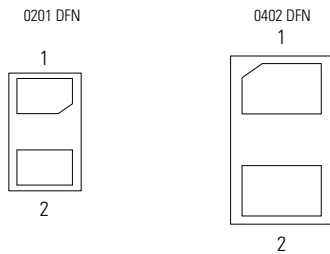


## SESD Series Enhanced ESD Discrete TVS

AUTOMOTIVE GRADE RoHS Pb GREEN ELV

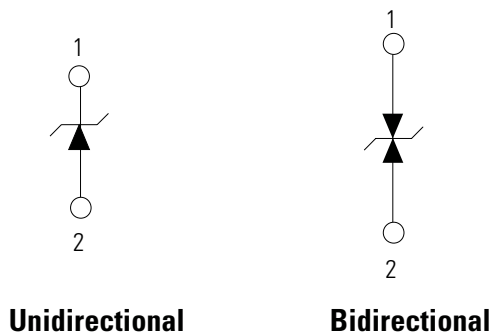


### Pinout



Bottom View

### Functional Block Diagram



Unidirectional

Bidirectional

### Description

The SESD Series Enhanced ESD Discrete TVS provides ultra low capacitance unidirectional and bidirectional ESD protection for the world's most challenging high speed serial interfaces. Ultra low capacitance helps ensure excellent signal integrity on the most challenging consumer electronics interfaces, such as USB 3.1, HDMI 2.0, DisplayPort, Thunderbolt, and V-by-One<sup>®</sup>. 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 SESD series sets higher standards for signal integrity and usability.

### Features

- 0.15pF TYP bidirectional
- 0.30pF TYP 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
- RoHS Compliant and Lead-free
- AEC-Q101 qualified
- PPAP capable

### Applications

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

### Additional Information



**Absolute Maximum Ratings**

| Symbol     | Parameter                        | Value      | Units |
|------------|----------------------------------|------------|-------|
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 2.5        | A     |
| $T_{OP}$   | Operating Temperature            | -55 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 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.

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

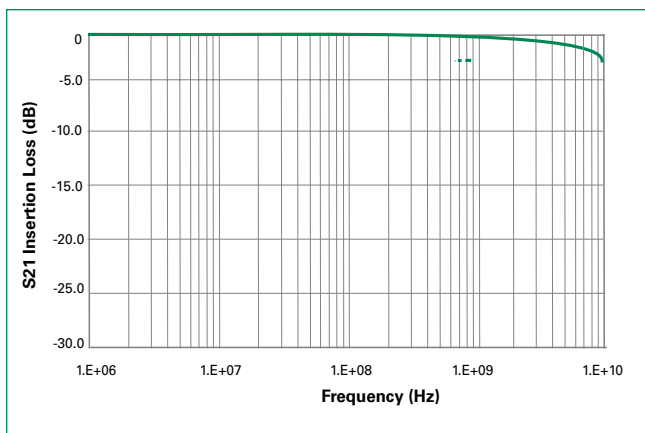
| Parameter                          | Test Conditions          | Min | Typ  | Max | Units |
|------------------------------------|--------------------------|-----|------|-----|-------|
| Diode Capacitance <sup>1</sup>     | Reverse Bias=0V, f=3GHz  |     | 0.30 |     | pF    |
| Breakdown Voltage                  | $V_{BR}$ @ $I_r=1mA$     |     | 8.80 |     | V     |
| Reverse Working Voltage            |                          |     |      | 7.0 | V     |
| Reverse Leakage Current            | $I_L$ @ $V_{RWM}=5.0V$   |     | 25   |     | nA    |
| Clamp Voltage <sup>1</sup>         | $V_{CL}$ @ $I_{PP}=2.5A$ |     | 13.0 |     | V     |
| ESD Withstand Voltage <sup>1</sup> | IEC61000-4-2 (Contact)   | ±22 |      |     | kV    |
|                                    | IEC61000-4-2 (Air)       | ±22 |      |     |       |

