

## Silicon ESD Protection Devices

The Silicon ESD (SESD) protection 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 protecting 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 vs. frequency helps minimize signal degradation.

The SESD0201C-120-058 (12pF) device & SESD0102P1BN-0400-090 (4pF) device are higher-capacitance bi-directional devices 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, while the SESD0201P1BN-0400-090 device offers 10kV contact and 16kV 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.

Also included in the product line is the SESD0402P1BN-0450-090 device. This device is a higher-capacitance device (4.5pF), SMD bi-directional device that offers 10kV contact and 16kV air discharge per IEC61000-4-2, level 4 standard.



### 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  $\leq$  900ppm, Cl  $\leq$  900ppm, Br+Cl  $\leq$  1500ppm)
- Low-leakage current - 1.0 $\mu$ A (max)
- Low-breakdown voltage 11V & < 5.8V
- Capable of withstanding numerous ESD strikes
- Low capacitance and insertion loss
- SOD-923 case epoxy material meets UL 94 V-0
- Devices meet MSL-1 requirements

### Applications:

- Mobile phones and portable electronics
- High-speed data lines (low capacitance 0201 and 0402)
- Low-voltage antenna ports (bidirectional 0201)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort (SESD0201C & SESD0402S)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort low voltage VBUS line (SESD0201P & SESD0402P)
- Applications requiring high ESD performance in a small package

## Maximum Ratings for SESD Devices

Part Numbers	IEC61000-4-2, level 4 (ESD Withstand)		Temperature		Total Power Dissipation on FR-4 board <sup>(2)</sup> (mW)
	Contact (kV)	Air (kV)	Operating (°C)	Storage (°C)	
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
SESD0201P1BN-0400-090	±10 <sup>(1)</sup>	±16	-40 to +125	-40 to +125	--
SESD0402P1BN-0450-090	±10 <sup>(1)</sup>	±16	-40 to +125	-40 to +125	--

<sup>(1)</sup> 10kV @ 50 ± pulses under IEC61000-4-2; 8kV @ 1,000 pulses under IEC61000-4-2

<sup>(2)</sup> FR-4 board = 30mm x 30mm x 2mm

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

Part Numbers	Input Capacitance <sup>(1)</sup>		Leakage Current (max)	Breakdown Voltage (min)	Working Reverse Voltage
	Typical (pF)	Maximun (pF)	$I_L @ V_{RWM} = 5.0V$ ( $\mu A$ )	$V_{br} @ I_t^{(4)} = 1mA$ (V)	$V_{RWM} @ peak$ (V)
SESD0201C-006-058	0.6 <sup>(2)</sup>	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 <sup>(3)</sup>	0.9	1.0	+5.4 / -1.0	5.0
SESD0201P1BN-0400-090	4.0	5.0	1.0 <sup>(5)</sup>	±9.0	6.0
SESD0402P1BN-0450-090	4.5	5.5	1.0 <sup>(5)</sup>	±9.0	6.0

