Product Overview

Single-channel Silicon ESD Protection Devices

TE Connectivity's Silicon ESD devices help to protect electronic circuits against damage from Electrostatic Discharge (ESD), surge and cable discharge events.

The Silicon ESD (SESD) devices help provide protection and improve reliability of applications including but not limited to consumer, portable and mobile electronics. The 0402- and 0201- sized devices have industry leading ultra-low capacitance of 0.10pF for bi-directional devices, and 0.20pF for uni-directional devices with low insertion loss which help provide protection for ultra-high-speed data signals. The single-channel SESD devices provide robust ESD protection with industry-leading 20kV contact and air discharge rating per IEC61000-4-2 standard. The ultra-low capacitance enables signal integrity for today's highest-speed interfaces including USB 3.0/2.0, HDMI, eSATA, DisplayPort, and Thunderbolt.

TE offers the single-channel devices in uni-directional and bi-directional configurations. Bi-directional devices offer the lowest capacitance and insertion loss, allow placement on the PCB without orientation constraint and do not clip signals that swing below ground. Uni-directional devices offer a low negative breakover voltage and help provide protection for high-speed digital interfaces. The 0201-sized XDFN small footprint — measuring a mere 0.6mm x 0.3mm x 0.31mm – offers designers placement flexibility in space-constrained applications.

APPLICATIONS

- Consumer, mobile and portable electronics
- Tablet PC and external storage with high speed interfaces
- Ultra-high speed data lines
- USB 3.0/2.0, HDMI 1.3/1.4, DisplayPort interface, Thunderbolt interface (Light Peak), V-by-One HS, and LVDS interface
- Applications requiring high ESD performance in small packages

BENEFITS

- Industry-leading lowest capacitance; provides lowest insertion loss for high speed data signals
- Provides ESD protection up to 20kV contact and air discharge per IEC61000-4-2
- Small size ESD protection diodes for high speed data signals (0402- and 0201- size devices)
- Helps protect electronic circuits against damage from Electrostatic Discharge (ESD), lightning and cable discharge events
- Assist equipment to pass IEC61000-4-2, level 4 testing

KEY FEATURES

- Low Capacitance –
  at 0.10pF (typ. bi-di 100fF),
  at 0.20pF (typ. uni-di 200fF)
- Low leakage current –
  50nA @ 5V (typ)
- Low clamping voltage –
  +10.0/-10.0V (typ. bi-di),
  +9.20/-0.80V (typ. uni-di)
  @ (tp=8x20μs, Ipp=2A)
- ESD – 20kV contact/air discharge per IEC61000-4-2
- Surge – 2A (max)
  @ (tp=8x20μs) per IEC61000-4-5
- Small size and low profile XDFN packages
- RoHS Complaint, Pb and Halogen Free (refers to: Br ≤ 900ppm, Cl ≤ 900ppm, Br+Cl ≤ 1500ppm)

DEVICE ELECTRICAL CHARACTERISTICS

Device Maximum Ratings

Devices	IEC 61000-4-2, level 4 (ESD withstand)		Temperature		Peak Current (tp=8x20µs)
	Contact (kV)	Air (kV)	Operating (°C)	Storage (°C)	Ipp (A)
SESD0201X1BN-0010-098 (1)	20	20	-55 to +125	-55 to +150	2.0
SESD0402X1BN-0010-098 (1)					
SESD0201X1UN-0020-090 (2)					
SESD0402X1UN-0020-090 (2)					

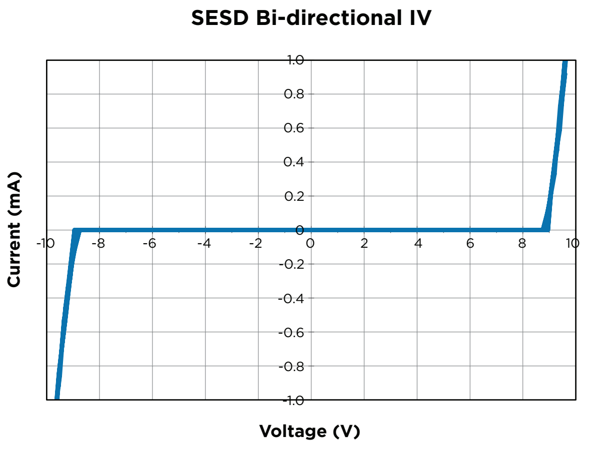
Caution: Stress exceeding Device Maximum Ratings may damage the device.
Prolong exposure to stresses above the Recommended Operating Conditions may affect device reliability.