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

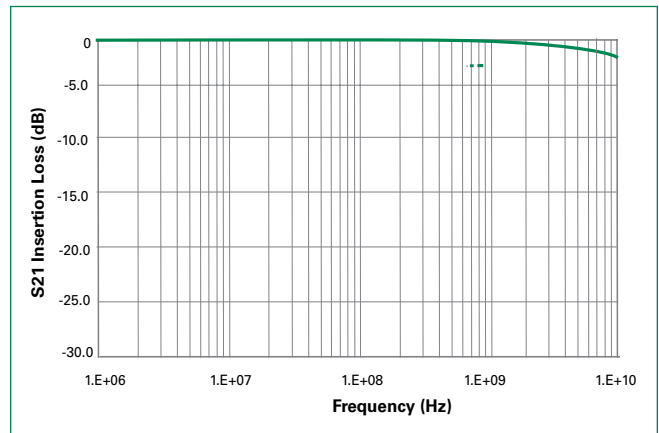
| Parameter                          | Test Conditions          | Min | Typ  | Max | Units |
|------------------------------------|--------------------------|-----|------|-----|-------|
| Diode Capacitance <sup>1</sup>     | Reverse Bias=0V, f=3GHz  |     | 0.15 |     | pF    |
| Breakdown Voltage                  | $V_{BR}$ @ $I_r=1mA$     |     | 9.6  |     | V     |
| Reverse Working Voltage            |                          |     |      | 7.0 | V     |
| Reverse Leakage Current            | $I_L$ @ $V_{RWM}=5.0V$   |     | 25   |     | nA    |
| Clamp Voltage <sup>1</sup>         | $V_{CL}$ @ $I_{PP}=2.5A$ |     | 14.0 |     | V     |
| ESD Withstand Voltage <sup>1</sup> | IEC61000-4-2 (Contact)   | ±22 |      |     | kV    |
|                                    | IEC61000-4-2 (Air)       | ±22 |      |     |       |

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

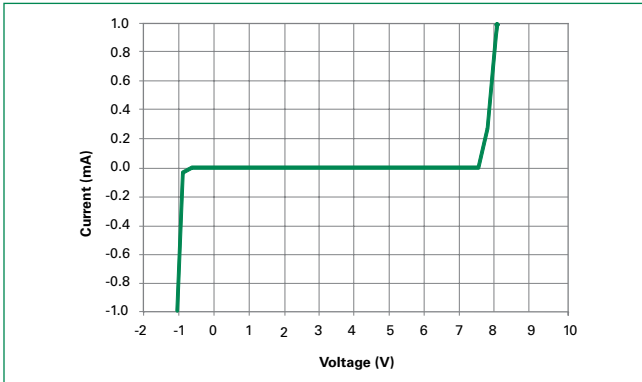
**Insertion Loss Diagram - Unidirectional**



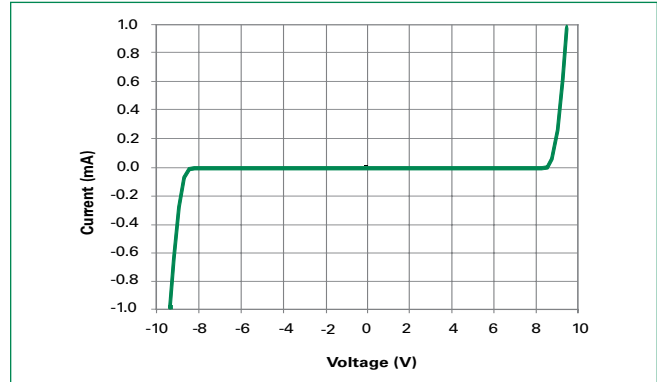
**Insertion Loss Diagram - Bidirectional**



