

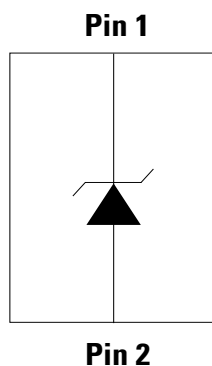
## SP11xx Series Discrete Unidirectional TVS Diode



### 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 ( $T_{OP}=25^{\circ}\text{C}$ )

| Parameter                          | Symbol     | Test Conditions                                       | Min      | Typ  | Max | Units         |
|------------------------------------|------------|-------------------------------------------------------|----------|------|-----|---------------|
| Reverse Standoff Voltage           | $V_{RWM}$  | $I_R \leq 1\mu\text{A}$                               | -        | -    | 5.0 | V             |
| Reverse Voltage Drop               | $V_R$      | $I_R = 1\text{mA}$                                    | 6.0      | -    | -   | V             |
| Leakage Current                    | $I_{LEAK}$ | $V_R = 5\text{V}$                                     | -        | -    | 1.0 | $\mu\text{A}$ |
| Clamp Voltage <sup>1</sup>         | $V_C$      | $I_{PP} = 1\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd  | -        | 7.3  | -   | V             |
|                                    |            | $I_{PP} = 70\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd | -        | 10.9 | -   | V             |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$  | TLP, $t_p = 100\text{ns}$ , I/O to GND                | -        | 0.05 | -   | $\Omega$      |
| Peak Pulse Current                 | $I_{PP}$   | $t_p = 8/20\mu\text{s}$                               | -        | -    | 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, $f = 1\text{MHz}$                    | -        | 630  | -   | pF            |

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

| Parameter                          | Symbol     | Test Conditions                                       | Min      | Typ  | Max | Units         |
|------------------------------------|------------|-------------------------------------------------------|----------|------|-----|---------------|
| Reverse Standoff Voltage           | $V_{RWM}$  | $I_R \leq 1\mu\text{A}$                               | -        | -    | 5.0 | V             |
| Reverse Voltage Drop               | $V_R$      | $I_R = 1\text{mA}$                                    | 6.0      | -    | 7.5 | V             |
| Leakage Current                    | $I_{LEAK}$ | $V_R = 5\text{V}$                                     | -        | -    | 1.0 | $\mu\text{A}$ |
| Clamp Voltage <sup>1</sup>         | $V_C$      | $I_{PP} = 40\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd | -        | 8.3  | -   | V             |
|                                    |            | $I_{PP} = 80\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd | -        | 9.2  | -   | V             |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$  | TLP, $t_p = 100\text{ns}$ , I/O to GND                | -        | 0.05 | -   | $\Omega$      |
| Peak Pulse Current                 | $I_{PP}$   | $t_p = 8/20\mu\text{s}$                               | -        | -    | 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, $f = 1\text{MHz}$                    | -        | 630  | -   | pF            |

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

| Parameter                          | Symbol      | Test Conditions                                       | Min      | Typ  | Max  | Units         |
|------------------------------------|-------------|-------------------------------------------------------|----------|------|------|---------------|
| Reverse Standoff Voltage           | $V_{RWM}$   | $I_R \leq 1\mu\text{A}$                               | -        | -    | 12.0 | V             |
| Reverse Voltage Drop               | $V_R$       | $I_R = 1\text{mA}$                                    | 13.3     | -    | -    | V             |
| Leakage Current                    | $I_{LEAK}$  | $V_R = 12\text{V}$                                    | -        | -    | 1.0  | $\mu\text{A}$ |
| Clamp Voltage <sup>1</sup>         | $V_C$       | $I_{PP} = 1\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd  | -        | 15.2 | -    | V             |
|                                    |             | $I_{PP} = 40\text{A}$ , $t_p = 8/20\mu\text{s}$ , Fwd | -        | 26.5 | -    | V             |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$   | TLP, $t_p = 100\text{ns}$ , I/O to GND                | -        | 0.05 | -    | $\Omega$      |
| Peak Pulse Current                 | $I_{PP}$    | $t_p = 8/20\mu\text{s}$                               | -        | -    | 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, $f = 1\text{MHz}$                    | -        | 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)

