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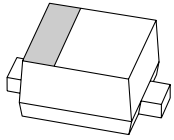
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Kind regards,

Team Nexperia



# PESDxS1UB series

ESD protection diodes in SOD523 package

Rev. 02 — 24 August 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Unidirectional ESD protection diode in a SOD523 plastic package designed to protect one transmission or data line from the damage caused by ESD (ElectroStatic Discharge) and other transients.

### 1.2 Features

- Unidirectional ESD protection of one line
- Max. peak pulse power:  $P_{PP} = 330 \text{ W}$  at  $t_p = 8/20 \mu\text{s}$
- Low clamping voltage:  $V_{CL} = 20 \text{ V}$  at  $I_{PP} = 18 \text{ A}$
- Ultra low leakage current:  $I_{RM} < 700 \text{ nA}$
- ESD protection  $> 23 \text{ kV}$
- IEC 61000-4-2, level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{PP} = 18 \text{ A}$  at  $t_p = 8/20 \mu\text{s}$

### 1.3 Applications

- Computers and peripherals
- Communication systems
- Audio and video equipment
- Data lines
- CAN bus protection

### 1.4 Quick reference data

Table 1. Quick reference data



| Symbol    | Parameter                | Conditions | Value | Unit |
|-----------|--------------------------|------------|-------|------|
| $V_{RWM}$ | reverse standoff voltage |            |       |      |
|           | PESD3V3S1UB              |            | 3.3   | V    |
|           | PESD5V0S1UB              |            | 5     | V    |
|           | PESD12VS1UB              |            | 12    | V    |
|           | PESD15VS1UB              |            | 15    | V    |
|           | PESD24VS1UB              |            | 24    | V    |

**Table 1. Quick reference data ...continued**

| Symbol         | Parameter                 | Conditions                      | Value | Unit |
|----------------|---------------------------|---------------------------------|-------|------|
| C <sub>d</sub> | diode capacitance         | V <sub>R</sub> = 0 V; f = 1 MHz |       |      |
|                | PESD3V3S1UB               |                                 | 207   | pF   |
|                | PESD5V0S1UB               |                                 | 152   | pF   |
|                | PESD12VS1UB               |                                 | 38    | pF   |
|                | PESD15VS1UB               |                                 | 32    | pF   |
|                | PESD24VS1UB               |                                 | 23    | pF   |
|                | number of protected lines |                                 | 1     |      |

## 2. Pinning information

**Table 2. Discrete pinning**

| Pin | Description | Simplified outline  | Symbol  |
|-----|-------------|---|---|
| 1   | cathode     | [1]   | <br>sym035 |
| 2   | anode       |  |   |

[1] The marking bar indicates the cathode.

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package |  | Version |
|-------------|---------|--|---------|
|             | Name    | Description                              |         |
| PESDxS1UB   | SC -79  | plastic surface mounted package; 2 leads | SOD523  |

## 4. Marking

**Table 4. Marking**

| Type number | Marking code |
|-------------|--------------|
| PESD3V3S1UB | N1           |
| PESD5V0S1UB | N2           |
| PESD12VS1UB | N3           |
| PESD15VS1UB | N4           |
| PESD24VS1UB | N5           |

## 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              | 8/20 μs    | [1] |      |      |
|                  | PESD3V3S1UB                   |            | -   | 330  | W    |
|                  | PESD5V0S1UB                   |            | -   | 260  | W    |
|                  | PESD12VS1UB                   |            | -   | 180  | W    |
|                  | PESD15VS1UB                   |            | -   | 160  | W    |
|                  | PESD24VS1UB                   |            | -   | 160  | W    |
| I <sub>PP</sub>  | peak pulse current            | 8/20 μs    | [1] |      |      |
|                  | PESD3V3S1UB                   |            | -   | 18   | A    |
|                  | PESD5V0S1UB                   |            | -   | 15   | A    |
|                  | PESD12VS1UB                   |            | -   | 5    | A    |
|                  | PESD15VS1UB                   |            | -   | 5    | A    |
|                  | PESD24VS1UB                   |            | -   | 3    | A    |
| T <sub>j</sub>   | junction temperature          |            | -   | 150  | °C   |
| T <sub>amb</sub> | operating ambient temperature |            | -65 | +150 | °C   |
| T <sub>stg</sub> | storage temperature           |            | -65 | +150 | °C   |

[1] Non-repetitive current pulse 8/20 μs exponentially decay waveform; see [Figure 1](#).

