

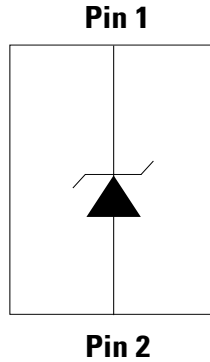
## SP11xx Series Discrete Unidirectional TVS Diode



### Description

Avalanche breakdown diodes fabricated in a proprietary silicon avalanche technology protect each I/O pin to provide a high level of protection for electronic equipment that may experience destructive electrostatic discharges (ESD). These robust diodes can safely absorb repetitive ESD strikes at  $\pm 30\text{kV}$  (contact and air discharge, IEC 61000-4-2) without performance degradation. Additionally, each diode can safely dissipate 80A (SP1105S) of 8/20 $\mu\text{s}$  surge current (IEC 61000-4-5 2<sup>nd</sup> edition) with very low clamping voltages.

### Pinout and Functional Block Diagram



### Features

- ESD, IEC 61000-4-2,  $\pm 30\text{kV}$  contact,  $\pm 30\text{kV}$  air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, IEC 61000-4-5 2<sup>nd</sup> edition, 80A ( $t_p=8/20\mu\text{s}$ , SP1105S)
- Low clamping voltage
- Low leakage current
- Moisture Sensitivity Level(MSL -1)
- Lead free and RoHS compliant
- AEC-Q101 qualified

### Applications

- Switches / Buttons
- Test Equipment / Instrumentation
- Point-of-Sale Terminals
- Medical Equipment
- Notebooks / Desktops / Servers
- Computer Peripherals
- Automotive Electronics

Life Support Note:

**Not Intended for Use in Life Support or Life Saving Applications**

The products shown herein are not designed for use in life sustaining or life saving applications unless otherwise expressly indicated.

### Absolute Maximum Ratings

| Symbol     | Parameter             | Value      | Units |
|------------|-----------------------|------------|-------|
| $T_{OP}$   | Operating Temperature | -40 to 125 | °C    |
| $T_{STOR}$ | Storage Temperature   | -55 to 150 | °C    |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### SP1105 Electrical Characteristics ( $T_{OP}=25^{\circ}C$ )

| Parameter                          | Symbol     | Test Conditions                      | Min      | Typ  | Max | Units    |
|------------------------------------|------------|--------------------------------------|----------|------|-----|----------|
| Reverse Standoff Voltage           | $V_{RWM}$  | $I_R \leq 1\mu A$                    | -        | -    | 5.0 | V        |
| Reverse Voltage Drop               | $V_R$      | $I_R = 1mA$                          | 6.0      | -    | -   | V        |
| Leakage Current                    | $I_{LEAK}$ | $V_R = 5V$                           | -        | -    | 1.0 | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$      | $I_{PP} = 1A, t_p = 8/20\mu s, Fwd$  | -        | 7.3  | -   | V        |
|                                    |            | $I_{PP} = 70A, t_p = 8/20\mu s, Fwd$ | -        | 10.9 | -   | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$  | TLP, $t_p = 100ns, I/O$ to GND       | -        | 0.05 | -   | $\Omega$ |
| Peak Pulse Current                 | $I_{PP}$   | $t_p = 8/20\mu s$                    | -        | -    | 70  | A        |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$  | IEC 61000-4-2 (Contact Discharge)    | $\pm 30$ | -    | -   | kV       |
|                                    |            | IEC 61000-4-2 (Air Discharge)        | $\pm 30$ | -    | -   | kV       |
| Diode Capacitance <sup>1</sup>     | $C_D$      | Reverse Bias=0V, f=1MHz              | -        | 630  | -   | pF       |

