

# PESDxL4UF; PESDxL4UG; PESDxL4UW

Low capacitance unidirectional quadruple ESD protection diode arrays

Rev. 04 — 28 February 2008

Product data sheet

## 1. Product profile

### 1.1 General description

Low capacitance unidirectional quadruple ElectroStatic Discharge (ESD) protection diode arrays in small Surface-Mounted Device (SMD) plastic packages designed to protect up to four signal lines from the damage caused by ESD and other transients.

Table 1. Product overview

| Type number | Package  |        |        | Package configuration     |
|-------------|----------|--------|--------|---------------------------|
|             | Nexperia | JEITA  | JEDEC  |                           |
| PESD3V3L4UF | SOT886   | -      | MO-252 | leadless ultra small      |
| PESD5V0L4UF | SOT886   | -      | MO-252 | leadless ultra small      |
| PESD3V3L4UG | SOT353   | SC-88A | -      | very small                |
| PESD5V0L4UG | SOT353   | SC-88A | -      | very small                |
| PESD3V3L4UW | SOT665   | -      | -      | ultra small and flat lead |
| PESD5V0L4UW | SOT665   | -      | -      | ultra small and flat lead |

### 1.2 Features

- ESD protection of up to four lines
- Low diode capacitance
- Max. peak pulse power:  $P_{PP} = 30 \text{ W}$
- Low clamping voltage:  $V_{CL} = 12 \text{ V}$
- Ultra low leakage current:  $I_{RM} = 5 \text{ nA}$
- ESD protection up to 20 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{PP} = 2.5 \text{ A}$

### 1.3 Applications

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

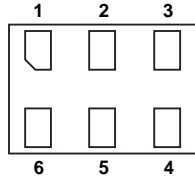
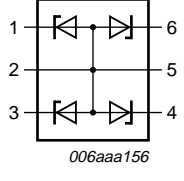
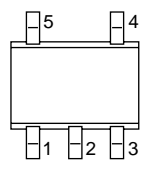
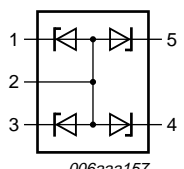
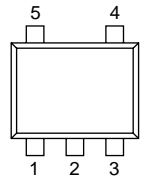
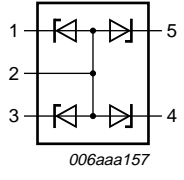
**1.4 Quick reference data**

**Table 2. Quick reference data**  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol           | Parameter                                 | Conditions                      | Min | Typ | Max | Unit |
|------------------|---|---------------------------------|-----|-----|-----|------|
| <b>Per diode</b> |   |                                 |     |     |     |      |
| V <sub>RWM</sub> | reverse standoff voltage                  |                                 |     |     |     |      |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |                                 | -   | -   | 3.3 | V    |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |                                 | -   | -   | 5.0 | V    |
| C <sub>d</sub>   | diode capacitance                         | f = 1 MHz; V <sub>R</sub> = 0 V |     |     |     |      |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |                                 | -   | 22  | 28  | pF   |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |                                 | -   | 16  | 19  | pF   |

**2. Pinning information**

**Table 3. Pinning**

| Pin                             | Description       | Simplified outline  | Symbol   |
|---------------------------------|-------------------|---|--|
| <b>PESD3V3L4UF; PESD5V0L4UF</b> |                   |   |  |
| 1                               | cathode (diode 1) |  <p>bottom view</p> |  <p>006aaa156</p> |
| 2                               | common anode      |   |  |
| 3                               | cathode (diode 2) |   |  |
| 4                               | cathode (diode 3) |   |  |
| 5                               | common anode      |   |  |
| 6                               | cathode (diode 4) |   |  |
| <b>PESD3V3L4UG; PESD5V0L4UG</b> |                   |   |  |
| 1                               | cathode (diode 1) |                     |  <p>006aaa157</p> |
| 2                               | common anode      |   |  |
| 3                               | cathode (diode 2) |   |  |
| 4                               | cathode (diode 3) |   |  |
| 5                               | cathode (diode 4) |   |  |
| <b>PESD3V3L4UW; PESD5V0L4UW</b> |                   |   |  |
| 1                               | cathode (diode 1) |                     |  <p>006aaa157</p> |
| 2                               | common anode      |   |  |
| 3                               | cathode (diode 2) |   |  |
| 4                               | cathode (diode 3) |   |  |
| 5                               | cathode (diode 4) |   |  |

