



# PESD1FLEX

FlexRay bus ESD protection diode

Rev. 02 — 15 February 2008

Product data sheet

## 1. Product profile

### 1.1 General description

PESD1FLEX in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package designed to protect two automotive FlexRay bus lines from the damage caused by ElectroStatic Discharge (ESD) and other transients.

### 1.2 Features

- Due to the integrated diode structure only one small SOT23 package is needed to protect two FlexRay bus lines
- Max. peak pulse power:  $P_{PP} = 200 \text{ W}$  at  $t_p = 8/20 \mu\text{s}$
- Low clamping voltage:  $V_{CL} = 40 \text{ V}$  at  $I_{PP} = 1 \text{ A}$
- Ultra low leakage current:  $I_{RM} < 1 \text{ nA}$
- Typ. diode capacitance matching:  $\Delta C_d/C_d = 0.1 \%$
- ESD protection up to 23 kV
- IEC 61000-4-2, level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{PP} = 3 \text{ A}$  at  $t_p = 8/20 \mu\text{s}$
- Small SMD plastic package

### 1.3 Applications

- FlexRay bus protection
- Automotive applications

### 1.4 Quick reference data

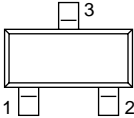
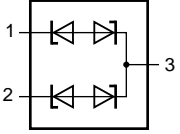
**Table 1. Quick reference data**

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

| Symbol           | Parameter                | Conditions                             | Min | Typ | Max | Unit |
|------------------|--------------------------|--|-----|-----|-----|------|
| <b>Per diode</b> |                          |  |     |     |     |      |
| $V_{RWM}$        | reverse standoff voltage |  | -   | -   | 24  | V    |
| $C_d$            | diode capacitance        | $f = 5 \text{ MHz}; V_R = 0 \text{ V}$ | -   | 11  | 17  | pF   |

## 2. Pinning information

**Table 2. Pinning**

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

006aaa155

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package |  |         |
|-------------|---------|--|---------|
|             | Name    | Description                              | Version |
| PESD1FLEX   | -       | plastic surface-mounted package; 3 leads | SOT23   |

## 4. Marking

**Table 4. Marking codes**

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PESD1FLEX   | ZJ*                         |

- [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 |
|-------------------|----------------------|--------------------------|----------|------|------|
| <b>Per diode</b>  |                      |                          |          |      |      |
| P <sub>PP</sub>   | peak pulse power     | t <sub>p</sub> = 8/20 μs | [1][2] - | 200  | W    |
| I <sub>PP</sub>   | peak pulse current   | t <sub>p</sub> = 8/20 μs | [1][2] - | 3    | A    |
| <b>Per device</b> |                      |                          |          |      |      |
| 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**

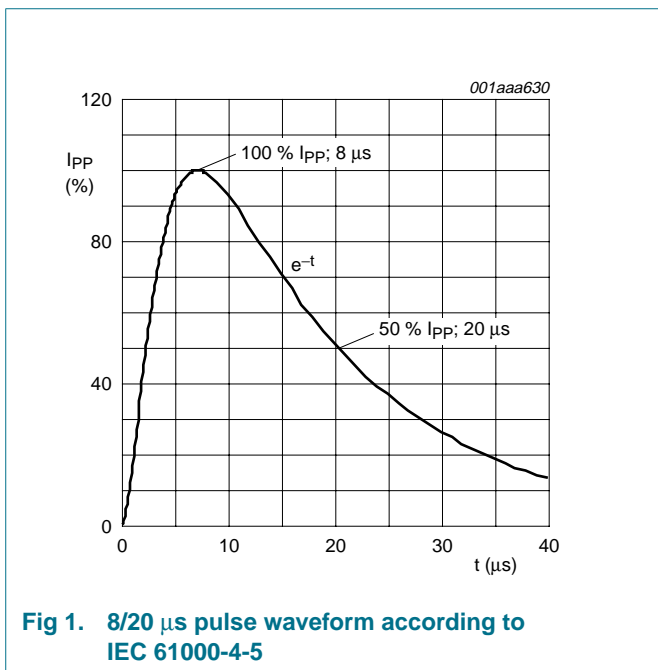
| Symbol           | Parameter                       | Conditions                        | Min    | Max | Unit  |
|------------------|---------------------------------|-----------------------------------|--------|-----|-------|
| <b>Per diode</b> |                                 |                                   |        |     |       |
| $V_{ESD}$        | electrostatic discharge voltage | IEC 61000-4-2 (contact discharge) | [1][2] | -   | 23 kV |
|                  |                                 | MIL-STD-883 (human body model)    | -      | 10  | kV    |

