PESD4V0W1BCSF

Extremely low capacitance bidirectional ESD protection diode

28 September 2021 | Product data sheet

1. General description

Extremely low capacitance bidirectional ElectroStatic Discharge (ESD) protection diode, part of the TrEOS protection family . The device is housed in a DSN0603-2 (SOD962-2) leadless ultra small Surface-Mounted Device (SMD) package designed to protect one signal line from the damage caused by ESD and other transients.

2. Features and benefits

- Bidirectional ESD protection of one line
- Surge robustness I_{PPM} = 20 A according to IEC 61000-4-5
- Extremely low diode capacitance C_d = 0.5 pF
- Extremely low clamping to protect sensitive I/Os
- Extremely low-inductance protection path to ground
- ESD protection up to ± 30 kV according to IEC 61000-4-2
- Ultra small SMD package

3. Applications

- USB3.2 and HDMI2.0 data lines
- Cellular handsets and accessories
- Portable electronics
- Communication systems
- Computers and peripherals

4. Quick reference data

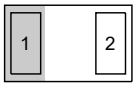
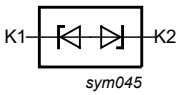
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C_d	diode capacitance	f = 1 MHz; V_R = 0 V		-	0.55	0.65	pF
V_{RWM}	reverse standoff voltage			-	-	4	V

nexperia

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K1	cathode (diode 1)	 Transparent top view **DSN0603-2 (SOD962-2)**	
2	K2	cathode (diode 2)		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PESD4V0W1BCSF	DSN0603-2	silicon, leadless ultra small package; 2 terminals; 0.4 mm pitch; 0.6 mm x 0.3 mm x 0.3 mm body	SOD962-2

7. Marking

Table 4. Marking codes

Type number	Marking code
PESD4V0W1BCSF	g

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8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{RWM}	reverse standoff voltage			-	4	V
I_{PPM}	rated peak pulse current	t_p = 8/20 µs	[1] [2]	-	20	A
T_{amb}	ambient temperature			-40	125	°C
T_{stg}	storage temperature			-65	150	°C
ESD maximum ratings						
V_{ESD}	electrostatic discharge voltage	IEC 61000-4-2; contact discharge	[3]	-30	30	kV
		IEC 61000-4-2; air discharge	[3]	-30	30	kV

[1] Device stressed with 8/20 µs exponential decay waveform according to IEC 61000-4-5.
[2] In positive and negative direction.
[3] Device stressed with ten non-repetitive ESD pulses.

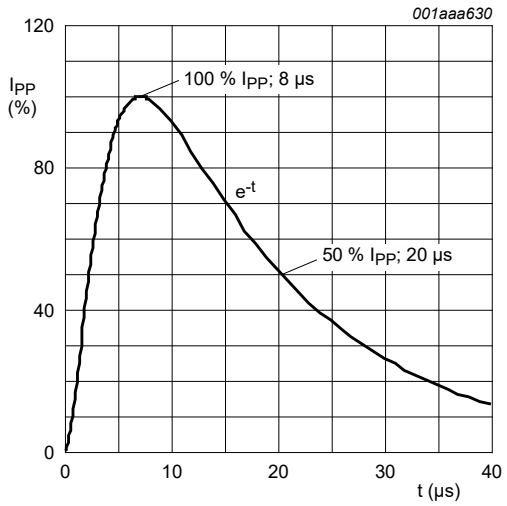

Fig. 1. 8/20 µs pulse waveform according to IEC 61000-4-5 and IEC 61643-321

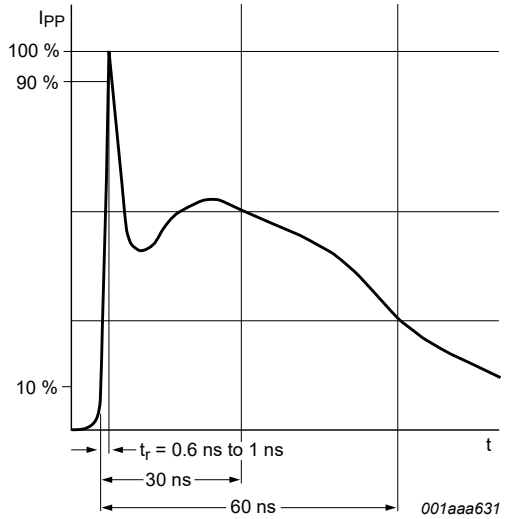

Fig. 2. ESD pulse waveform according to IEC 61000-4-2

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9. Characteristics

Table 6. Characteristics

t_{amb} = 25°C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{BR}	breakdown voltage	I_R = 1 mA		4.2	6.8	8	V
I_{RM}	reverse leakage current	V_{RWM} = 4 V; T_{amb} = 25 °C		-	1	50	nA
C_d	diode capacitance	f = 1 MHz; V_R = 0 V		-	0.55	0.65	pF
		f = 1 MHz; V_R = 1.5 V		-	0.5	0.6	pF
V_{CL}	clamping voltage	I_{PPM} = 20 A	[1]	-	5.1	-	V
R_{dyn}	dynamic resistance	I_R = 10 A	[2]	-	0.1	-	Ω
		I_R = -10 A	[2]	-	0.1	-	Ω
f_{-3dB}	-3 dB cut-off frequency	normalized to attenuation at 1 MHz		-	11.6	-	GHz

[1] Device stressed with 8/20 µs exponential decay waveform according to IEC 61000-4-5.
[2] Non-repetitive current pulse, Transmission Line Pulse (TLP); square pulse; ANSI / ESD STM5.5.1-2008.

