

# PESDxL2BT series

Low capacitance double bidirectional ESD protection diodes in SOT23

Rev. 02 — 25 August 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Low capacitance double bidirectional ElectroStatic Discharge (ESD) protection diodes in a SOT23 small Surface Mounted Device (SMD) plastic package designed to protect two signal lines from the damage caused by ESD and other transients.

### 1.2 Features

- ESD protection of two lines
- Max. peak pulse power:  $P_{PP} = 350 \text{ W}$
- Low clamping voltage:  $V_{CL} = 26 \text{ V}$
- Small SMD plastic package
- Ultra low leakage current:  $I_{RM} < 90 \text{ nA}$
- ESD protection up to 23 kV
- IEC 61000-4-2, level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{PP} = 15 \text{ A}$

### 1.3 Applications

- Computers and peripherals
- Audio and video equipment
- Cellular handsets and accessories
- Communication systems
- Portable electronics
- Subscriber Identity Module (SIM) card protection

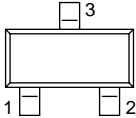
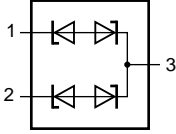
### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol    | Parameter                | Conditions                                  | Min | Typ | Max | Unit |
|-----------|--------------------------|---|-----|-----|-----|------|
| $V_{RWM}$ | reverse standoff voltage |   |     |     |     |      |
|           | PESD3V3L2BT              |   | -   | -   | 3.3 | V    |
|           | PESD5V0L2BT              |   | -   | -   | 5.0 | V    |
|           | PESD12VL2BT              |   | -   | -   | 12  | V    |
|           | PESD15VL2BT              |   | -   | -   | 15  | V    |
|           | PESD24VL2BT              |   | -   | -   | 24  | V    |
| $C_d$     | diode capacitance        | $V_R = 0 \text{ V};$<br>$f = 1 \text{ MHz}$ |     |     |     |      |
|           | PESD3V3L2BT              |   | -   | 101 | -   | pF   |
|           | PESD5V0L2BT              |   | -   | 75  | -   | pF   |
|           | PESD12VL2BT              |   | -   | 19  | -   | pF   |
|           | PESD15VL2BT              |   | -   | 16  | -   | pF   |
|           | PESD24VL2BT              |   | -   | 11  | -   | pF   |

## 2. Pinning information

**Table 2. Pinning**

| Pin | Description    | Simplified outline  | Symbol  |
|-----|----------------|---|---|
| 1   | cathode 1      |  |  |
| 2   | cathode 2      |   |   |
| 3   | double cathode |   |   |

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## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package |  |         |
|-------------|---------|--|---------|
|             | Name    | Description                              | Version |
| PESD3V3L2BT | -       | plastic surface mounted package; 3 leads | SOT23   |
| PESD5V0L2BT |         |  |         |
| PESD12VL2BT |         |  |         |
| PESD15VL2BT |         |  |         |
| PESD24VL2BT |         |  |         |

## 4. Marking

**Table 4. Marking codes**

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PESD3V3L2BT | V3*                         |
| PESD5V0L2BT | V4*                         |
| PESD12VL2BT | V5*                         |
| PESD15VL2BT | V6*                         |
| PESD24VL2BT | V7*                         |

[1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China

## 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][2] |      |      |
|                  | PESD3V3L2BT          |                          | -      | 350  | W    |
|                  | PESD5V0L2BT          |                          | -      | 350  | W    |
|                  | PESD12VL2BT          |                          | -      | 200  | W    |
|                  | PESD15VL2BT          |                          | -      | 200  | W    |
|                  | PESD24VL2BT          |                          | -      | 200  | W    |
| I <sub>PP</sub>  | peak pulse current   | t <sub>p</sub> = 8/20 μs | [1][2] |      |      |
|                  | PESD3V3L2BT          |                          | -      | 15   | A    |
|                  | PESD5V0L2BT          |                          | -      | 13   | A    |
|                  | PESD12VL2BT          |                          | -      | 5    | A    |
|                  | PESD15VL2BT          |                          | -      | 5    | A    |
|                  | PESD24VL2BT          |                          | -      | 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.

[2] Measured from pin 1 to 3 or 2 to 3.

