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Kind regards,


Team Nexperia

# PESDxS1UL series

**Unidirectional ESD protection diodes**

Rev. 3 — 25 October 2011                                        **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 and benefits

- Ultra small SMD plastic package
- ESD protection of one line
- Max. peak pulse power: $P_{PP}$ = 150 W
- Low clamping voltage: $V_{CL}$ = 20 V
- AEC-Q101 qualified

- Ultra low leakage current: $I_{RM}$ < 700 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 standoff voltage | | | | | |
| | PESD3V3S1UL | | - | - | 3.3 | V |
| | PESD5V0S1UL | | - | - | 5.0 | V |
| | PESD12VS1UL | | - | - | 12 | V |
| | PESD15VS1UL | | - | - | 15 | V |
| | PESD24VS1UL | | - | - | 24 | V |
| $C_d$ | diode capacitance | f = 1 MHz; $V_R$ = 0 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 | Graphic symbol |
|-----|-------------|--------------------|----------------|
| 1 | cathode [1] | | |
| 2 | anode | | |

Transparent top view

sym035

[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 |

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## 5. Limiting values

**Table 5.  Limiting values**
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|--------|-----------|------------|---|-----|-----|------|
| $P_{PP}$ | peak pulse power | $t_p = 8/20$ $\mu$s | [1] | - | 150 | W |
| $I_{PP}$ | peak pulse current | $t_p = 8/20$ $\mu$s | [1] | | | |
| | | PESD3V3S1UL | | - | 15 | A |
| | | PESD5V0S1UL | | - | 15 | A |
| | | PESD12VS1UL | | - | 5 | A |
| | | PESD15VS1UL | | - | 5 | A |
| | | PESD24VS1UL | | - | 3 | A |
| $T_j$ | junction temperature | | | - | 150 | °C |
| $T_{amb}$ | ambient temperature | | | −65 | +150 | °C |
| $T_{stg}$ | storage temperature | | | −65 | +150 | °C |

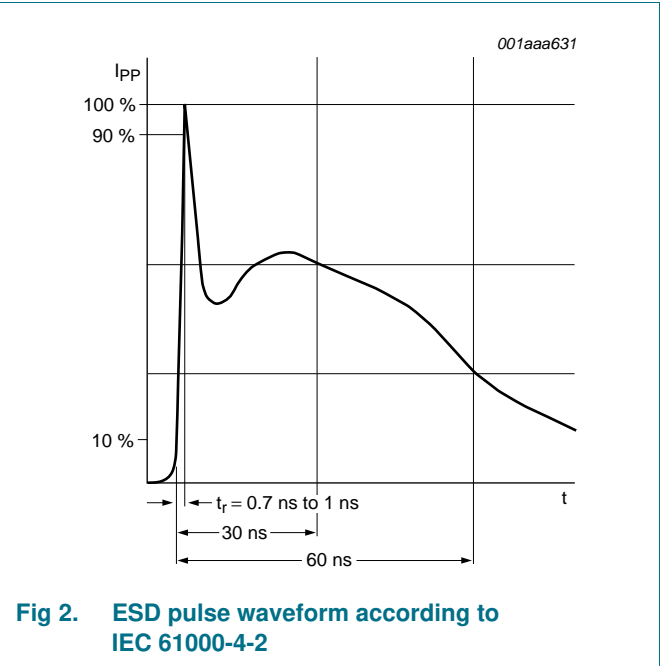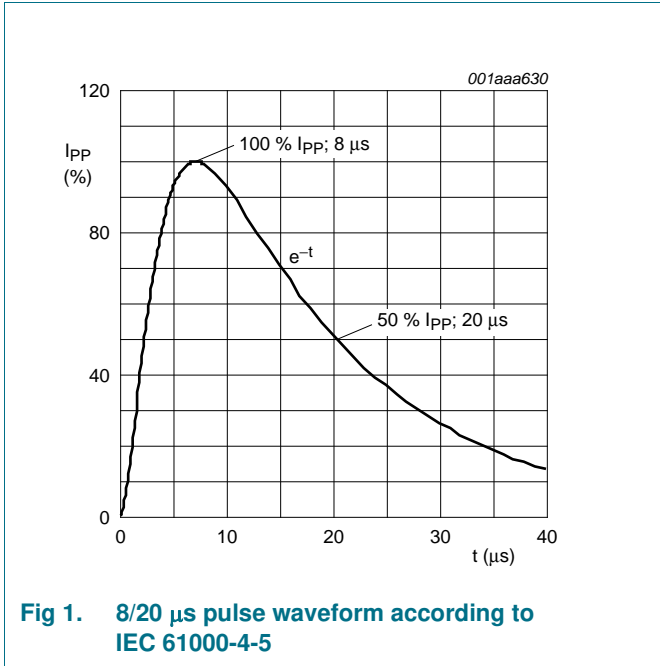[1]  Non-repetitive current pulse 8/20 $\mu$s exponential decay waveform according to IEC 61000-4-5.