### SP1105S Electrical Characteristics ( $T_{OP}=25^{\circ}C$ )

| Parameter                          | Symbol     | Test Conditions                      | Min      | Typ  | Max | Units    |
|------------------------------------|------------|--------------------------------------|----------|------|-----|----------|
| Reverse Standoff Voltage           | $V_{RWM}$  | $I_R \leq 1\mu A$                    | -        | -    | 5.0 | V        |
| Reverse Voltage Drop               | $V_R$      | $I_R = 1mA$                          | 6.0      | -    | 7.5 | V        |
| Leakage Current                    | $I_{LEAK}$ | $V_R = 5V$                           | -        | -    | 1.0 | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$      | $I_{PP} = 40A, t_p = 8/20\mu s, Fwd$ | -        | 8.3  | -   | V        |
|                                    |            | $I_{PP} = 80A, t_p = 8/20\mu s, Fwd$ | -        | 9.2  | -   | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$  | TLP, $t_p = 100ns, I/O$ to GND       | -        | 0.05 | -   | $\Omega$ |
| Peak Pulse Current                 | $I_{PP}$   | $t_p = 8/20\mu s$                    | -        | -    | 80  | A        |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$  | IEC 61000-4-2 (Contact Discharge)    | $\pm 30$ | -    | -   | kV       |
|                                    |            | IEC 61000-4-2 (Air Discharge)        | $\pm 30$ | -    | -   | kV       |
| Diode Capacitance <sup>1</sup>     | $C_D$      | Reverse Bias=0V, f=1MHz              | -        | 630  | -   | pF       |

### SP1112 Electrical Characteristics ( $T_{OP}=25^{\circ}C$ )

| Parameter                          | Symbol      | Test Conditions                      | Min      | Typ  | Max  | Units    |
|------------------------------------|-------------|--------------------------------------|----------|------|------|----------|
| Reverse Standoff Voltage           | $V_{RWM}$   | $I_R \leq 1\mu A$                    | -        | -    | 12.0 | V        |
| Reverse Voltage Drop               | $V_R$       | $I_R = 1mA$                          | 13.3     | -    | -    | V        |
| Leakage Current                    | $I_{LEAK}$  | $V_R = 12V$                          | -        | -    | 1.0  | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$       | $I_{PP} = 1A, t_p = 8/20\mu s, Fwd$  | -        | 15.2 | -    | V        |
|                                    |             | $I_{PP} = 40A, t_p = 8/20\mu s, Fwd$ | -        | 26.5 | -    | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$   | TLP, $t_p = 100ns, I/O$ to GND       | -        | 0.05 | -    | $\Omega$ |
| Peak Pulse Current                 | $I_{PP}$    | $t_p = 8/20\mu s$                    | -        | -    | 40.0 | A        |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$   | IEC 61000-4-2 (Contact Discharge)    | $\pm 30$ | -    | -    | kV       |
|                                    |             | IEC 61000-4-2 (Air Discharge)        | $\pm 30$ | -    | -    | kV       |
| Diode Capacitance <sup>1</sup>     | $C_{D-GND}$ | Reverse Bias=0V, f=1MHz              | -        | 230  | -    | pF       |

### SP1115 Electrical Characteristics (T<sub>OP</sub>=25°C)

| Parameter                          | Symbol               | Test Conditions                                      | Min  | Typ  | Max  | Units |
|------------------------------------|----------------------|--|------|------|------|-------|
| Reverse Standoff Voltage           | V <sub>RWM</sub>     | I <sub>R</sub> ≤ 1 μA                                | -    | -    | 15.0 | V     |
| Reverse Voltage Drop               | V <sub>R</sub>       | I <sub>R</sub> = 1 mA                                | 16.7 | -    | -    | V     |
| Leakage Current                    | I <sub>LEAK</sub>    | V <sub>R</sub> = 15V                                 | -    | -    | 1.0  | μA    |
| Clamp Voltage <sup>1</sup>         | V <sub>C</sub>       | I <sub>pp</sub> = 1A, t <sub>p</sub> = 8/20 μs, Fwd  | -    | 19.3 | -    | V     |
|                                    |                      | I <sub>pp</sub> = 30A, t <sub>p</sub> = 8/20 μs, Fwd | -    | 30.2 | -    | V     |
| Dynamic Resistance <sup>2</sup>    | R <sub>DYN</sub>     | TLP, t <sub>p</sub> = 100ns, I/O to GND              | -    | 0.05 | -    | Ω     |
| Peak Pulse Current                 | I <sub>pp</sub>      | t <sub>p</sub> = 8/20 μs                             | -    | -    | 30.0 | A     |
| ESD Withstand Voltage <sup>1</sup> | V <sub>ESD</sub>     | IEC 61000-4-2 (Contact Discharge)                    | ±30  | -    | -    | kV    |
|                                    |                      | IEC 61000-4-2 (Air Discharge)                        | ±30  | -    | -    | kV    |
| Diode Capacitance <sup>1</sup>     | C <sub>I/O-GND</sub> | Reverse Bias = 0V, f = 1 MHz                         | -    | 180  | -    | pF    |