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

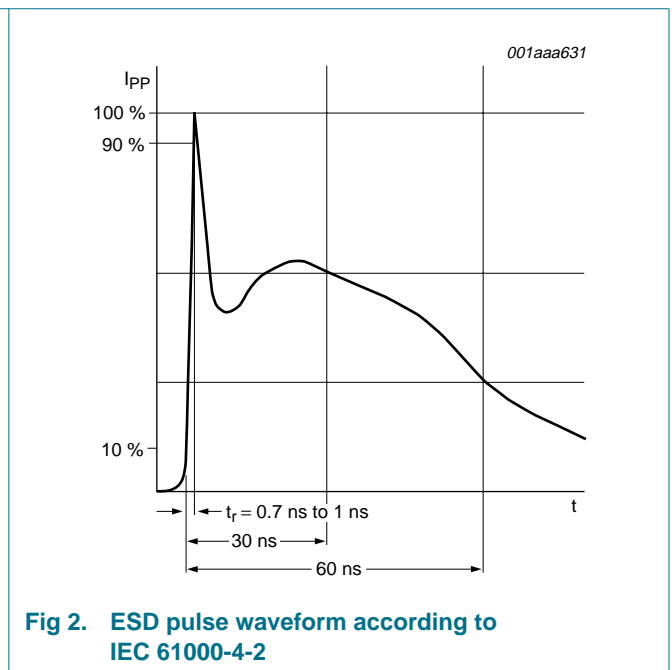
[2] Measured from pin 1 to 3 or 2 to 3.

**Table 7. ESD standards compliance**

| Standard                                | Conditions                      |
|---|---------------------------------|
| <b>Per diode</b>                        |                                 |
| IEC 61000-4-2; level 4 (ESD)            | > 15 kV (air); > 8 kV (contact) |
| MIL-STD-883; class 3 (human body model) | > 4 kV                          |



**Fig 1. 8/20  $\mu s$  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     |
|------------------|----------------------------|--|--------|------|------|----------|
| <b>Per diode</b> |                            |  |        |      |      |          |
| $V_{RWM}$        | reverse standoff voltage   |  | -      | -    | 24   | V        |
| $I_{RM}$         | reverse leakage current    | $V_{RWM} = 24\text{ V}$                | -      | < 1  | 50   | nA       |
| $V_{BR}$         | breakdown voltage          | $I_R = 5\text{ mA}$                    | 25.4   | 27.8 | 30.3 | V        |
| $C_d$            | diode capacitance          | $f = 5\text{ MHz}; V_R = 0\text{ V}$   | -      | 11   | 17   | pF       |
| $\Delta C_d/C_d$ | diode capacitance matching |  | [1]    |      |      |          |
|                  |                            | $f = 5\text{ MHz}; V_R = 0\text{ V}$   | -      | 0.1  | -    | %        |
|                  |                            | $f = 5\text{ MHz}; V_R = 2.5\text{ V}$ | -      | 0.1  | -    | %        |
| $V_{CL}$         | clamping voltage           |  | [2][3] |      |      |          |
|                  |                            | $I_{PP} = 1\text{ A}$                  | -      | -    | 40   | V        |
|                  |                            | $I_{PP} = 3\text{ A}$                  | -      | -    | 70   | V        |
| $r_{dif}$        | differential resistance    | $I_R = 1\text{ mA}$                    | -      | -    | 300  | $\Omega$ |

[1]  $\Delta C_d$  is the difference of the capacitance measured between pin 1 and pin 3 and the capacitance measured between pin 2 and pin 3.