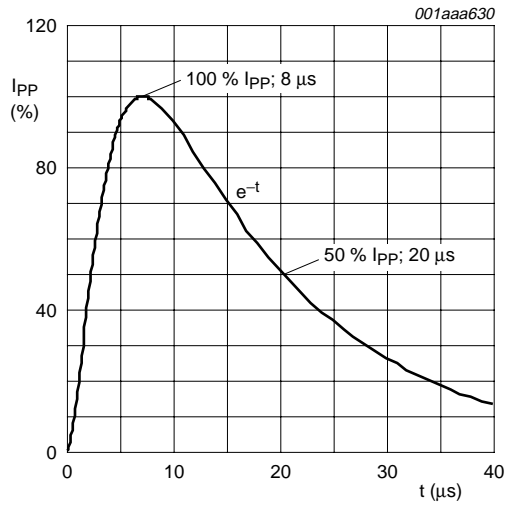
**Table 6. ESD maximum ratings**

| Symbol | Parameter                          | Conditions                        | Min | Max | Unit |
|--------|------------------------------------|-----------------------------------|-----|-----|------|
| ESD    | electrostatic discharge capability | IEC 61000-4-2 (contact discharge) | [1] |     |      |
|        | PESD3V3S1UB                        |                                   | -   | 30  | kV   |
|        | PESD5V0S1UB                        |                                   | -   | 30  | kV   |
|        | PESD12VS1UB                        |                                   | -   | 30  | kV   |
|        | PESD15VS1UB                        |                                   | -   | 30  | kV   |
|        | PESD24VS1UB                        |                                   | -   | 23  | kV   |
|        | PESDxS1UB series                   | HBM MIL-STD883                    | -   | 10  | kV   |

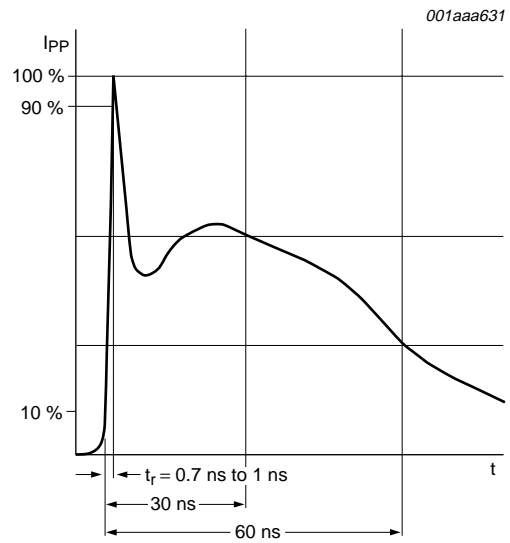
[1] Device stressed with ten non-repetitive ElectroStatic Discharge (ESD) pulses; see [Figure 2](#).

**Table 7. ESD standards compliance**

| Standard                     | Conditions                      |
|------------------------------|---------------------------------|
| IEC 61000-4-2, level 4 (ESD) | > 15 kV (air); > 8 kV (contact) |
| HBM MIL-STD883, class 3      | > 4 kV                          |



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



**Fig 2. ElectroStatic Discharge (ESD) pulse waveform according to IEC 61000-4-2**

## 6. Characteristics

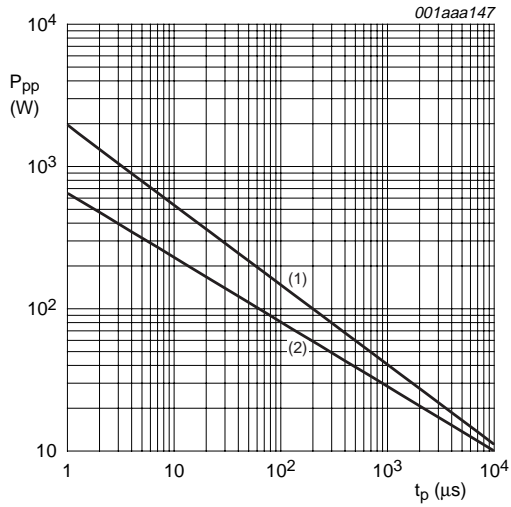
**Table 8. Characteristics**
 $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