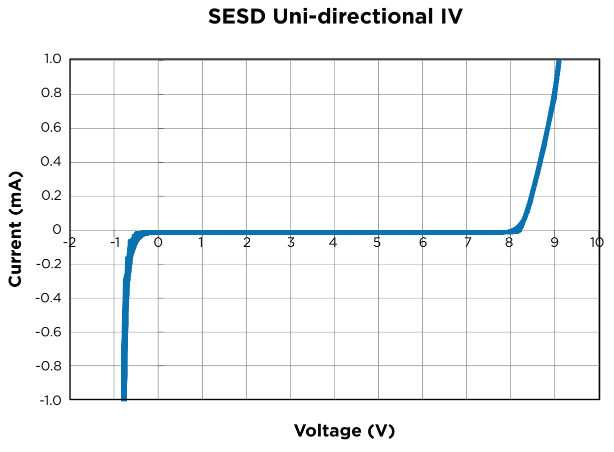
Device Electrical Characteristics @ T=25°C

Devices	Input Capacitance (3)		Breakdown Voltage (typ)	Reverse Leakage Current (typ)	Clamping Voltage (typ)
	Typical (pF)	Maximun (pF)	V_{br} @ I_t = 1mA (V)	I_L @ V_{RWM}= 5.0V (nA)	V_{CL} @ Ipp = 2.0A (V)
SESD0201X1BN-0010-098 (1)	0.10	0.12	+9.80 / -9.80	50.0	+10.0 / -10.0
SESD0402X1BN-0010-098 (1)					
SESD0201X1UN-0020-090 (2)	0.20	0.22	+9.00 / -0.80		+9.20 / -0.80
SESD0402X1UN-0020-090 (2)					

(1) Bi-directional (2) Uni-directional (3) @ Vr = 0V, f = 3GHz

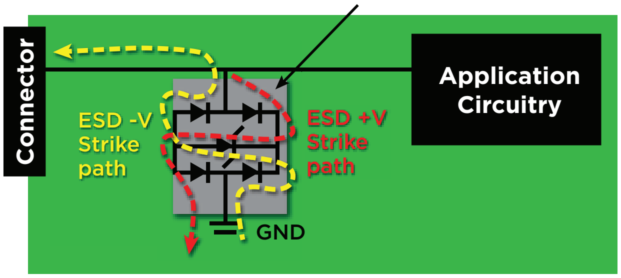
DEVICE IV CHARACTERISTICS


SESD Bi-directional IV


SESD Uni-directional IV

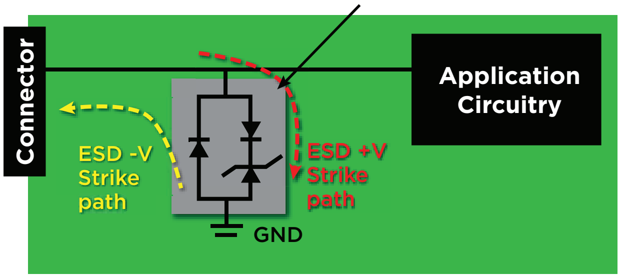
FUNCTIONAL DIAGRAM: BI-DIRECTIONAL AND UNI-DIRECTIONAL OPERATION

Single-channel Bi-directional Device



- Helps protect against damage from V_{ESD} strikes to 20kV contact & air discharge.
- If the signal voltage goes below -9.8V or above +9.8V the ESD device turns on and shunts to GND.