**Table 6.  ESD maximum ratings**

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|--------|-----------|------------|---|-----|-----|------|
| $V_{ESD}$ | 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 | MIL-STD-883 (human body model) | - | 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) |
| MIL-STD-883; class 3B (human body model) | > 8 kV |

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**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 °C unless otherwise specified*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------|-----|-----|-----|------|
| $V_{RWM}$ | reverse standoff 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 V | - | 0.7 | 2 | µA |
| | PESD5V0S1UL | $V_{RWM}$ = 5.0 V | - | 0.1 | 1 | µA |
| | PESD12VS1UL | $V_{RWM}$ = 12 V | - | < 1 | 50 | nA |
| | PESD15VS1UL | $V_{RWM}$ = 15 V | - | < 1 | 50 | nA |
| | PESD24VS1UL | $V_{RWM}$ = 24 V | - | < 1 | 50 | nA |
| $V_{BR}$ | breakdown voltage | $I_R$ = 5 mA [1] | | | | |
| | 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 |

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**Table 8.    Characteristics** *…continued*
$T_{amb} = 25\ °C$ *unless otherwise specified*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_d$ | diode capacitance | f = 1 MHz; $V_R$ = 0 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 | [2] | | | | |
| | PESD3V3S1UL | $I_{PP}$ = 1 A | - | - | 8 | V |
| | | $I_{PP}$ = 15 A | - | - | 20 | V |
| | PESD5V0S1UL | $I_{PP}$ = 1 A | - | - | 9 | V |
| | | $I_{PP}$ = 15 A | - | - | 20 | V |
| | PESD12VS1UL | $I_{PP}$ = 1 A | - | - | 19 | V |
| | | $I_{PP}$ = 5 A | - | - | 35 | V |
| | PESD15VS1UL | $I_{PP}$ = 1 A | - | - | 23 | V |
| | | $I_{PP}$ = 5 A | - | - | 40 | V |
| | PESD24VS1UL | $I_{PP}$ = 1 A | - | - | 36 | V |
| | | $I_{PP}$ = 3 A | - | - | 70 | V |
| $r_{dif}$ | differential resistance | | | | | |
| | PESD3V3S1UL | $I_R$ = 1 mA | - | - | 400 | $\Omega$ |
| | PESD5V0S1UL | $I_R$ = 1 mA | - | - | 80 | $\Omega$ |
| | PESD12VS1UL | $I_R$ = 1 mA | - | - | 200 | $\Omega$ |
| | PESD15VS1UL | $I_R$ = 1 mA | - | - | 225 | $\Omega$ |
| | PESD24VS1UL | $I_R$ = 0.5 mA | - | - | 300 | $\Omega$ |

[1]    Pulse test: $t_p \leq 300\ \mu s$; duty cycle $\leq 0.02$.

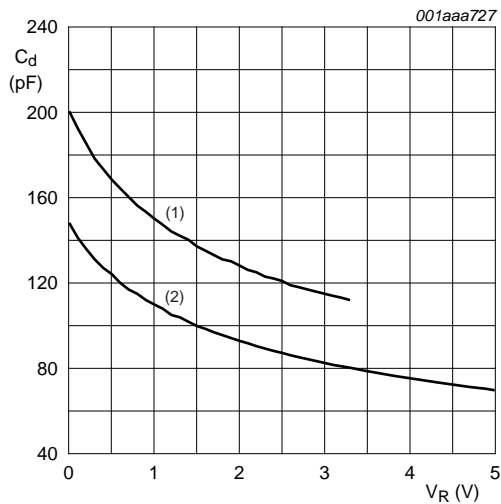[2]    Non-repetitive current pulse 8/20 $\mu s$ exponential decay waveform according to IEC 61000-4-5.
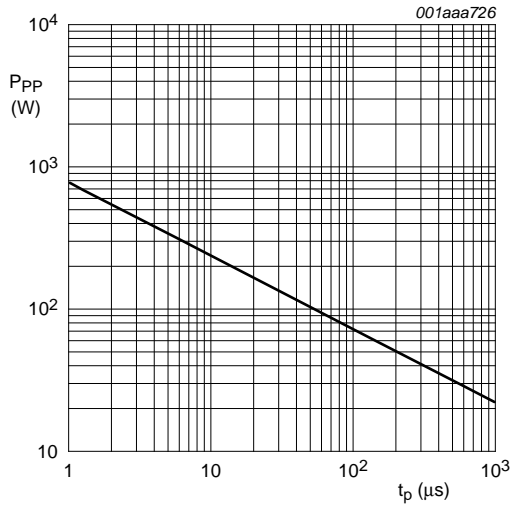
T_amb = 25 °C

