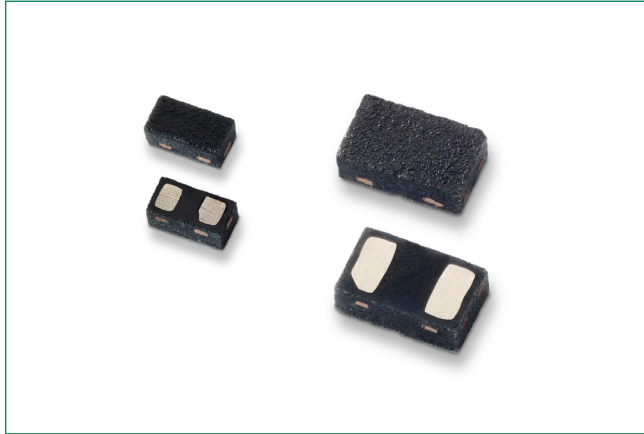


# Ultra Low Capacitance Discrete TVS Series



## Additional Information



Resources



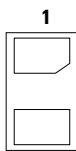
Accessories



Samples

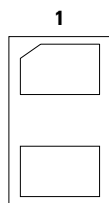
## Pinout

0201 DFN



2

0402 DFN



2

Bottom View

## Description

The Ultra Low Capacitance Discrete TVS series provides unidirectional and bidirectional ESD protection for the world's most challenging high speed serial interfaces. Ultra low capacitance permits excellent signal integrity on the most challenging consumer electronics interfaces, such as USB 3.1, HDMI 2.0, DisplayPort, and V-by-One®. Providing in excess of 20kV contact ESD protection (IEC61000-4-2) while maintaining extremely low leakage and dynamic resistance, offered in the industry's most popular footprints (0402 and 0201), the series sets higher standards for signal integrity and usability.

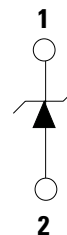
## Features & Benefits

- 0.13pF MAX bidirectional
- 0.25pF MAX unidirectional
- ESD, IEC61000-4-2,  $\pm 20\text{kV}$  contact,  $\pm 20\text{kV}$  air
- Low clamping voltage of  $10\text{V}$  @  $I_{PP}=2\text{A}$  (Bidirectional) ( $t_p=8/20\mu\text{s}$ )
- Low profile 0201 and 0402 DFN packages
- Facilitates excellent signal integrity
- ELV Compliant
- Halogen free, Lead free and RoHS compliant

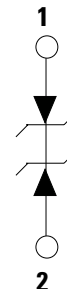
## Applications

- Ultra-high speed data lines
- USB 3.1, 3.0, 2.0
- HDMI 2.0, 1.4a, 1.3
- DisplayPort™
- Thunderbolt (Light Peak)
- V-by-One®
- LVDS interfaces
- Consumer, mobile and portable electronics
- Tablet PC and external storage with high speed interfaces
- Applications requiring high ESD performance in small packages

## Functional Block Diagram



Unidirectional



Bidirectional

# Ultra Low Capacitance Discrete TVS Series

## Absolute Maximum Ratings

| Symbol     | Parameter                        | Value      | Units |
|------------|----------------------------------|------------|-------|
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 2.0        | A     |
| $T_{OP}$   | Operating Temperature            | -40 to 150 | °C    |
| $T_{STOR}$ | Storage Temperature              | -55 to 150 | °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    |

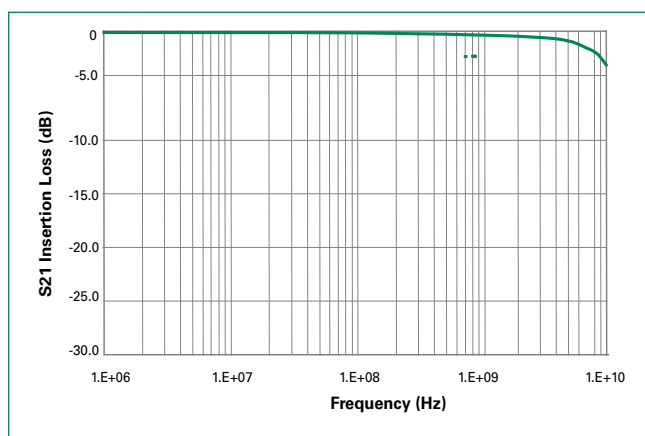
## Unidirectional Electrical Characteristics - ( $T_{OP}=25^{\circ}C$ )

