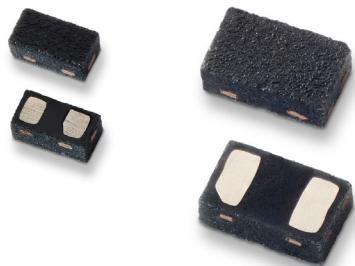


Enhanced ESD Discrete TVS Series

Description

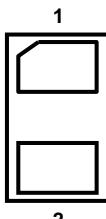
The Enhanced ESD Discrete TVS Series provides ultra low capacitance unidirectional and bidirectional ESD protection for the world's most challenging high speed serial interfaces. Ultra low capacitance permits excellent signal integrity on the most challenging consumer electronics interfaces, such as USB 3.1, HDMI 2.0, DisplayPort, and V-by-One®. Providing in excess of 22kV contact ESD protection (IEC 61000-4-2) 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.

Pinout

0201DFN



0402 DFN



Bottom View

Functional Block Diagram



Unidirectional



Bidirectional

Features

- 0.15 pFTYP bidirectional
- 0.30 pFTYP unidirectional
- ESD, IEC 61000-4-2, ±22kV contact, ±22kV air
- Low clamping voltage of 14V @ $I_{PP}=2.5A$ (Bidirectional) ($t_p=8/20\mu s$)
- 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™
- 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

Disclaimer Notice - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications.
 Read complete Disclaimer Notice at www.littelfuse.com/disclaimer-electronics.

Absolute Maximum Ratings

| Symbol | Parameter | Value | Units |
|------------|------------------------------------|------------|-------|
| I_{PP} | Peak Current ($t_p = 8/20\mu s$) | 2.5 | A |
| T_{OP} | Operating Temperature | -30 to 85 | °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.

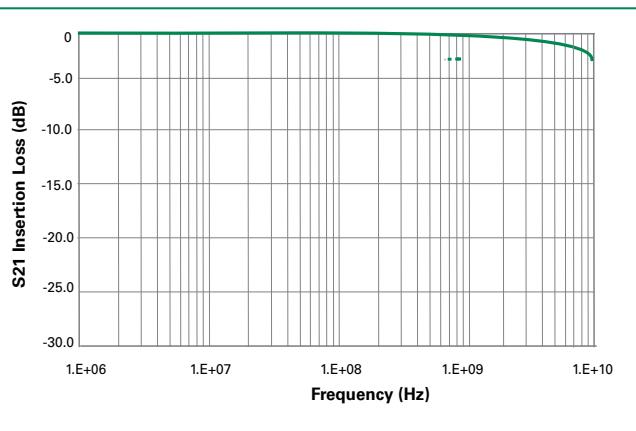
Unidirectional Electrical Characteristics - ($T_{OP}=25^\circ C$)

| Parameter | Test Conditions | Min | Typ | Max | Units |
|-------------------------|---------------------------|-----|------|-----|-------|
| Input Capacitance | @ $V_R = 0V$, $f = 3GHz$ | | 0.30 | | pF |
| Breakdown Voltage | V_{BR} @ $I_T=1mA$ | | 8.80 | | V |
| Reverse Working Voltage | | | | 7.0 | V |
| Reverse Leakage Current | I_L @ $V_{RWM}=5.0V$ | | 25 | | nA |
| Clamping Voltage | V_{CL} @ $I_{PP}=2.5A$ | | 13.0 | | V |
| ESD Withstand Voltage | IEC 61000-4-2 (Contact) | ±22 | | | kV |
| | IEC 61000-4-2 (Air) | ±22 | | | |

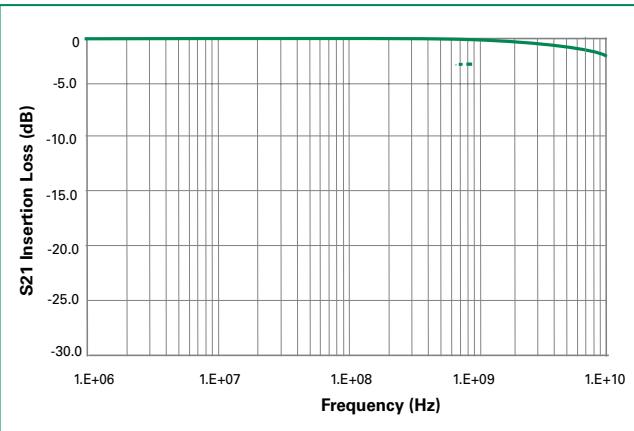
Bidirectional Electrical Characteristics - ($T_{OP}=25^\circ C$)