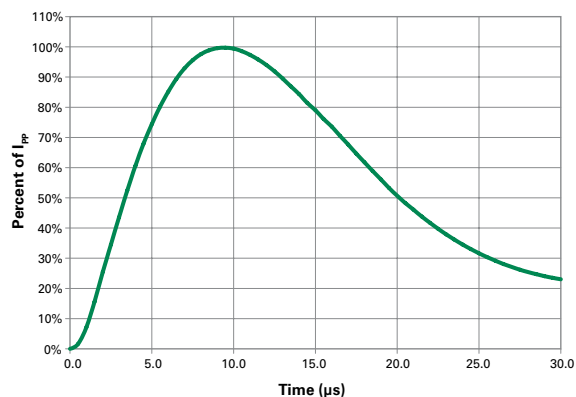
| Parameter                          | Symbol               | Test Conditions                                      | Min  | Typ  | Max  | Units |
|------------------------------------|----------------------|------------------------------------------------------|------|------|------|-------|
| Reverse 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:**

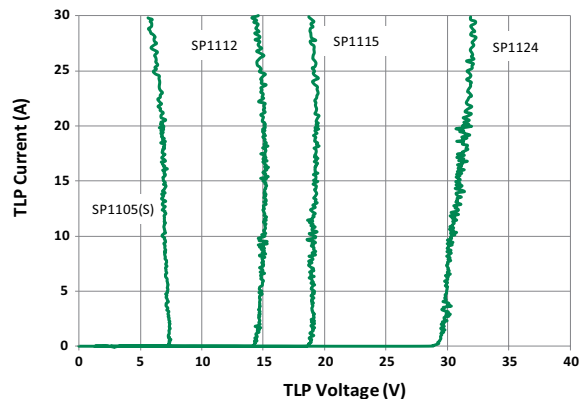
1. Parameter is guaranteed by design and/or component characterization.

2. Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window t1=70ns to t2= 90ns

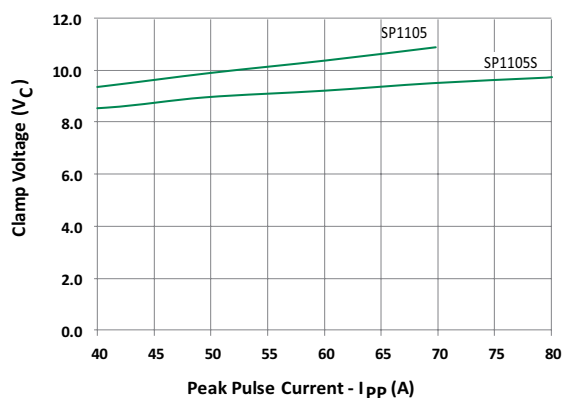
### 8/20μs Pulse Waveform



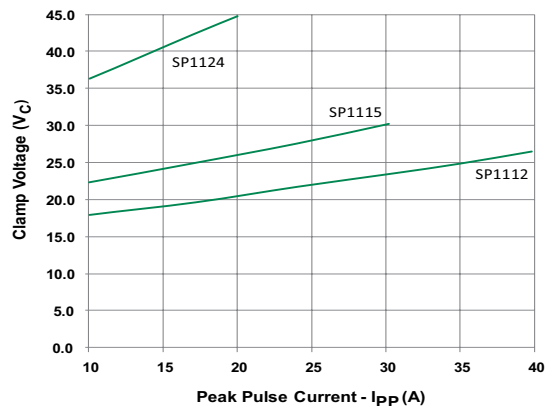
### Transmission Line Pulsing (TLP) Plot



