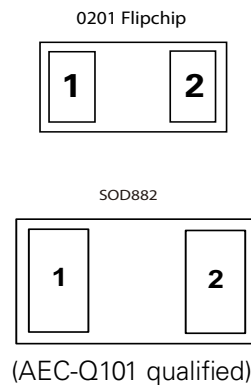


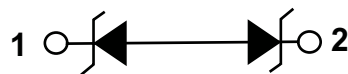
# SP3022 Series 0.35pF 20kV Bidirectional Discrete TVS



## Pinout



## Functional Block Diagram



## Description

The SP3022 includes back-to-back TVS diodes fabricated in a proprietary silicon avalanche technology to provide protection for electronic equipment that may experience destructive electrostatic discharges (ESD). These robust diodes can safely absorb repetitive ESD strikes up to the maximum level specified in the IEC 61000-4-2 international standard ( $\pm 20\text{kV}$  contact discharge) without performance degradation. The back-to-back configuration provides symmetrical ESD protection for data lines when AC signals are present and the low loading capacitance makes it ideal for protecting high speed data lines such as HDMI, USB2.0, USB3.0 and eSATA.

## Features

- RoHS compliant and lead-free
- ESD protection of  $\pm 20\text{kV}$  contact discharge,  $\pm 30\text{kV}$  air discharge, (IEC 61000-4-2)
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning protection, IEC 61000-4-5 2nd edition, 3A ( $t_p=8/20\mu\text{s}$ )
- Low capacitance of  $0.35\text{pF}$  @  $V_R=0\text{V}$  (TYP)
- Low leakage current of  $100\text{nA}$  at  $5.3\text{V}$  (MAX)
- Space efficient 0201 and 0402 footprint
- Extremely low dynamic resistance ( $0.7\Omega$  TYP)
- AEC-Q101 qualified (SOD882 package)

## Applications

- USB 3.0/USB 2.0/MHL
- MIPI Camera and Display
- HDMI 2.0, DisplayPort 1.3, eSATA
- Set Top Boxes, Game Consoles
- Smart Phones
- External Storage
- Ultrabooks, Notebooks
- Tablets, eReaders
- Automotive Electronics

## Additional Information



Datasheet



Resources



Samples

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 |
|----------|--------------------------------------|------------|-------|
| $P_{PK}$ | Peak Pulse Power ( $t_p=8/20\mu s$ ) | 20         | W     |
| $I_{PP}$ | Peak Current ( $t_p=8/20\mu s$ )     | 3.0        | A     |
| $T_{OP}$ | Operating Temperature                | -40 to 125 | °C    |

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

### Thermal Information

| Parameter                                   | Rating     | Units |
|---------------------------------------------|------------|-------|
| Storage Temperature Range                   | -55 to 150 | °C    |
| Maximum Junction Temperature                | 150        | °C    |
| Maximum Lead Temperature (Soldering 20-40s) | 260        | °C    |

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

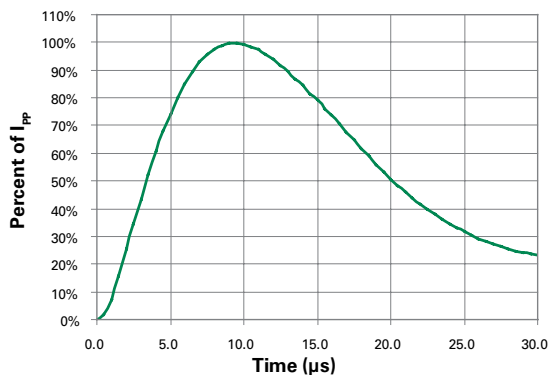
| Parameter                          | Symbol     | Test Conditions                     | Min      | Typ  | Max  | Units    |
|------------------------------------|------------|-------------------------------------|----------|------|------|----------|
| Reverse Standoff Voltage           | $V_{RWM}$  |                                     |          |      | 5.3  | V        |
| Reverse Breakdown Voltage          | $V_{BR}$   | $I_R=1mA$                           | 6.8      | 7.8  | 9.0  | V        |
| Reverse Leakage Current            | $I_{LEAK}$ | $V_R=5.3V$                          |          | <10  | 100  | nA       |
| Clamp Voltage <sup>1</sup>         | $V_C$      | $I_{PP}=1A$ , $t_p=8/20\mu s$ , Fwd |          |      | 12.0 | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$  | TLP, $t_p=100ns$ , I/O to GND       |          | 0.7  |      | $\Omega$ |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$  | IEC 61000-4-2 (Contact)             | $\pm 20$ |      |      | kV       |
|                                    |            | IEC 61000-4-2 (Air)                 | $\pm 30$ |      |      | kV       |
| Diode Capacitance <sup>1</sup>     | $C_D$      | Reverse Bias=0V                     |          | 0.35 | 0.5  | pF       |