**Table 6. ESD maximum ratings**

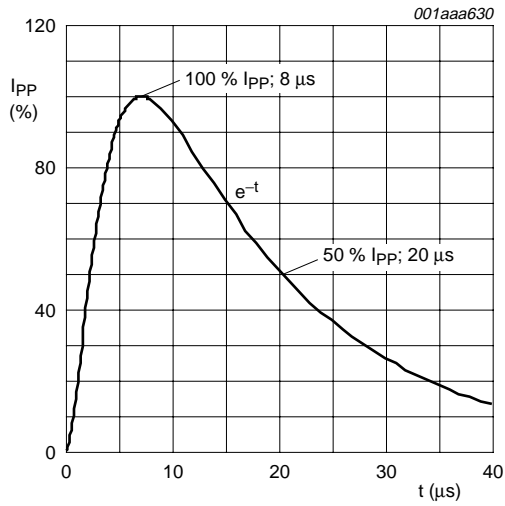
| Symbol           | Parameter                       | Conditions                        | Min    | Max | Unit |
|------------------|---------------------------------|-----------------------------------|--------|-----|------|
| V <sub>ESD</sub> | electrostatic discharge voltage | IEC 61000-4-2 (contact discharge) | [1][2] |     |      |
|                  | PESD3V3L2BT                     |                                   | -      | 30  | kV   |
|                  | PESD5V0L2BT                     |                                   |        |     |      |
|                  | PESD12VL2BT                     |                                   |        |     |      |
|                  | PESD15VL2BT                     |                                   |        |     |      |
|                  | PESD24VL2BT                     |                                   | -      | 23  | kV   |
|                  | PESDxL2BT series                | HBM MIL-STD883                    | -      | 10  | kV   |

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

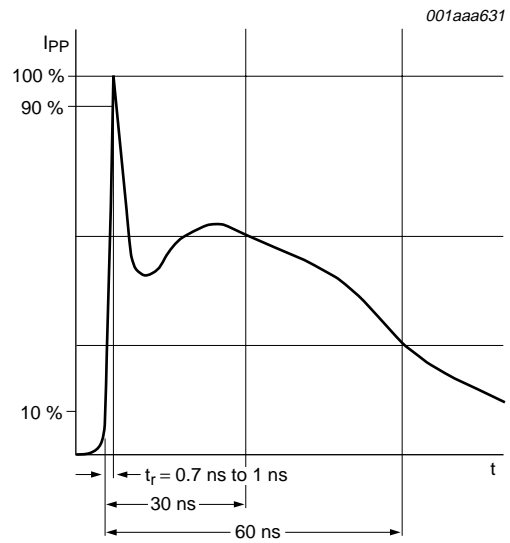
[2] Measured from pin 1 to 3 or 2 to 3.