### 3. Ordering information

Table 4. Ordering information

| Type number                | Package |  |         |
|----------------------------|---------|--|---------|
|                            | Name    | Description  | Version |
| PESD3V3L4UF<br>PESD5V0L4UF | XSON6   | plastic extremely thin small outline package;<br>no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886  |
| PESD3V3L4UG<br>PESD5V0L4UG | SC-88A  | plastic surface-mounted package; 5 leads   | SOT353  |
| PESD3V3L4UW<br>PESD5V0L4UW | -       | plastic surface-mounted package; 5 leads   | SOT665  |

### 4. Marking

Table 5. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PESD3V3L4UF | A5                          |
| PESD5V0L4UF | A6                          |
| PESD3V3L4UG | L1*                         |
| PESD5V0L4UG | L2*                         |
| PESD3V3L4UW | A2                          |
| PESD5V0L4UW | A1                          |

[1] \* = -: made in Hong Kong

\* = p: made in Hong Kong

\* = t: made in Malaysia

\* = W: made in China

### 5. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol           | Parameter                                 | Conditions                   | Min                         | Max | Unit |   |
|------------------|---|------------------------------|-----------------------------|-----|------|---|
| <b>Per diode</b> |   |                              |                             |     |      |   |
| $P_{PP}$         | peak pulse power                          | $t_p = 8/20 \mu s$           | <a href="#">[1][2][3]</a> - | 30  | W    |   |
| $I_{PP}$         | peak pulse current                        | $t_p = 8/20 \mu s$           | <a href="#">[1][2][3]</a>   | -   | 3.0  | A |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |                              |                             | -   | 2.5  | A |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |                              |                             | -   | 3.5  | A |
| $I_{FSM}$        | non-repetitive peak forward current       | square wave;<br>$t_p = 1 ms$ | -                           | 3.5 | A    |   |

**Table 6. Limiting values ...continued**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol            | Parameter                                     | Conditions                           | Min | Max  | Unit |
|-------------------|---|--------------------------------------|-----|------|------|
| $I_{ZSM}$         | non-repetitive peak reverse current           | square wave;<br>$t_p = 1 \text{ ms}$ |     |      |      |
|                   | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW     |                                      | -   | 0.9  | A    |
|                   | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW     |                                      | -   | 0.8  | A    |
| $P_{ZSM}$         | non-repetitive peak reverse power dissipation | square wave;<br>$t_p = 1 \text{ ms}$ | -   | 6    | W    |
| <b>Per device</b> |   |                                      |     |      |      |
| $T_j$             | 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  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.

[2] For PESDxL4UF measured from pin 1, 3, 4 or 6 to pin 2 or 5.

[3] For PESDxL4UG and PESDxL4UW measured from pin 1, 3, 4 or 5 to pin 2.

**Table 7. ESD maximum ratings** $T_{amb} = 25^\circ\text{C}$  unless otherwise specified.

| Symbol           | Parameter                       | Conditions                           | Min       | Max | Unit |    |
|------------------|---------------------------------|--------------------------------------|-----------|-----|------|----|
| <b>Per diode</b> |                                 |                                      |           |     |      |    |
| $V_{ESD}$        | electrostatic discharge voltage | IEC 61000-4-2<br>(contact discharge) | [1][2][3] | -   | 20   | kV |
|                  |                                 | MIL-STD-883 (human body model)       |           | -   | 10   | kV |