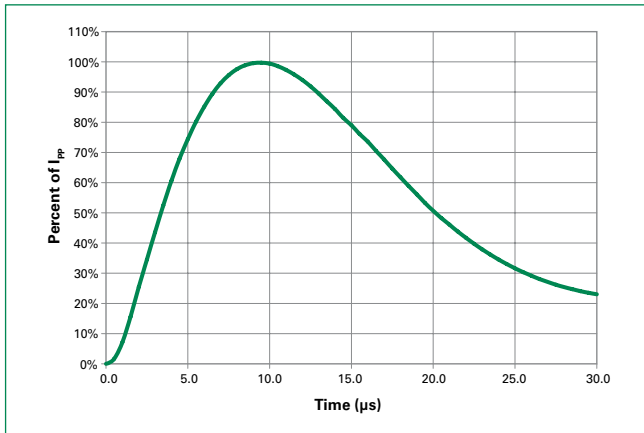
### SP1124 Electrical Characteristics (T<sub>OP</sub>=25°C)

| Parameter                          | Symbol               | Test Conditions                                      | Min  | Typ  | Max  | Units |
|------------------------------------|----------------------|--|------|------|------|-------|
| Reverse Standoff Voltage           | V <sub>RWM</sub>     | I <sub>R</sub> ≤ 1 μA                                | -    | -    | 24.0 | V     |
| Reverse Voltage Drop               | V <sub>R</sub>       | I <sub>R</sub> = 1 mA                                | 26.7 | -    | -    | V     |
| Leakage Current                    | I <sub>LEAK</sub>    | V <sub>R</sub> = 24V                                 | -    | -    | 1.0  | μA    |
| Clamp Voltage <sup>1</sup>         | V <sub>C</sub>       | I <sub>pp</sub> = 1A, t <sub>p</sub> = 8/20 μs, Fwd  | -    | 29.8 | -    | V     |
|                                    |                      | I <sub>pp</sub> = 20A, t <sub>p</sub> = 8/20 μs, Fwd | -    | 44.7 | -    | V     |
| Dynamic Resistance <sup>2</sup>    | R <sub>DYN</sub>     | TLP, t <sub>p</sub> = 100ns, I/O to GND              | -    | 0.1  | -    | Ω     |
| Peak Pulse Current                 | I <sub>pp</sub>      | t <sub>p</sub> = 8/20 μs                             | -    | -    | 20.0 | A     |
| ESD Withstand Voltage <sup>1</sup> | V <sub>ESD</sub>     | IEC 61000-4-2 (Contact Discharge)                    | ±30  | -    | -    | kV    |
|                                    |                      | IEC 61000-4-2 (Air Discharge)                        | ±30  | -    | -    | kV    |
| Diode Capacitance <sup>1</sup>     | C <sub>I/O-GND</sub> | Reverse Bias = 0V, f = 1 MHz                         | -    | 130  | -    | pF    |

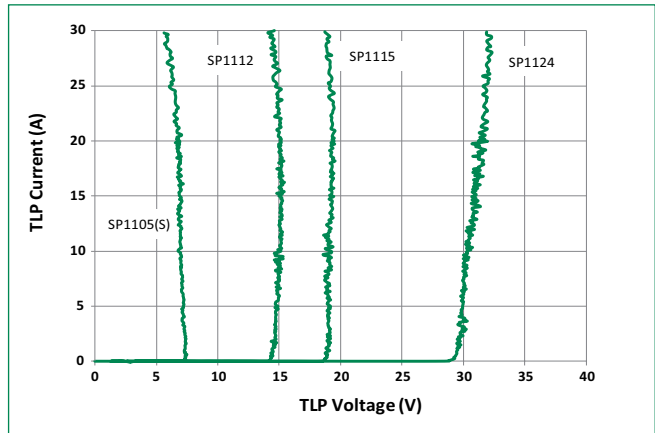
**Note:**

- Parameter is guaranteed by design and/or component characterization.
- Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window t1=70ns to t2= 90ns