**Table 7. ESD standards compliance**

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

## 6. Characteristics

**Table 8. Characteristics**

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

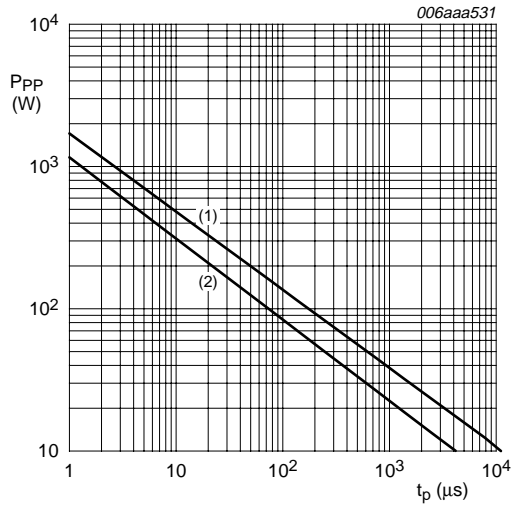
| Symbol    | Parameter                | Conditions                                | Min  | Typ  | Max  | Unit          |
|-----------|--------------------------|---|------|------|------|---------------|
| $V_{RWM}$ | reverse standoff voltage |   |      |      |      |               |
|           | PESD3V3L2BT              |   | -    | -    | 3.3  | V             |
|           | PESD5V0L2BT              |   | -    | -    | 5.0  | V             |
|           | PESD12VL2BT              |   | -    | -    | 12   | V             |
|           | PESD15VL2BT              |   | -    | -    | 15   | V             |
|           | PESD24VL2BT              |   | -    | -    | 24   | V             |
| $I_{RM}$  | reverse leakage current  |   |      |      |      |               |
|           | PESD3V3L2BT              | $V_{RWM} = 3.3\text{ V}$                  | -    | 0.09 | 2    | $\mu\text{A}$ |
|           | PESD5V0L2BT              | $V_{RWM} = 5.0\text{ V}$                  | -    | 0.01 | 1    | $\mu\text{A}$ |
|           | PESD12VL2BT              | $V_{RWM} = 12\text{ V}$                   | -    | < 1  | 50   | nA            |
|           | PESD15VL2BT              | $V_{RWM} = 15\text{ V}$                   | -    | < 1  | 50   | nA            |
|           | PESD24VL2BT              | $V_{RWM} = 24\text{ V}$                   | -    | < 1  | 50   | nA            |
| $V_{BR}$  | breakdown voltage        | $I_R = 5\text{ mA}$                       |      |      |      |               |
|           | PESD3V3L2BT              |   | 5.8  | 6.4  | 6.9  | V             |
|           | PESD5V0L2BT              |   | 7.0  | 7.6  | 8.2  | V             |
|           | PESD12VL2BT              |   | 14.2 | 15.8 | 16.7 | V             |
|           | PESD15VL2BT              |   | 17.1 | 18.8 | 20.3 | V             |
|           | PESD24VL2BT              |   | 25.4 | 27.8 | 30.3 | V             |
| $C_d$     | diode capacitance        | $V_R = 0\text{ V};$<br>$f = 1\text{ MHz}$ |      |      |      |               |
|           | PESD3V3L2BT              |   | -    | 101  | -    | pF            |
|           | PESD5V0L2BT              |   | -    | 75   | -    | pF            |
|           | PESD12VL2BT              |   | -    | 19   | -    | pF            |
|           | PESD15VL2BT              |   | -    | 16   | -    | pF            |
|           | PESD24VL2BT              |   | -    | 11   | -    | pF            |
| $V_{CL}$  | clamping voltage         |   |      |      |      |               |
|           | PESD3V3L2BT              | $I_{PP} = 1\text{ A}$                     | -    | -    | 8    | V             |
|           |                          | $I_{PP} = 15\text{ A}$                    | -    | -    | 26   | V             |
|           | PESD5V0L2BT              | $I_{PP} = 1\text{ A}$                     | -    | -    | 10   | V             |
|           |                          | $I_{PP} = 13\text{ A}$                    | -    | -    | 28   | V             |
|           | PESD12VL2BT              | $I_{PP} = 1\text{ A}$                     | -    | -    | 20   | V             |
|           |                          | $I_{PP} = 5\text{ A}$                     | -    | -    | 37   | V             |
|           | PESD15VL2BT              | $I_{PP} = 1\text{ A}$                     | -    | -    | 25   | V             |
|           |                          | $I_{PP} = 5\text{ A}$                     | -    | -    | 44   | V             |
|           | PESD24VL2BT              | $I_{PP} = 1\text{ A}$                     | -    | -    | 40   | V             |
|           |                          | $I_{PP} = 3\text{ A}$                     | -    | -    | 70   | V             |

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

| Symbol    | Parameter               | Conditions          | Min | Typ | Max | Unit     |
|-----------|-------------------------|---------------------|-----|-----|-----|----------|
| $r_{dif}$ | differential resistance | $I_R = 1\text{ mA}$ |     |     |     |          |
|           | PESD3V3L2BT             |                     | -   | -   | 400 | $\Omega$ |
|           | PESD5V0L2BT             |                     | -   | -   | 80  | $\Omega$ |
|           | PESD12VL2BT             |                     | -   | -   | 200 | $\Omega$ |
|           | PESD15VL2BT             |                     | -   | -   | 225 | $\Omega$ |
|           | PESD24VL2BT             |                     | -   | -   | 300 | $\Omega$ |

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

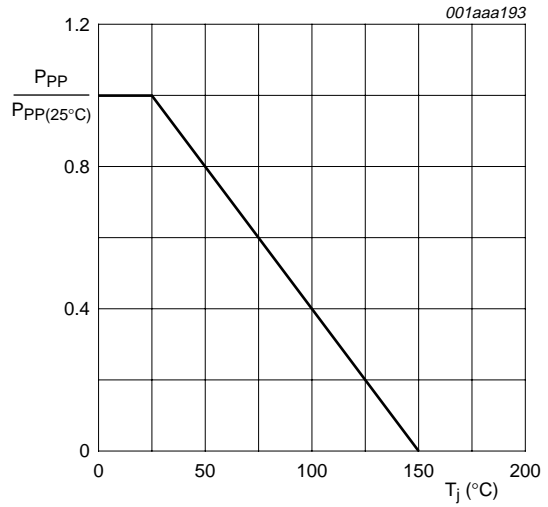
[2] Measured from pin 1 to 3 or 2 to 3.