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

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

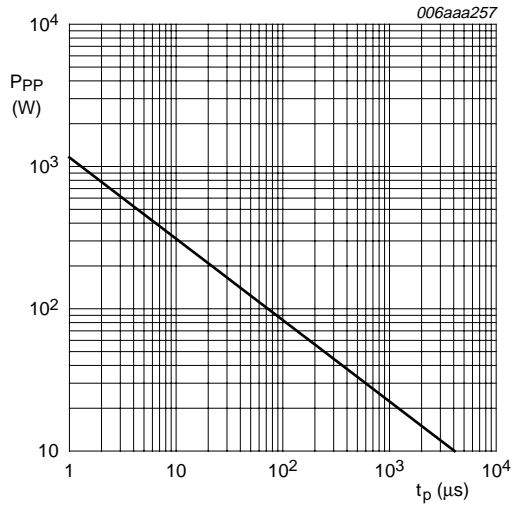


Fig 3. Peak pulse power as a function of exponential pulse duration; typical values

$T_{amb} = 25\text{ °C}$

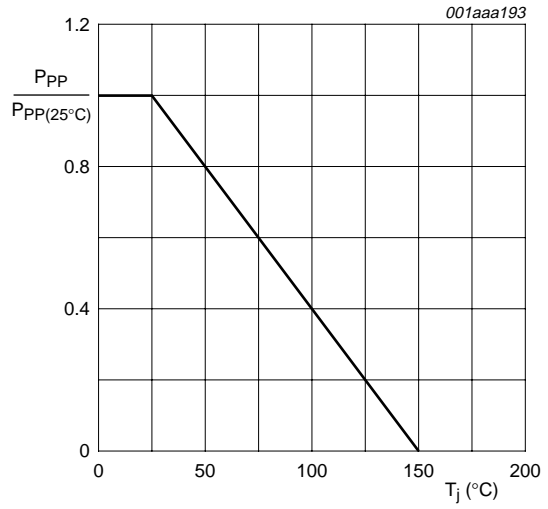


Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values

