# Silicon ESD Protection Devices

NEW






Silicon ESD (SESD) devices help protect electronic circuits against damage from electrostatic discharge (ESD) events. The 0201-sized SESD device's miniature footprint – measuring 0.6mm x 0.3mm x 0.3mm - is approximately 70 percent smaller than prior-generation devices, offering designers flexibility in space-constrained applications.

The SESD0201C-006-058 device is a bi-directional and ultra-low capacitance 0.6 picofarad (pF) device that is suitable for helping to protect very-high-speed data lines, such as USB and HDMI, or low-voltage antenna ports. The device's ultra-low capacitance, low insertion loss (<0.5dB up to 3GHz), and high linearity of capacitance versus frequency helps minimize signal degradation.

The SESD0201C-120-058 device is a higher-capacitance (12pF) bi-directional device that can be used for low-speed generic interfaces such as keypads, power buttons, speakers, and microphone ports in portable electronics. Both SESD0201C-006-058 and SESD0201C-120-058 devices offer 8kV contact and 15kV air discharge protection per the IEC61000-4-2, level 4 standard.

Also included in the product line is the SESD0402S-005-054 device, an ultra-low-capacitance SOD-923 (0402-size package) uni-directional device with 0.5pF typical capacitance. This device offers a 10kV contact discharge rating per IEC61000-4-2, level 4 and can be used with digital applications such as USB and HDMI.

## Benefits

- Small size SESD protection diodes for high speed signals
- ESD protection in space-constrained portable electronics and mobile handsets
- Helps protect electronic circuits against damage from ESD
- Assist equipment to pass IEC61000-4-2, level 4 testing

## Features

- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Low-leakage current – 1.0µA (max)
- Low-breakdown voltage < 5.8V
- Capable of withstanding numerous ESD strikes
- Low capacitance and insertion loss
- SOD-923 case epoxy material meets UL 94 V-0
- SESD0402S devices meet MSL-1 requirements

## Applications

- Mobile phones and portable electronics
- High-speed data lines (low capacitance 0201 and 0402)
- Low-voltage antenna ports (bi-directional 0201)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort
- Applications requiring high ESD performance in a small package

## Table SE1 Maximum Ratings for SESD Devices

| Part Number | IEC61000-4-2, level 4 (ESD Withstand) Contact (kV) | IEC61000-4-2, level 4 (ESD Withstand) Air (kV) | Temperature Operating (°C) | Temperature Storage (°C) | Total Power Dissipation on FR-4 board* (mW) |
|---|---|---|---|---|---|
| SESD0201C-006-058 | ±8 | ±15 | -40 to +125 | -40 to +125 | 150 |
| SESD0201C-120-058 | ±8 | ±15 | -40 to +125 | -40 to +125 | 250 |
| SESD0402S-005-054 | ±10 | ±15 | -55 to +125 | -55 to +150 | 250 |

*FR-4 board = 30mm x 30mm x 2mm

## Table SE2 Electrical Characteristics @T=25°C for SESD Devices

| Part Number | Input Capacitance* Typical (pF) | Input Capacitance* Maximum (pF) | Leakage Current (max) $I_L$ @ $V_{WRV}$ = 5.0V (µA) | Breakdown Voltage (min) $V_{br}$ @ $I_T$** = 1mA (V) | Working Reverse Voltage $V_{WRV}$ @ peak (V) |
|---|---|---|---|---|---|
| SESD0201C-006-058 | 0.6† | 0.9 | 1.0 | ±5.8 | 5.0 |
| SESD0201C-120-058 | 12.0 | 13.5 | 1.0 | ±5.8 | 5.0 |
| SESD0402S-005-054 | 0.5‡ | 0.9 | 1.0 | +5.4 / -1.0 | 5.0 |

* @Vr=0V, f=1MHz
† 0.19pF@f=3GHz
‡ 0.17pF@f=3GHz
** $V_{br}$ is measured at test current $I_T$