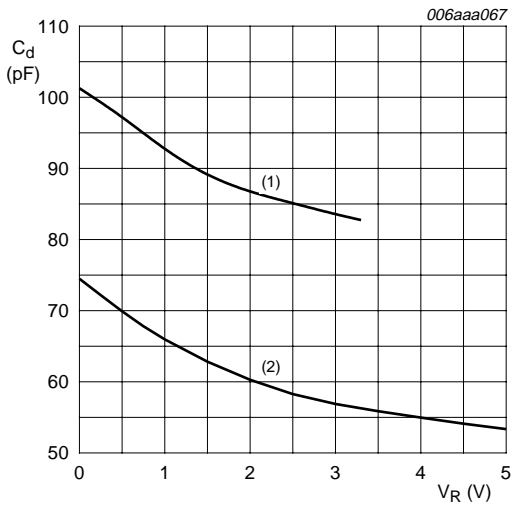
$T_{amb} = 25\text{ }^\circ\text{C}$

- (1) PESD3V3L2BT and PESD5V0L2BT
- (2) PESD12VL2BT, PESD15VL2BT, PESD24VL2BT

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



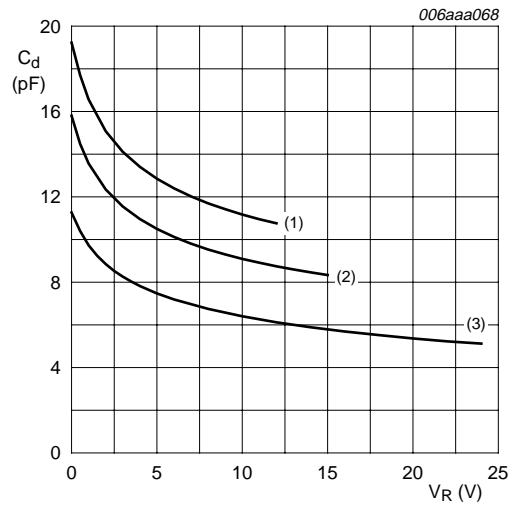
**Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values**



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

- (1) PESD3V3L2BT
- (2) PESD5V0L2BT

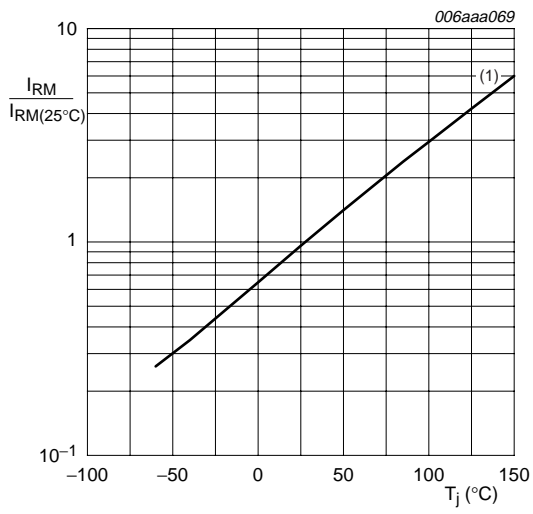
**Fig 5. Diode capacitance as a function of reverse voltage; typical values**



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

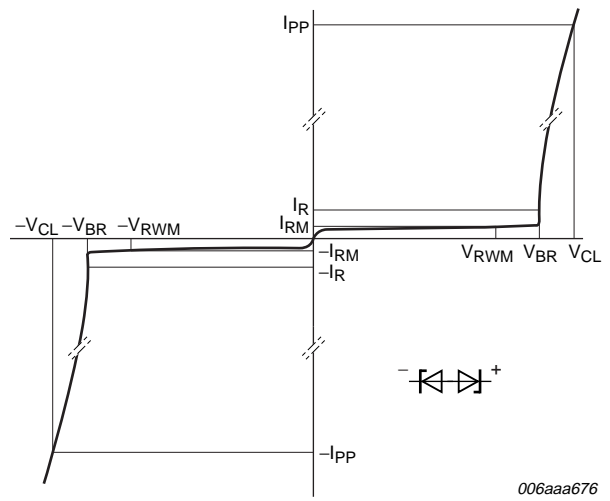
- (1) PESD12VL2BT
- (2) PESD15VL2BT
- (3) PESD24VL2BT