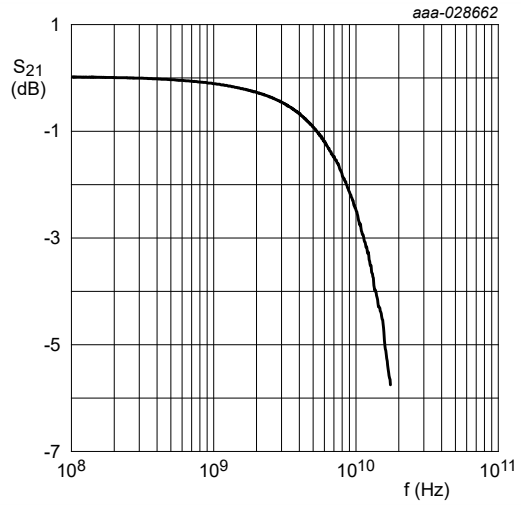
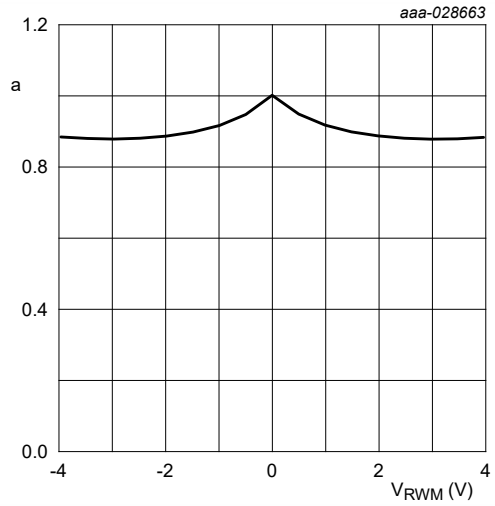


Fig. 3. Insertion loss; typical values



$$a = \frac{C_d}{C_d(V_{RWM} = 0\ V)}$$

Fig. 4. Relative capacitance as a function of reverse standoff voltage; typical values

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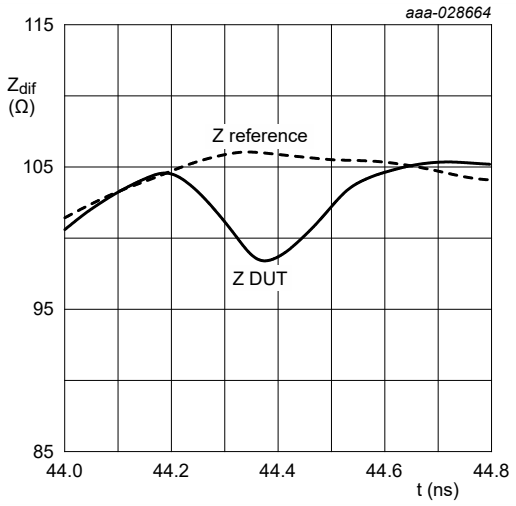
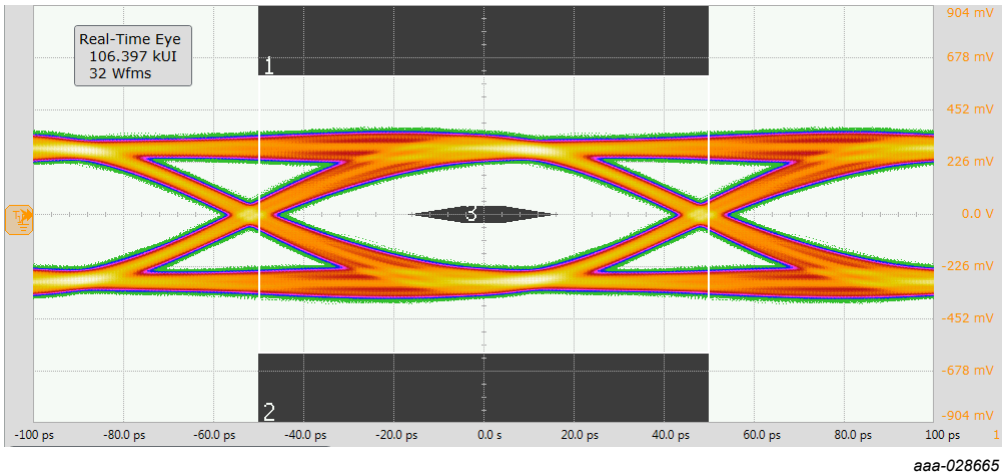