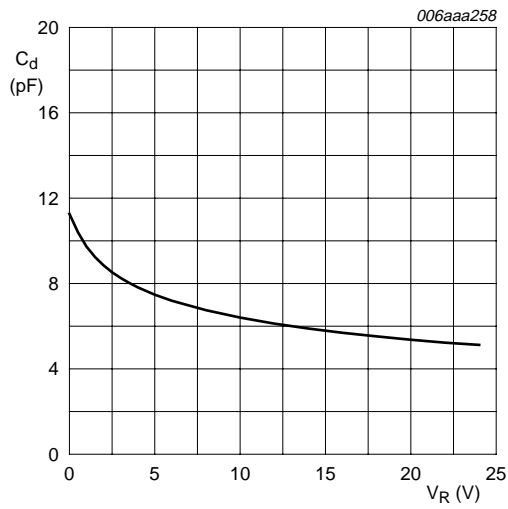


Fig 5. Diode capacitance as a function of reverse voltage; typical values

$f = 5\text{ MHz}; T_{amb} = 25\text{ °C}$

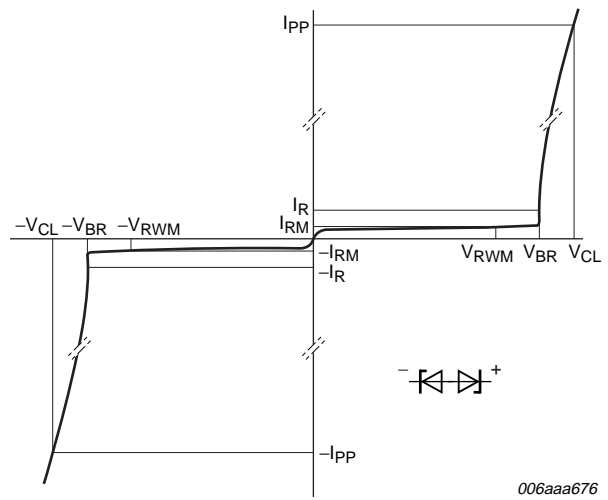
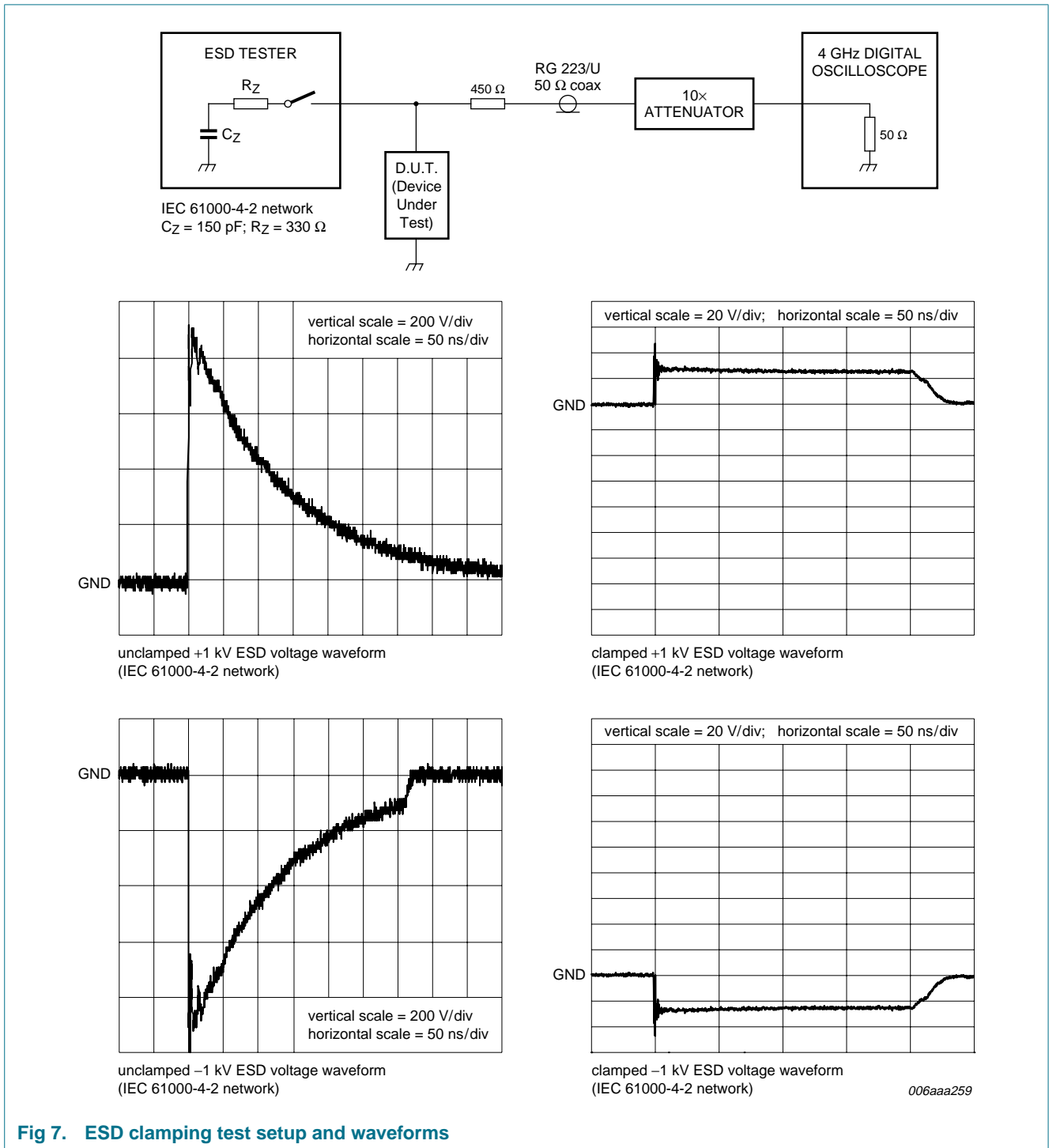


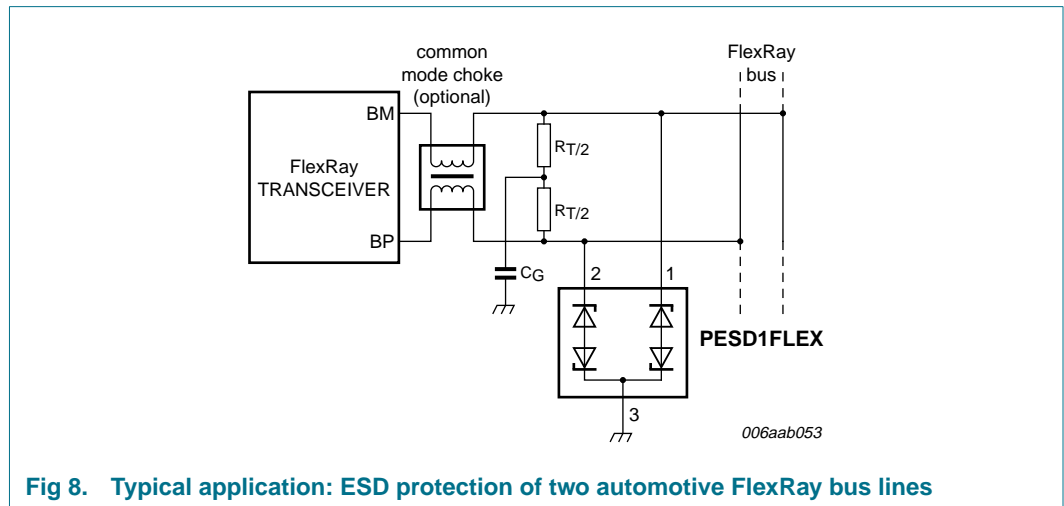
Fig 6. V-I characteristics for a bidirectional ESD protection diode



