

# PESDxS1UL series

ESD protection diodes in a SOD882 package

Rev. 02 — 20 August 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Unidirectional ElectroStatic Discharge (ESD) protection diodes in a SOD882 leadless ultra small Surface Mounted Device (SMD) plastic package designed to protect one signal line from the damage caused by ESD and other transients.

### 1.2 Features

- Ultra small SMD plastic package
- ESD protection of one line
- Max. peak pulse power:  $P_{PP} = 150 \text{ W}$
- Low clamping voltage:  $V_{CL} = 20 \text{ V}$
- Ultra low leakage current:  $I_{RM} < 700 \text{ nA}$
- ESD protection up to 30 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5; (surge);  $I_{PP}$  up to 15 A

### 1.3 Applications

- Computers and peripherals
- Audio and video equipment
- Parallel ports
- Communication systems
- High-speed data lines



### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{RWM}$	reverse stand-off voltage					
	PESD3V3S1UL		-	-	3.3	V
	PESD5V0S1UL		-	-	5.0	V
	PESD12VS1UL		-	-	12	V
	PESD15VS1UL		-	-	15	V
	PESD24VS1UL		-	-	24	V
$C_d$	diode capacitance	$f = 1 \text{ MHz}; V_R = 0 \text{ V}$				
	PESD3V3S1UL		-	207	300	pF
	PESD5V0S1UL		-	152	200	pF
	PESD12VS1UL		-	38	75	pF
	PESD15VS1UL		-	32	70	pF
	PESD24VS1UL		-	23	50	pF

## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Symbol
1	cathode	 <p>Transparent top view</p>	 <p>sym035</p>
2	anode		

[1] The marking bar indicates the cathode.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PESD3V3S1UL	-	leadless ultra small plastic package; 2 terminals; body 1.0 × 0.6 × 0.5 mm	SOD882
PESD5V0S1UL			
PESD12VS1UL			
PESD15VS1UL			
PESD24VS1UL			

## 4. Marking

Table 4. Marking codes

Type number	Marking code
PESD3V3S1UL	G1
PESD5V0S1UL	G2
PESD12VS1UL	G3
PESD15VS1UL	G4
PESD24VS1UL	G5

## 5. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
P <sub>PP</sub>	peak pulse power	t <sub>p</sub> = 8/20 μs	[1]	-	150 W
I <sub>PP</sub>	peak pulse current	t <sub>p</sub> = 8/20 μs	[1]		
	PESD3V3S1UL		-	15	A
	PESD5V0S1UL		-	15	A
	PESD12VS1UL		-	5	A
	PESD15VS1UL		-	5	A
	PESD24VS1UL		-	3	A
T <sub>j</sub>	junction temperature		-	150	°C
T <sub>amb</sub>	ambient temperature		-65	+150	°C
T <sub>stg</sub>	storage temperature		-65	+150	°C

[1] Non-repetitive current pulse 8/20 μs exponential decay waveform according to IEC 61000-4-5.

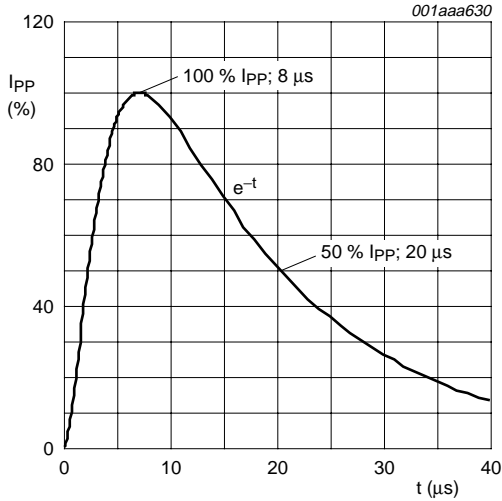
**Table 6. ESD maximum ratings**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>ESD</sub>	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge)	[1]		
	PESD3V3S1UL		-	30	kV
	PESD5V0S1UL		-	30	kV
	PESD12VS1UL		-	30	kV
	PESD15VS1UL		-	30	kV
	PESD24VS1UL		-	23	kV
	PESDxS1UL series	HBM MIL-STD-883	-	10	kV