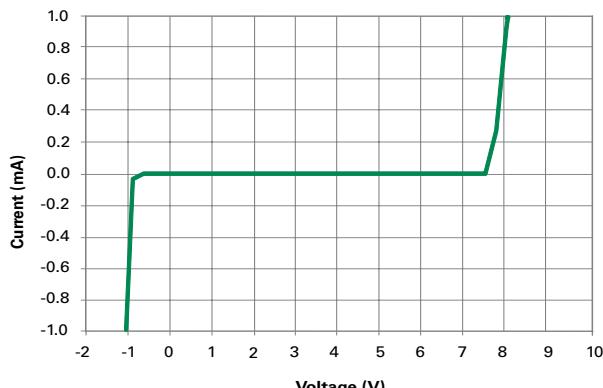
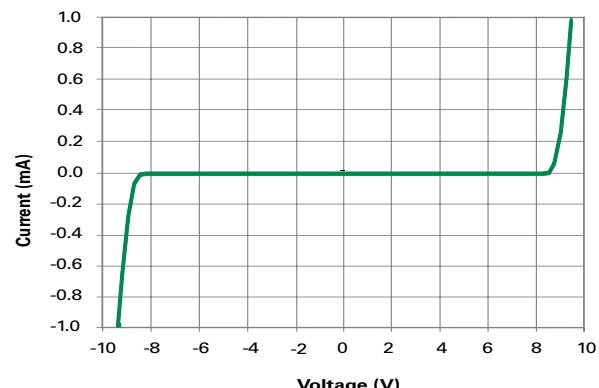
| Parameter | Test Conditions | Min | Typ | Max | Units |
|-----------------------|---------------------------|-----|--------|-----|-------|
| Input Capacitance | @ $V_R = 0V$, $f = 3GHz$ | | 0.15 | | pF |
| Breakdown Voltage | V_{BR} @ $I_T=1mA$ | | ± 9.6 | | V |
| Clamping Voltage | V_{CL} @ $I_{PP}=2.5A$ | | ± 14.0 | | V |
| ESD Withstand Voltage | IEC 61000-4-2 (Contact) | ±22 | | | kV |
| | IEC 61000-4-2 (Air) | ±22 | | | |

Insertion Loss Diagram - Unidirectional

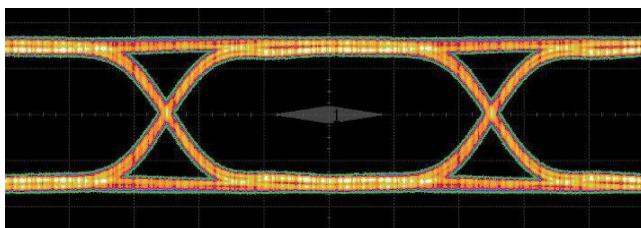


Insertion Loss Diagram - Bidirectional

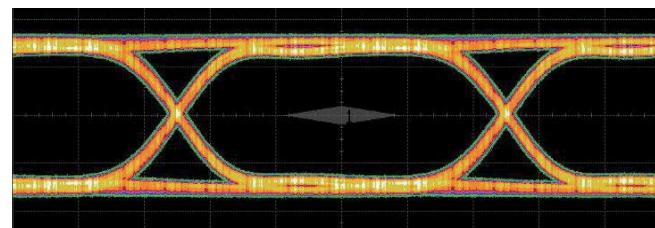


Device IV Curve - Unidirectional**Device IV Curve - Bidirectional****USB3.0 Eye Diagram**

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



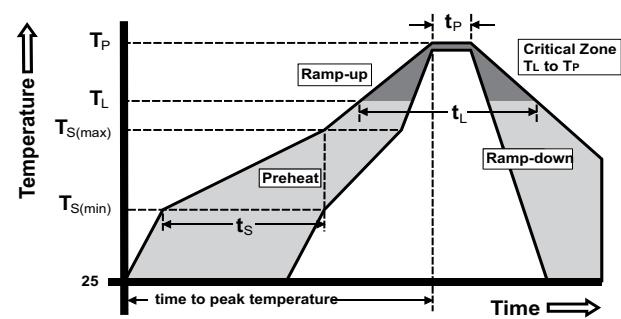
Without Device



With Device

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 ^{+0/-5} °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 |

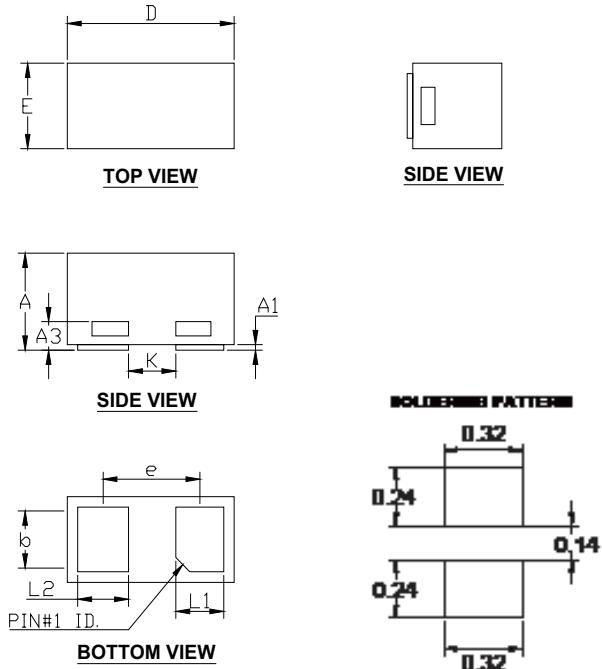
**Product Characteristics of 0402 DFN Package**

| | |
|---------------------------|--|
| 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 Recognized epoxy meeting flammability rating V-0. |