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



(1) PESD3V3L2BT, PESD5V0L2BT  
 PESD12VL2BT, PESD15VL2BT and PESD24VL2BT:  
 $I_{RM} < 20 \text{ nA}$ ;  $T_j = 150 \text{ }^\circ\text{C}$

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



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



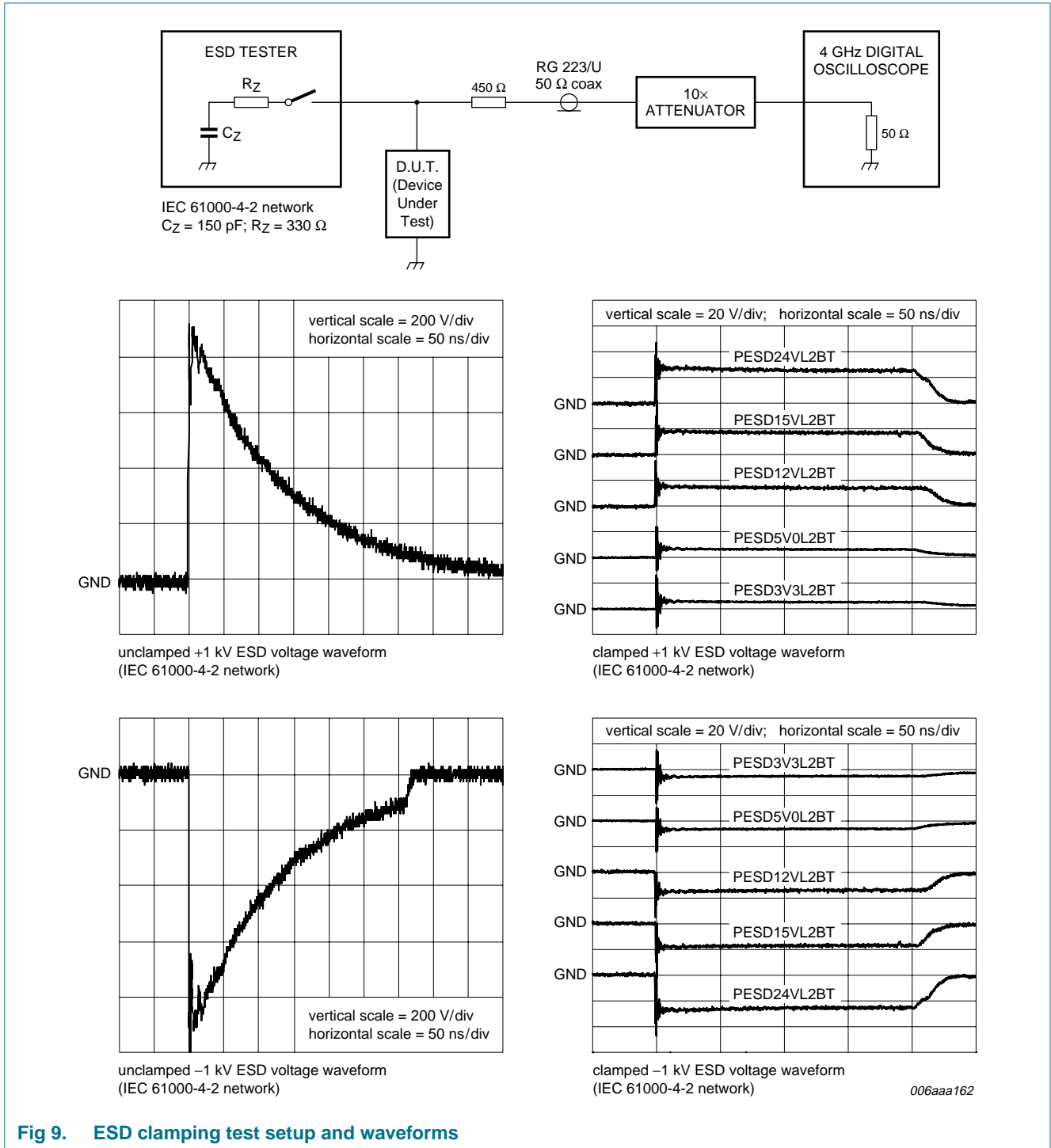


Fig 9. ESD clamping test setup and waveforms

## 7. Application information

The PESDxL2BT series is designed for the protection of two bidirectional signal lines from the damage caused by ESD and surge pulses. The PESDxL2BT series may be used on lines where the signal polarities are above and below ground. The PESDxL2BT series provides a surge capability of up to 350 W per line for an 8/20  $\mu$ s waveform.