<sup>(1)</sup> @ Vr=0V, f=1MHz

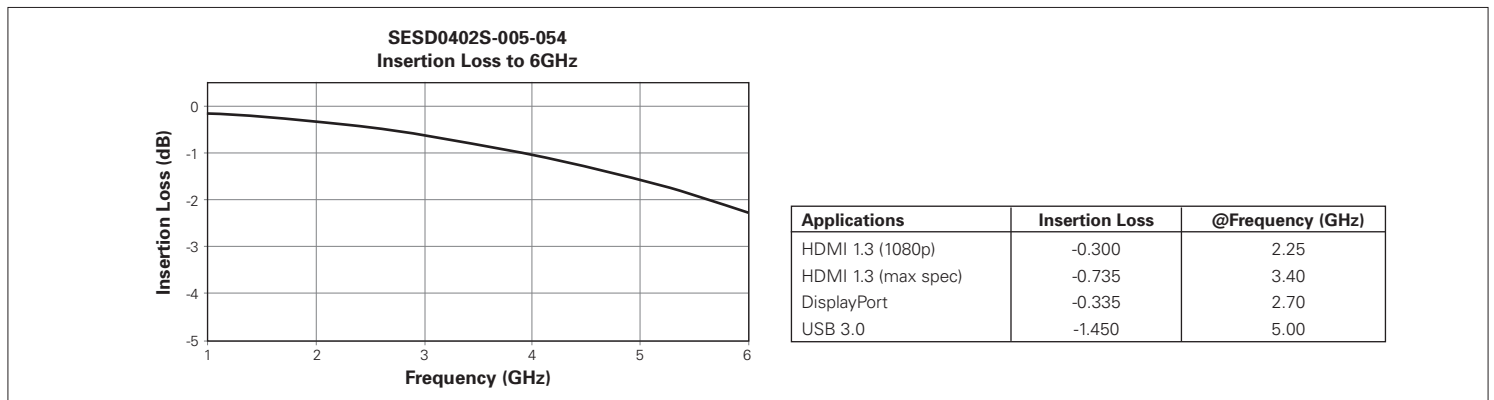
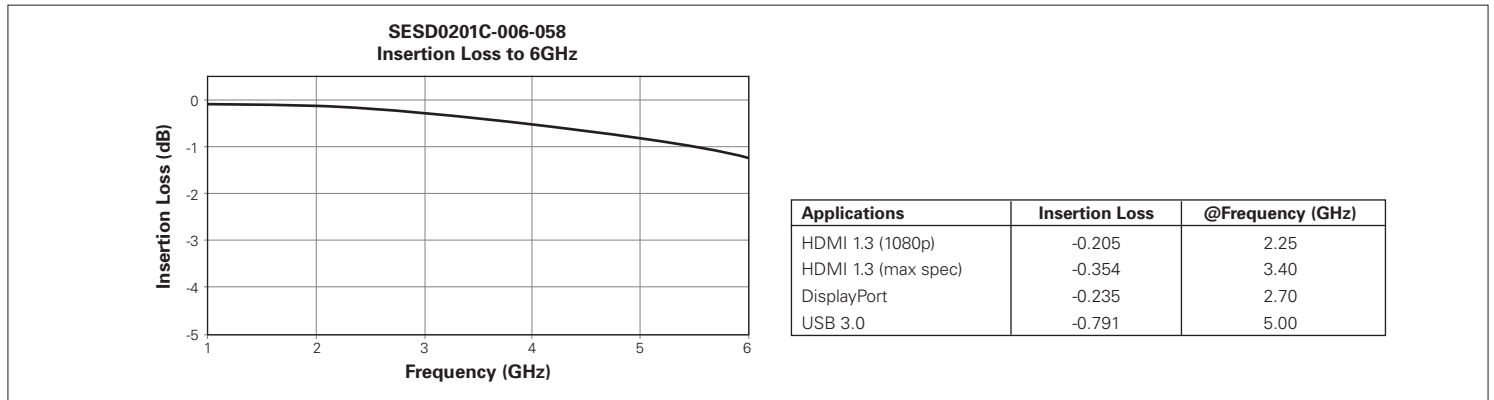
<sup>(2)</sup> 0.19pF @ f=3GHz

<sup>(3)</sup> 0.17pF @ f=3GHz

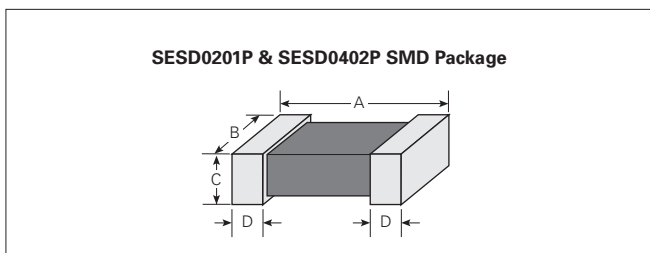
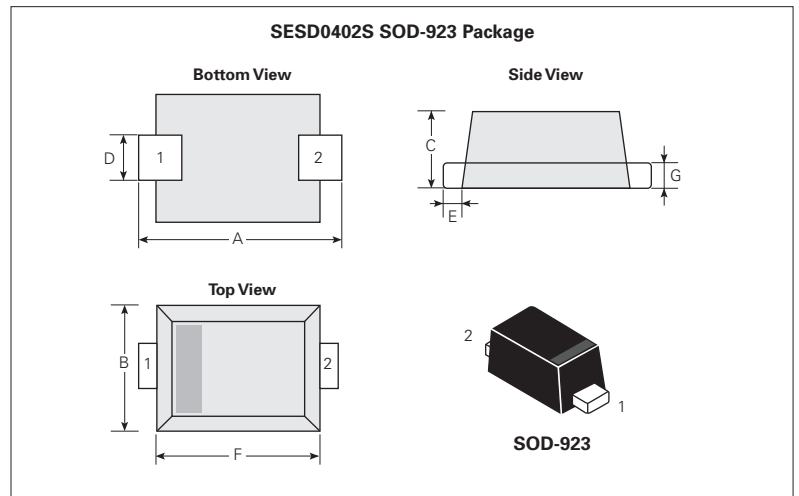
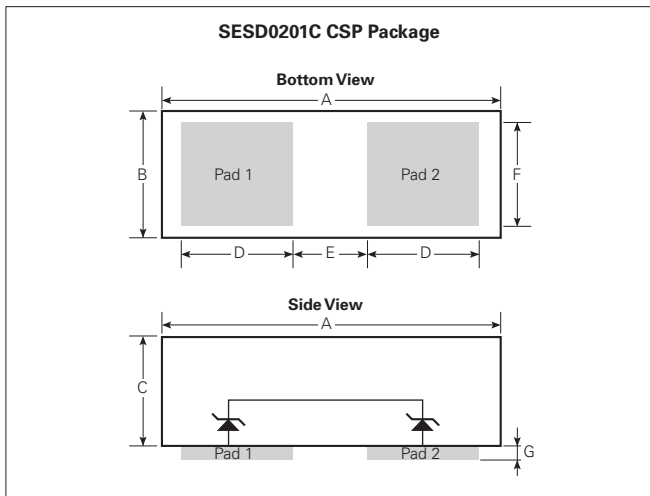
<sup>(4)</sup>  $V_{br}$  is measured at test current  $I_t$