## Figure SE1-SE2 Capacitance vs Frequency for SESD Devices

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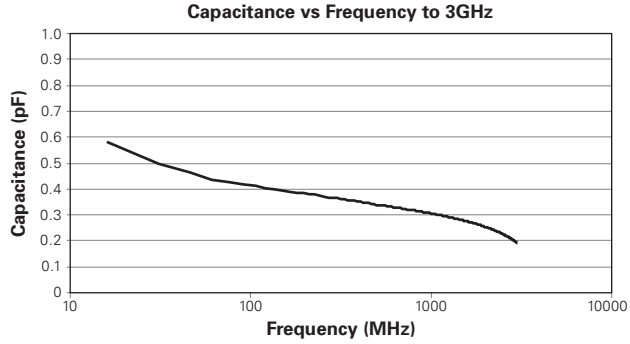
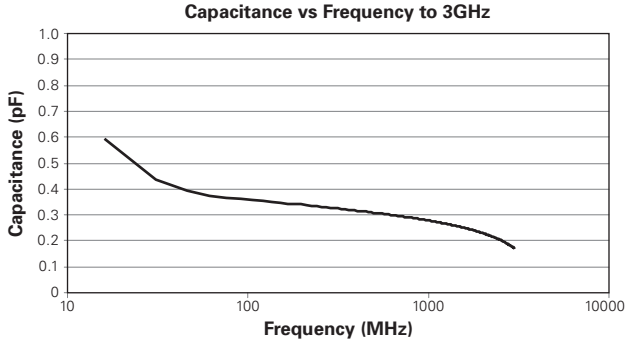
### Figure SE1

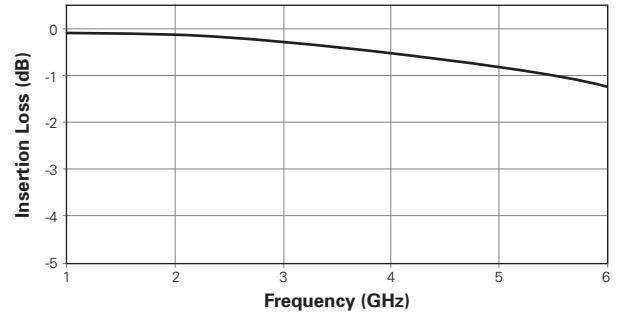



### Figure SE2



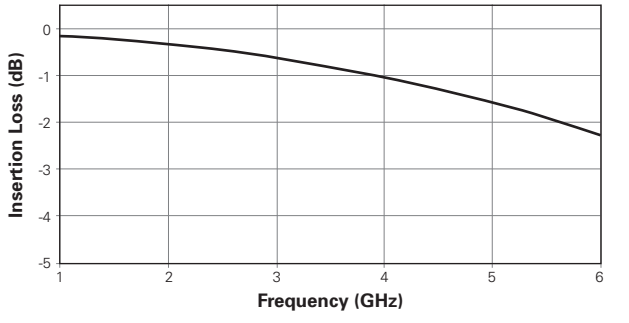

## Figure SE3-SE4 Insertion Loss Diagram for SESD Devices

### Figure SE3




| Applications | Insertion Loss | @Frequency (GHz) |
|---|---|---|
| HDMI 1.3 (1080p) | -0.205 | 2.25 |
| HDMI 1.3 (max spec) | -0.354 | 3.40 |
| DisplayPort | -0.235 | 2.70 |
| USB 3.0 | -0.791 | 5.00 |

### Figure SE4




| Applications | Insertion Loss | @Frequency (GHz) |
|---|---|---|
| HDMI 1.3 (1080p) | -0.300 | 2.25 |
| HDMI 1.3 (max spec) | -0.735 | 3.40 |
| DisplayPort | -0.335 | 2.70 |
| USB 3.0 | -1.450 | 5.00 |



RoHS Compliant, ELV Compliant HF Halogen Free

## Table SE3 Dimensions for SESD Devices in Millimeters (Mils)*

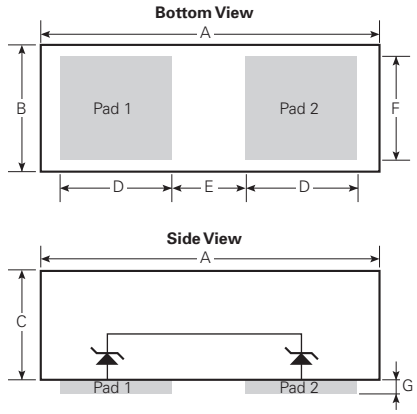
| Part Number | A | B | C | D | E | F | G | Figure |
|---|---|---|---|---|---|---|---|---|
| SESD0201C | 0.60 ± 0.03 | 0.30 ± 0.03 | 0.27 ± 0.03 | 0.15 ± 0.03 | 0.25 ± 0.03 | 0.25 ± 0.03 | 0.005 (max) | SE5 |
| | (23.62 ± 1.20) | (11.81 ± 1.20) | (10.63 ± 1.20) | (5.91 ± 1.20) | (9.84 ± 1.20) | (9.84 ± 1.20) | (0.197) (max) | |
| SESD0402S | 1.00 ± 0.05 | 0.60 ± 0.05 | 0.37 ± 0.03 | 0.20 ± 0.05 | 0.10 ± 0.05 | 0.80 ± 0.05 | 0.12 ± 0.05 | SE6 |
| | 39.37 ± 0.40 | 23.62 ± 0.40 | 14.57 ± 1.20 | 7.87 ± 2.00 | 3.94 ± 2.00 | 31.50 ± 2.00 | 4.72 ± 2.00 | |

