 56 PCS / Inner Box | BULK                     |
| SPCL6-XXXX-12     | SPCL Package  | 12 PCS / Inner Box | BULK                     |

TVS

TVS



# 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.