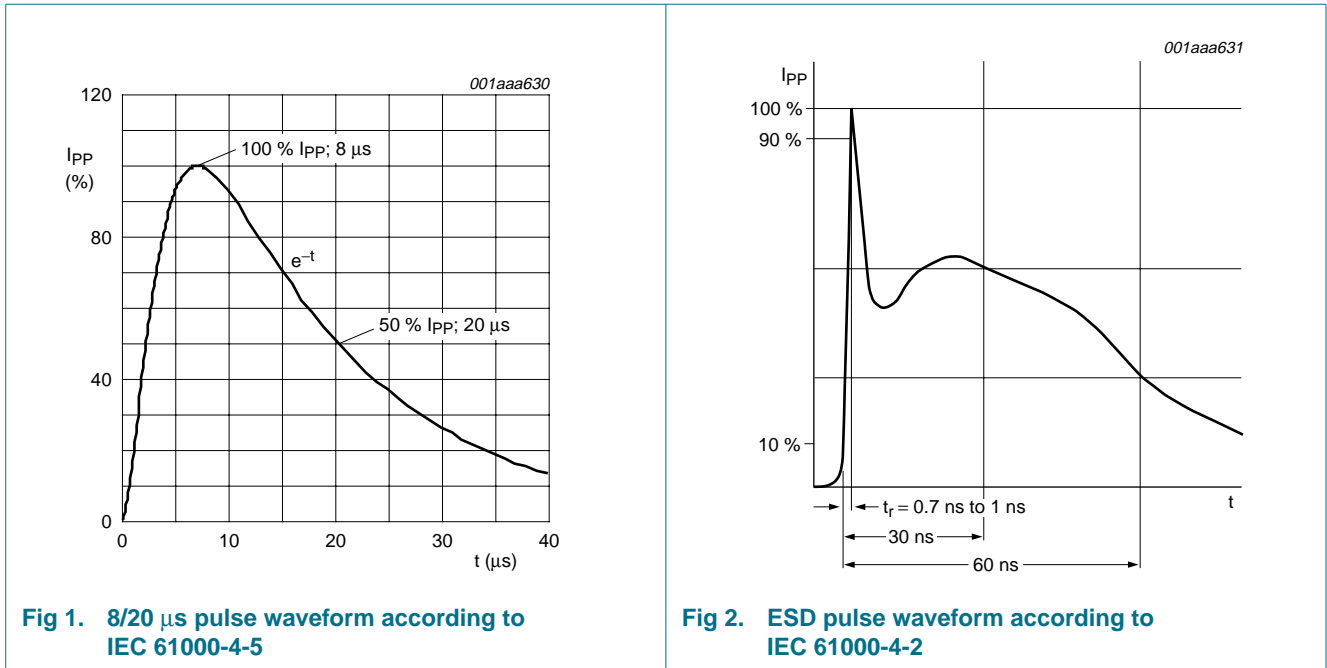
[1] Device stressed with ten non-repetitive ESD pulses.

[2] For PESDxL4UF measured from pin 1, 3, 4 or 6 to pin 2 or 5.

[3] For PESDxL4UG and PESDxL4UW measured from pin 1, 3, 4 or 5 to pin 2.

**Table 8. 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                          |



## 6. Characteristics

**Table 9. Characteristics**  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol           | Parameter                                 | Conditions               | Min  | Typ | Max  | Unit |
|------------------|---|--------------------------|------|-----|------|------|
| <b>Per diode</b> |   |                          |      |     |      |      |
| V <sub>RWM</sub> | reverse standoff voltage                  |                          |      |     |      |      |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |                          | -    | -   | 3.3  | V    |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |                          | -    | -   | 5.0  | V    |
| I <sub>RM</sub>  | reverse leakage current                   |                          |      |     |      |      |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW | V <sub>RWM</sub> = 3.3 V | -    | 75  | 300  | nA   |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW | V <sub>RWM</sub> = 5.0 V | -    | 5   | 25   | nA   |
| V <sub>BR</sub>  | breakdown voltage                         | I <sub>R</sub> = 1 mA    |      |     |      |      |
|                  | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |                          | 5.32 | 5.6 | 5.88 | V    |
|                  | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |                          | 6.46 | 6.8 | 7.14 | V    |

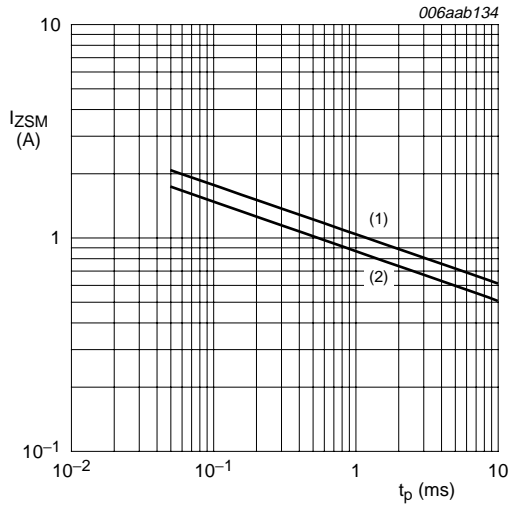
**Table 9. Characteristics ...continued**  
 $T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified.

| Symbol                                    | Parameter                                 | Conditions                                | Min | Typ       | Max | Unit     |
|---|---|---|-----|-----------|-----|----------|
| $C_d$                                     | diode capacitance                         | $f = 1\text{ MHz};$<br>$V_R = 0\text{ V}$ |     |           |     |          |
|   | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |   | -   | 22        | 28  | pF       |
|   | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |   | -   | 16        | 19  | pF       |
|   | $V_{CL}$                                  | clamping voltage                          |     | [1][2][3] |     |          |
|   | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW | $I_{PP} = 1\text{ A}$                     | -   | -         | 8   | V        |
|   | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW | $I_{PP} = 3\text{ A}$                     | -   | -         | 12  | V        |
| PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW | $I_{PP} = 1\text{ A}$                     | -   | -   | 10        | V   |          |
| PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW | $I_{PP} = 2.5\text{ A}$                   | -   | -   | 13        | V   |          |
| $r_{dif}$                                 | differential resistance                   | $I_R = 1\text{ mA}$                       |     |           |     |          |
|   | PESD3V3L4UF<br>PESD3V3L4UG<br>PESD3V3L4UW |   | -   | -         | 200 | $\Omega$ |
|   | PESD5V0L4UF<br>PESD5V0L4UG<br>PESD5V0L4UW |   | -   | -         | 100 | $\Omega$ |