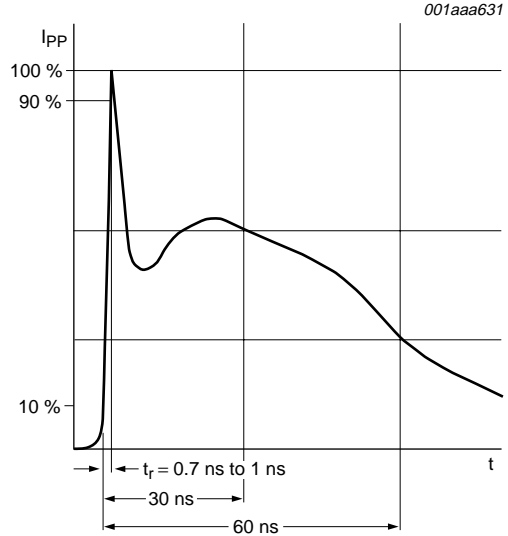
[1] Device stressed with ten non-repetitive ESD pulses.

**Table 7. ESD standards compliance**

Standard	Conditions
IEC 61000-4-2; level 4 (ESD)	> 15 kV (air); > 8 kV (contact)
HBM MIL-STD-883; class 3	> 4 kV



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



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

## 6. Characteristics

**Table 8. Characteristics**

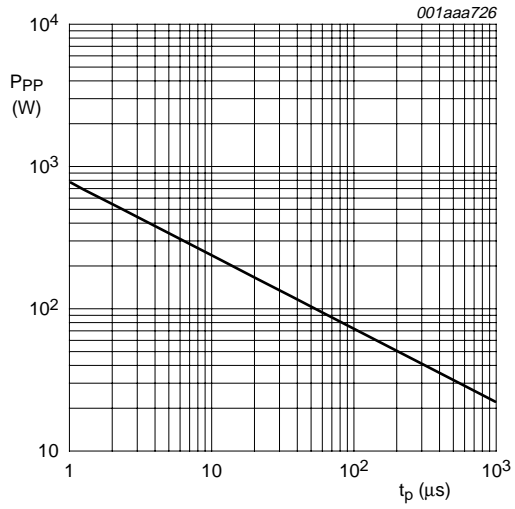
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{RWM}$	reverse stand-off voltage					
	PESD3V3S1UL		-	-	3.3	V
	PESD5V0S1UL		-	-	5.0	V
	PESD12VS1UL		-	-	12	V
	PESD15VS1UL		-	-	15	V
	PESD24VS1UL		-	-	24	V
$I_{RM}$	reverse leakage current					
	PESD3V3S1UL	$V_{RWM} = 3.3\text{ V}$	-	0.7	2	$\mu\text{A}$
	PESD5V0S1UL	$V_{RWM} = 5.0\text{ V}$	-	0.1	1	$\mu\text{A}$
	PESD12VS1UL	$V_{RWM} = 12\text{ V}$	-	< 1	50	nA
	PESD15VS1UL	$V_{RWM} = 15\text{ V}$	-	< 1	50	nA
	PESD24VS1UL	$V_{RWM} = 24\text{ V}$	-	< 1	50	nA
$V_{BR}$	breakdown voltage	$I_R = 5\text{ mA}$				
	PESD3V3S1UL		5.2	5.6	6.0	V
	PESD5V0S1UL		6.4	6.8	7.2	V
	PESD12VS1UL		14.7	15.0	15.3	V
	PESD15VS1UL		17.6	18.0	18.4	V
	PESD24VS1UL		26.5	27.0	27.5	V