* Round off approximation

## Figure SE5-SE6 Dimension Figures for SESD Devices

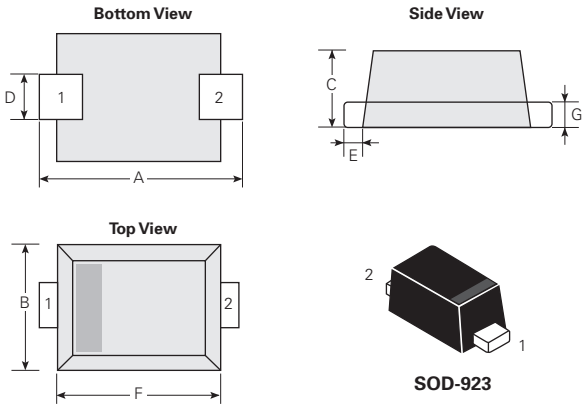
### Figure SE5

**SESD0201C CSP Package**




### Figure SE6

**SESD0402S SOD-923 Package**



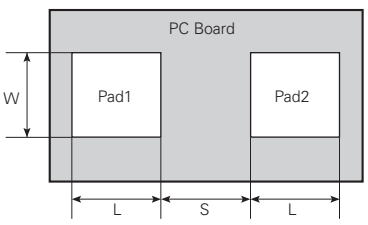

## Table SE4 PCB Pad Layout for SESD Devices in Millimeters (Mils)*

| Part Number | L | S | W | Figure |
|---|---|---|---|---|
| SESD0201C | 0.28 ± 0.01 | 0.19 ± 0.01 | 0.30 ± 0.01 | SE7 |
| | (11.0 ± 0.40) | (7.50 ± 0.40) | (11.80 ± 0.40) | |
| SESD0402S | 0.30 ± 0.01 | 0.60 ± 0.01 | 0.40 ± 0.01 | SE7 |
| | (11.80 ± 0.40) | (23.60 ± 0.40) | (15.70 ± 0.40) | |

* Round off approximation

### Figure SE7

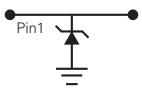
**Recommended Landing Pattern**




**SESD0201C can be oriented either direction**

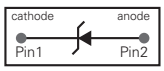
### Figure SE8

**Typical SESD Protected Signal**




### Figure SE9

**SESD0402S-005-054 uni-directional board placement**




**Orient Pin1 to Pad1**

## Table SE5 Tape and Reel Specifications for SESD Devices

| Tape Dimension<br>EIA Mark | SESD0201C-006-058<br>Dimension (mm) | SESD0201C-120-058<br>Dimension (mm) | SESD0402S-005-054<br>Dimension (mm) |
|---|---|---|---|
| $A_0$ | 0.37 ± 0.03 | 0.37 ± 0.03 | 0.66 ± 0.05 |
| $B_0$ | 0.67 ± 0.03 | 0.67 ± 0.03 | 1.06 ± 0.05 |
| $D_0$ | 1.60 (max) | 1.60 (max) | 1.60 (max) |
| $D_1$ | 1.00 (min) | 1.00 (min) | 1.00 (min) |
| $E_1$ | 1.75 ± 0.10 | 1.75 ± 0.10 | 1.75 ± 0.10 |
| $E_2$ | 5.85 (min) | 5.85 (min) | 5.85 (min) |
| F | 3.50 ± 0.05 | 3.50 ± 0.05 | 3.50 ± 0.05 |
| $P_0$ | 4.00 ± 0.10 | 4.00 ± 0.10 | 4.00 ± 0.10 |
| $P_1$ | 2.00 ± 0.05 | 2.00 ± 0.05 | 2.00 ± 0.05 |
| $P_2$ | 2.00 ± 0.10 | 2.00 ± 0.10 | 2.00 ± 0.10 |
| W | 8.00 ± 0.30 | 8.00 ± 0.30 | 8.00 ± 0.30 |
| **Tape Thickness** | | | |
| **EIA Mark** | **Dimension (mm)** | **Dimension (mm)** | **Dimension (mm)** |
| $B_1$ | 0.67 ± 0.03 | 0.67 ± 0.03 | 1.06 ± 0.05 |
| $K_0$ | 0.35 ± 0.03 | 0.35 ± 0.03 | 0.48 ± 0.05 |
| T | 0.60 (max) | 0.60 (max) | 0.60 (max) |
| $T_1$ | 0.10 (min) | 0.10 (min) | 0.10 (min) |
| $T_2$ | 1.05 ± 0.03 | 1.05 ± 0.03 | 1.05 ± 0.03 |
| **Reel Dimension** | | | |
| **EIA Mark** | **Dimension (mm)** | **Dimension (mm)** | **Dimension (mm)** |
| A | 178 (max) | 178 (max) | 178 (max) |
| B | 1.60 (min) | 1.60 (min) | 1.60 (min) |
| C | 13.0 ± 0.2 | 13.0 ± 0.2 | 13.0 ± 0.2 |
| D | 20.2 (min) | 20.2 (min) | 20.2 (min) |
| N | 50.0 (min) | 50.0 (min) | 50.0 (min) |
| $W_1$ | 9.15 ± 0.75 | 9.15 ± 0.75 | 9.15 ± 0.75 |
| $W_2$ | 14.4 (max) | 14.4 (max) | 14.4 (max) |
| $W_3$ | 10.9 (max) | 10.9 (max) | 10.9 (max) |