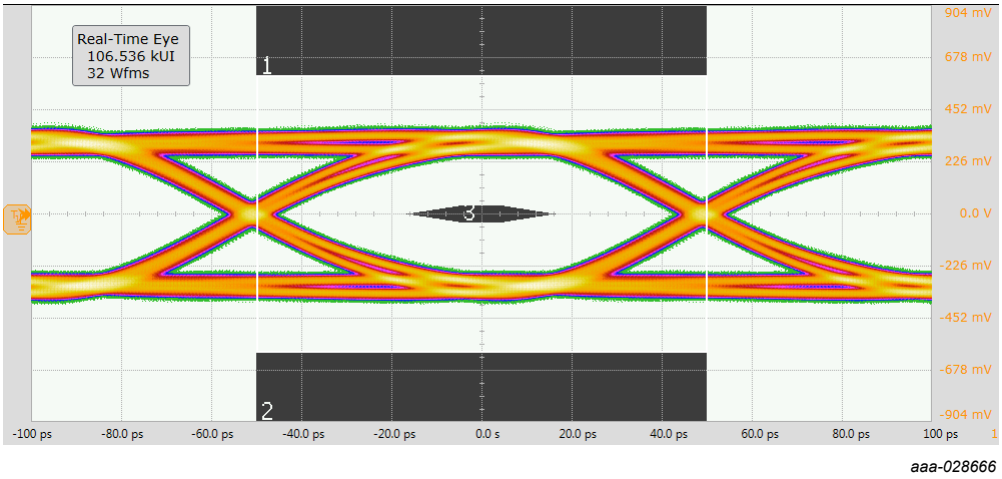
rise time = 200 ps

Fig. 5. Differential Time Domain Reflectometer (TDR) plot; typical values



Data rate: 10 Gbit/s

Fig. 6. USB 3.2 eye diagram, PCB with device; typical values



Data rate: 10 Gbit/s

Fig. 7. USB 3.2 eye diagram, PCB without device; typical values

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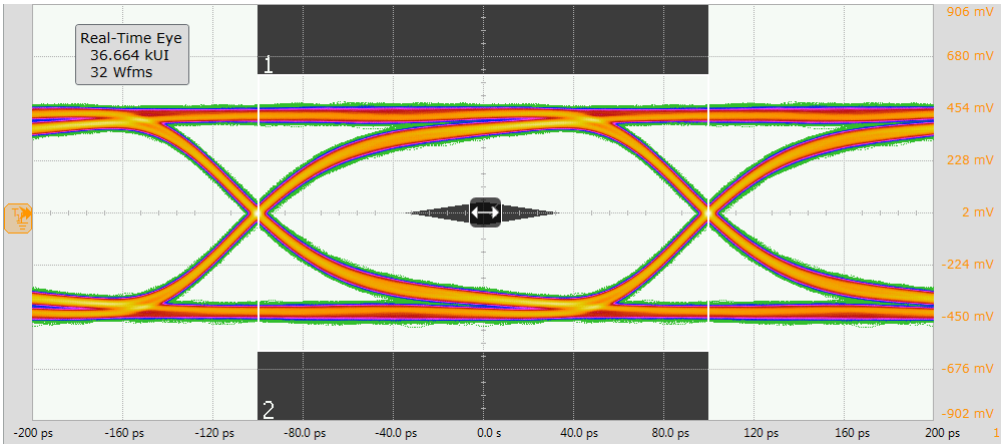
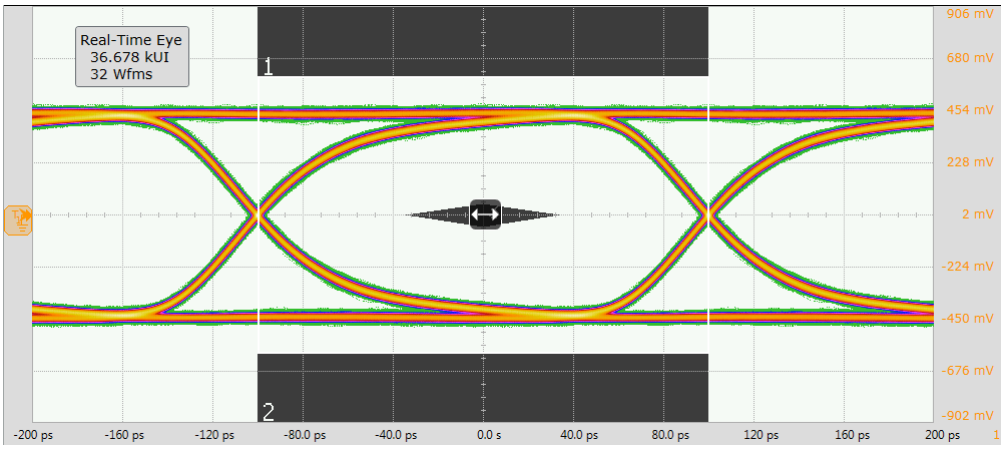