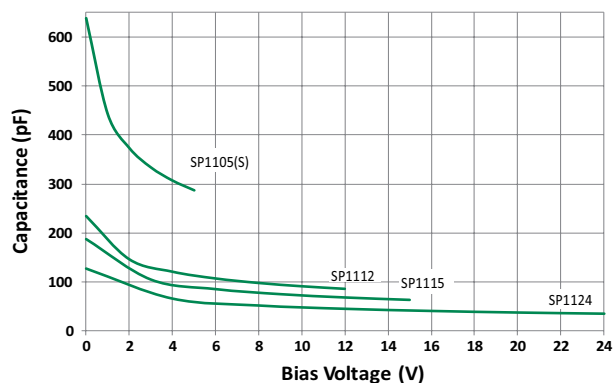
### SP1105, SP1105S Clamping voltage vs. $I_{PP}$ for 8/20μs waveshape



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



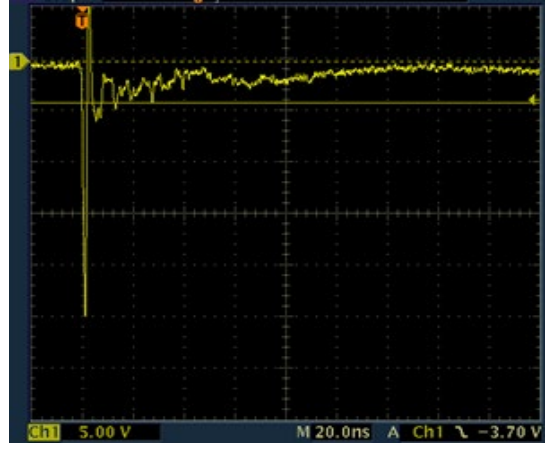
### Capacitance vs. Bias



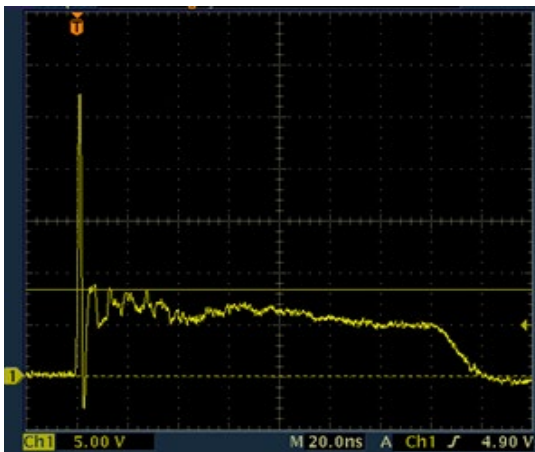
**SP1105 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



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



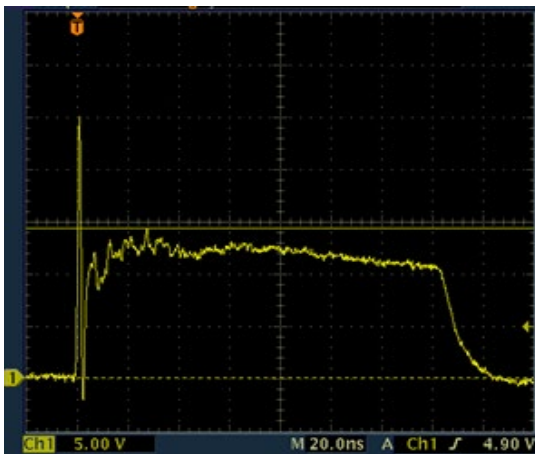
**SP1105S IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



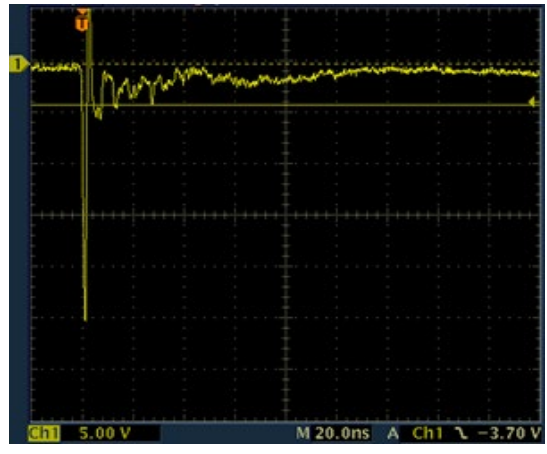
**SP1105S IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