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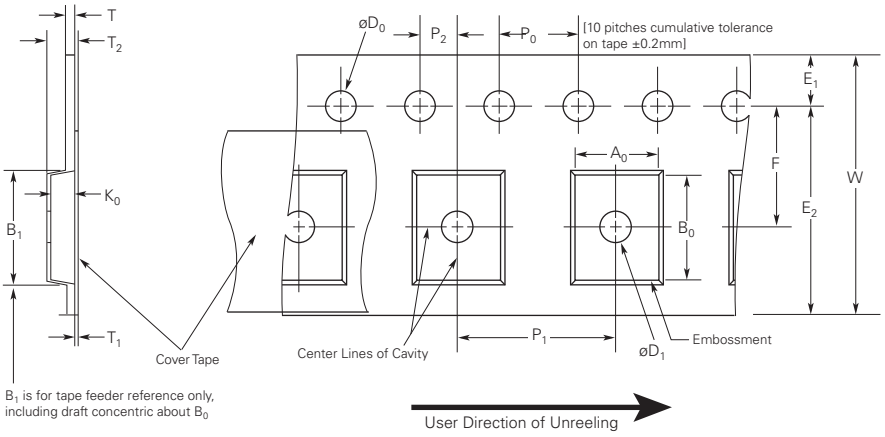
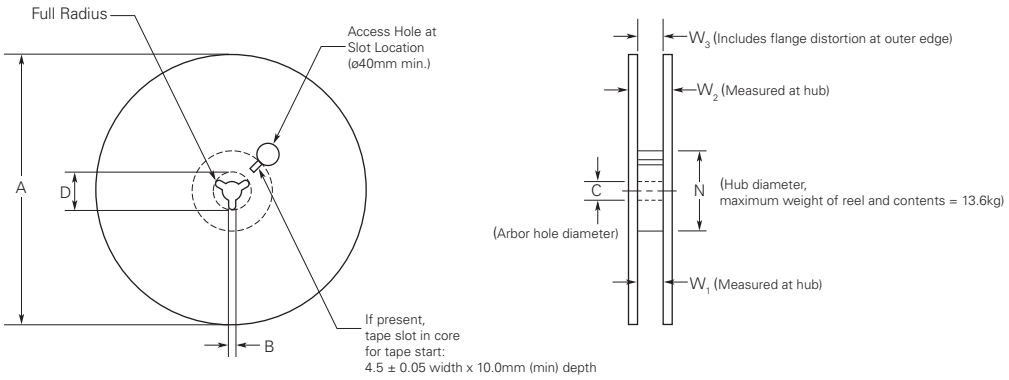
## Figure SE10 EIA Referenced Taped Component Dimensions for SESD Devices






RoHS Compliant, ELV Compliant HF Halogen Free

## Figure SE11 EIA Referenced Reel Dimensions for SESD Devices




## Definitions of Terms for SESD Devices

| | |
|---|---|
| $I_L$ | Reverse Leakage Current @ $V_{RWM}$ |
| $V_{WRV}$ | Working Peak Reverse Voltage |
| $V_{br}$ | Breakdown Voltage @ $I_T$ |
| $I_T$ | Test Current |



## Part Numbering System for SESD Devices

**SESD 0402 S - 005 - 054**

**Breakdown Voltage (min)**
054 = 5.4V
058 = 5.8V

**Input Capacitance (typ)**
005 = 0.5pF
006 = 0.6pF
120 = 12.0pF

**Package**
C = Chip Scale
S = SOD-923

**EIA Size**
0201
0402

**Series**
Silicon ESD

## ⚠ Warning :

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