**Device IV Curve - Unidirectional**

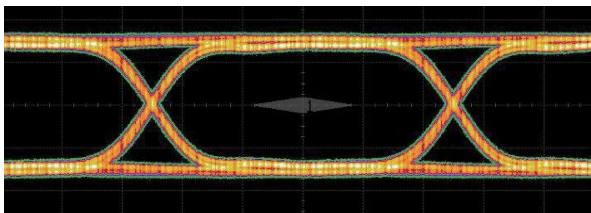


**Device IV Curve - Bidirectional**

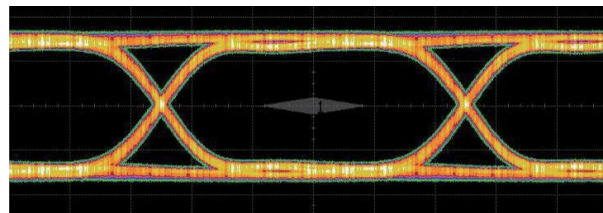


**USB3.0 Eye Diagram**

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



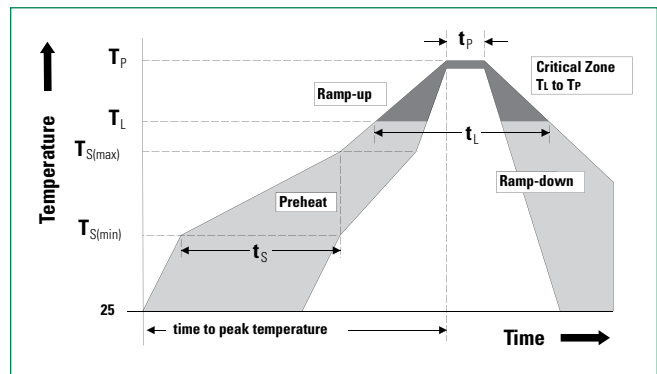
Without SESD Device



With SESD Device

**Soldering Parameters**

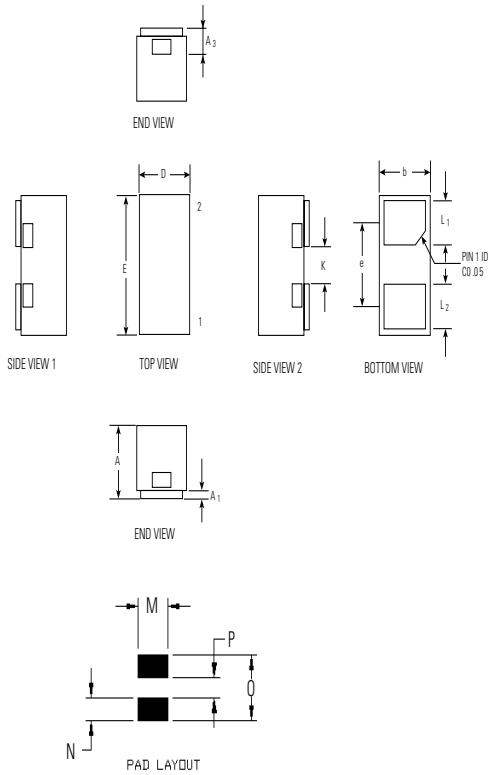
|  |                                    |                         |
|--|------------------------------------|-------------------------|
| <b>Reflow Condition</b>  |                                    | Pb – Free assembly      |
| <b>Pre Heat</b>  | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - 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                   |



**Product Characteristics of 0402 DFN Package**

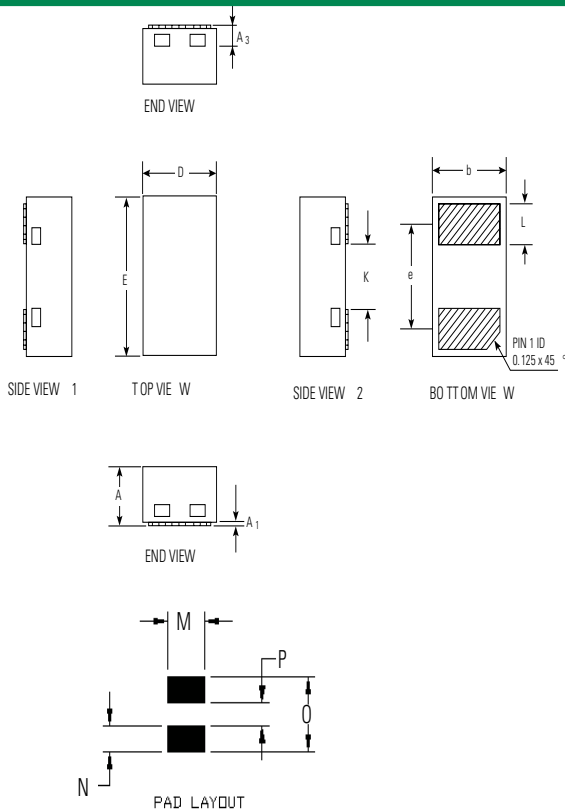
|                           |  |
|---------------------------|--|
| <b>Lead Plating</b>       | Pre-Plated Frame                                     |
| <b>Lead Material</b>      | Copper Alloy   |
| <b>Substrate Material</b> | Silicon  |
| <b>Body Material</b>      | UL Recognized epoxy meeting flammability rating V-0. |