Note:

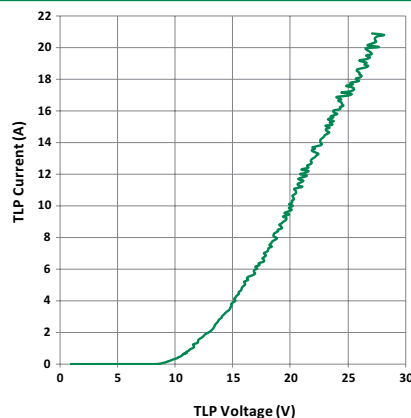
<sup>1</sup> Parameter is guaranteed by design and/or device characterization.

<sup>2</sup> Transmission Line Pulse (TLP) with 100ns width and 200ps rise time.

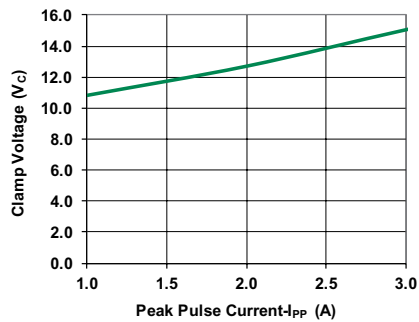
### Pulse Waveform



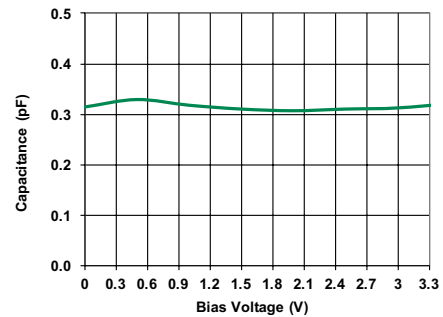
### Transmission Line Pulsing(TLP) Plot



### Clamping Voltage vs $I_{PP}$

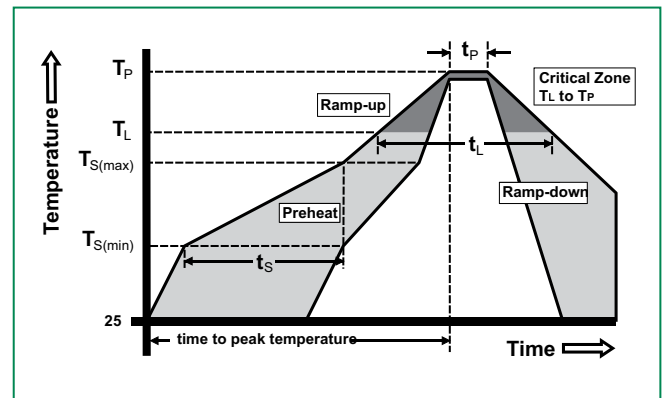


### Capacitance vs. Reverse Bias



### Soldering Parameters

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



### Product Characteristics of 0201 Flipchip

|                    |                |
|--------------------|----------------|
| Lead Plating       | Sn             |
| Lead Material      | Copper         |
| Lead Coplanarity   | 6 $\mu$ m(max) |
| Substrate material | Silicon        |
| Body Material      | Silicon        |

### Product Characteristics of SOD882

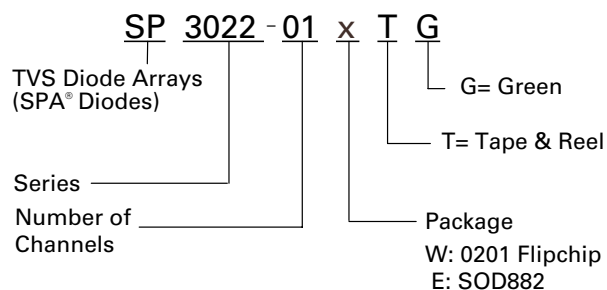
|                    |                               |
|--------------------|-------------------------------|
| Lead Plating       | Pre-Plated Frame or Matte Tin |
| Lead Material      | Copper Alloy                  |
| Lead Coplanarity   | 0.0004 inches (0.102mm)       |
| Substrate material | Silicon                       |
| Body Material      | Molded Epoxy                  |
| Flammability       | UL 94 V-0                     |

- Notes :
1. All dimensions are in millimeters
  2. Dimensions include solder plating.
  3. Dimensions are exclusive of mold flash & metal burr.
  4. Blo is facing up for mold and facing down for trim/form, i.e. reverse trim/form.
  5. Package surface matte finish VDI 11-13.