| Symbol      | Parameter                | Conditions  | Min  | Typ                 | Max  | Unit          |
|-------------|--------------------------|---|------|---------------------|------|---------------|
| $V_{RWM}$   | reverse standoff voltage |   |      |                     |      |               |
|             | PESD3V3S1UB              |   | -    | -                   | 3.3  | V             |
|             | PESD5V0S1UB              |   | -    | -                   | 5    | V             |
|             | PESD12VS1UB              |   | -    | -                   | 12   | V             |
|             | PESD15VS1UB              |   | -    | -                   | 15   | V             |
|             | PESD24VS1UB              |   | -    | -                   | 24   | V             |
| $I_{RM}$    | reverse leakage current  | see <a href="#">Figure 7</a>  |      |                     |      |               |
|             | PESD3V3S1UB              | $V_{RWM} = 3.3\text{ V}$  | -    | 0.7                 | 2    | $\mu\text{A}$ |
|             | PESD5V0S1UB              | $V_{RWM} = 5\text{ V}$  | -    | 0.1                 | 1    | $\mu\text{A}$ |
|             | PESD12VS1UB              | $V_{RWM} = 12\text{ V}$   | -    | < 1                 | 50   | nA            |
|             | PESD15VS1UB              | $V_{RWM} = 15\text{ V}$   | -    | < 1                 | 50   | nA            |
|             | PESD24VS1UB              | $V_{RWM} = 24\text{ V}$   | -    | < 1                 | 50   | nA            |
| $V_{BR}$    | breakdown voltage        | $I_R = 5\text{ mA}$   |      |                     |      |               |
|             | PESD3V3S1UB              |   | 5.2  | 5.6                 | 6.0  | V             |
|             | PESD5V0S1UB              |   | 6.4  | 6.8                 | 7.2  | V             |
|             | PESD12VS1UB              |   | 14.7 | 15.0                | 15.3 | V             |
|             | PESD15VS1UB              |   | 17.6 | 18.0                | 18.4 | V             |
|             | PESD24VS1UB              |   | 26.5 | 27.0                | 27.5 | V             |
| $C_d$       | diode capacitance        | $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$ ;<br>see <a href="#">Figure 5</a> and <a href="#">6</a> |      |                     |      |               |
|             | PESD3V3S1UB              |   | -    | 207                 | 300  | pF            |
|             | PESD5V0S1UB              |   | -    | 152                 | 200  | pF            |
|             | PESD12VS1UB              |   | -    | 38                  | 75   | pF            |
|             | PESD15VS1UB              |   | -    | 32                  | 70   | pF            |
|             | PESD24VS1UB              |   | -    | 23                  | 50   | pF            |
| $V_{(CLR)}$ | clamping voltage         |   |      | <a href="#">[1]</a> |      |               |
|             | PESD3V3S1UB              | $I_{PP} = 1\text{ A}$   | -    | -                   | 7    | V             |
|             |                          | $I_{PP} = 18\text{ A}$  | -    | -                   | 20   | V             |
|             | PESD5V0S1UB              | $I_{PP} = 1\text{ A}$   | -    | -                   | 9    | V             |
|             |                          | $I_{PP} = 15\text{ A}$  | -    | -                   | 20   | V             |
|             | PESD12VS1UB              | $I_{PP} = 1\text{ A}$   | -    | -                   | 19   | V             |
|             |                          | $I_{PP} = 5\text{ A}$   | -    | -                   | 35   | V             |
|             | PESD15VS1UB              | $I_{PP} = 1\text{ A}$   | -    | -                   | 23   | V             |
|             |                          | $I_{PP} = 5\text{ A}$   | -    | -                   | 40   | V             |
|             | PESD24VS1UB              | $I_{PP} = 1\text{ A}$   | -    | -                   | 36   | V             |
|             |                          | $I_{PP} = 3\text{ A}$   | -    | -                   | 70   | V             |