**Package Dimensions — 0201 DFN**



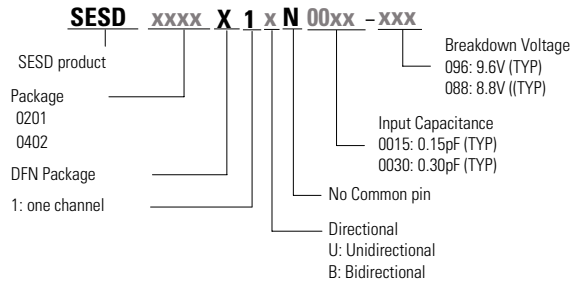
| Symbol | Millimeters |      |      | Inches     |       |       |
|--------|-------------|------|------|------------|-------|-------|
|        | Min         | Typ  | Max  | Min        | Typ   | Max   |
| A      | 0.28        | 0.30 | 0.32 | 0.011      | 0.012 | 0.013 |
| A1     | 0           | -    | 0.05 | 0          | -     | 0.002 |
| A3     | 0.102 ref.  |      |      | 0.004 ref. |       |       |
| D      | 0.25        | 0.30 | 0.35 | 0.010      | 0.012 | 0.014 |
| E      | 0.55        | 0.60 | 0.65 | 0.022      | 0.024 | 0.026 |
| K      | 0.11        | 0.17 | 0.22 | 0.004      | 0.007 | 0.009 |
| b      | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| L1     | 0.13        | 0.18 | 0.23 | 0.005      | 0.008 | 0.009 |
| L2     | 0.14        | 0.19 | 0.24 | 0.006      | 0.007 | 0.009 |
| e      | 0.356 BSC   |      |      | 0.014 BSC  |       |       |
| M      |             | 0.32 |      |            | 0.013 |       |
| N      |             | 0.24 |      |            | 0.009 |       |
| O      |             | 0.62 |      |            | 0.024 |       |
| P      |             | 0.14 |      |            | 0.006 |       |

**Package Dimensions — 0402 DFN**

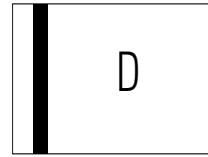


| Symbol | Millimeters |      |      | Inches     |       |       |
|--------|-------------|------|------|------------|-------|-------|
|        | Min         | Typ  | Max  | Min        | Typ   | Max   |
| A      | 0.33        | 0.38 | 0.43 | 0.013      | 0.015 | 0.017 |
| A1     | 0           | -    | 0.05 | 0          | -     | 0.002 |
| A3     | 0.13 ref.   |      |      | 0.005 ref. |       |       |
| D      | 0.55        | 0.60 | 0.65 | 0.022      | 0.024 | 0.026 |
| E      | 0.95        | 1.00 | 1.05 | 0.037      | 0.039 | 0.041 |
| K      | 0.35        | 0.40 | 0.45 | 0.014      | 0.016 | 0.018 |
| b      | 0.45        | 0.50 | 0.55 | 0.018      | 0.020 | 0.022 |
| L      | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| e      | 0.65 BSC    |      |      | 0.026 BSC  |       |       |
| M      |             | 0.60 |      |            | 0.024 |       |
| N      |             | 0.35 |      |            | 0.014 |       |
| O      |             | 1.00 |      |            | 0.039 |       |
| P      |             | 0.30 |      |            | 0.012 |       |