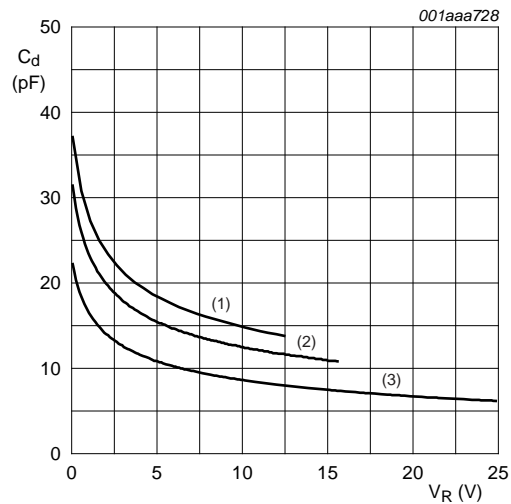**Fig 3.** Peak pulse power as a function of exponential pulse duration; typical values
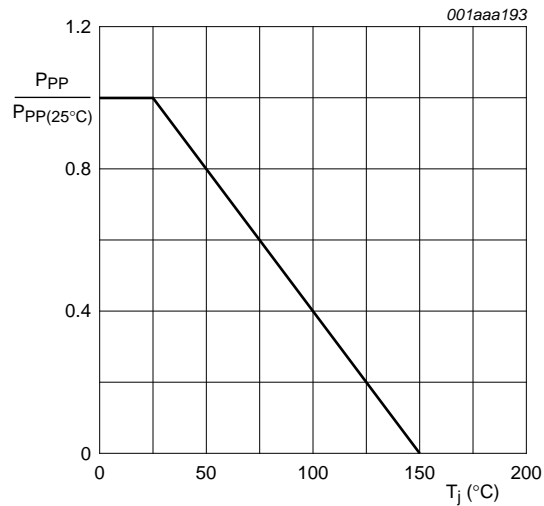


