

# PESDxL1BA series

Low capacitance bidirectional ESD protection diodes in SOD323

Rev. 01 — 4 October 2004

Product data sheet

## 1. Product profile

### 1.1 General description

Bidirectional ElectroStatic Discharge (ESD) protection diodes in a very small SOD323 (SC-76) SMD plastic package designed to protect one signal line from the damage caused by ESD and other transients.

### 1.2 Features

- Bidirectional ESD protection of one line
- Max. peak pulse power:  $P_{pp} = 500 \text{ W}$
- Low clamping voltage:  $V_{(CL)R} = 26 \text{ V}$
- Ultra low leakage current:  $I_{RM} < 0.09 \mu\text{A}$
- ESD protection  $> 23 \text{ kV}$
- IEC 61000-4-2, level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{pp} = 18 \text{ A}$
- Very small SMD plastic package.

### 1.3 Applications

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

### 1.4 Quick reference data


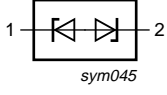
Table 1: Quick reference data

| Symbol    | Parameter                 | Conditions                                  | Min | Typ | Max | Unit |
|-----------|---------------------------|---|-----|-----|-----|------|
| $V_{RWM}$ | reverse stand-off voltage |   |     |     |     |      |
|           | PESD3V3L1BA               |   | -   | -   | 3.3 | V    |
|           | PESD5V0L1BA               |   | -   | -   | 5.0 | V    |
|           | PESD12VL1BA               |   | -   | -   | 12  | V    |
|           | PESD15VL1BA               |   | -   | -   | 15  | V    |
|           | PESD24VL1BA               |   | -   | -   | 24  | V    |
| $C_d$     | diode capacitance         | $V_R = 0 \text{ V};$<br>$f = 1 \text{ MHz}$ |     |     |     |      |
|           | PESD3V3L1BA               |   | -   | 101 | -   | pF   |
|           | PESD5V0L1BA               |   | -   | 75  | -   | pF   |
|           | PESD12VL1BA               |   | -   | 19  | -   | pF   |
|           | PESD15VL1BA               |   | -   | 16  | -   | pF   |
|           | PESD24VL1BA               |   | -   | 11  | -   | pF   |

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## 2. Pinning information

Table 2: Pinning

| Pin | Description | Simplified outline  | Symbol  |
|-----|-------------|---|---|
| 1   | cathode 1   |  |  |
| 2   | cathode 2   |   |   |

## 3. Ordering information

Table 3: Ordering information

| Type number      | Package |  |         |
|------------------|---------|--|---------|
|                  | Name    | Description                              | Version |
| PESDxL1BA series | SC-76   | plastic surface mounted package; 2 leads | SOD323  |

## 4. Marking

Table 4: Marking codes

| Type number | Marking code |
|-------------|--------------|
| PESD3V3L1BA | AB           |
| PESD5V0L1BA | AC           |
| PESD12VL1BA | AD           |
| PESD15VL1BA | AE           |
| PESD24VL1BA | AF           |

## 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] |      |      |
|                  | PESD3V3L1BA          |            | -   | 500  | W    |
|                  | PESD5V0L1BA          |            | -   | 500  | W    |
|                  | PESD12VL1BA          |            | -   | 200  | W    |
|                  | PESD15VL1BA          |            | -   | 200  | W    |
|                  | PESD24VL1BA          |            | -   | 200  | W    |
| I <sub>pp</sub>  | peak pulse current   | 8/20 μs    | [1] |      |      |
|                  | PESD3V3L1BA          |            | -   | 18   | A    |
|                  | PESD5V0L1BA          |            | -   | 15   | A    |
|                  | PESD12VL1BA          |            | -   | 5    | A    |
|                  | PESD15VL1BA          |            | -   | 5    | A    |
|                  | PESD24VL1BA          |            | -   | 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; see [Figure 1](#).