| Parameter               | Test Conditions           | Min      | Typ  | Max  | Units |
|-------------------------|---------------------------|----------|------|------|-------|
| Input Capacitance       | @ $V_R = 0V$ , $f = 3GHz$ |          | 0.20 | 0.25 | pF    |
| Breakdown Voltage       | $V_{BR}$ @ $I_T=1mA$      |          | 9.00 |      | V     |
| Reverse Working Voltage |                           |          |      | 7.0  | V     |
| Reverse Leakage Current | $I_L$ @ $V_{RWM}=5.0V$    |          | 25   | 50   | nA    |
| Clamping Voltage        | $V_{CL}$ @ $I_{PP}=2.0A$  |          | 9.20 |      | V     |
| ESD Withstand Voltage   | IEC61000-4-2 (Contact)    | $\pm 20$ |      |      | kV    |
|                         | IEC61000-4-2 (Air)        | $\pm 20$ |      |      |       |

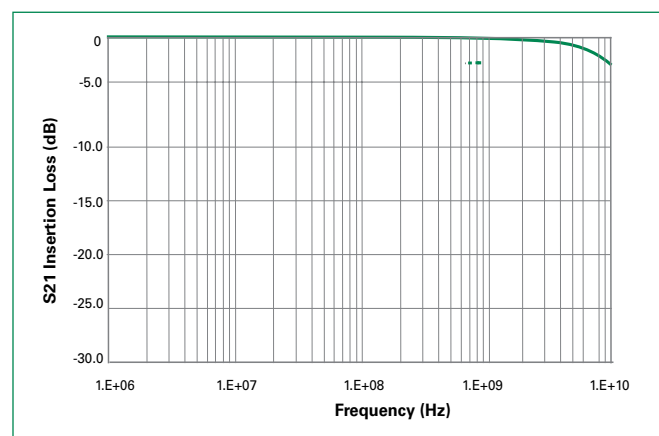
## Bidirectional Electrical Characteristics - ( $T_{OP}=25^{\circ}C$ )

| Parameter               | Test Conditions           | Min      | Typ  | Max  | Units |
|-------------------------|---------------------------|----------|------|------|-------|
| Input Capacitance       | @ $V_R = 0V$ , $f = 3GHz$ |          | 0.10 | 0.13 | pF    |
| Breakdown Voltage       | $V_{BR}$ @ $I_T=1mA$      |          | 9.80 |      | V     |
| Reverse Working Voltage |                           | -7.0     |      | 7.0  | V     |
| Reverse Leakage Current | $I_L$ @ $V_{RWM}=5.0V$    |          | 25   | 50   | nA    |
| Clamping Voltage        | $V_{CL}$ @ $I_{PP}=2.0A$  |          | 10.0 |      | V     |
| ESD Withstand Voltage   | IEC61000-4-2 (Contact)    | $\pm 20$ |      |      | kV    |
|                         | IEC61000-4-2 (Air)        | $\pm 20$ |      |      |       |