**Fig 4.** Relative variation of peak pulse power as a function of junction temperature; typical values



f = 1 MHz; T_amb = 25 °C

(1) PESD3V3S1UL; V_RWM = 3.3 V

(2) PESD5V0S1UL; V_RWM = 5.0 V

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



f = 1 MHz; T_amb = 25 °C

(1) PESD12VS1UL; V_RWM = 12 V

(2) PESD15VS1UL; V_RWM = 15 V

(3) PESD24VS1UL; V_RWM = 24 V

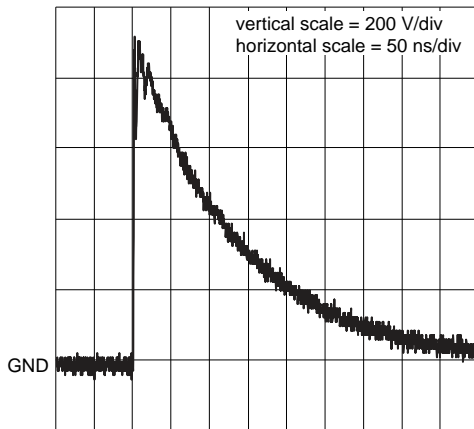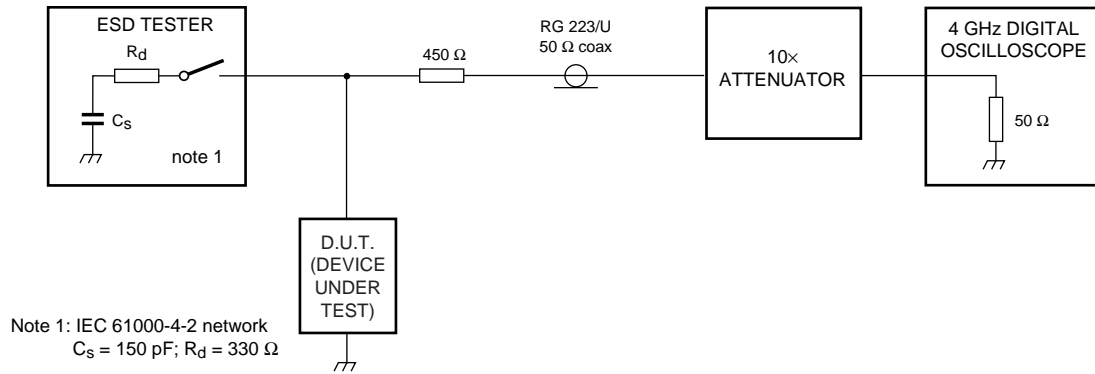**Fig 6.** Diode capacitance as a function of reverse voltage; typical values
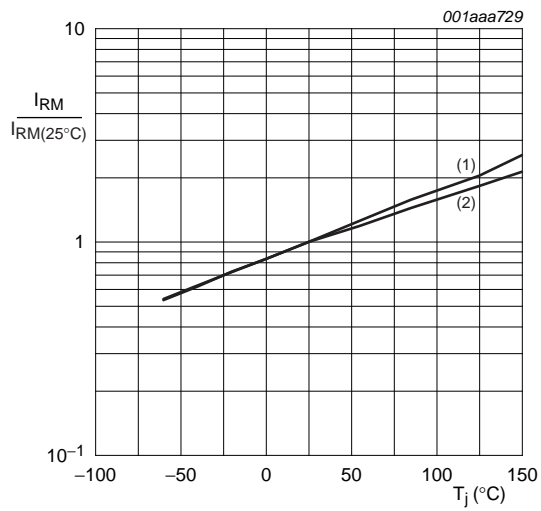
(1)   PESD3V3S1UL; $V_{RWM}$ = 3.3 V

(2)   PESD5V0S1UL; $V_{RWM}$ = 5.0 V

$I_R$ is less than 15 nA at 150 °C for:

PESD12VS1UL; $V_{RWM}$ = 12 V

PESD15VS1UL; $V_{RWM}$ = 15 V

PESD24VS1UL; $V_{RWM}$ = 24 V

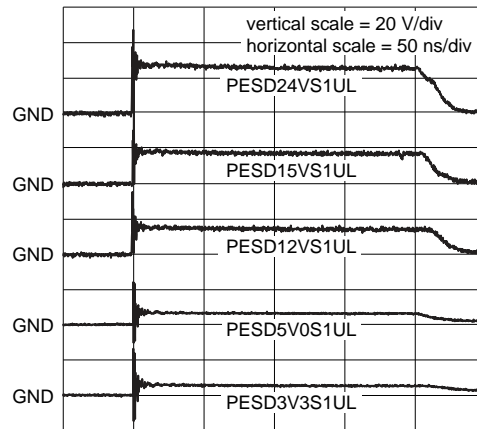**Fig 7.   Relative variation of reverse leakage current as a function of junction temperature; typical values**
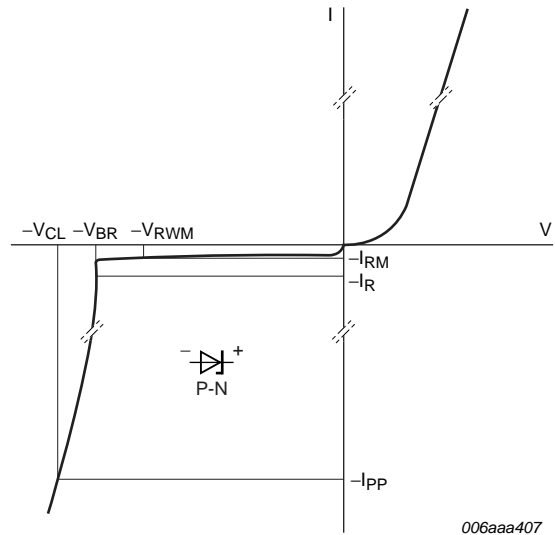