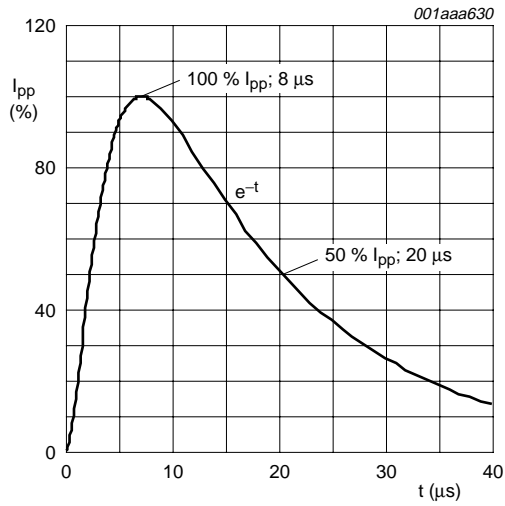
**Table 6: ESD maximum ratings**

| Symbol | Parameter                          | Conditions                           | Min | Max | Unit |
|--------|------------------------------------|--------------------------------------|-----|-----|------|
| ESD    | electrostatic discharge capability | IEC 61000-4-2<br>(contact discharge) | [1] |     |      |
|        | PESD3V3L1BA                        |                                      | -   | 30  | kV   |
|        | PESD5V0L1BA                        |                                      | -   | 30  | kV   |
|        | PESD12VL1BA                        |                                      | -   | 30  | kV   |
|        | PESD15VL1BA                        |                                      | -   | 30  | kV   |
|        | PESD24VL1BA                        |                                      | -   | 23  | kV   |
|        | PESDxL1BA series                   | HBM MIL-Std 883                      | -   | 10  | kV   |

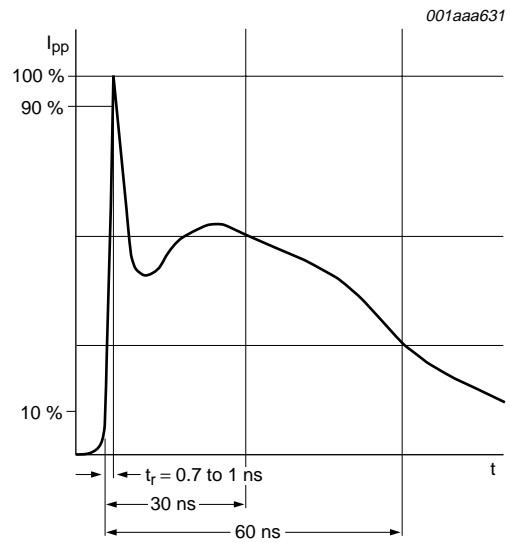
[1] Device stressed with ten non-repetitive ESD pulses; see [Figure 2](#).

**Table 7: ESD standards compliance**

| Standard   | Conditions                      |
|--|---------------------------------|
| IEC 61000-4-2; level 4 (ESD); <a href="#">Figure 2</a> | > 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**