aaa-028667

Data rate: 5 Gbit/s

Fig. 8. USB 3.2 eye diagram, PCB with device; typical values



aaa-028668

Data rate: 5 Gbit/s

Fig. 9. USB 3.2 eye diagram, PCB without device; typical values

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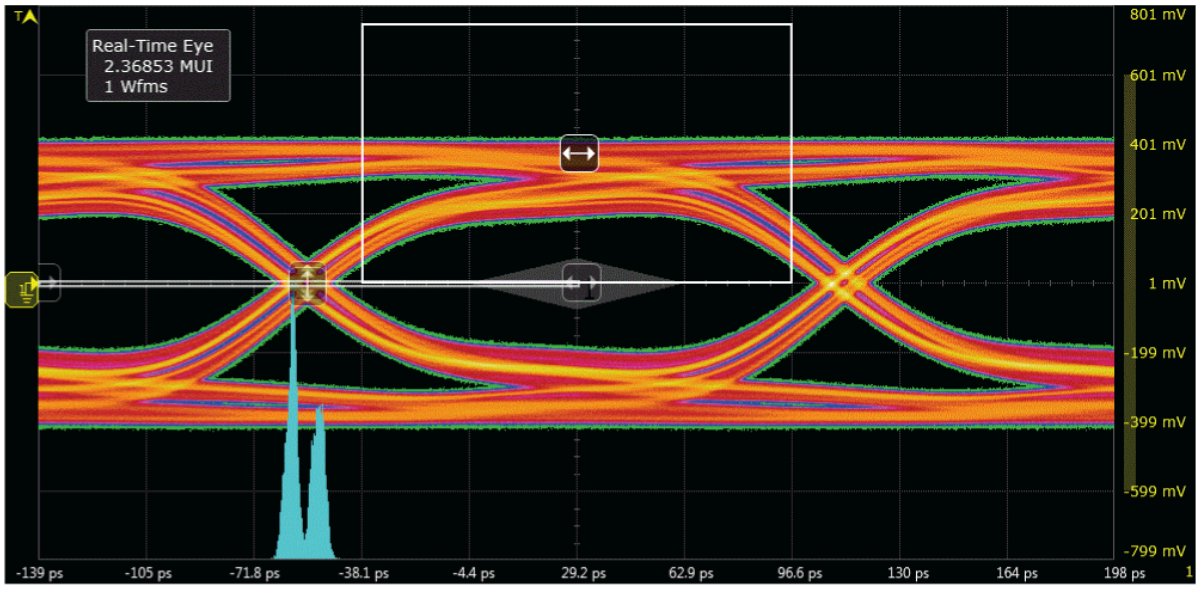
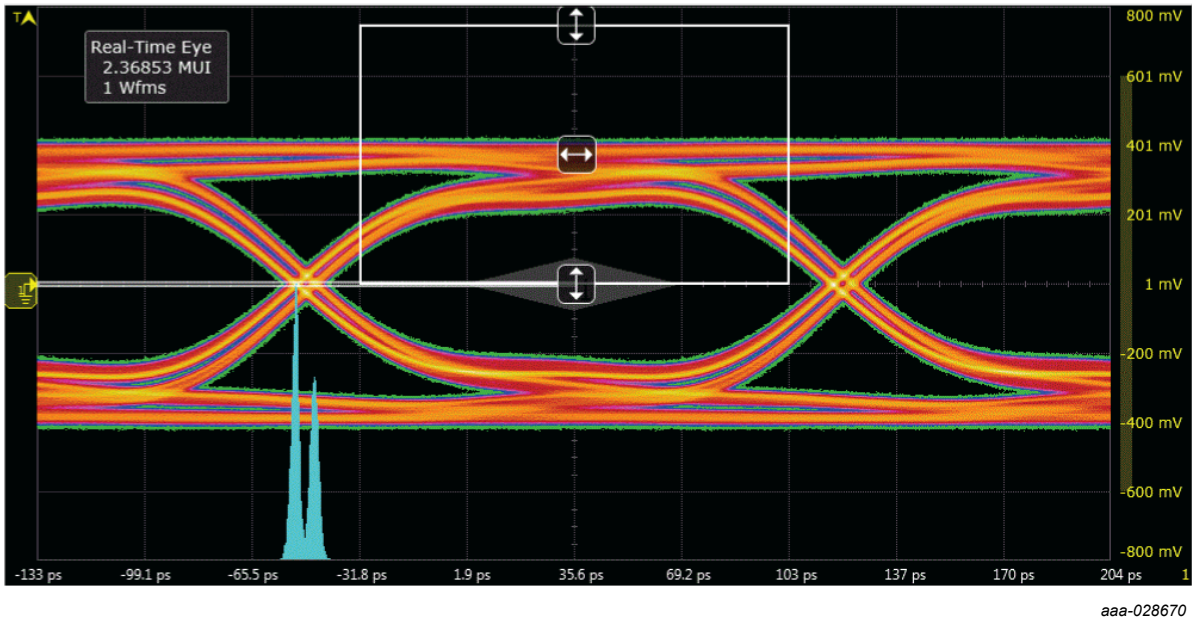