<sup>(5)</sup>  $I_L @ V_{RWM} = 6.0V$  ( $\mu A$ )

## Insertion Loss Diagram for SESD Devices



## Device Dimensions for SESD Devices in Millimeters (Mils)\*



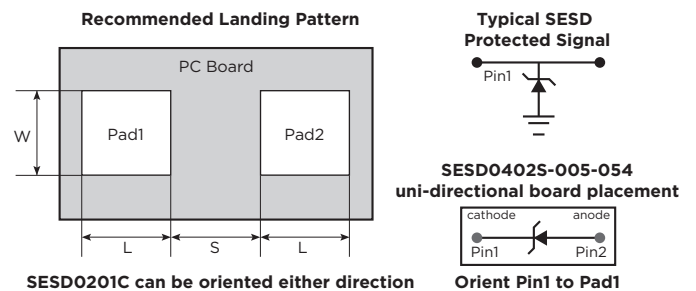
Part Numbers	A	B	C	D	E	F	G
SESD0201C	0.60 ± 0.03	0.30 ± 0.03	0.27 ± 0.03	0.15 ± 0.03	0.25 ± 0.03	0.25 ± 0.03	0.005 max
	(23.62 ± 1.20)	(11.81 ± 1.20)	(10.63 ± 1.20)	(5.91 ± 1.20)	(9.84 ± 1.20)	(9.84 ± 1.20)	(0.197) max
SESD0402S	1.00 ± 0.01	0.60 ± 0.01	0.37 ± 0.03	0.20 ± 0.05	0.10 ± 0.05	0.80 ± 0.05	0.12 ± 0.05
	(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)
SESD0201P	0.60 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.21 ± 0.07	--	--	--
	(23.62 ± 2.0)	(11.81 ± 2.0)	(11.81 ± 2.0)	(8.27 ± 2.8)	--	--	--
SESD0402P	1.10 ± 0.1	0.50 ± 0.1	0.50 ± 0.1	0.25 ± 0.15	--	--	--
	(43.31 ± 0.40)	(19.69 ± 4.0)	(19.69 ± 4.0)	(9.84 ± 6.0)	--	--	--

\* Round off approximation

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

Part Numbers	L	S	W
SESD0201C	0.28 ± 0.01	0.19 ± 0.01	0.30 ± 0.01
	(11.0 ± 0.40)	(7.50 ± 0.40)	(11.80 ± 0.40)
SESD0402S	0.30 ± 0.01	0.30 ± 0.01	0.40 ± 0.01
	(11.80 ± 0.40)	(11.80 ± 0.40)	(15.70 ± 0.40)
SESD0201P	0.28 ± 0.01	0.19 ± 0.01	0.30 ± 0.01
	(11.0 ± 0.40)	(7.50 ± 0.40)	(11.80 ± 0.40)
SESD0402P	0.61 ± 0.05	0.52 ± 0.05	0.50 ± 0.05
	(24.0 ± 2.0)	(21.0 ± 2.0)	(20.0 ± 2.0)

\* Round off approximation



## SESD Application Examples

<p><b>HDMI 1.3/1.4</b></p>		<p>Ethernet low voltage control line is unique to HDMI 1.4; all other signals same as HDMI 1.3.</p>	<p><b>VBUS and low power lines:</b> Use SESD0201P1BN-0400-090 or SESD0402P1BN-0450-090</p>
<p><b>USB 2.0/3.0</b></p>		<p>USB 3.0 signals are ten times faster than USB 2.0 signals. USB 3.0 port includes USB 2.0 signals for backward compatibility.</p>	<p><b>High speed HDMI/USB/DisplayPort signals:</b> Use SESD0201C-006-058 or SESD0402S-005-054</p> <p><b>HDMI/USB/DisplayPort control lines:</b> Use SESD0201C-120-058 or SESD0201C-006-058 or SESD0201P1BN-0400-090 or SESD0402S-005-054 or SESD0402P1BN-0450-090</p>
<p><b>DisplayPort</b></p>		<p>DisplayPort signals run as high as 2.7GHz, requiring low capacitance for minimal insertion loss.</p>	
<p><b>RF/Antenna</b></p>		<p>RF/Antenna signals require low clamping voltage, bi-directional operation, and low capacitance for minimal insertion loss.</p>	<p>Use 0201 size Bi-directional SESD0201C-006-058</p>

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