**Fig 7. ESD clamping test setup and waveforms**

## 7. Application information

The PESD1FLEX is designed for the protection of two automotive FlexRay data lines from the damage caused by ESD and surge pulses. The device supports a FlexRay data rate of 10 Mbit/s. The PESD1FLEX provides a surge capability of up to 200 W per line for an 8/20  $\mu$ s waveform.



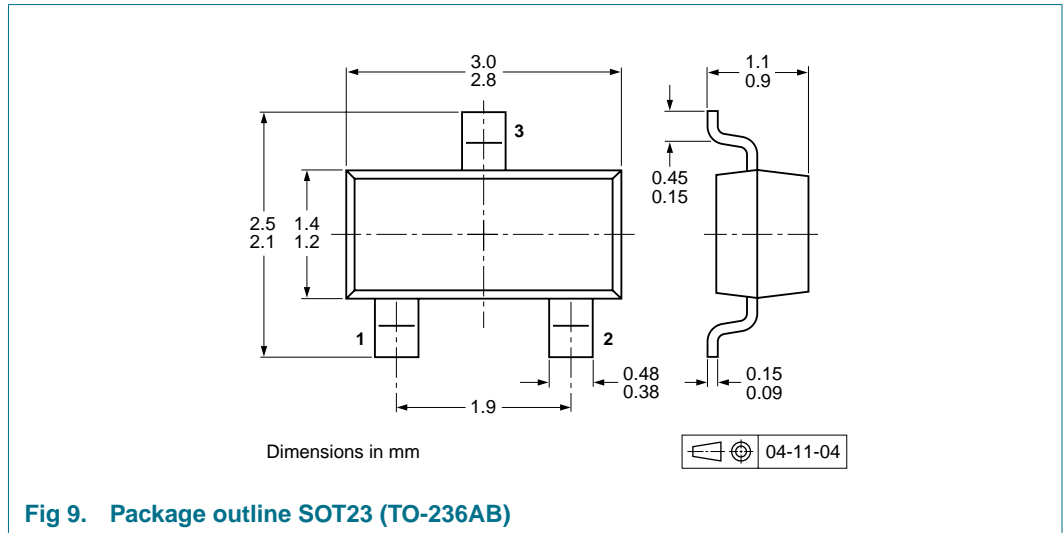
**Fig 8. Typical application: ESD protection of two automotive FlexRay bus lines**

### 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 PESD1FLEX as close to the input terminal or connector as possible.
2. The path length between the PESD1FLEX and the protected line should be minimized.
3. Keep parallel signal paths to a minimum.
4. Avoid running protection 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**