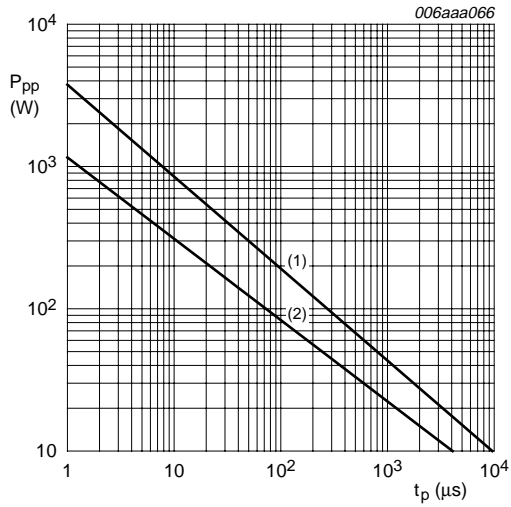
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol      | Parameter                 | Conditions  | Min  | Typ  | Max  | Unit          |
|-------------|---------------------------|---|------|------|------|---------------|
| $V_{RWM}$   | reverse stand-off voltage |   |      |      |      |               |
|             | PESD3V3L1BA               |   | -    | -    | 3.3  | V             |
|             | PESD5V0L1BA               |   | -    | -    | 5.0  | V             |
|             | PESD12VL1BA               |   | -    | -    | 12   | V             |
|             | PESD15VL1BA               |   | -    | -    | 15   | V             |
|             | PESD24VL1BA               |   | -    | -    | 24   | V             |
| $I_{RM}$    | reverse leakage current   | see <a href="#">Figure 7</a>  |      |      |      |               |
|             | PESD3V3L1BA               | $V_{RWM} = 3.3\text{ V}$  | -    | 0.09 | 2    | $\mu\text{A}$ |
|             | PESD5V0L1BA               | $V_{RWM} = 5.0\text{ V}$  | -    | 0.01 | 1    | $\mu\text{A}$ |
|             | PESD12VL1BA               | $V_{RWM} = 12\text{ V}$   | -    | < 1  | 50   | nA            |
|             | PESD15VL1BA               | $V_{RWM} = 15\text{ V}$   | -    | < 1  | 50   | nA            |
|             | PESD24VL1BA               | $V_{RWM} = 24\text{ V}$   | -    | < 1  | 50   | nA            |
| $V_{(BR)}$  | breakdown voltage         | $I_R = 5\text{ mA}$   |      |      |      |               |
|             | PESD3V3L1BA               |   | 5.8  | 6.4  | 6.9  | V             |
|             | PESD5V0L1BA               |   | 7.0  | 7.6  | 8.2  | V             |
|             | PESD12VL1BA               |   | 14.2 | 15.9 | 16.7 | V             |
|             | PESD15VL1BA               |   | 17.1 | 18.9 | 20.3 | V             |
|             | PESD24VL1BA               |   | 25.4 | 27.8 | 30.3 | 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> |      |      |      |               |
|             | PESD3V3L1BA               |   | -    | 101  | -    | pF            |
|             | PESD5V0L1BA               |   | -    | 75   | -    | pF            |
|             | PESD12VL1BA               |   | -    | 19   | -    | pF            |
|             | PESD15VL1BA               |   | -    | 16   | -    | pF            |
|             | PESD24VL1BA               |   | -    | 11   | -    | pF            |
| $V_{(CLR)}$ | clamping voltage          |   | [1]  |      |      |               |
|             | PESD3V3L1BA               | $I_{pp} = 1\text{ A}$   | -    | -    | 8    | V             |
|             |                           | $I_{pp} = 18\text{ A}$  | -    | -    | 26   | V             |
|             | PESD5V0L1BA               | $I_{pp} = 1\text{ A}$   | -    | -    | 10   | V             |
|             |                           | $I_{pp} = 15\text{ A}$  | -    | -    | 33   | V             |
|             | PESD12VL1BA               | $I_{pp} = 1\text{ A}$   | -    | -    | 20   | V             |
|             |                           | $I_{pp} = 5\text{ A}$   | -    | -    | 37   | V             |
|             | PESD15VL1BA               | $I_{pp} = 1\text{ A}$   | -    | -    | 25   | V             |
|             |                           | $I_{pp} = 5\text{ A}$   | -    | -    | 44   | V             |
|             | PESD24VL1BA               | $I_{pp} = 1\text{ A}$   | -    | -    | 40   | V             |
|             |                           | $I_{pp} = 3\text{ A}$   | -    | -    | 70   | V             |

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

| Symbol    | Parameter               | Conditions          | Min | Typ | Max | Unit     |
|-----------|-------------------------|---------------------|-----|-----|-----|----------|
| $r_{dif}$ | differential resistance | $I_R = 1\text{ mA}$ |     |     |     |          |
|           | PESD3V3L1BA             |                     | -   | -   | 400 | $\Omega$ |
|           | PESD5V0L1BA             |                     | -   | -   | 80  | $\Omega$ |
|           | PESD12VL1BA             |                     | -   | -   | 200 | $\Omega$ |
|           | PESD15VL1BA             |                     | -   | -   | 225 | $\Omega$ |
|           | PESD24VL1BA             |                     | -   | -   | 300 | $\Omega$ |

[1] Non-repetitive current pulse 8/20  $\mu\text{s}$  exponential decay waveform; see [Figure 1](#).



