



# Silicon ESD

## Product Overview

### 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.



## KEY 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

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 and SESD0201P1BN-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.

## 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 (SESD0201C & SESD0402S)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort low voltage  $V_{BUS}$  line (SESD0201P & SESD0402P)
- Applications requiring high ESD performance in a small package

## 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

**MAXIMUM RATINGS FOR SESD DEVICES**

Part Numbers	IEC61000-4-2, level 4 (ESD Withstand)		Temperature		Total Power Dissipation
	Contact (kV)	Air (kV)	Operating (°C)	Storage (°C)	on FR-4 board <sup>(2)</sup> (mW)
SESD0201C-006-058	±8	±15	-40 to +125	-40 to +125	250
SESD0201C-120-058	±8	±15	-40 to +125	-40 to +125	250
SESD0402S-005-054	±10	±15	-55 to +125	-55 to +150	150
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 <sub>L</sub> @ V <sub>RWM</sub> = 5.0V (µA)	V <sub>br</sub> @ I <sub>t</sub> <sup>(4)</sup> = 1mA (V)	V <sub>RWM</sub> @ 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

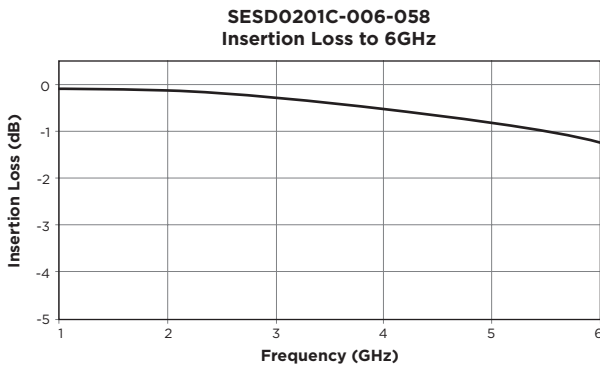
<sup>(2)</sup> 0.19pF @ f=3GHz

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

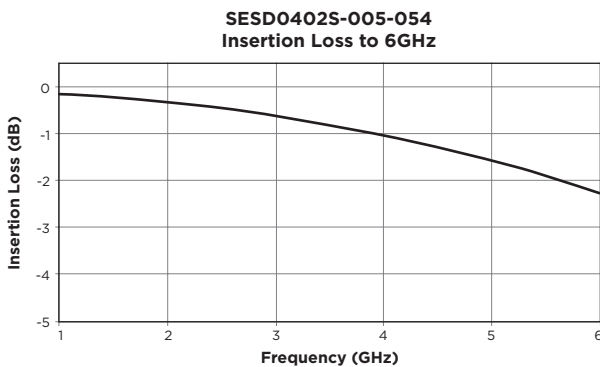
<sup>(4)</sup> V<sub>br</sub> is measured at test current I<sub>t</sub>

<sup>(5)</sup> I<sub>L</sub> @ V<sub>RWM</sub> = 6.0V (µA)