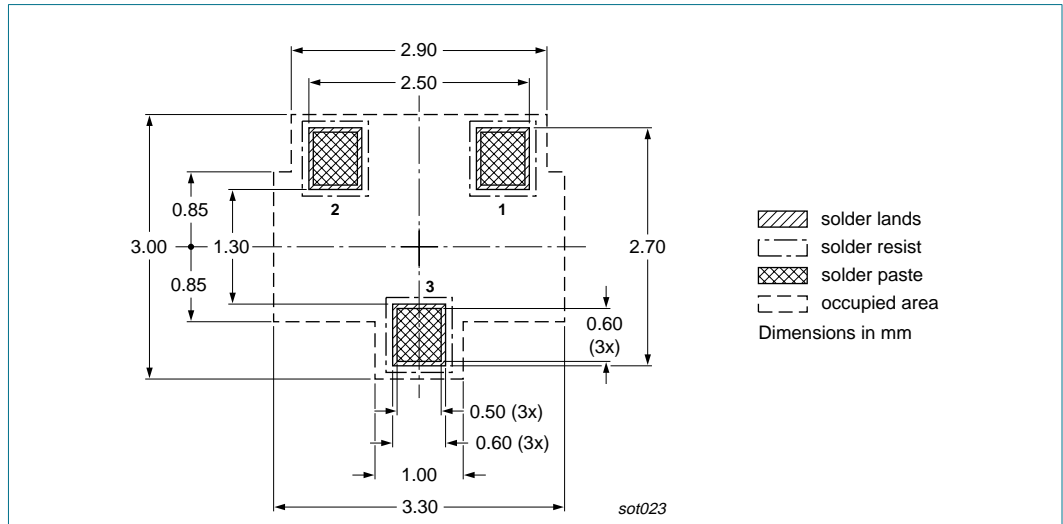
The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| PESD1FLEX   | SOT23   | 4 mm pitch, 8 mm tape and reel | -215             | -235  |

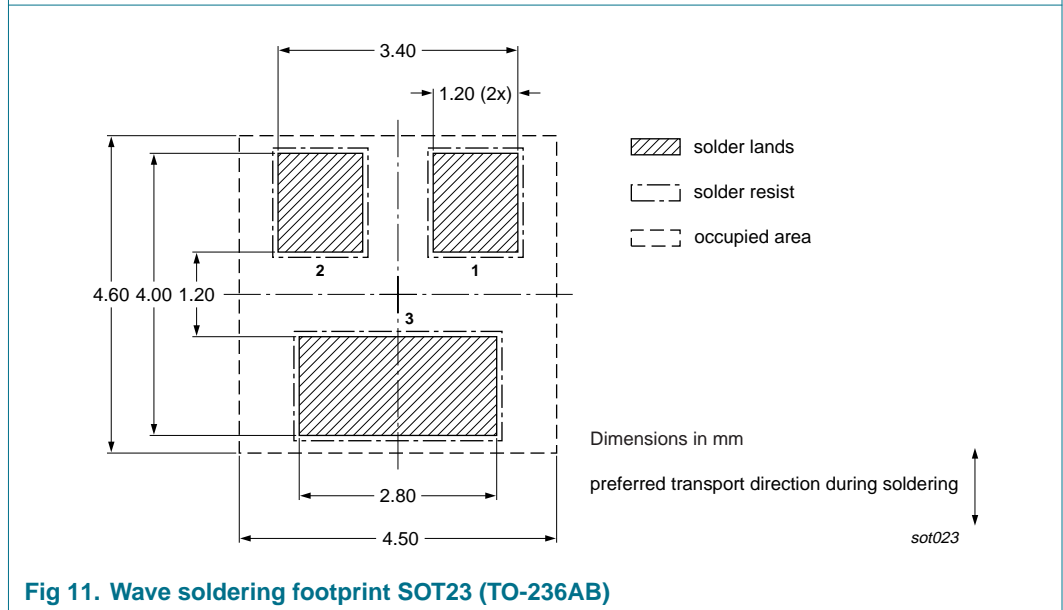
[1] For further information and the availability of packing methods, see [Section 13](#).



## 10. Soldering



**Fig 10. Reflow soldering footprint SOT23 (TO-236AB)**



**Fig 11. Wave soldering footprint SOT23 (TO-236AB)**

## 11. Revision history

Table 10. Revision history

| Document ID    | Release date | Data sheet status  | Change notice  | Supersedes  |
|----------------|--------------|--------------------|--|-------------|
| PESD1FLEX_2    | 20080215     | Product data sheet | -  | PESD1FLEX_1 |
| Modifications: |              |                    |  |             |
|                |              |                    | <ul style="list-style-type: none"><li>• <a href="#">Section 1.2 "Features"</a>: list item for diode capacitance matching added</li><li>• <a href="#">Table 8 "Characteristics"</a>: <math>\Delta C_d/C_d</math> diode capacitance matching added</li></ul> |             |
| PESD1FLEX_1    | 20070521     | Product data sheet | -  | -           |

## 12. Legal information

### 12.1 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.                       |
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[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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