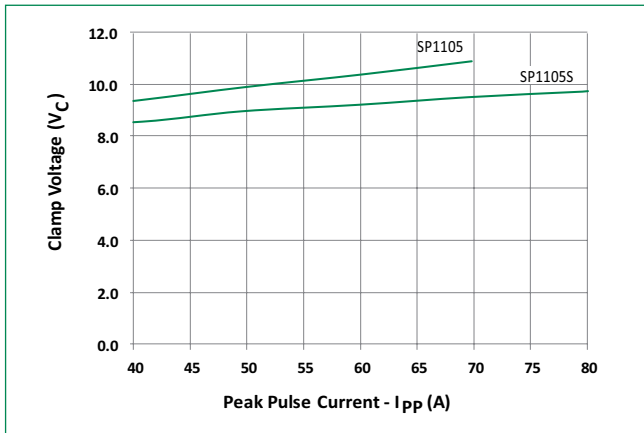
**8/20µs Pulse Waveform**



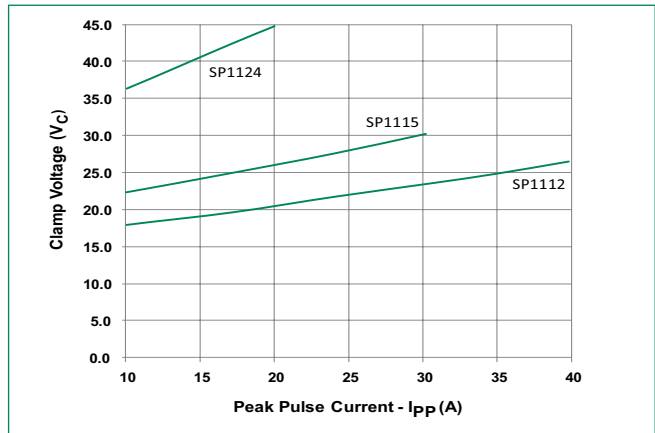
**Transmission Line Pulsing (TLP) Plot**



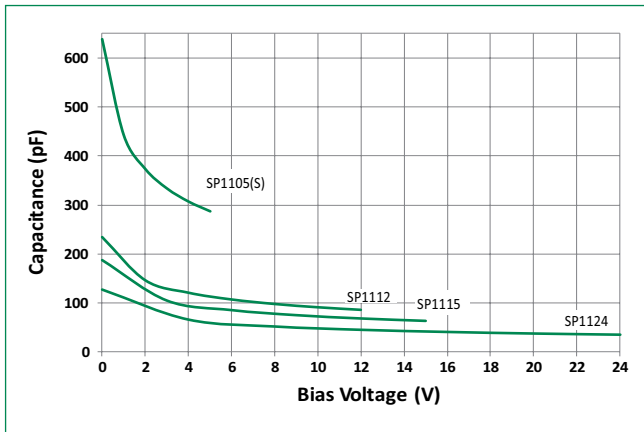
**SP1105, SP1105S Clamping voltage vs.  $I_{pp}$  for 8/20µs waveshape**



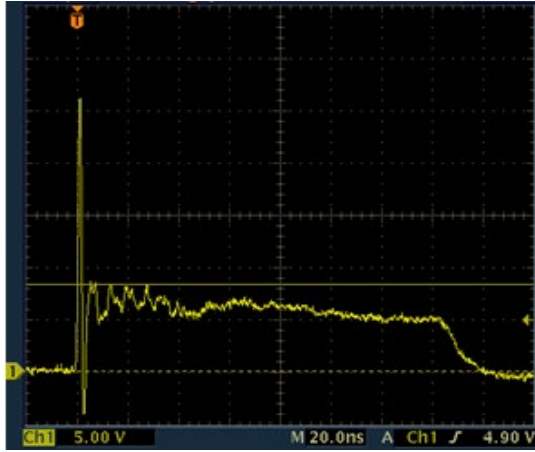
**SP1112, SP1115, SP1124 Clamping voltage vs.  $I_{pp}$  for 8/20µs waveshape**