**INSERTION LOSS DIAGRAM FOR SESD DEVICES**

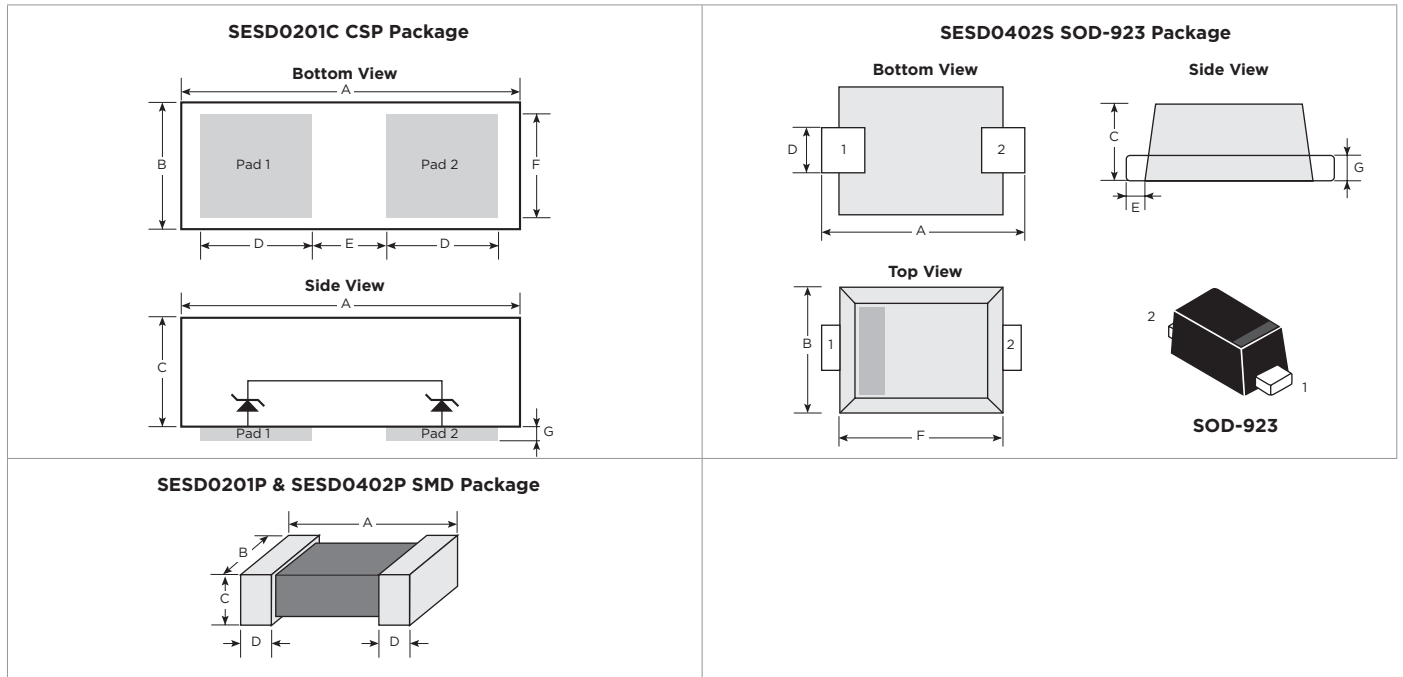


Applications	Insertion Loss	@Frequency (GHz)
HDMI 1.3 (1080p)	-0.205	2.25
HDMI 1.3 (max spec)	-0.354	3.40
DisplayPort	-0.235	2.70
USB 3.0	-0.791	5.00



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

DEVICE DIMENSIONS FOR SESD DEVICES IN MILLIMETERS (MILS)\*



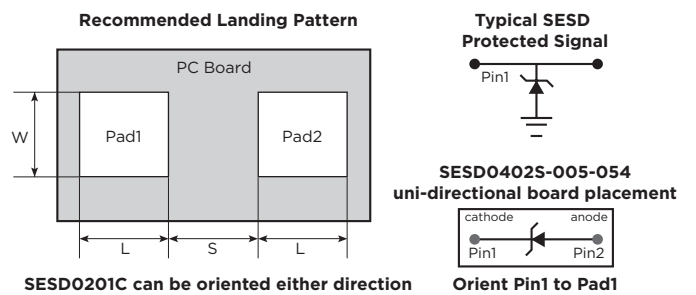
Part Numbers	A	B	C	D	E	F	G
SESD0201C	0.60 ± 0.03	0.30 ± 0.03	0.27 ± 0.03	0.15 ± 0.03	0.25 ± 0.03	0.25 ± 0.03	0.005 max
	(23.62 ± 1.20)	(11.81 ± 1.20)	(10.63 ± 1.20)	(5.91 ± 1.20)	(9.84 ± 1.20)	(9.84 ± 1.20)	(0.197) max
SESD0402S	1.00 ± 0.01	0.60 ± 0.01	0.37 ± 0.03	0.20 ± 0.05	0.10 ± 0.05	0.80 ± 0.05	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>HDMI 1.3 / 1.4 Controller / Transceiver Chipset</p> <p>HDMI 1.4 Connector</p> <p>3.4Gbps</p> <p>Control &amp; 100Mbps Ethernet</p> <p>SESD Devices</p> <p>Chassis</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 SESD0201PIBN-0400-090 or SESD0402PIBN-0450-090</p>
<p><b>USB 2.0/3.0</b></p>	<p>USB 3.0 Controller / Transceiver Chipset</p> <p>USB 3.0 Host Connector</p> <p>480Mbps</p> <p>5Gbps</p> <p>SESD Devices</p> <p>Chassis</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 SESD0201PIBN-0400-090 or SESD0402S-005-054 or SESD0402PIBN-0450-090</p>
<p><b>DisplayPort</b></p>	<p>DisplayPort Connector</p> <p>Video/DisplayPort Chipset</p> <p>ML_Lane0 to 4 (+ and -)</p> <p>SESD Devices</p> <p>Chassis GND</p> <p>Aux_CH(p) Aux_CH(n) Hot Plug Detect Return DP_PWR DP_PWR</p> <p>SESD Devices</p> <p>Chassis GND</p> <p>PolySwitch nanoSMD</p>	<p>DisplayPort signals run as high as 2.7GHz, requiring low capacitance for minimal insertion loss.</p>	<p>Use SESD0201C-120-058 or SESD0201C-006-058 or SESD0201PIBN-0400-090 or SESD0402S-005-054 or SESD0402PIBN-0450-090</p>
<p><b>RF/Antenna</b></p>	<p>Antenna</p> <p>Low voltage RF Chipsets</p> <p>SESD</p>	<p>RF/Antenna signals require low clamping voltage, bi-directional operation, and low capacitance for minimal insertion loss.</p>	<p>Use O201 size Bi-directional SESD0201C-006-058</p>