**Table 8. Characteristics ...continued** $T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified

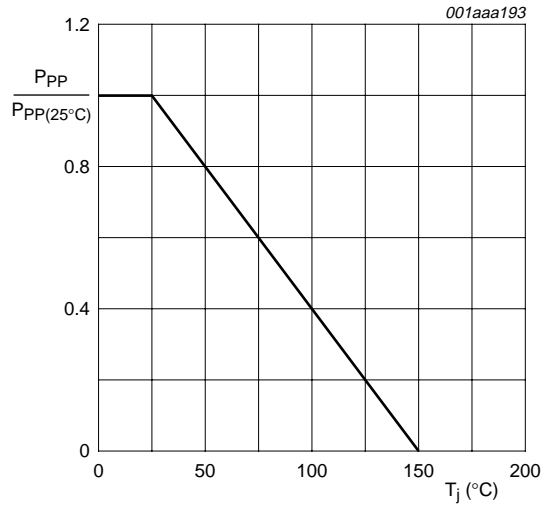
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_d$	diode capacitance	$f = 1\text{ MHz}; V_R = 0\text{ V}$				
	PESD3V3S1UL		-	207	300	pF
	PESD5V0S1UL		-	152	200	pF
	PESD12VS1UL		-	38	75	pF
	PESD15VS1UL		-	32	70	pF
	PESD24VS1UL		-	23	50	pF
$V_{CL}$	clamping voltage		[1]			
	PESD3V3S1UL	$I_{PP} = 1\text{ A}$	-	-	8	V
		$I_{PP} = 15\text{ A}$	-	-	20	V
	PESD5V0S1UL	$I_{PP} = 1\text{ A}$	-	-	9	V
		$I_{PP} = 15\text{ A}$	-	-	20	V
	PESD12VS1UL	$I_{PP} = 1\text{ A}$	-	-	19	V
		$I_{PP} = 5\text{ A}$	-	-	35	V
	PESD15VS1UL	$I_{PP} = 1\text{ A}$	-	-	23	V
		$I_{PP} = 5\text{ A}$	-	-	40	V
	PESD24VS1UL	$I_{PP} = 1\text{ A}$	-	-	36	V
		$I_{PP} = 3\text{ A}$	-	-	70	V
	$r_{dif}$	differential resistance				
PESD3V3S1UL		$I_R = 1\text{ mA}$	-	-	400	$\Omega$
PESD5V0S1UL		$I_R = 1\text{ mA}$	-	-	80	$\Omega$
PESD12VS1UL		$I_R = 1\text{ mA}$	-	-	200	$\Omega$
PESD15VS1UL		$I_R = 1\text{ mA}$	-	-	225	$\Omega$
PESD24VS1UL		$I_R = 0.5\text{ mA}$	-	-	300	$\Omega$

[1] Non-repetitive current pulse 8/20  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.

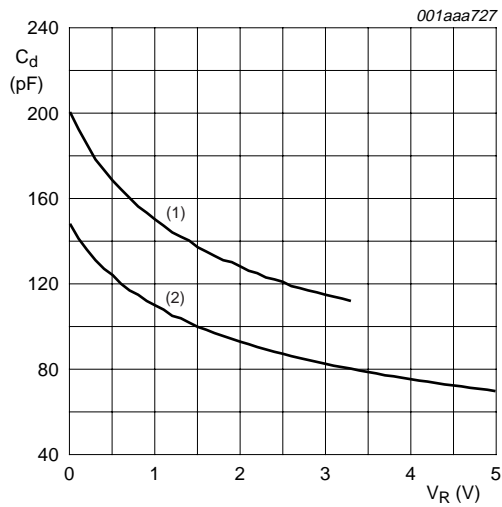


$T_{amb} = 25\text{ }^{\circ}\text{C}$

**Fig 3. Peak pulse power as a function of exponential pulse duration; typical values**



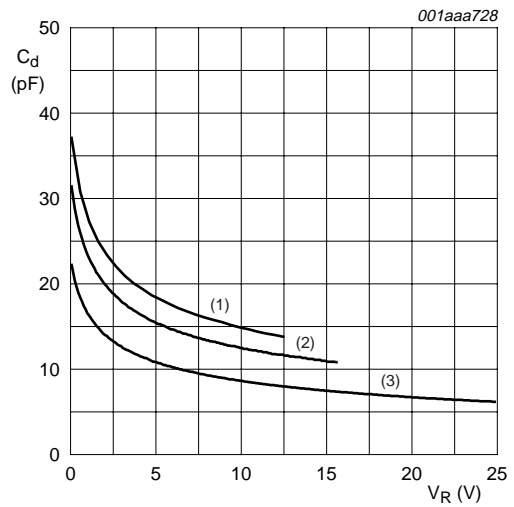
**Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values**