1080p
Data rate: 6 Gbit/s

Fig. 10. HDMI2.0 TP1 eye diagram, PCB with device; typical values



1080p
Data rate: 6 Gbit/s

Fig. 11. HDMI2.0 TP1 eye diagram, PCB without device; typical values

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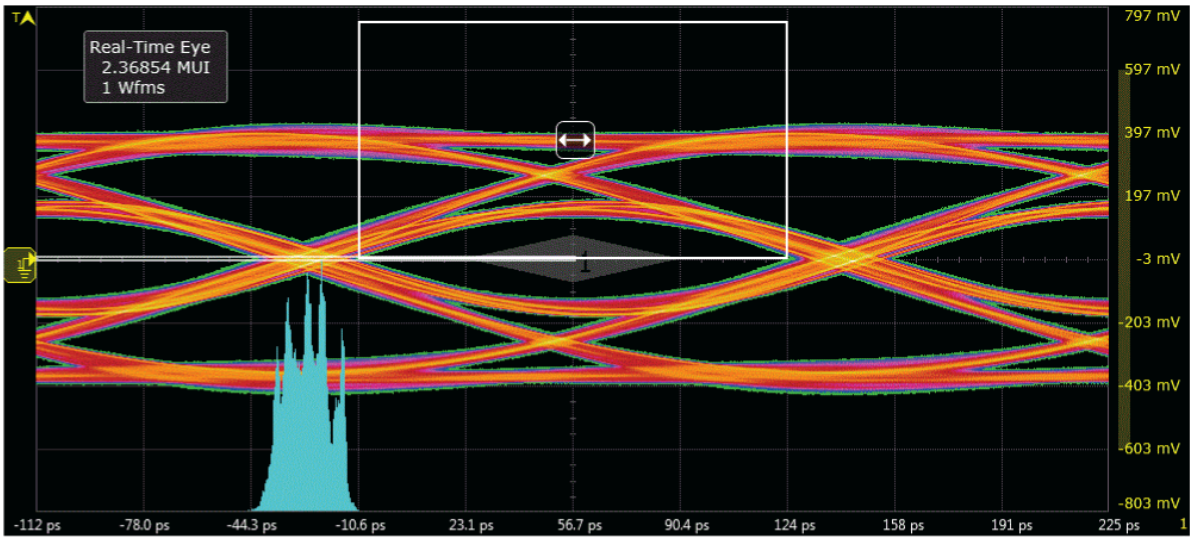
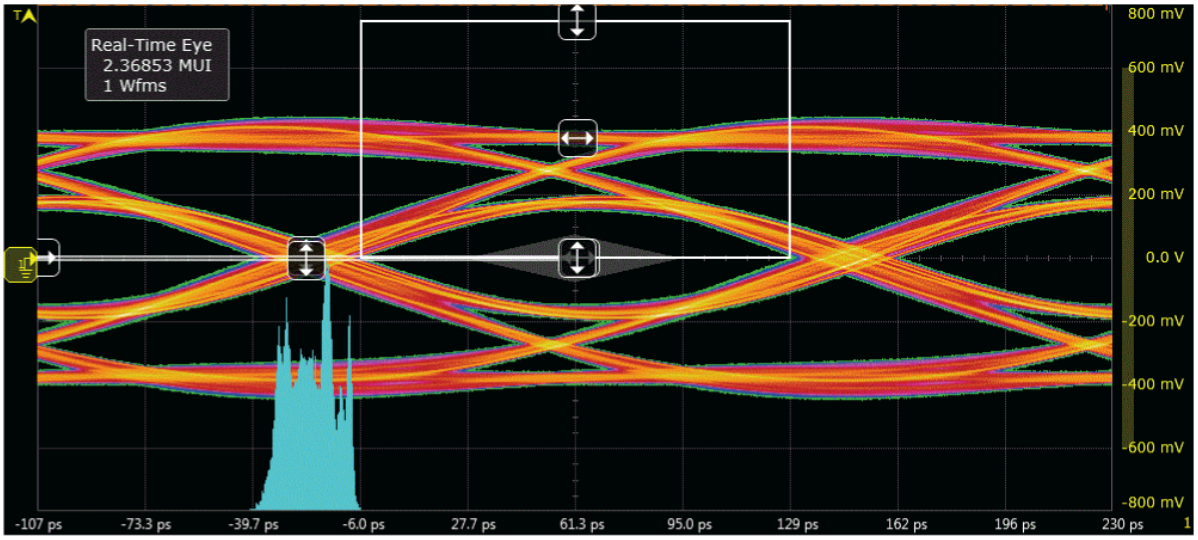