**Capacitance vs. Bias**



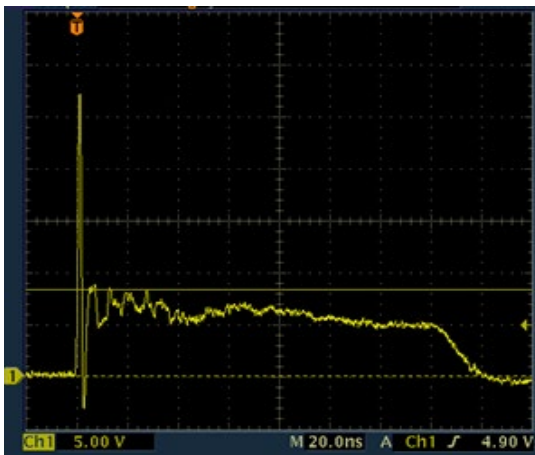
**SP1105 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



**SP1105 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



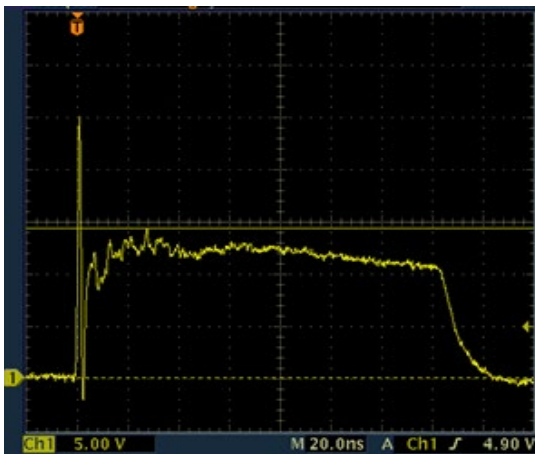
**SP1105S IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



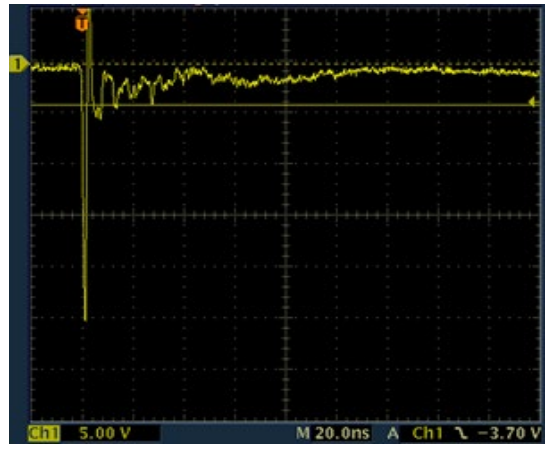
**SP1105S IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



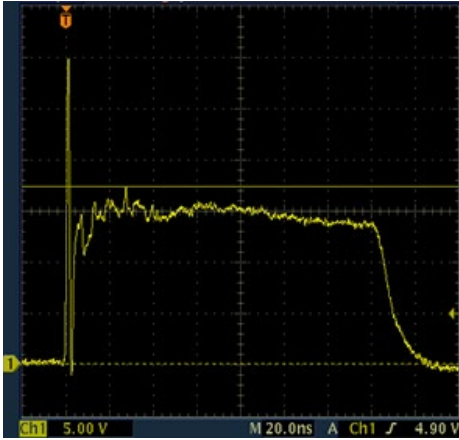
**SP1112 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