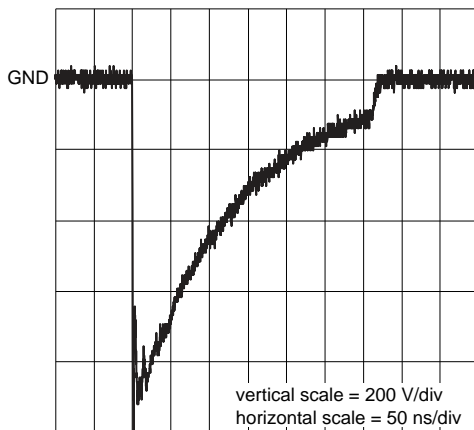**Fig 8.   V-I characteristics for a unidirectional ESD protection diode**
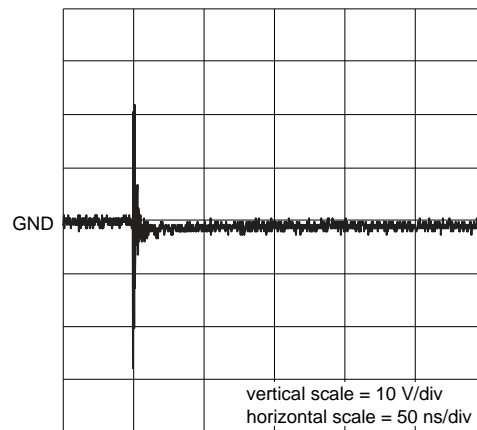
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**Fig 9.** **ESD clamping test setup and waveforms**

## 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 μs waveform.
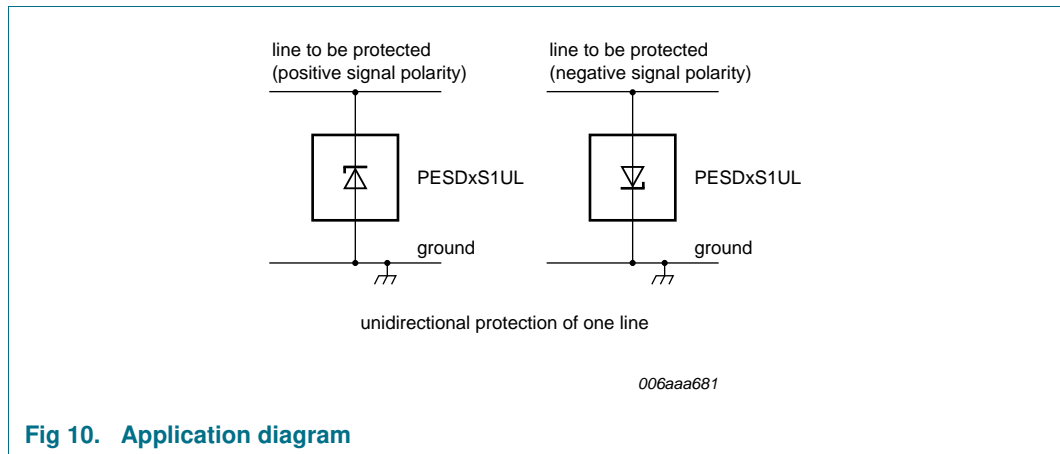


line to be protected
(positive signal polarity)

line to be protected
(negative signal polarity)