Notes :

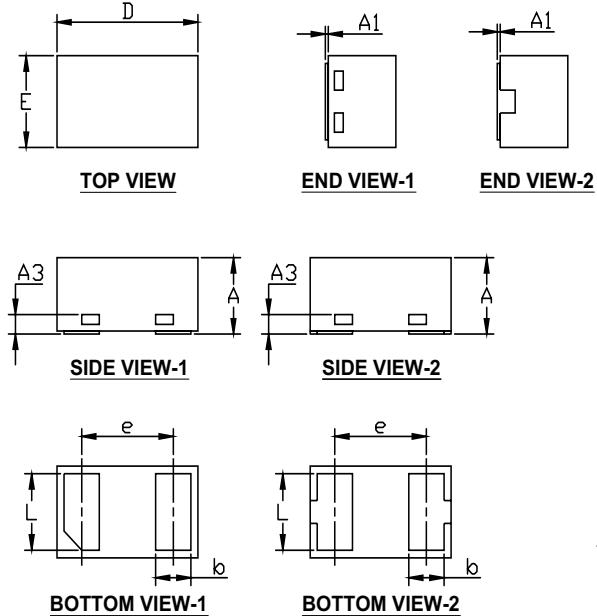
1. All dimensions are in millimeters
2. Dimensions include solder plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. Blo is facing up for mold and facing down for trim/form, i.e. reverse trim/form.
5. Package surface matte finish VDI 11-13.

Package Dimensions – 0201 DFN

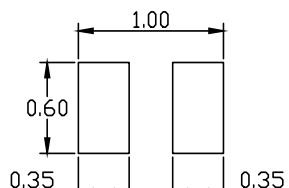


| Symbol | Millimeters | | Inches | |
|--------|---------------|------|-----------------|-------|
| | Min | Max | Min | Max |
| A | 0.23 | 0.33 | 0.009 | 0.013 |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 |
| A3 | 0.100 ref. | | 0.004 ref. | |
| b | 0.2 | 0.3 | 0.008 | 0.012 |
| D | 0.55 | 0.65 | 0.022 | 0.026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

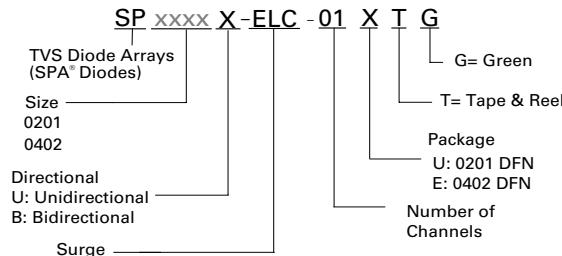
Package Dimensions – 0402 DFN



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



SOLDERING PATTERN

Part Numbering System**Part Marking System**

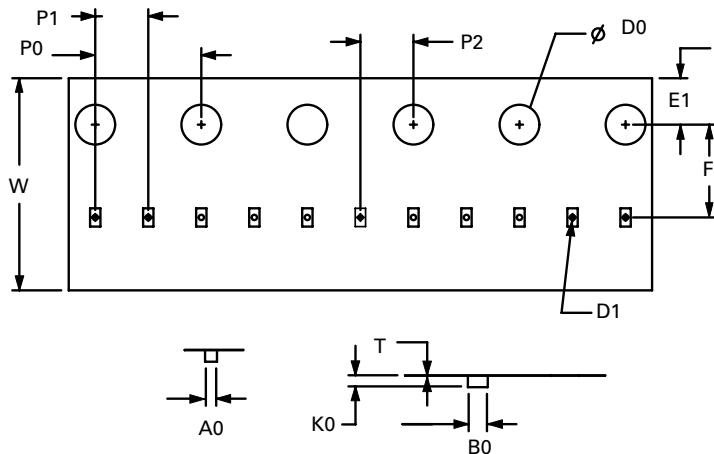
Unidirectional



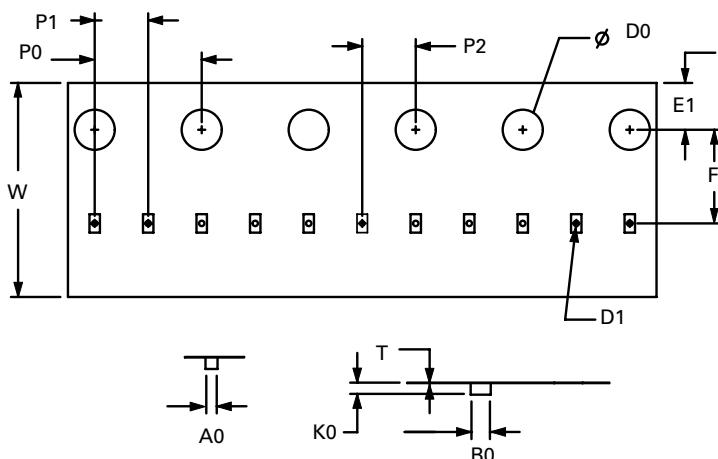
Bidirectional

Ordering Information

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