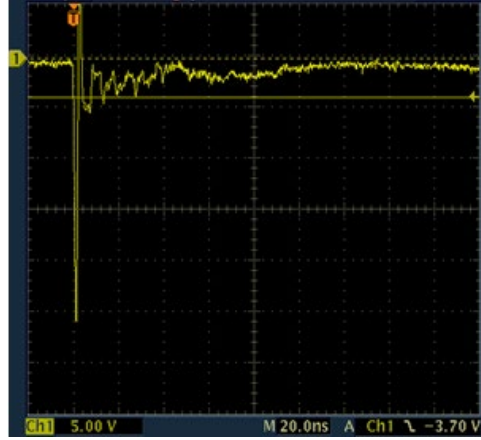
**SP1112 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



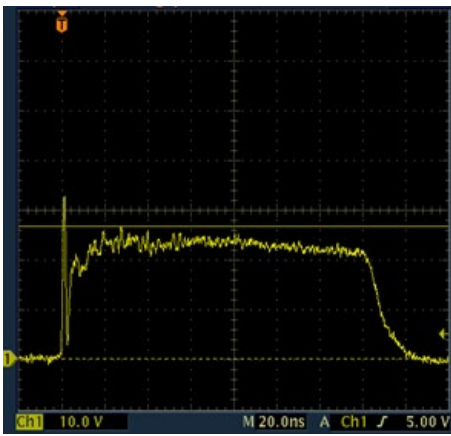
**SP1115 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



**SP1115 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



**SP1124 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**

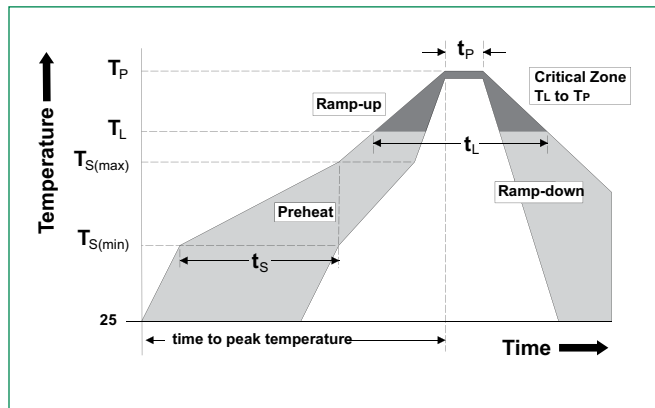


**SP1124 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**

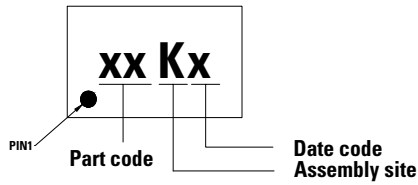


**Soldering Parameters**

|  |                                    |                         |
|--|------------------------------------|-------------------------|
| <b>Reflow Condition</b>  |                                    | Pb - Free assembly      |
| <b>Pre Heat</b>  | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|  | - Time (min to max) ( $t_s$ )      | 60 - 180 secs           |
| <b>Average ramp up rate (Liquidus) Temp (<math>T_L</math>) to peak</b> |                                    | 3°C/second max          |
| <b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>      |                                    | 3°C/second max          |
| <b>Reflow</b>  | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|  | - Temperature ( $t_L$ )            | 60 - 150 seconds        |
| <b>Peak Temperature (<math>T_p</math>)</b>                             |                                    | 260 <sup>+0/-5</sup> °C |
| <b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>   |                                    | 20 - 40 seconds         |
| <b>Ramp-down Rate</b>  |                                    | 6°C/second max          |
| <b>Time 25°C to peak Temperature (<math>T_p</math>)</b>                |                                    | 8 minutes Max.          |
| <b>Do not exceed</b>   |                                    | 260°C                   |

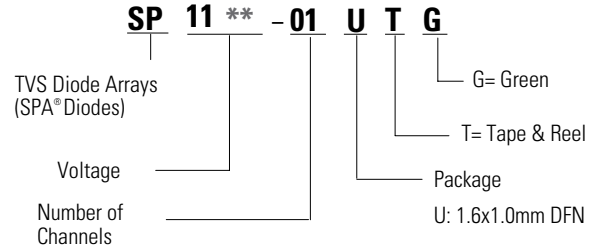


**Part Marking System**



**Part code :**  
**AA = SP1105-01UTG**  
**AB = SP1112-01UTG**  
**AC = SP1115-01UTG**  
**AD = SP1124-01UTG**  
**AE = SP1105S-01UTG**