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

$t_p = 8/20\text{ }\mu\text{s}$  exponential decay waveform; see Figure 1.

- (1) PESD3V3L1BA and PESD5V0L1BA.
- (2) PESD12VL1BA; PESD15VL1BA; PESD24VL1BA.

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

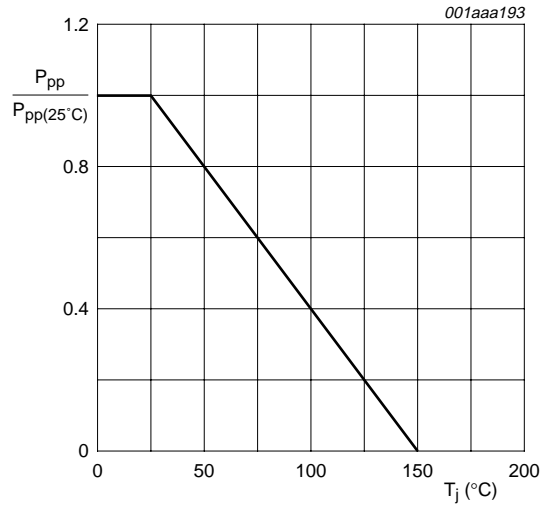
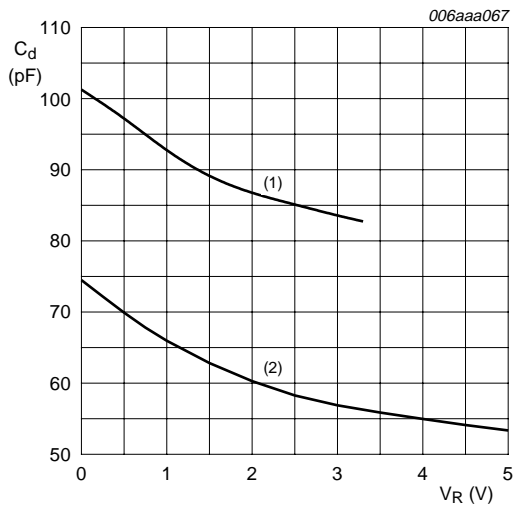


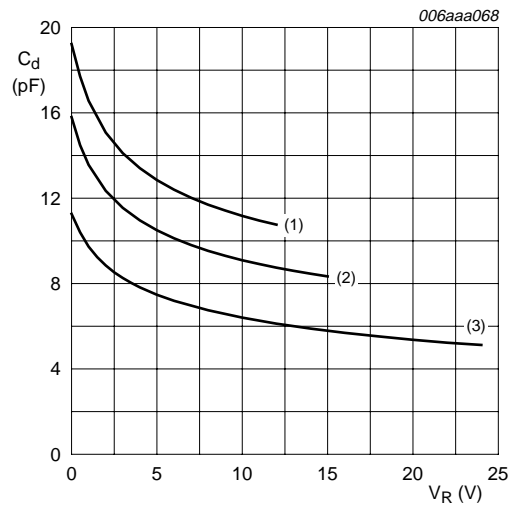
Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values.



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

- (1) PESD3V3L1BA.
- (2) PESD5V0L1BA.