$f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$

- (1) PESD3V3S1UL;  $V_{RWM} = 3.3\text{ V}$
- (2) PESD5V0S1UL;  $V_{RWM} = 5.0\text{ V}$

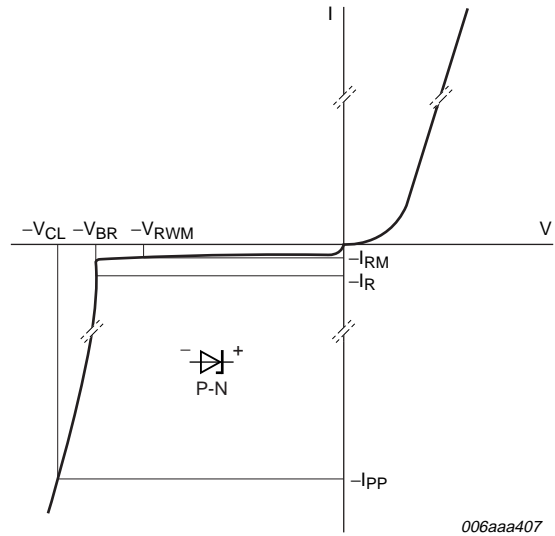
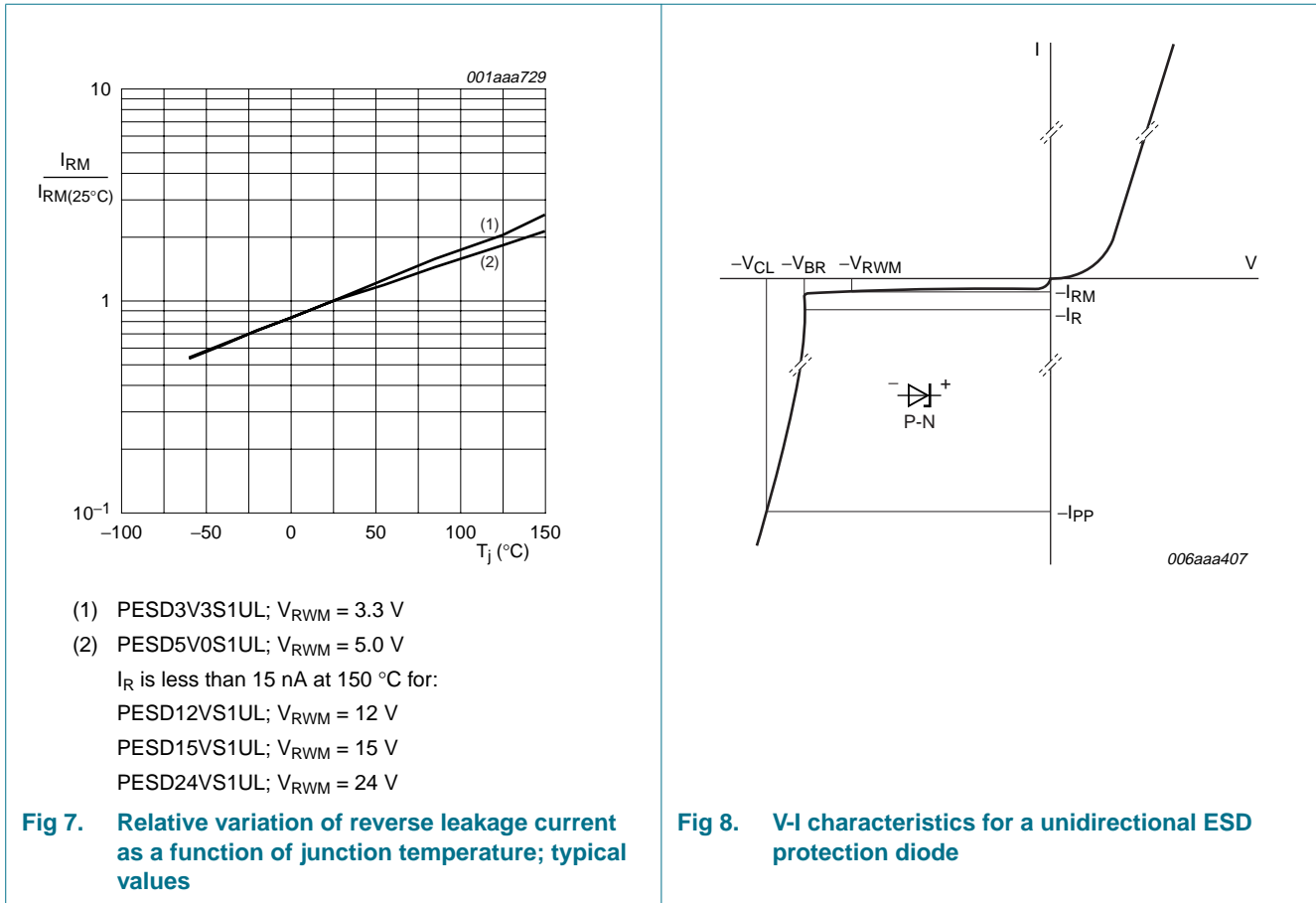
**Fig 5. Diode capacitance as a function of reverse voltage; typical values**