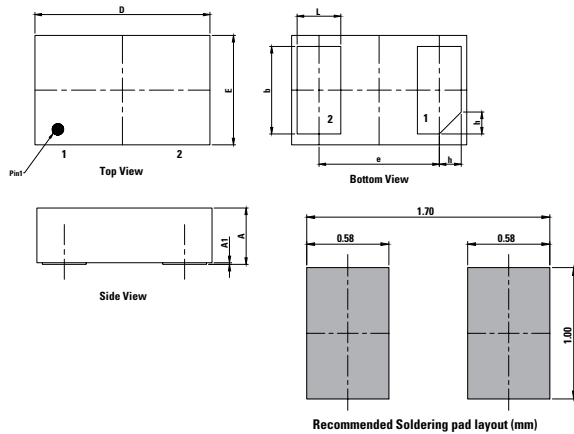
**Part Numbering System**



**Ordering Information**

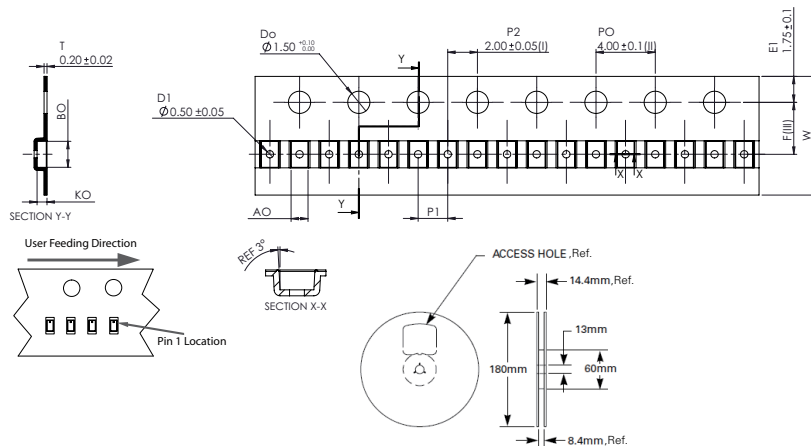
| Part Number   | Package       | Marking | Min. Order Qty. |
|---------------|---------------|---------|-----------------|
| SP1105-01UTG  | 1.6x1.0mm DFN | AAKx    | 3000            |
| SP1112-01UTG  | 1.6x1.0mm DFN | ABKx    | 3000            |
| SP1115-01UTG  | 1.6x1.0mm DFN | ACKx    | 3000            |
| SP1124-01UTG  | 1.6x1.0mm DFN | ADKx    | 3000            |
| SP1105S-01UTG | 1.6x1.0mm DFN | AEKx    | 3000            |

**Package Dimensions**



| Symbol    | 1.6x1.0mm DFN |      |      |
|-----------|---------------|------|------|
|           | Millimeters   |      |      |
|           | Min           | Nor  | Max  |
| <b>A</b>  | 0.45          | 0.50 | 0.55 |
| <b>A1</b> | -             | 0.02 | 0.05 |
| <b>D</b>  | 1.55          | 1.60 | 1.65 |
| <b>E</b>  | 0.95          | 1.00 | 1.05 |
| <b>b</b>  | 0.75          | 0.80 | 0.85 |
| <b>L</b>  | 0.35          | 0.40 | 0.45 |
| <b>e</b>  | 1.10 BSC      |      |      |
| <b>h</b>  | 0.15          | 0.20 | 0.25 |

**Embossed Carrier Tape & Reel Specification**



| Symbol    | Millimeters   |
|-----------|---------------|
| <b>A0</b> | 1.14 +/- 0.03 |
| <b>B0</b> | 1.75 +/- 0.03 |
| <b>K0</b> | 0.67 +/- 0.05 |
| <b>F</b>  | 3.50 +/- 0.05 |
| <b>P1</b> | 2.00 +/- 0.10 |
| <b>W</b>  | 8.00 +/- 0.10 |

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