PESDxS1UL

PESDxS1UL

ground

ground

unidirectional protection of one line

006aaa681

**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. Test information

### 8.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

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## 9. Package outline



0.62
0.55

0.50
0.46

0.30
0.22

2

0.65

1.02
0.95

0.30
0.22

1

0.55
0.47

cathode marking on top side (if applicable)
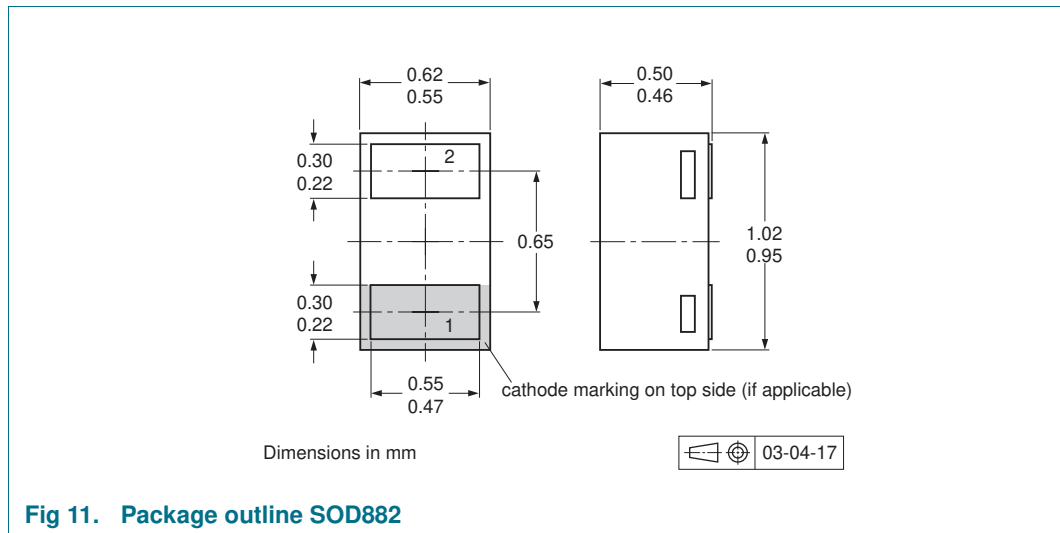
Dimensions in mm

03-04-17

**Fig 11.   Package outline SOD882**
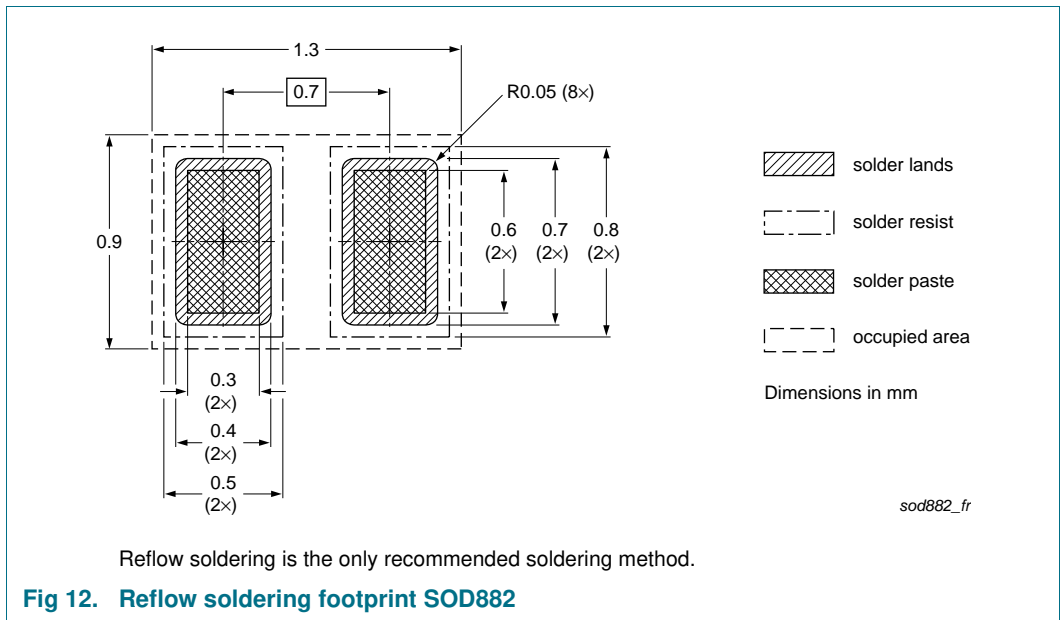
## 10. Packing information

**Table 9.     Packing methods**

*The indicated -xxx are the last three digits of the 12NC ordering code.*[1]

| 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 14**.

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## 11. Soldering



Reflow soldering is the only recommended soldering method.

**Fig 12. Reflow soldering footprint SOD882**

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## 12. Revision history

**Table 10.   Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PESDXS1UL_SER v.3 | 20111025 | Product data sheet | - | PESDXS1UL_SER v.2 |
| Modifications: | • Section 1.2 "Features and benefits": updated<br>• Table 7: updated<br>• Table 8: added pulse conditions for breakdown voltage $V_{BR}$<br>• Section 8 "Test information": added<br>• Section 11 "Soldering": added<br>• Section 13 "Legal information": updated | | | |
| PESDXS1UL_SER v.2 | 20090820 | Product data sheet | - | PESDXS1UL_SER v.1 |
| PESDXS1UL_SER v.1 | 20060331 | Product data sheet | - | - |

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# 13. Legal information

## 13.1 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 URL http://www.nxp.com.

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**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.

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