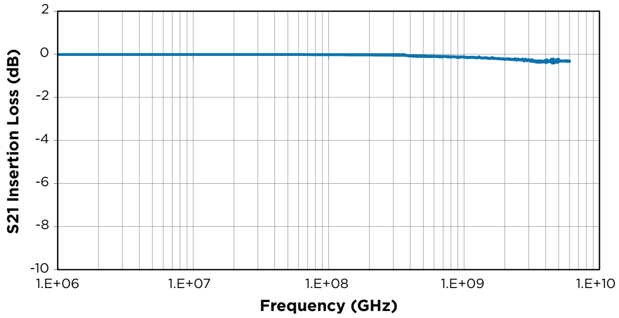
Single-channel Uni-directional Device



- Helps protect against damage from V_{ESD} strikes to 20kV contact & air discharge.
- If the signal voltage goes below -0.8V or above 9V the ESD device turns on and shunts to GND.

INSERTION LOSS

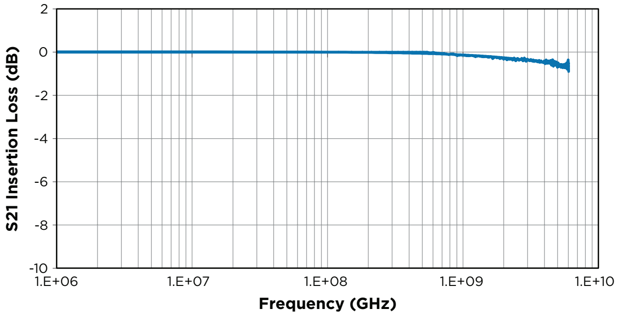
[SESD0402X1BN / SESD0201X1BN]-0010-098
(Bi-Directional Operation)



Application	Bit Rate (Gbps)	@Frequency (GHz)	Insertion Loss (dB)
HDMI 1.4 (1080P)	2.25	1.13	-0.12
DisplayPort	2.70	1.35	-0.16
HDMI 1.4 (max spec)*	3.40	1.70	-0.19
USB3.0	5.00	2.50	-0.23
eSATA	6.00	3.00	-0.27
Thunderbolt	10.00	5.00	-0.30

* Devices are HDMI 4K / QuadHD resolutions (4096 x 2160) ready

[SESD0402X1UN / SESD0201X1UN]-0020-090
(Uni-Directional Operation)

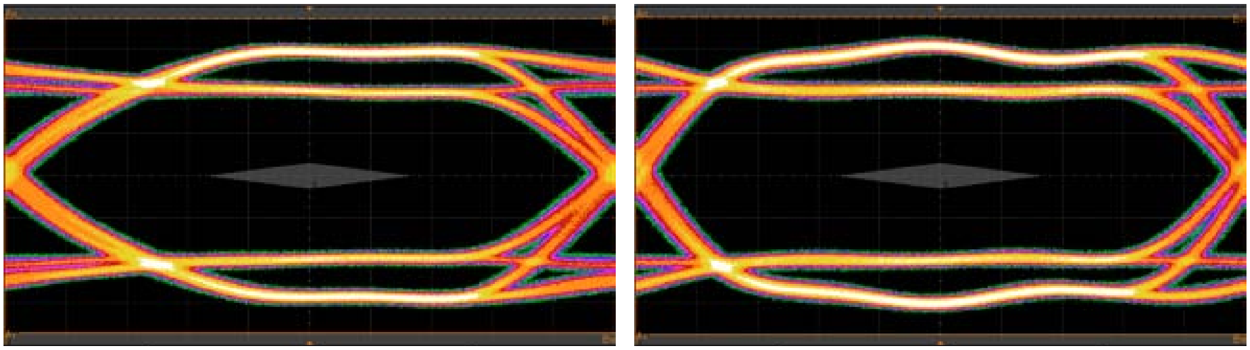


Application	Bit Rate (Gbps)	@Frequency (GHz)	Insertion Loss (dB)
HDMI 1.4 (1080P)	2.25	1.13	-0.15
DisplayPort	2.70	1.35	-0.20
HDMI 1.4 (max spec)*	3.40	1.70	-0.23
USB3.0	5.00	2.50	-0.29
eSATA	6.00	3.00	-0.35
Thunderbolt	10.00	5.00	-0.50