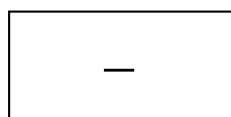
### Ordering Information

| Part Number  | Package       | Marking | Min. Order Qty. | Packaging Option               | P0/P1   | Packaging Specification |
|--------------|---------------|---------|-----------------|--------------------------------|---------|-------------------------|
| SP3022-01WTG | 0201 Flipchip | -       | 10000           | Tape & Reel – 8mm tape/7" reel | 4mm/2mm | EIA RS-481              |
| SP3022-01ETG | SOD882        | -       | 10000           | Tape & Reel – 8mm tape/7" reel | 4mm/2mm | EIA RS-481              |

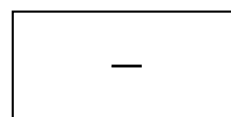
### Part Numbering System



### Part Marking System

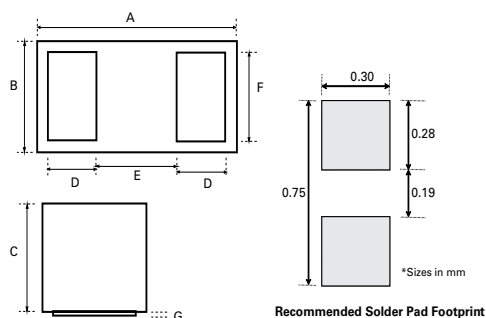


SP3022-01WTG



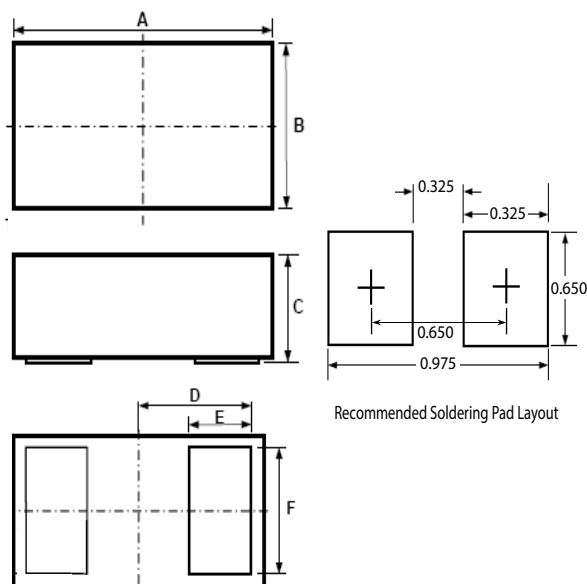
SP3022-01ETG

### Package Dimensions — 0201 Flipchip



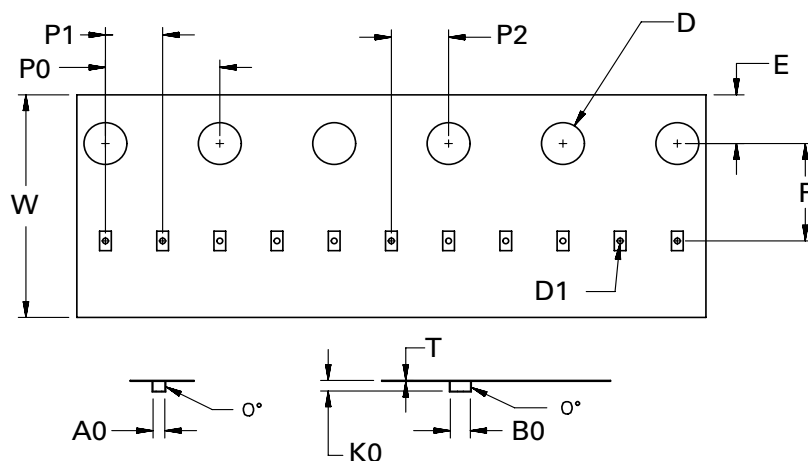
| Symbol | 0201 Flipchip |       |       |        |        |        |
|--------|---------------|-------|-------|--------|--------|--------|
|        | Millimeters   |       |       | Inches |        |        |
|        | Min           | Typ   | Max   | Min    | Typ    | Max    |
| A      | 0.595         | 0.620 | 0.645 | 0.0234 | 0.0244 | 0.0254 |
| B      | 0.295         | 0.320 | 0.345 | 0.0116 | 0.0126 | 0.0136 |
| C      | 0.245         | 0.275 | 0.305 | 0.0096 | 0.0108 | 0.0120 |
| D      | 0.145         | 0.150 | 0.155 | 0.0057 | 0.0059 | 0.0061 |
| E      | 0.245         | 0.250 | 0.255 | 0.0096 | 0.0098 | 0.0100 |
| F      | 0.245         | 0.250 | 0.255 | 0.0096 | 0.0098 | 0.0100 |
| G      | 0.005         | 0.010 | 0.015 | 0.0002 | 0.0004 | 0.0006 |