**Table 8. Characteristics ...continued**  
*T<sub>amb</sub> = 25 °C unless otherwise specified*

| Symbol            | Parameter               | Conditions              | Min | Typ | Max | Unit |
|-------------------|-------------------------|-------------------------|-----|-----|-----|------|
| R <sub>diff</sub> | differential resistance |                         |     |     |     |      |
|                   | PESD3V3S1UB             | I <sub>R</sub> = 1 mA   | -   | -   | 400 | Ω    |
|                   | PESD5V0S1UB             | I <sub>R</sub> = 1 mA   | -   | -   | 80  | Ω    |
|                   | PESD12VS1UB             | I <sub>R</sub> = 1 mA   | -   | -   | 200 | Ω    |
|                   | PESD15VS1UB             | I <sub>R</sub> = 1 mA   | -   | -   | 225 | Ω    |
|                   | PESD24VS1UB             | I <sub>R</sub> = 0.5 mA | -   | -   | 300 | Ω    |

[1] Non-repetitive current pulse 8/20 μs exponentially decay waveform; see [Figure 1](#).

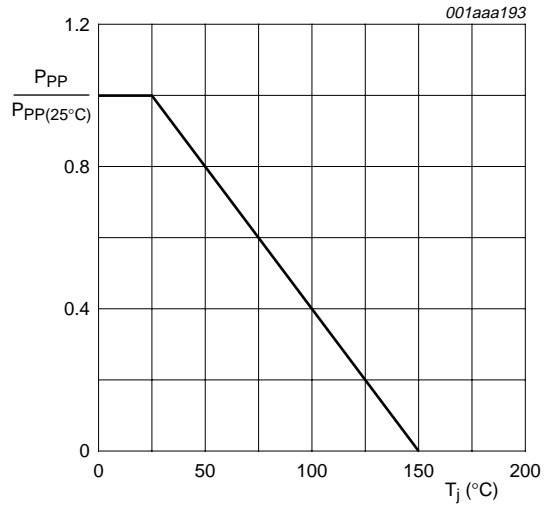


$T_{amb} = 25\text{ °C}$

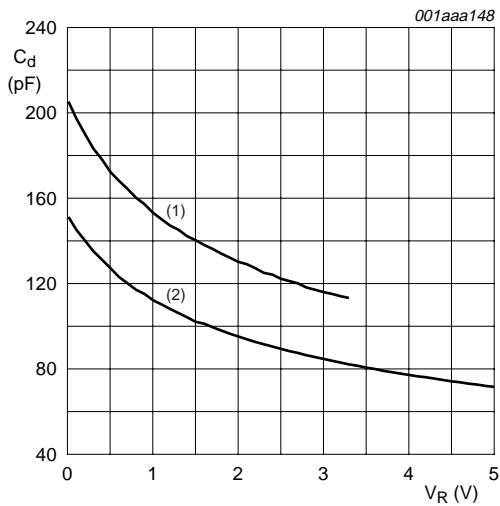
$t_p = 8/20\text{ }\mu\text{s}$  exponentially decay waveform, see [Figure 1](#)

- (1) PESD3V3S1UB and PESD5V0S1UB
- (2) PESD12VS1UB, PESD15VS1UB; PESD24VS1UB

**Fig 3. Peak pulse power dissipation as a function of pulse time; typical values**



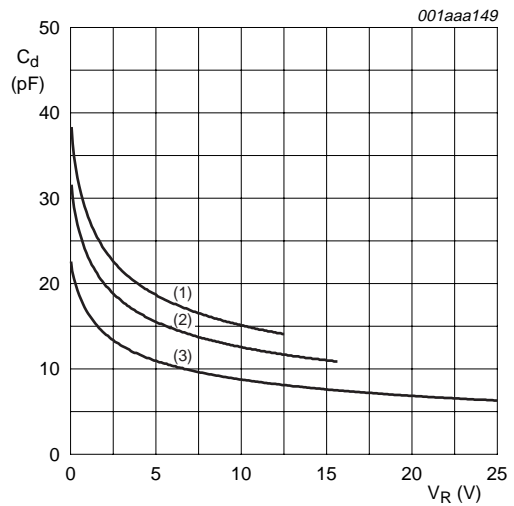
**Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values**