* Devices are HDMI 4K / QuadHD resolutions (4096 x 2160) ready

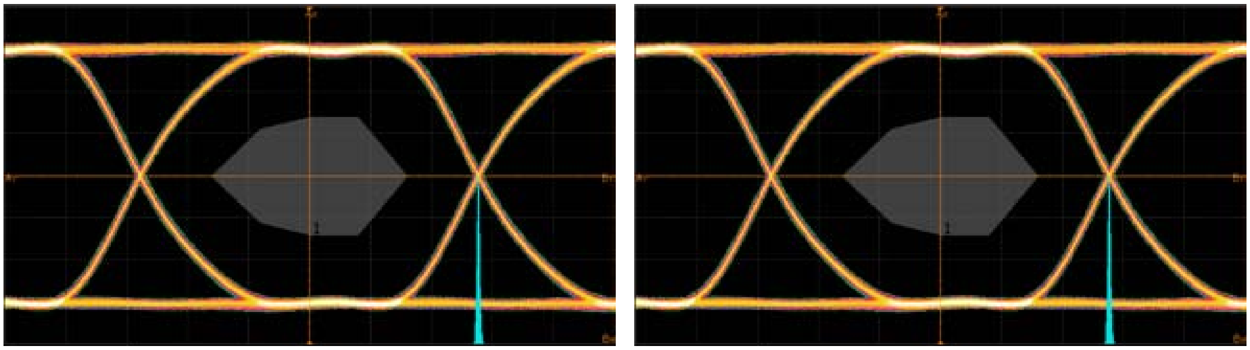
EYE DIAGRAMS

USB3.0 Eye Diagrams
5.0Gb/s, 1000mV differential, CPO Compliant Test Pattern



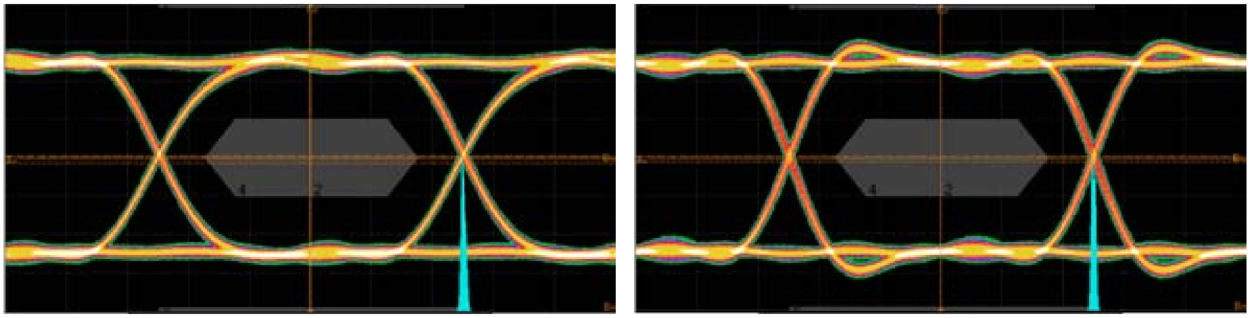
Without SESD Device With SESD Device

DisplayPort Eye Diagrams
2.7Gb/s, 800mV differential, PRBS7 Compliant Test Pattern, SSC enabled