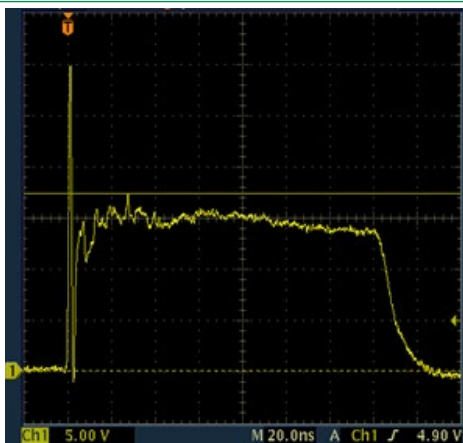
**SP1112 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



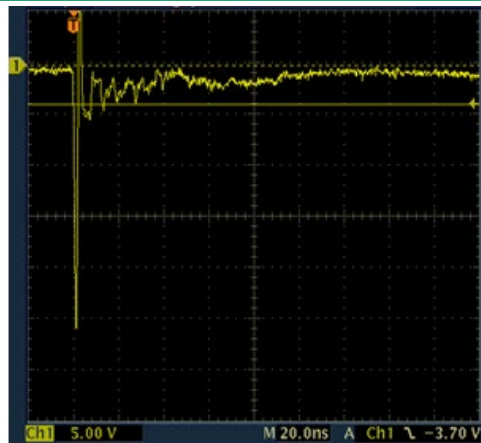
**SP1112 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



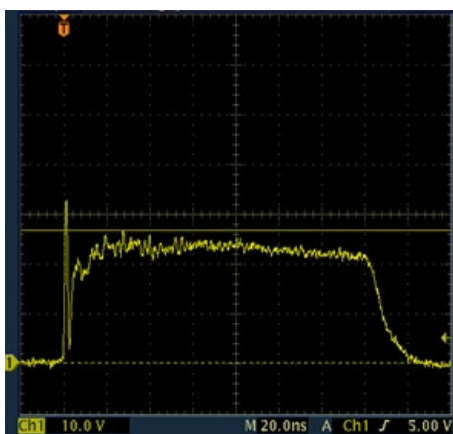
**SP1115 IEC 61000 -4-2 +8 kV Contact ESD Clamping Voltage**



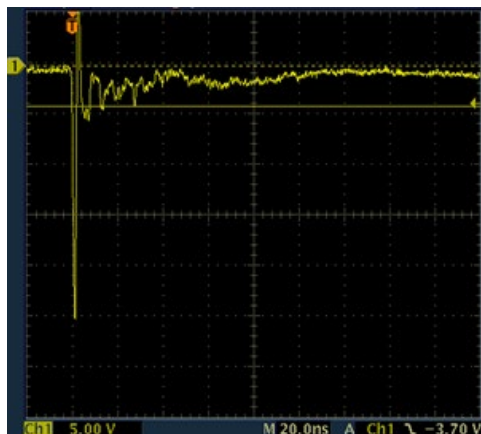
**SP1115 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**



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

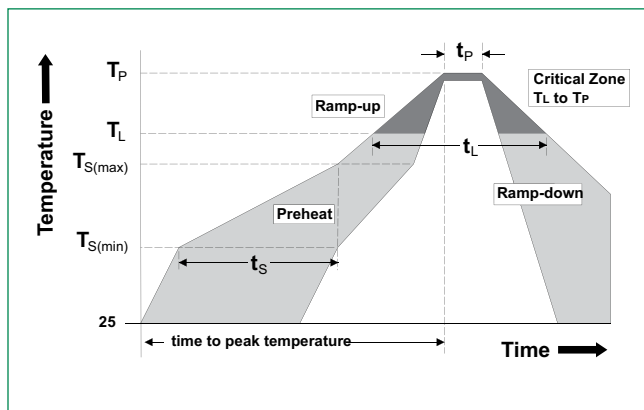


**SP1124 IEC 61000 -4-2 -8 kV Contact ESD Clamping Voltage**

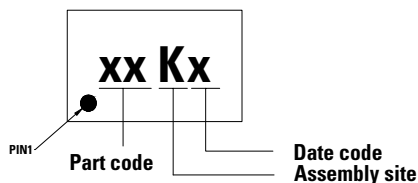


## Soldering Parameters

|                                                                        |                                    |                         |
|------------------------------------------------------------------------|------------------------------------|-------------------------|
| <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                   |