## FOR MORE INFORMATION

### TE Circuit Protection

308 Constitution Drive  
Menlo Park, CA USA 94025-1164  
Tel : (800) 227-7040, (650) 361-6900  
Fax : (650) 361-4600

[www.circuitprotection.com](http://www.circuitprotection.com)  
[www.circuitprotection.com.hk](http://www.circuitprotection.com.hk) (Chinese)  
[www.te.com/japan/bu/circuitprotection/](http://www.te.com/japan/bu/circuitprotection/) (Japanese)

#### Brazil

Tel : 55-11-2103-6090  
Fax: 55-11-2103-6216

#### UK / Eire / Benelux / Israel

**South Africa / Nordic / Baltic / Others**  
Tel : 49-89-6089485  
Fax: 49-89-6089394

#### Germany / Austria / Switzerland / Eastern Europe / Russia

Tel : 49-89-6089584  
Fax: 49-89-6089394

#### France / Italy / Iberia / Greece / Turkey

Tel : 33-1-34208455  
Fax: 33-1-34208479

#### Japan

Tel : 81-44-900-5110  
Fax: 81-44-900-5140

#### Korea

Tel : 82-2-3415-4654  
Fax: 82-2-3486-1786

#### Taiwan

Tel : 886-2-8768-2788 x 211  
Fax: 886-2-8768-1277

#### China, Hong Kong

Tel : 852-2738-8181  
Fax: 852-2735-1185

#### China, Beijing

Tel : 86-10-6569-3488 x 16526  
Fax: 86-10-6569-3206

#### China, Shanghai

Tel : 86-21-6106-7379  
Fax: 86-21-6485-3255

#### China, Shenzhen / Guangzhou

Tel : 86-755-2515-4797  
Fax: 86-755-2598-0419

#### Singapore / Indonesia

Tel : 65-6590-5089  
Fax: 65-6481-9377

#### Thailand / Malaysia / Vietnam

Tel : 6-04-217-8112  
Fax: 6-04-229-8177

#### Australia / Philippines

Tel : 63-2-988-9465  
Fax: 63-2-848-0205

#### India

Tel : 91-80-4161-3745  
Mobile : 91-99-0248-8886

Part numbers in this brochure are RoHS Compliant\*, unless marked otherwise.  
\*as defined [www.te.com/leadfree](http://www.te.com/leadfree)

### te.com

© 2011 Tyco Electronics Corporation, a TE Connectivity Ltd. Company. All Rights Reserved.

RCPO064E 07/2011

HDMI is a trademark of HDMI Licensing LLC. DisplayPort is a trademark of the Video Electronics Standards Association.

PolySwitch, TE Connectivity and TE connectivity (logo) are trademarks. Other logos, product and/or company names might be trademarks of their respective owners.

While TE has made every reasonable effort to ensure the accuracy of the information in this brochure, TE does not guarantee that it is error-free, nor does TE make any other representation, warranty or guarantee that the information is accurate, correct, reliable or current. TE reserves the right to make any adjustments to the information contained herein at any time without notice. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. The dimensions in this catalog are for reference purposes only and are subject to change without notice. Specifications are subject to change without notice. Consult TE for the latest dimensions and design specifications.