## Insertion Loss Diagram - Unidirectional

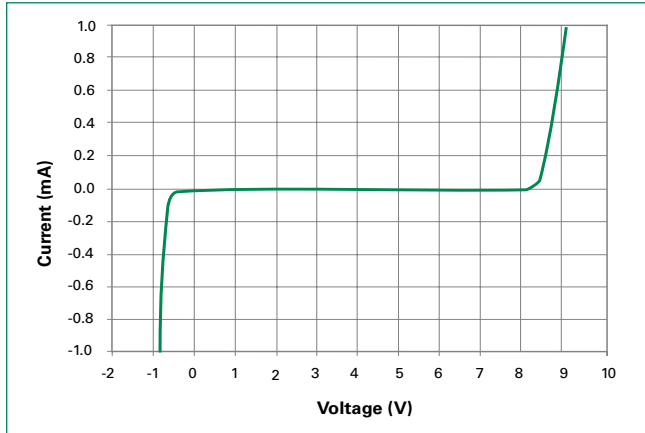


## Insertion Loss Diagram - Bidirectional

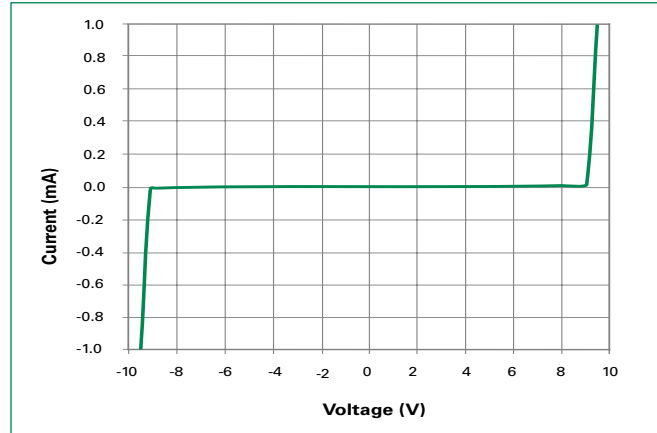


# Ultra Low Capacitance Discrete TVS Series

Device IV Curve - Unidirectional

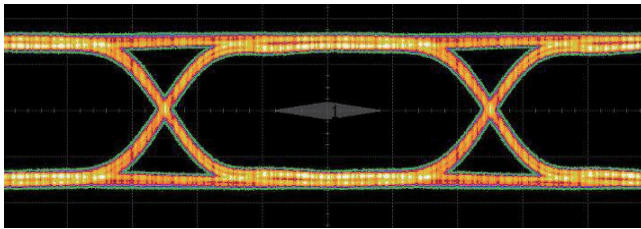


Device IV Curve - Bidirectional

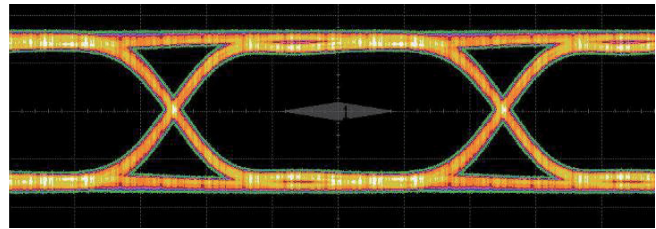


USB3.0 Eye Diagram

5.0 Gb/s, 1000mV differential, CPO Compliant Test Pattern



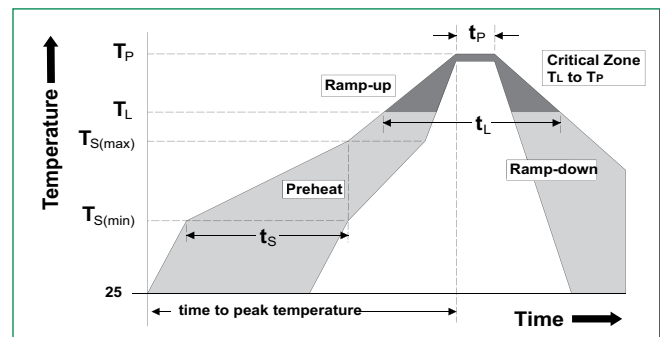
Without Component



With Component

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 – 120 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 ( $t_p$ )   |                                    | 30 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 0402 DFN Package

|                    |                       |
|--------------------|-----------------------|
| Lead Plating       | Pre-Plated Frame      |
| Lead Material      | Copper Alloy          |
| Lead Coplanarity   | 0.004 inches(0.102mm) |
| Substrate material | Silicon               |
| Body Material      | Molded Epoxy          |
| Flammability       | UL 94 V-0             |

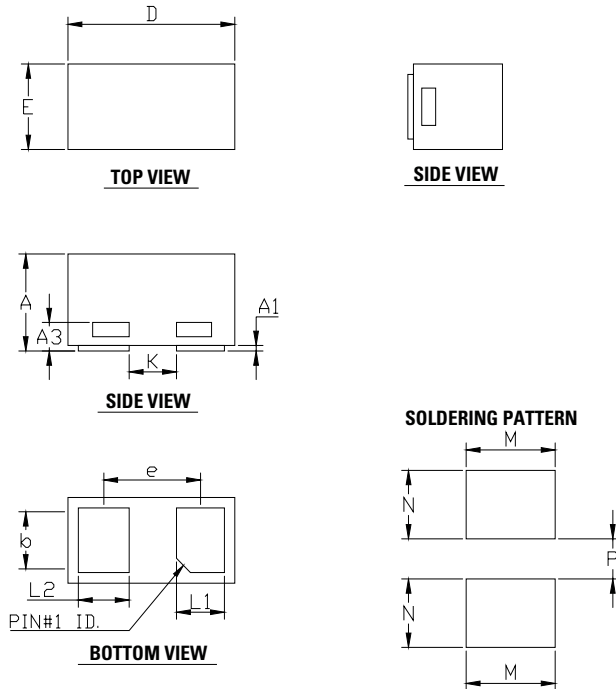
## Notes :

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.