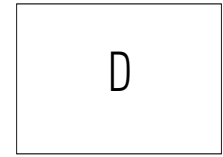
**Part Numbering System**



**Part Marking System**



**Unidirectional**

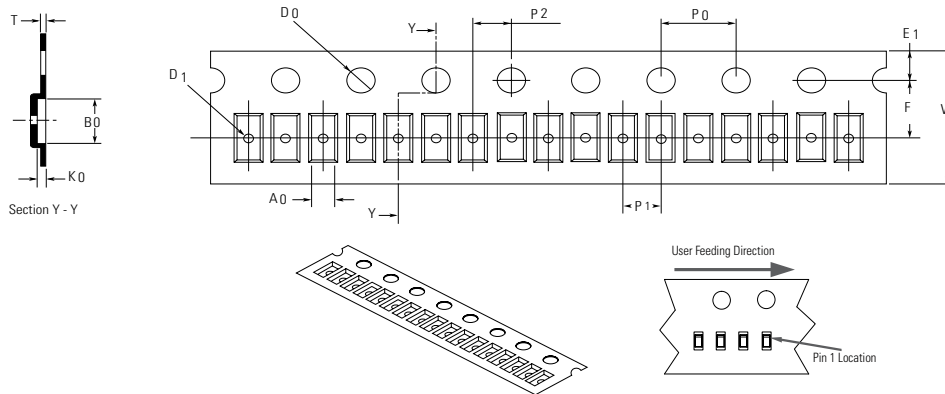


**Bidirectional**

**Ordering Information**

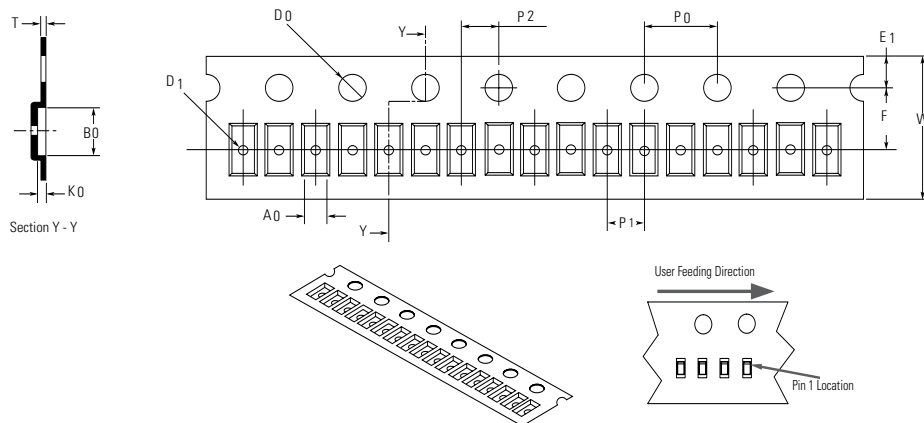
| Part Number           | Package  | Ordering Part Number | Minimum Order Quantity |
|-----------------------|----------|----------------------|------------------------|
| SESD0201X1UN-0030-088 | 0201 DFN | RF3917-000           | 75000                  |
| SESD0201X1BN-0015-096 | 0201 DFN | RF3918-000           | 75000                  |
| SESD0402X1UN-0030-088 | 0402 DFN | RF3920-000           | 50000                  |
| SESD0402X1BN-0015-096 | 0402 DFN | RF3922-000           | 50000                  |

**Embossed Carrier Tape & Reel Specification – 0201 DFN**



| Symbol | Millimeters       |
|--------|-------------------|
| A0     | 0.36+/-0.03       |
| B0     | 0.66+/-0.03       |
| D0     | ø 1.50+/- 0.10/-0 |
| D1     | ø 0.20+/- 0.05    |
| E1     | 1.75+/-0.10       |
| F      | 3.50+/-0.05       |
| K0     | 0.33+/-0.03       |
| P0     | 4.00+/-0.10       |
| P1     | 2.00+/-0.10       |
| P2     | 2.00+/-0.05       |
| W      | 8.00+/-0.10       |
| T      | 0.23+/-0.02       |

**Embossed Carrier Tape & Reel Specification – 0402 DFN**



| Symbol | Millimeters     |
|--------|-----------------|
| A0     | 0.70+/-0.05     |
| B0     | 1.15+/-0.05     |
| D0     | ø 1.55 + 0.05   |
| D1     | ø 0.40 +/- 0.05 |
| E1     | 1.75+/-0.10     |
| F      | 3.50+/-0.05     |
| K0     | 0.47+/-0.05     |
| P0     | 4.00+/-0.10     |
| P1     | 2.00+/-0.10     |
| P2     | 2.00+/-0.05     |
| W      | 8.00+/-0.10     |
| T      | 0.20+/-0.05     |