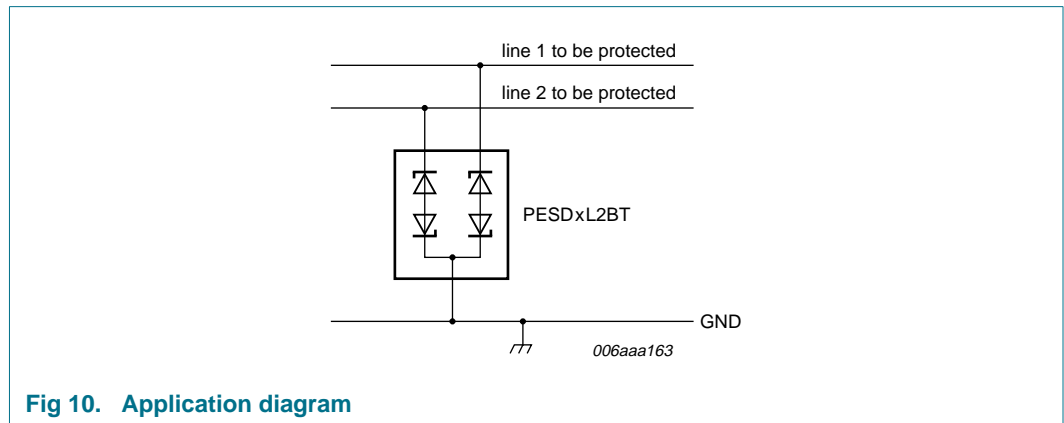


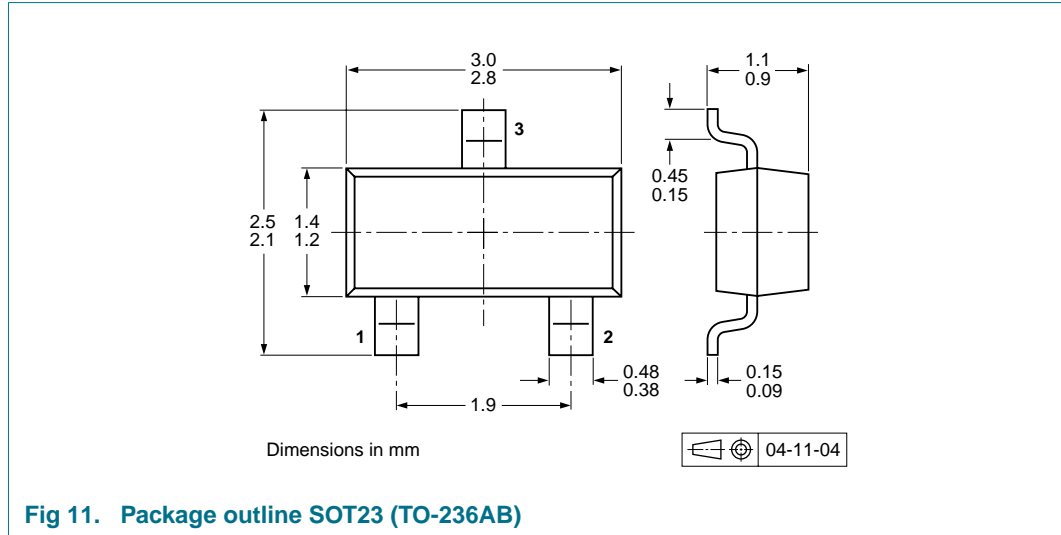
Fig 10. Application diagram

### 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 PESDxL2BT as close to the input terminal or connector as possible.
2. The path length between the PESDxL2BT 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 |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PESD3V3L2BT | SOT23   | 4 mm pitch, 8 mm tape and reel | -215             | -235  |
| PESD5V0L2BT |         |                                |                  |       |
| PESD12VL2BT |         |                                |                  |       |
| PESD15VL2BT |         |                                |                  |       |
| PESD24VL2BT |         |                                |                  |       |

[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      |
|-----------------|---|--------------------|---------------|-----------------|
| PESDXL2BT_SER_2 | 20090825  | Product data sheet | -             | PESDXL2BT_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> <li><a href="#">Table 2 "Pinning"</a>: amended</li> </ul> |                    |               |                 |
| PESDXL2BT_SER_1 | 20051101  | 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>.

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



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