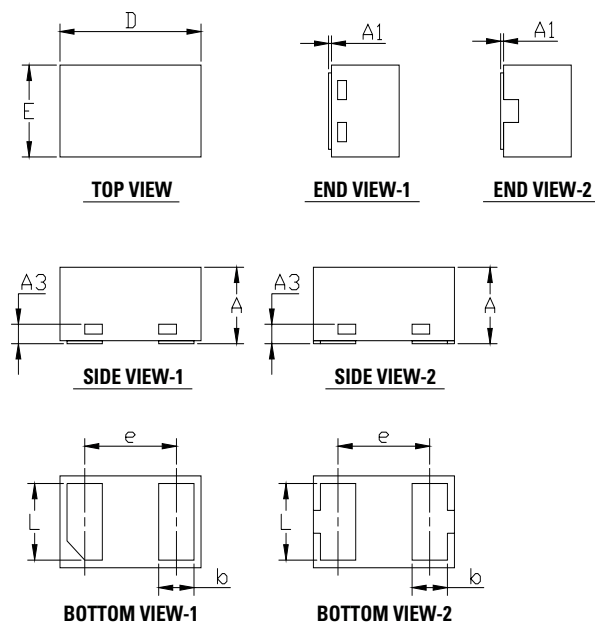
# Ultra Low Capacitance Discrete TVS Series

## Package Dimensions — 0201 DFN

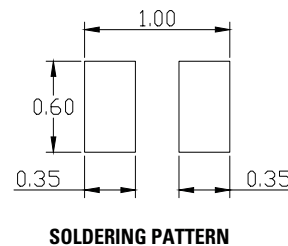


| Symbol    | Millimeters   |      | Inches          |       |
|-----------|---------------|------|-----------------|-------|
|           | Min           | Max  | Min             | Max   |
| <b>A</b>  | 0.23          | 0.33 | 0.009           | 0.013 |
| <b>A1</b> | 0.00          | 0.05 | 0.000           | 0.002 |
| <b>A3</b> | 0.100 ref.    |      | 0.004 ref.      |       |
| <b>b</b>  | 0.2           | 0.3  | 0.008           | 0.012 |
| <b>D</b>  | 0.55          | 0.65 | 0.022           | 0.026 |
| <b>E</b>  | 0.25          | 0.35 | 0.010           | 0.014 |
| <b>e</b>  | 0.35-0.40 BSC |      | 0.014-0.016 BSC |       |
| <b>L1</b> | 0.12          | 0.23 | 0.005           | 0.009 |
| <b>L2</b> | 0.12          | 0.24 | 0.005           | 0.009 |
| <b>K</b>  | 0.17 BSC      |      | 0.007 BSC       |       |
| <b>M</b>  | 0.32          |      | 0.013           |       |
| <b>N</b>  | 0.24          |      | 0.009           |       |
| <b>P</b>  | 0.14          |      | 0.006           |       |

## Package Dimensions — 0402 DFN

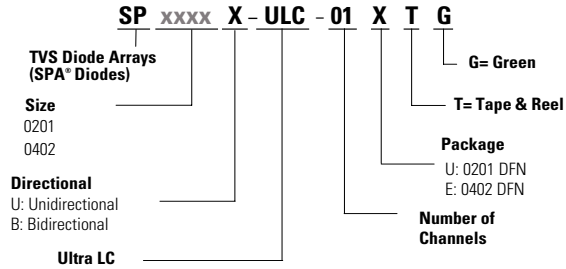


| Symbol    | Millimeters |      |      | Inches   |       |       |
|-----------|-------------|------|------|----------|-------|-------|
|           | Min         | Typ  | Max  | Min      | Typ   | Max   |
| <b>A</b>  | 0.33        | -    | 0.55 | 0.013    | -     | 0.022 |
| <b>A1</b> | 0           | -    | 0.05 | 0.000    | -     | 0.002 |
| <b>A3</b> | 0.13REF     |      |      | 0.005REF |       |       |
| <b>b</b>  | 0.20        | 0.25 | 0.30 | 0.008    | 0.010 | 0.012 |
| <b>D</b>  | 0.95        | 1.00 | 1.05 | 0.037    | 0.039 | 0.041 |
| <b>E</b>  | 0.55        | 0.60 | 0.65 | 0.022    | 0.024 | 0.026 |
| <b>e</b>  | 0.65BSC     |      |      | 0.026BSC |       |       |
| <b>L</b>  | 0.45        | 0.50 | 0.55 | 0.018    | 0.020 | 0.022 |