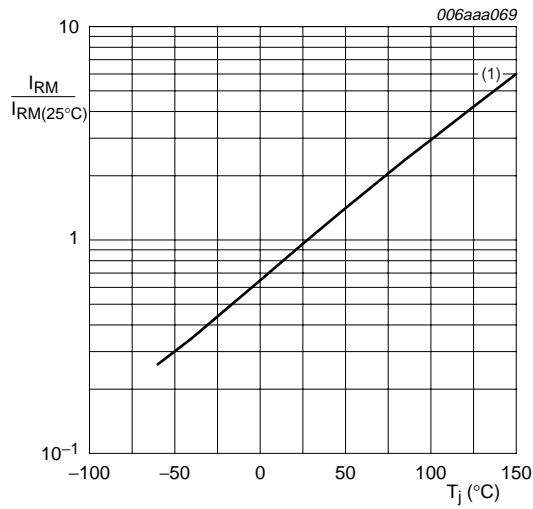
Fig 5. Diode capacitance as a function of reverse voltage; typical values.



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

- (1) PESD12VL1BA.
- (2) PESD15VL1BA.
- (3) PESD24VL1BA.

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



(1) PESD3V3L1BA; PESD5V0L1BA.

For PESD12VL1BA, PESD15VL1BA and PESD24VL1BA,  $I_{RM} < 20 \text{ nA}$  at  $150 \text{ }^\circ\text{C}$ .

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



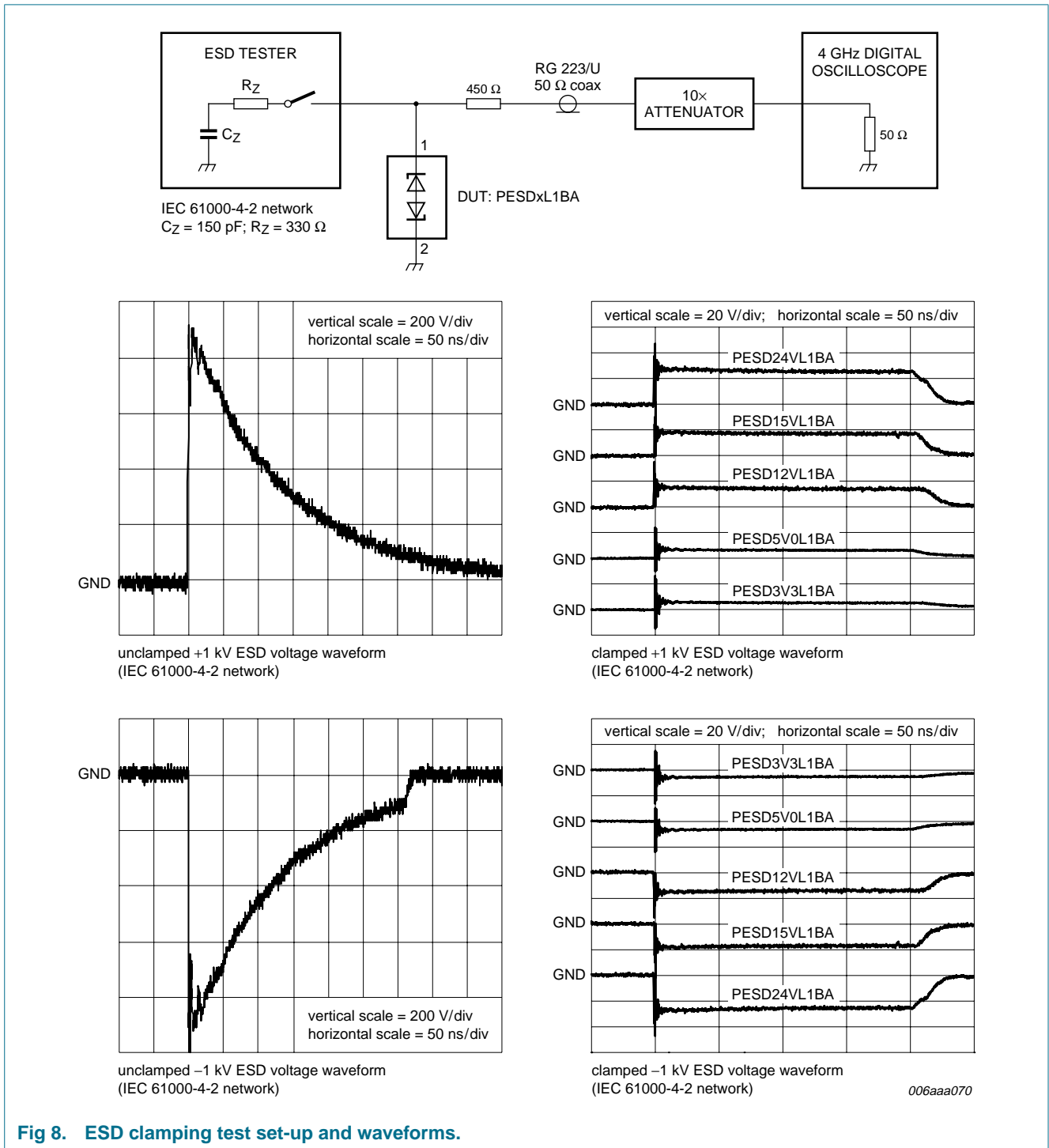
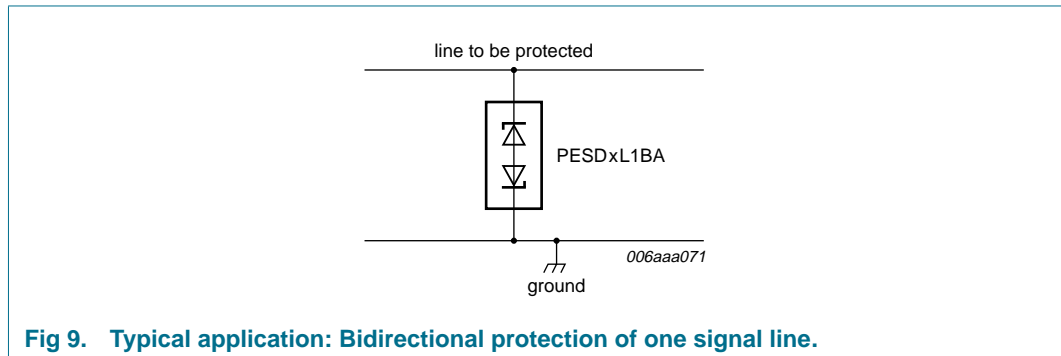