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

- (1) PESD3V3S1UB
- (2) PESD5V0S1UB

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

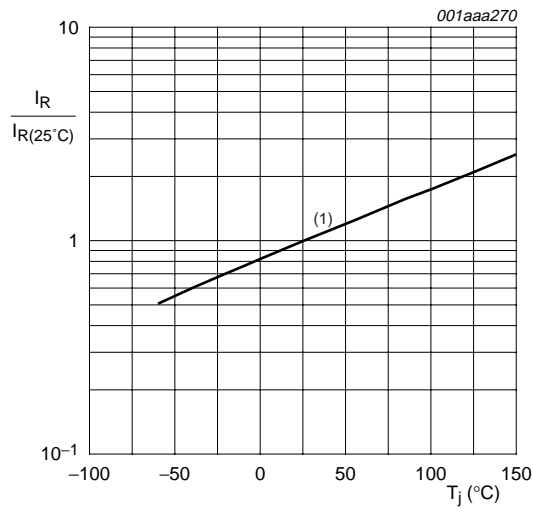


$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

- (1) PESD12VS1UB
- (2) PESD15VS1UB
- (3) PESD24VS1UB

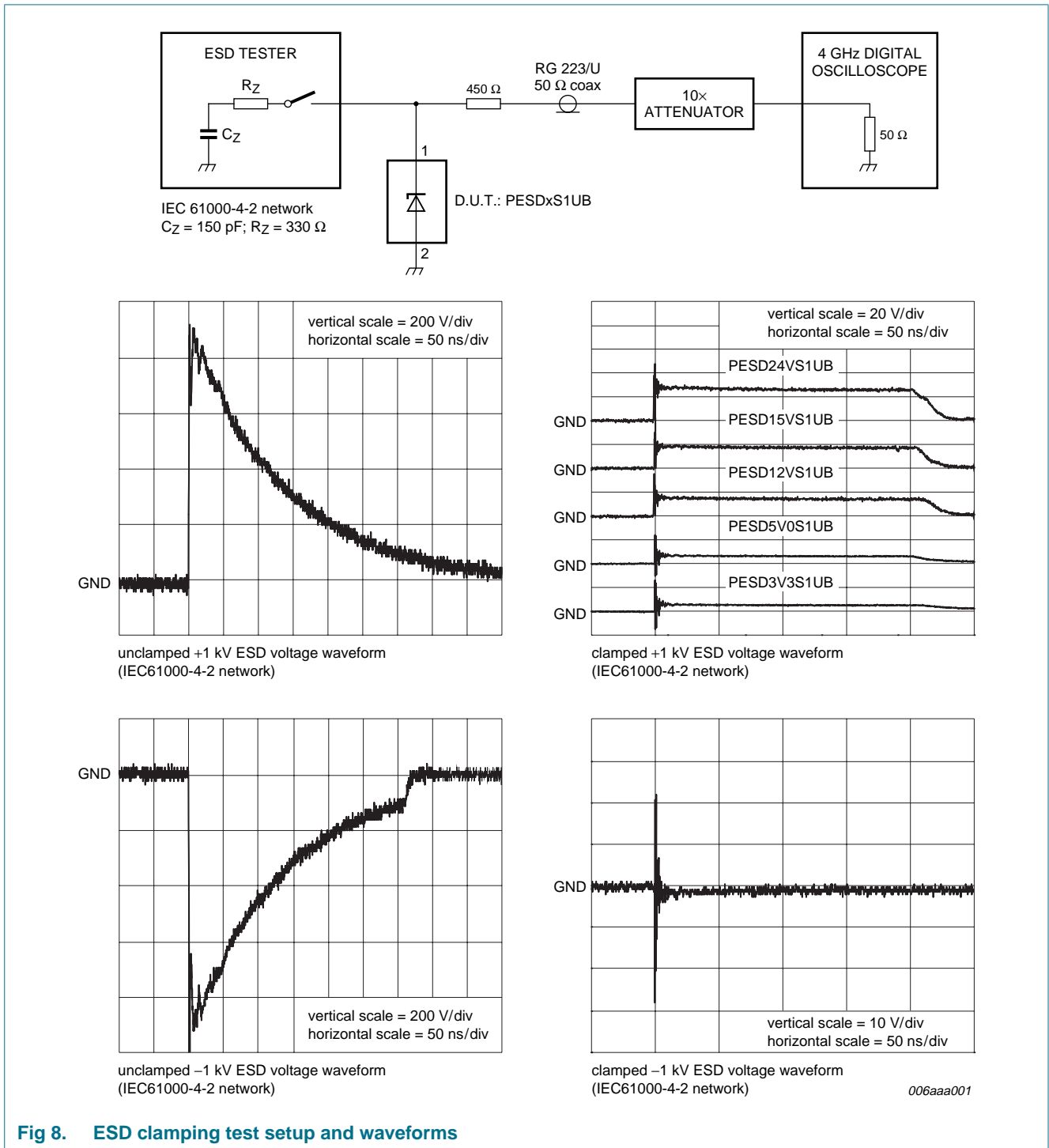
**Fig 6. Diode capacitance as a function of reverse voltage; typical values**