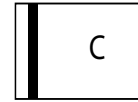


# Ultra Low Capacitance Discrete TVS Series

## Part Numbering System



## Part Marking System



Unidirectional

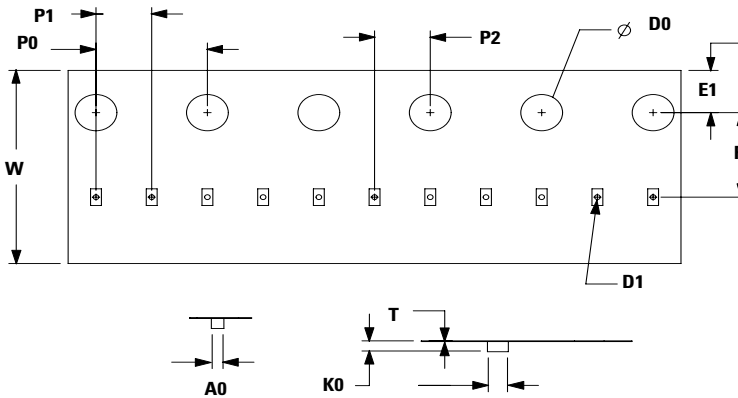


Bidirectional

## Ordering Information

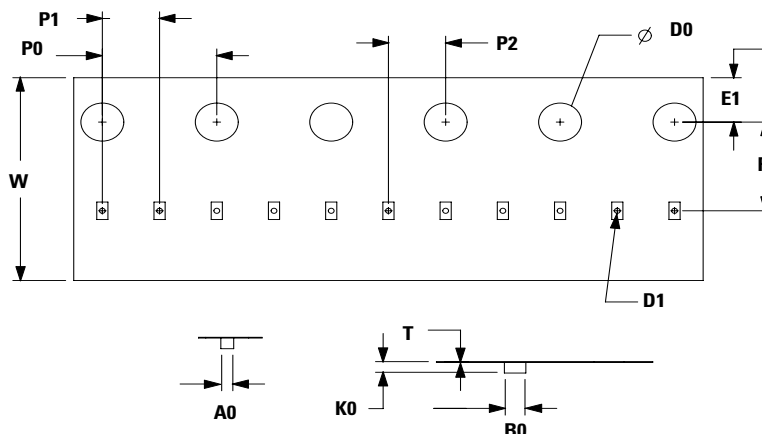
| Part Number       | Package  | Marking | Reel Quantity |
|-------------------|----------|---------|---------------|
| SP0201U-ULC-01UTG | 0201 DFN | I C     | 15000         |
| SP0201B-ULC-01UTG | 0201 DFN | C       | 15000         |
| SP0402U-ULC-01ETG | 0402 DFN | I C     | 10000         |
| SP0402B-ULC-01ETG | 0402 DFN | C       | 10000         |

## Embossed Carrier Tape & Reel Specification — 0201 DFN



| Symbol | Millimeters       |
|--------|-------------------|
| A0     | 0.33 min/0.41 max |
| B0     | 0.63 min/0.71 max |
| D0     | ø 1.50 +0.10/-0   |
| D1     | ø 0.20 +/- 0.05   |
| E1     | 1.75+/-0.10       |
| F      | 3.50+/-0.05       |
| K0     | 0.30 min/0.39 max |
| P0     | 4.00+/-0.10       |
| P1     | 2.00+/-0.10       |
| P2     | 2.00+/-0.05       |
| W      | 8.00+0.30/-0.10   |
| T      | 0.13 min/0.25 max |

## Embossed Carrier Tape & Reel Specification — 0402 DFN



| Symbol | Millimeters     |
|--------|-----------------|
| A0     | 0.70+/-0.05     |
| B0     | 1.15+/-0.05     |
| D0     | ø 1.50+/-0.10   |
| D1     | ø 0.40 +/-0.10  |
| E1     | 1.75+/-0.10     |
| F      | 3.50+/-0.10     |
| K0     | 0.55+/-0.05     |
| P0     | 4.00+/-0.10     |
| P1     | 2.00+/-0.10     |
| P2     | 2.00+/-0.05     |
| W      | 8.00+0.30/-0.10 |
| T      | 0.20+/-0.05     |

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