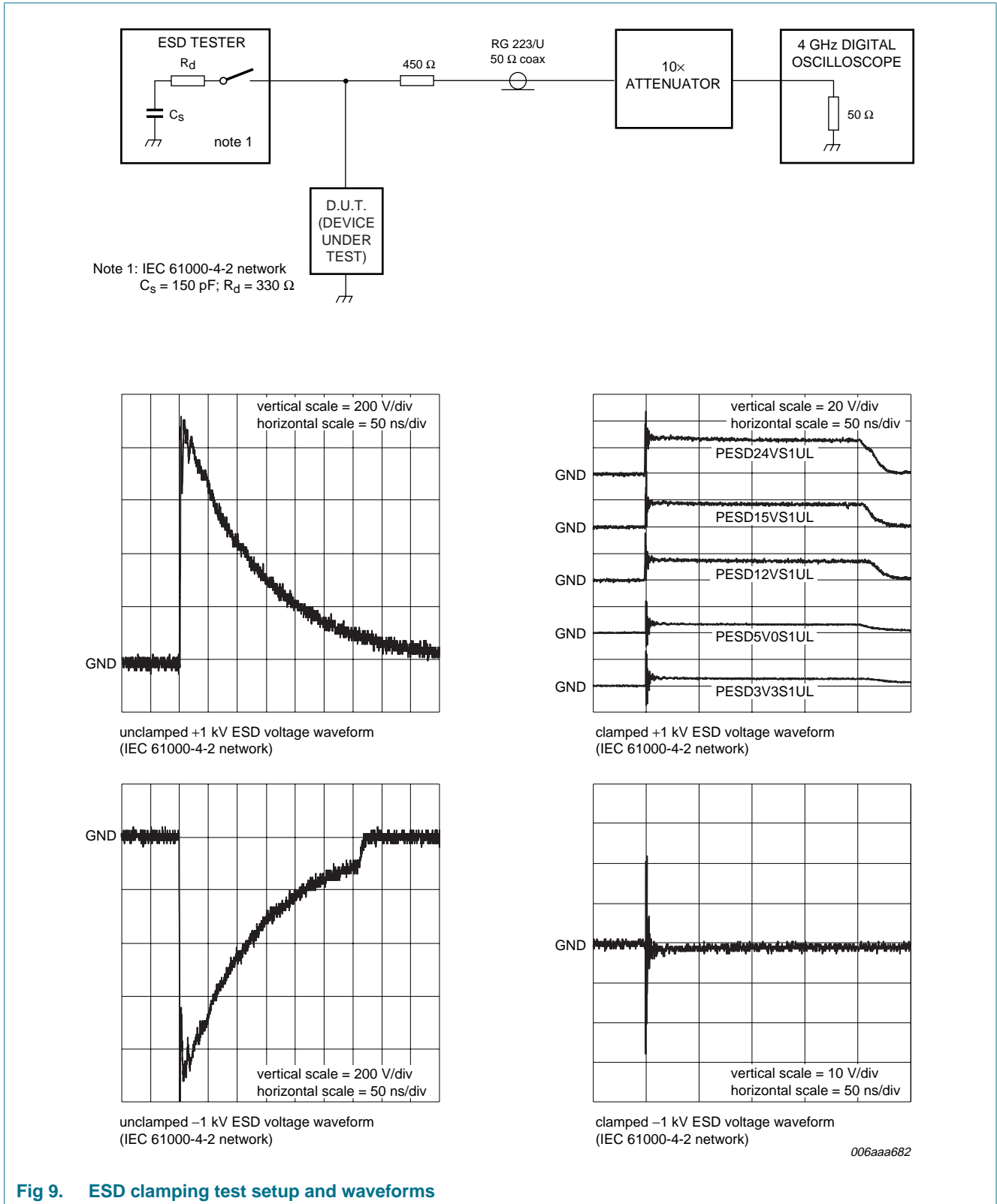
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$