- (1) PESD3V3S1UB;  $V_{RWM} = 3.3$  V
- PESD5V0S1UB;  $V_{RWM} = 5$  V
- $I_R$  is less than 10 nA at 150 °C for:
- PESD12VS1UB;  $V_{RWM} = 12$  V
- PESD15VS1UB;  $V_{RWM} = 15$  V
- PESD24VS1UB;  $V_{RWM} = 24$  V

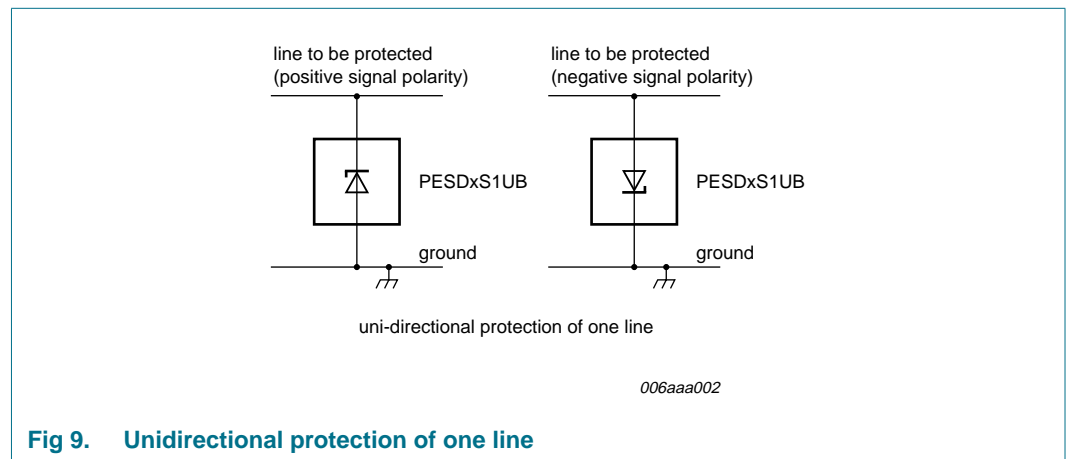
**Fig 7. Relative variation of reverse leakage current as a function of junction temperature; typical values**



**Fig 8. ESD clamping test setup and waveforms**

## 7. Application information

The PESDxS1UB series is designed for unidirectional protection of one single data line from the damage caused by ESD (ElectroStatic Discharge) and Surge Pulses. The PESDxS1UB series may be used on lines where the signal polarity is above or below ground. The PESDxS1UB series provides a surge capability of up to 330 Watts per line for a 8/20  $\mu$ s waveform.



**Fig 9. Unidirectional protection of one line**

Circuit board layout and protection device placement:

Circuit board layout is critical for the suppression of ESD, EFT and Surge transients. The following guidelines are recommended:

1. Place the protection device as close to the input terminal or connector as possible.
2. The path length between the protection device and the protected line should be minimized.
3. Keep parallel signal paths to a minimum.
4. Avoid running protection conductors in parallel with unprotected conductor.
5. Minimize all printed-circuit board 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 printed-circuit boards, use ground vias.