aaa-028671

1080p
Data rate: 6 Gbit/s

Fig. 12. HDMI2.0 TP2 eye diagram, PCB with device; typical values



aaa-028672

1080p
Data rate: 6 Gbit/s

Fig. 13. HDMI2.0 TP2 eye diagram, PCB without device; typical values

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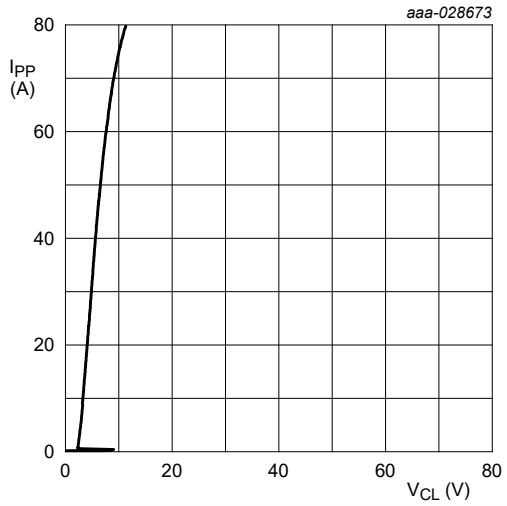
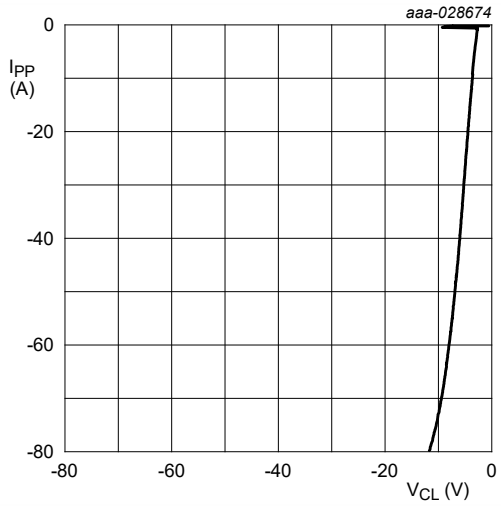


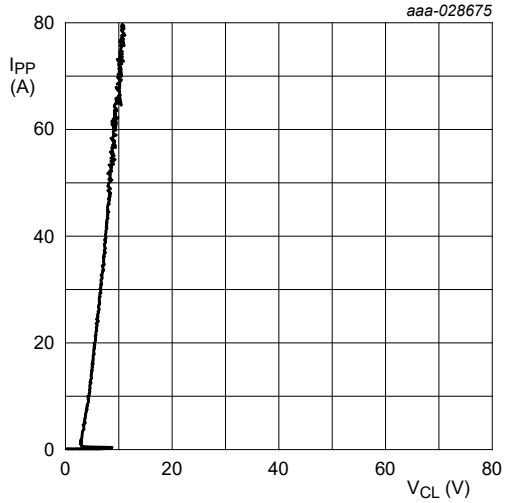
t_r = 1 ns
t_p = 100 ns; Transmission Line Pulse (TLP)

Fig. 14. Dynamic resistance with positive clamping; typical values



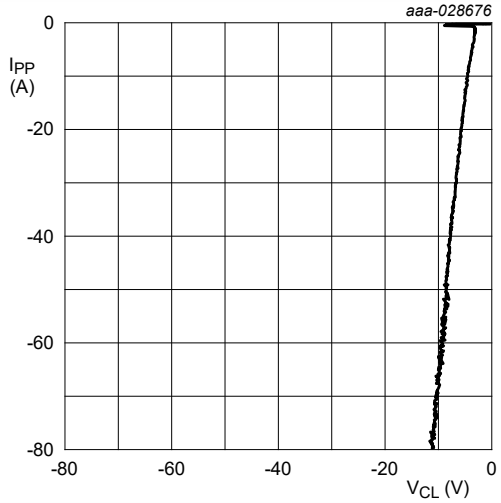
t_r = 1 ns
t_p = 100 ns; Transmission Line Pulse (TLP)

Fig. 15. Dynamic resistance with negative clamping; typical values



t_r = 600 ps
t_p = 5 ns; Very-Fast Transmission Line Pulse (VF-TLP)

Fig. 16. Dynamic resistance with positive clamping; typical values



t_r = 600 ps
t_p = 5 ns; Very-Fast Transmission Line Pulse (VF-TLP)