- (1) PESD12VS1UL;  $V_{RWM} = 12\text{ V}$
- (2) PESD15VS1UL;  $V_{RWM} = 15\text{ V}$
- (3) PESD24VS1UL;  $V_{RWM} = 24\text{ V}$

**Fig 6. Diode capacitance as a function of reverse voltage; typical values**



**Fig 8. V-I characteristics for a unidirectional ESD protection diode**

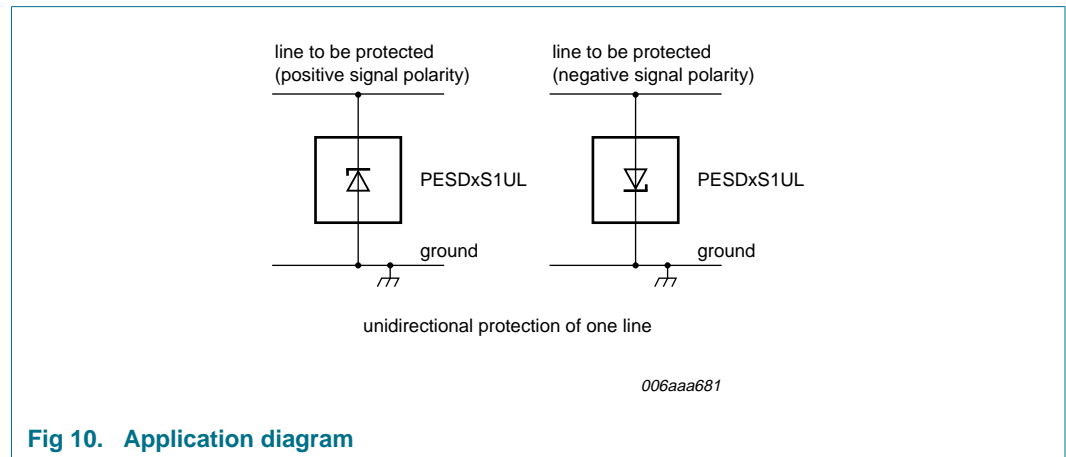


**Fig 9. ESD clamping test setup and waveforms**



## 7. Application information

The PESDxS1UL series is designed for protection of one unidirectional data line from the damage caused by ESD and surge pulses. The PESDxS1UL series may be used on lines where the signal polarities are either positive or negative with respect to ground. The PESDxS1UL series provides a surge capability of 150 W for an 8/20  $\mu$ s waveform.