**8. Package outline**

Plastic surface-mounted package; 2 leads

SOD523

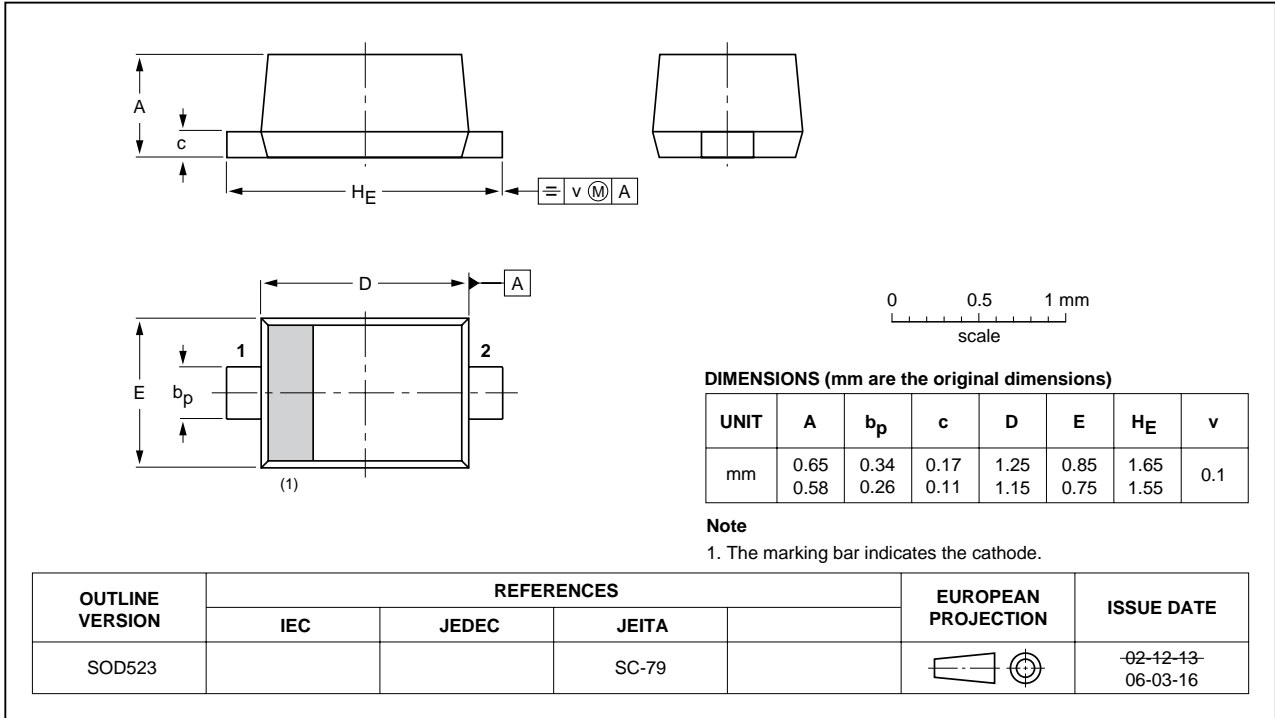


Fig 10. Package outline

## 9. Packing information

**Table 9. Possible packing methods**

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

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PESD3V3S1UB | SOD523  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |
| PESD5V0S1UB | SOD523  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |
| PESD12VS1UB | SOD523  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |
| PESD15VS1UB | SOD523  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |
| PESD24VS1UB | SOD523  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |

[1] For further information see [Section 12](#).

## 10. Revision history

Table 10. Revision history

| Document ID        | Release date | Data sheet status  | Change notice | Supersedes         |
|--------------------|--------------|--|---------------|--------------------|
| PESDXS1UB_SERIES_2 | 20090824     | Product data   | -             | PESDXS1UB_SERIES_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><li><a href="#">Figure 10 "Package outline"</a>: updated</li></ul> |               |                    |
| PESDXS1UB_SERIES_1 | 20040614     | Product data   | -             | -                  |

## 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".

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