Fig. 17. Dynamic resistance with negative clamping; typical values

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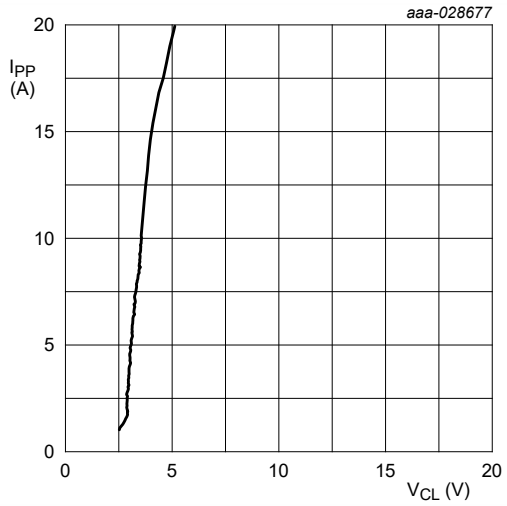
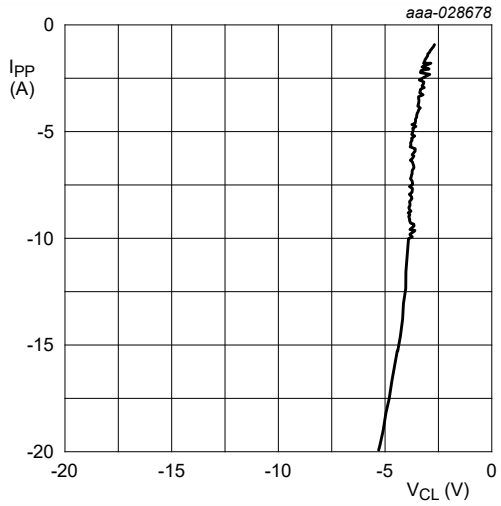


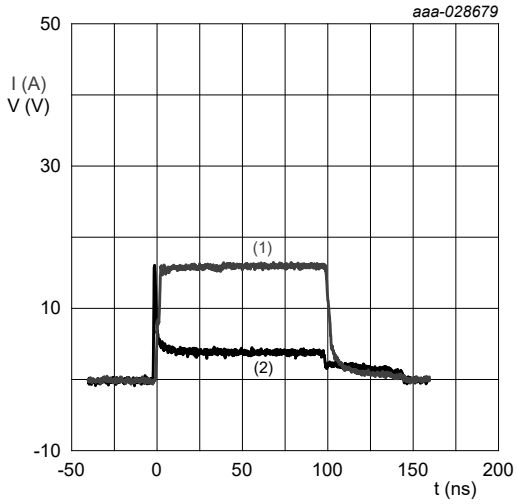
IEC 61000-4-5; t_p = 8/20 μs; positive pulse

Fig. 18. Dynamic resistance with positive clamping; typical values



IEC 61000-4-5; t_p = 8/20 μs; negative pulse

Fig. 19. Dynamic resistance with negative clamping; typical values



t_r = 1 ns
(1) TLP current
(2) TLP voltage

Fig. 20. TLP voltage and current over time, typical values

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10. Application information

The device is designed for the protection of one bidirectional data line from surge pulses and ESD damage. The device is suitable on lines where the signal polarities are both positive and negative with respect to ground.

The device uses an advanced clamping structure showing a negative dynamic resistance. This snap-back behavior strongly reduces the clamping voltage to the system behind the ESD protection during an ESD event. Do not connect unlimited DC current sources to the data lines to avoid keeping the ESD protection device in snap-back state after exceeding breakdown voltage (due to an ESD pulse for instance).

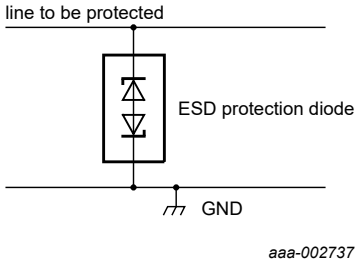

Fig. 21. Application diagram

Circuit board layout and protection device placement

Circuit board layout is critical for the suppression of ESD, Electrical Fast Transient (EFT) and surge transients. The following guidelines are recommended:

1. Place the device as close to the input terminal or connector as possible.
2. Minimize the path length between the device and the protected line.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit Board (PCB) conductive loops including power and ground loops.
6. Minimize the length of the transient return path to ground.
7. Avoid using shared transient return paths to a common ground point.
8. Use ground planes whenever possible. For multilayer PCBs, use ground vias.