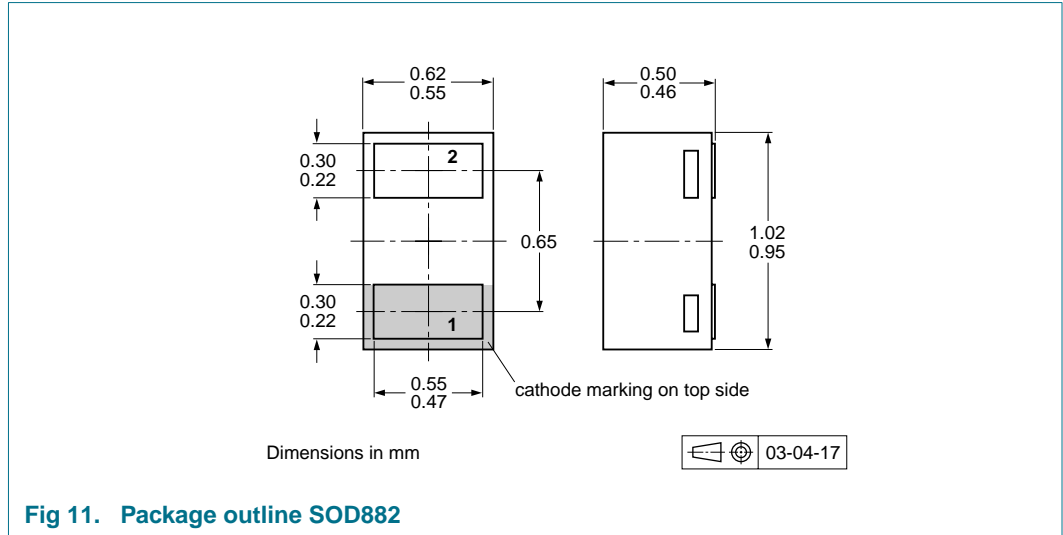
**Fig 10. Application diagram**

### 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 PESDxS1UL as close to the input terminal or connector as possible.
2. The path length between the PESDxS1UL and the protected line should be minimized.
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. Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

## 8. Package outline



## 9. Packing information

**Table 9. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

Type number	Package	Description	Packing quantity
			10000
PESD3V3S1UL	SOD882	4 mm pitch, 8 mm tape and reel	-315
PESD5V0S1UL			
PESD12VS1UL			
PESD15VS1UL			
PESD24VS1UL			

[1] For further information and the availability of packing methods, see [Section 12](#).

## 10. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PESDXS1UL_SER_2	20090820	Product data sheet	-	PESDXS1UL_SER_1
Modifications:	<ul style="list-style-type: none"><li>This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content.</li></ul>			
PESDXS1UL_SER_1	20060331	Product data sheet	-	-

## 11. Legal information

### 11.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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 URL <http://www.nxp.com>.

### 11.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

### 11.3 Disclaimers

**General** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental

damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

**Terms and conditions of sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

**Quick reference data** — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

### 11.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 12. Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

**13. Contents**

**1 Product profile . . . . . 1**

1.1 General description . . . . . 1

1.2 Features . . . . . 1

1.3 Applications . . . . . 1

1.4 Quick reference data . . . . . 1

**2 Pinning information . . . . . 2**

**3 Ordering information . . . . . 2**

**4 Marking . . . . . 2**

**5 Limiting values . . . . . 3**

**6 Characteristics . . . . . 4**

**7 Application information . . . . . 9**

**8 Package outline . . . . . 10**

**9 Packing information . . . . . 10**

**10 Revision history . . . . . 11**

**11 Legal information . . . . . 12**

11.1 Data sheet status . . . . . 12

11.2 Definitions . . . . . 12

11.3 Disclaimers . . . . . 12

11.4 Trademarks . . . . . 12

**12 Contact information . . . . . 12**

**13 Contents . . . . . 13**

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.



© NXP B.V. 2009.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

Date of release: 20 August 2009

Document identifier: PESDxS1UL\_SER\_2