Fig 8. ESD clamping test set-up and waveforms.

## 7. Application information

The PESDxL1BA series is designed for bidirectional protection of one signal line from the damage caused by Electro Static Discharge (ESD) and surge pulses. The PESDxL1BA series may be used on lines where the signal polarity is above and below ground. The PESDxL1BA series provides a surge capability of up to 500 W per line for a 8/20  $\mu$ s waveform.



**Fig 9. Typical application: Bidirectional protection of one signal line.**

### 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 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 protected 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

SOD323

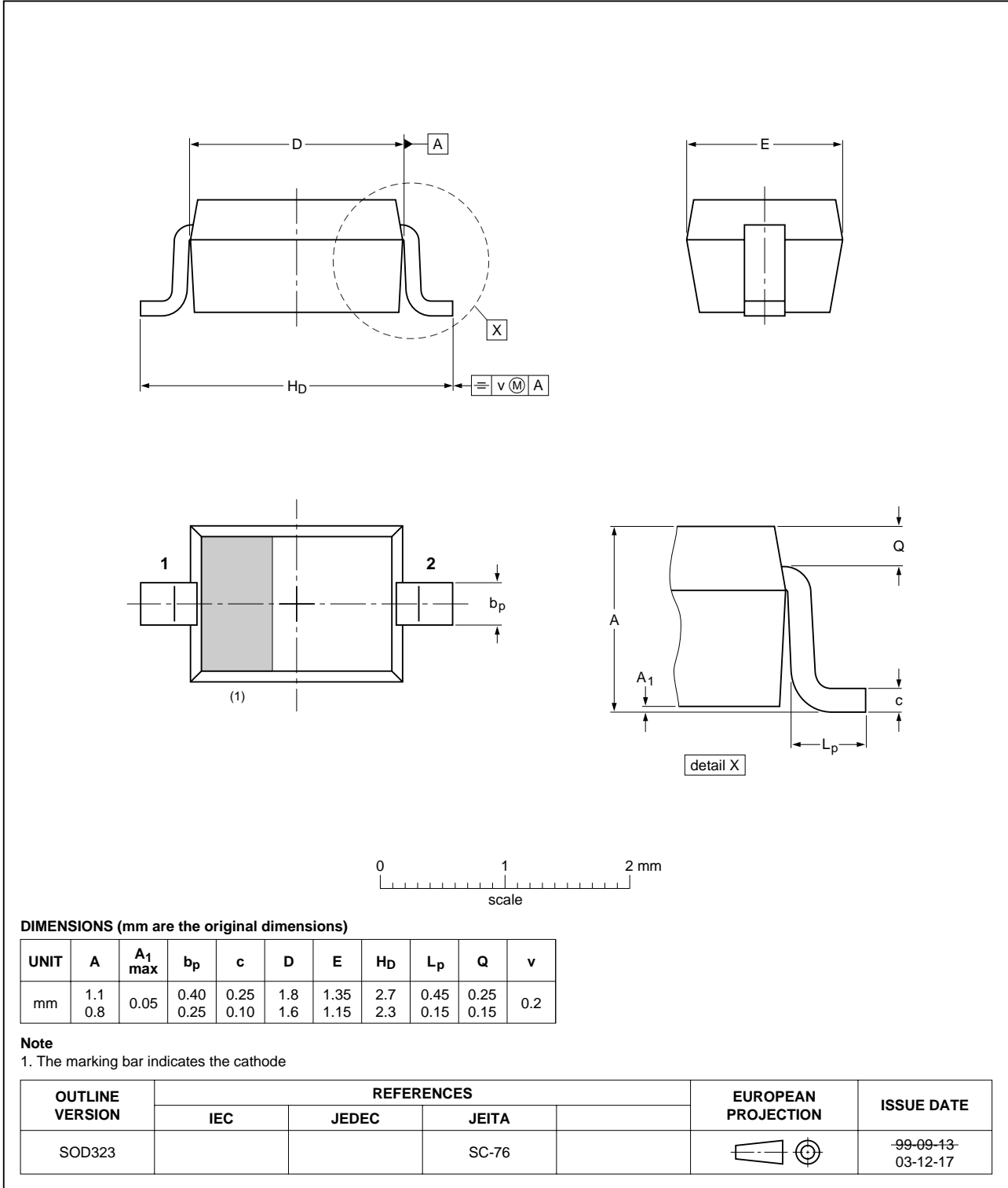


Fig 10. Package outline SOD323 (SC-76).

## 9. 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 |       |
|------------------|---------|--------------------------------|------------------|-------|
|                  |         |                                | 3000             | 10000 |
| PESDxL1BA series | SOD323  | 4 mm pitch, 8 mm tape and reel | -115             | -135  |

[1] For further information and the availability of packing methods, see [Section 14](#).

## 10. Revision history

Table 10: Revision history

| Document ID     | Release date | Data sheet status  | Change notice | Doc. number    | Supersedes |
|-----------------|--------------|--------------------|---------------|----------------|------------|
| PESDXL1BA_SER_1 | 20041004     | Product data sheet | -             | 9397 750 13595 | -          |

## 11. Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2]</sup> <sup>[3]</sup> | Definition   |
|-------|----------------------------------|--|--|
| I     | Objective data                   | Development                                  | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.  |
| II    | Preliminary data                 | Qualification                                | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 12. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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

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