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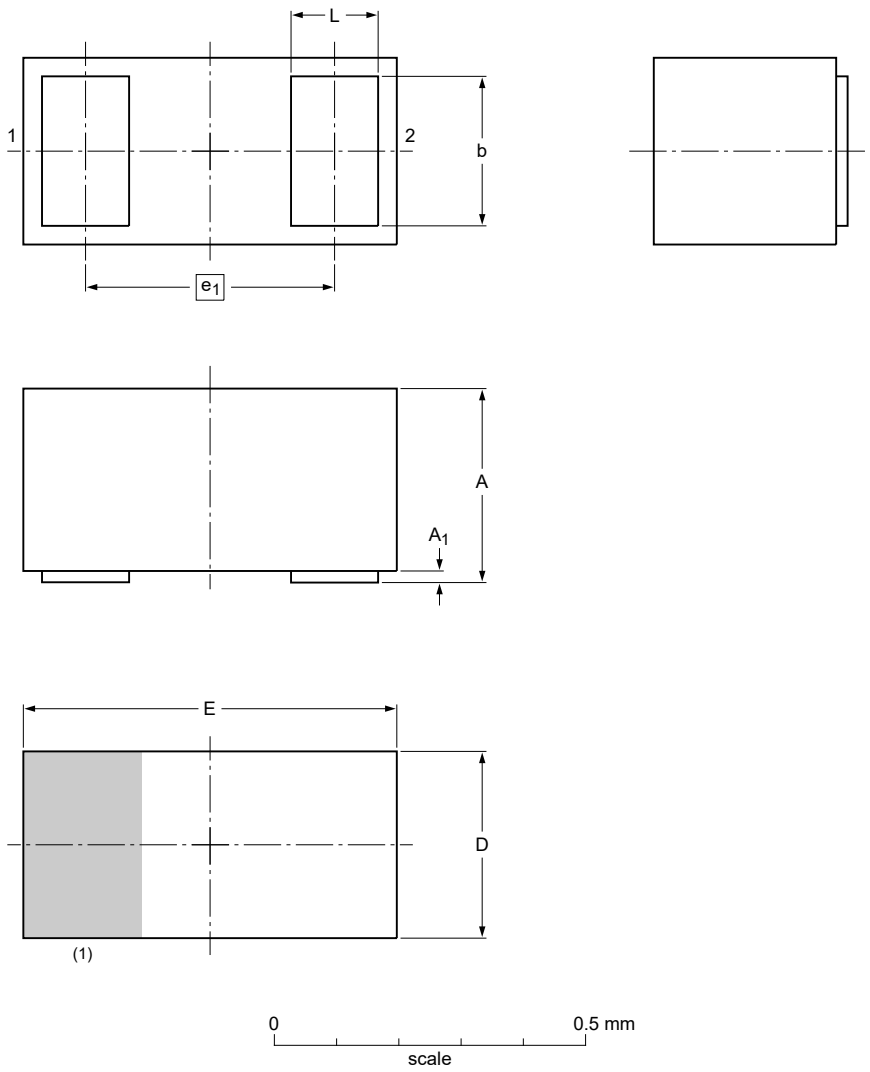
11. Package outline

Leadless ultra small package; 2 terminals; body 0.6 x 0.3 x 0.3 mm **SOD962-2**



Dimensions (mm are the original dimensions)

Unit		A	A_1	b	D	E	e_1	L
mm	max	0.32	0.03	0.25	0.325	0.625		0.15
	nom						0.4	
	min	0.28		0.23	0.275	0.575		0.13

Note
1. The marking bar indicates the cathode.

sod962-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOD962-2						~~13-07-12~~ 13-07-17

Fig. 22. Package outline DSN0603-2 (SOD962-2)

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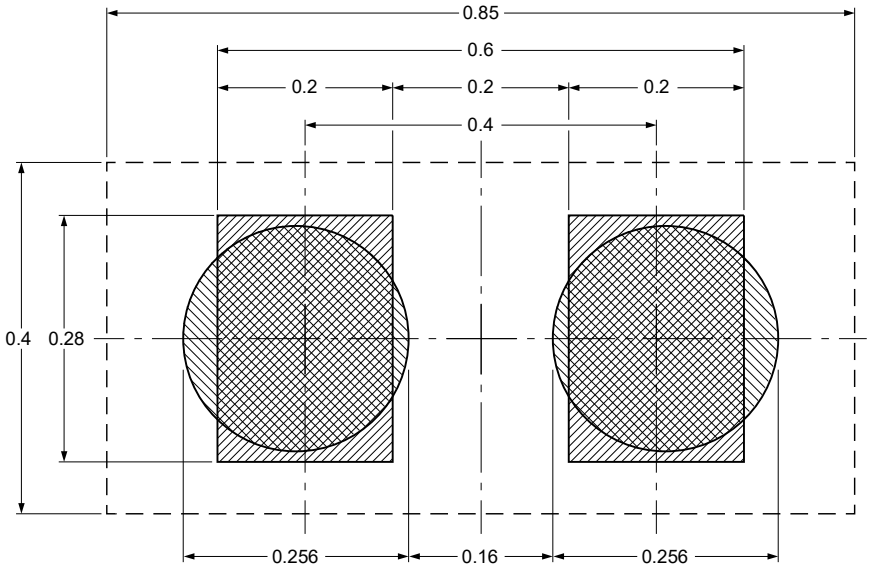
12. Soldering

Footprint information for reflow soldering of leadless ultra small package; 2 terminals **SOD962-2**



recommended stencil thickness: 0.1 mm

occupied area

solder paste

solder lands

Dimensions in mm

Issue date ~~16-02-01~~ 20-09-15

sod962-2_fr

Fig. 23. Reflow soldering footprint for DSN0603-2 (SOD962-2)

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13. Revision history

Table 7. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PESD4V0W1BCSF v.4	20210928	Product data sheet	-	PESD4V0W1BCSF v.3
Modifications:	• Chapter "Characteristics": added limits to parameter V_{BR}			
PESD4V0W1BCSF v.3	20210302	Product data sheet	-	PESD4V0W1BCSF v.2
PESD4V0W1BCSF v.2	20190403	Product data sheet	-	PESD4V0W1BCSF v.1
PESD4V0W1BCSF v.1	20180627	Product data sheet	-	-

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14. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

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Date of release: 28 September 2021