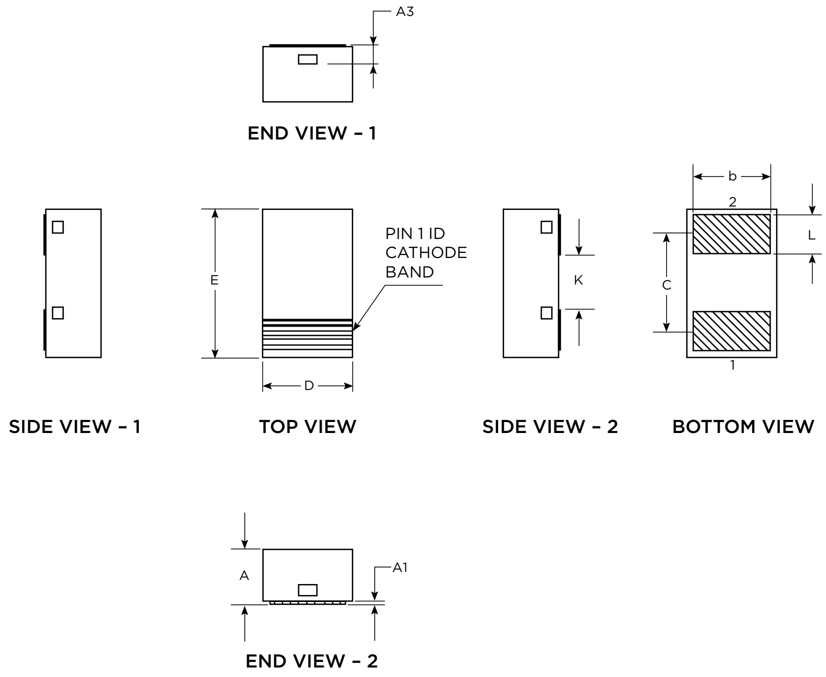
Without SESD Device With SESD Device

HDMI Eye Diagrams
3.4Gb/s, 990mV differential, TMDS Data



Without SESD Device With SESD Device

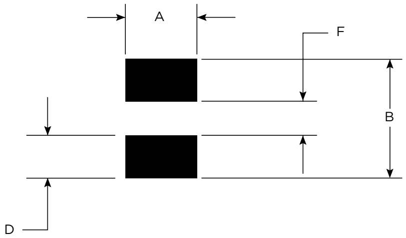
DEVICE DIMENSION



Dim	SESD0402 XDFN						SESD0201 XDFN					
	Millimeters			Inches			Millimeters			Inches		
	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
A	0.330	0.380	0.430	0.0130	0.0150	0.0170	0.30	0.31	0.32	0.0115	0.0122	0.0125
A1	0	–	0.050	0	–	0.0020	0	–	0.05	0	–	0.0020
A3	0.130 ref.			0.005 ref.			0.102 ref.			0.0040 ref.		
D	0.550	0.600	0.650	0.0220	0.0240	0.0260	0.285	0.320	0.355	0.0112	0.0120	0.0139
E	0.950	1.000	1.050	0.0370	0.0390	0.0410	0.585	0.620	0.655	0.0230	0.0244	0.0237
K	0.350	0.400	0.450	0.0140	0.0160	0.0180	0.130	0.155	0.180	0.0052	0.0061	0.0071
b	0.450	0.500	0.550	0.0180	0.0200	0.0220	0.235	0.260	0.285	0.0083	0.0102	0.0112
L	0.200	0.250	0.300	0.0080	0.0100	0.0120	0.175	0.200	0.225	0.0069	0.0079	0.0088
e	0.650 BSC			0.026 BSC			0.355 BSC			0.014 BSC		

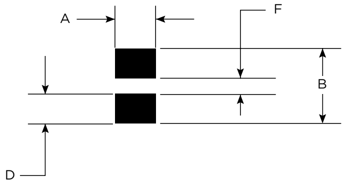
RECOMMENDED SOLDER PAD LAYOUT

Single-channel SESD 0402 XDFN Pad Layout



SESD Landing Pad Layout 0402 Package		
Symbol	Millimeters	Inches
A	0.60	0.024
B	1.00	0.039
D	0.35	0.014
F	0.30	0.012

Single-channel SESD 0201 XDFN Pad Layout



SESD Landing Pad Layout 0201 Package		
Symbol	Millimeters	Inches
A	0.32	0.013
B	0.62	0.024
D	0.24	0.009
F	0.14	0.006

MATERIAL INFORMATION

RoHS Compliant

Directive 2000/53/EC Compliant

ELV Compliant

Directive 2002/95/EC Compliant

Halogen Free*

HF

Pb-Free

Pb

* Halogen Free refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm.

SESD devices meet MSL-1 Requirements
DFN case epoxy meets UL 94 V-0

FOR MORE INFORMATION

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Part numbers in this brochure are RoHS Compliant*, unless marked otherwise.
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