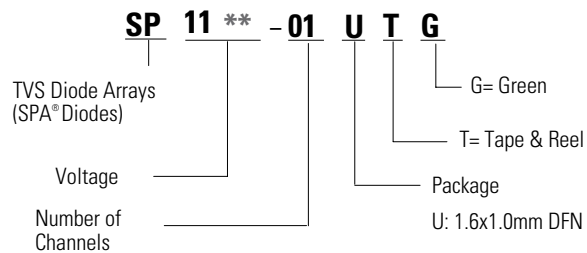
### Part Marking System



#### Part code :

AA = SP1105-01UTG  
AB = SP1112-01UTG  
AC = SP1115-01UTG  
AD = SP1124-01UTG  
AE = SP1105S-01UTG

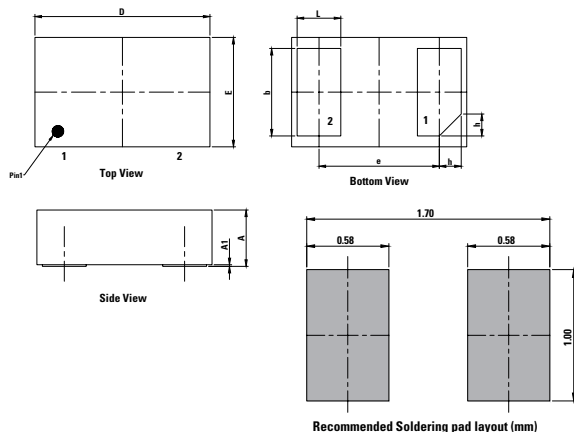
### Part Numbering System



### Ordering Information

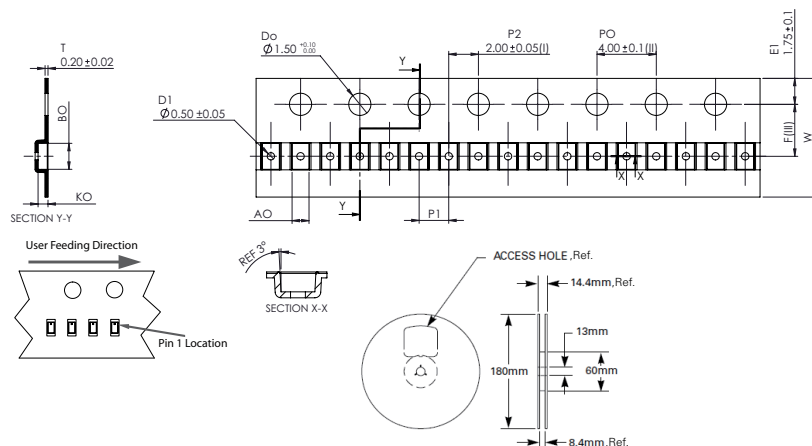
| Part Number   | Package       | Marking | Min. Order Qty. |
|---------------|---------------|---------|-----------------|
| SP1105-01UTG  | 1.6x1.0mm DFN | AAKx    | 3000            |
| SP1112-01UTG  | 1.6x1.0mm DFN | ABKx    | 3000            |
| SP1115-01UTG  | 1.6x1.0mm DFN | ACKx    | 3000            |
| 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  |
| A      | 0.45          | 0.50 | 0.55 |
| A1     | -             | 0.02 | 0.05 |
| D      | 1.55          | 1.60 | 1.65 |
| E      | 0.95          | 1.00 | 1.05 |
| b      | 0.75          | 0.80 | 0.85 |
| L      | 0.35          | 0.40 | 0.45 |
| e      | 1.10 BSC      |      |      |
| h      | 0.15          | 0.20 | 0.25 |

### Embossed Carrier Tape & Reel Specification



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

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