### Package Dimensions — SOD882



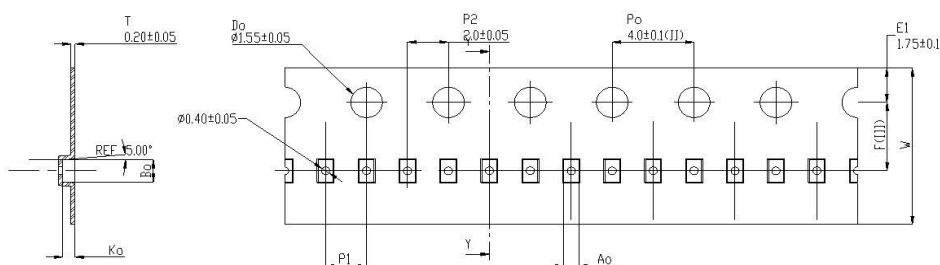
| Symbol | Package     | SOD882 |      |        |       |       |
|--------|-------------|--------|------|--------|-------|-------|
|        | JEDEC       | MO-236 |      |        |       |       |
|        | Millimeters |        |      | Inches |       |       |
|        | Min         | Typ    | Max  | Min    | Typ   | Max   |
| A      | 0.95        | 1.00   | 1.05 | 0.037  | 0.039 | 0.041 |
| B      | 0.55        | 0.60   | 0.65 | 0.022  | 0.024 | 0.026 |
| C      | 0.50        | 0.55   | 0.60 | 0.020  | 0.022 | 0.024 |
| D      | 0.45        |        |      | 0.018  |       |       |
| E      | 0.20        | 0.25   | 0.30 | 0.008  | 0.010 | 0.012 |
| F      | 0.45        | 0.50   | 0.55 | 0.018  | 0.020 | 0.022 |

### Embossed Carrier Tape & Reel Specification — 0201 Flipchip

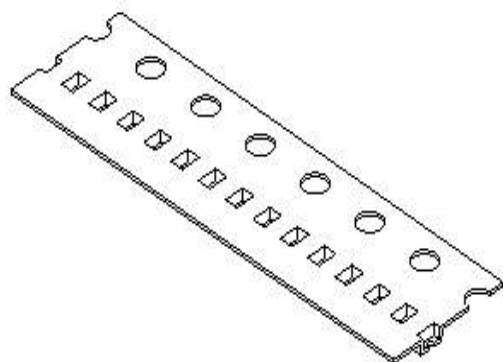


| Symbol | Millimeters       |
|--------|-------------------|
| A0     | 0.41+/-0.03       |
| B0     | 0.70+/-0.03       |
| D      | ø 1.50 + 0.10     |
| D1     | ø 0.20 +/- 0.05   |
| E      | 1.75+/-0.10       |
| F      | 3.50+/-0.05       |
| K0     | 0.38+/-0.03       |
| P0     | 4.00+/-0.10       |
| P1     | 2.00+/-0.05       |
| P2     | 2.00+/-0.05       |
| W      | 8.00 + 0.30 -0.10 |
| T      | 0.23+/-0.02       |

### Embossed Carrier Tape & Reel Specification — SOD882



| Symbol | Millimeters       |
|--------|-------------------|
| A0     | 0.70+/-0.045      |
| B0     | 1.10+/-0.045      |
| K0     | 0.65+/-0.045      |
| F      | 3.50+/-0.05       |
| P1     | 2.00+/-0.10       |
| W      | 8.00 + 0.30 -0.10 |



Notes :  
1. All dimensions are in millimeters