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

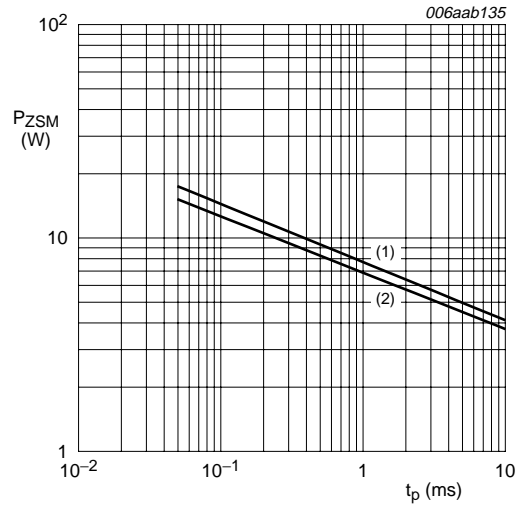
[2] For PESDxL4UF measured from pin 1, 3, 4 or 6 to pin 2 or 5.

[3] For PESDxL4UG and PESDxL4UW measured from pin 1, 3, 4 or 5 to pin 2.



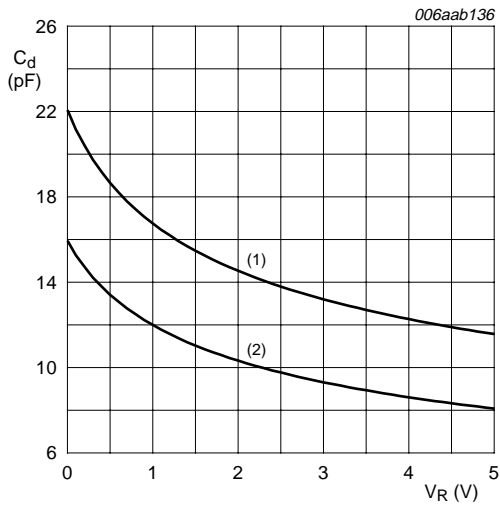
$T_{amb} = 25\text{ °C}$   
 (1) PESD3V3L4UF; PESD3V3L4UG; PESD3V3L4UW  
 (2) PESD5V0L4UF; PESD5V0L4UG; PESD5V0L4UW

**Fig 3. Non-repetitive peak reverse current as a function of pulse duration; maximum values**



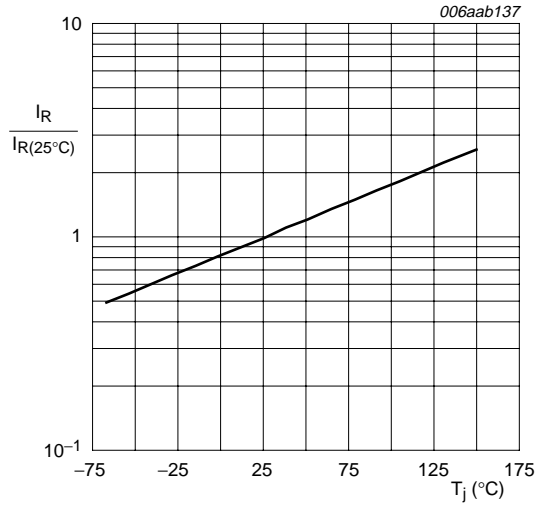
$T_{amb} = 25\text{ °C}$   
 (1) PESD3V3L4UF; PESD3V3L4UG; PESD3V3L4UW  
 (2) PESD5V0L4UF; PESD5V0L4UG; PESD5V0L4UW

**Fig 4. Non-repetitive peak reverse power dissipation as a function of pulse duration; maximum values**



$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$   
 (1) PESD3V3L4UF; PESD3V3L4UG; PESD3V3L4UW  
 (2) PESD5V0L4UF; PESD5V0L4UG; PESD5V0L4UW

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



**Fig 6. Relative variation of reverse current as a function of junction temperature; typical values**

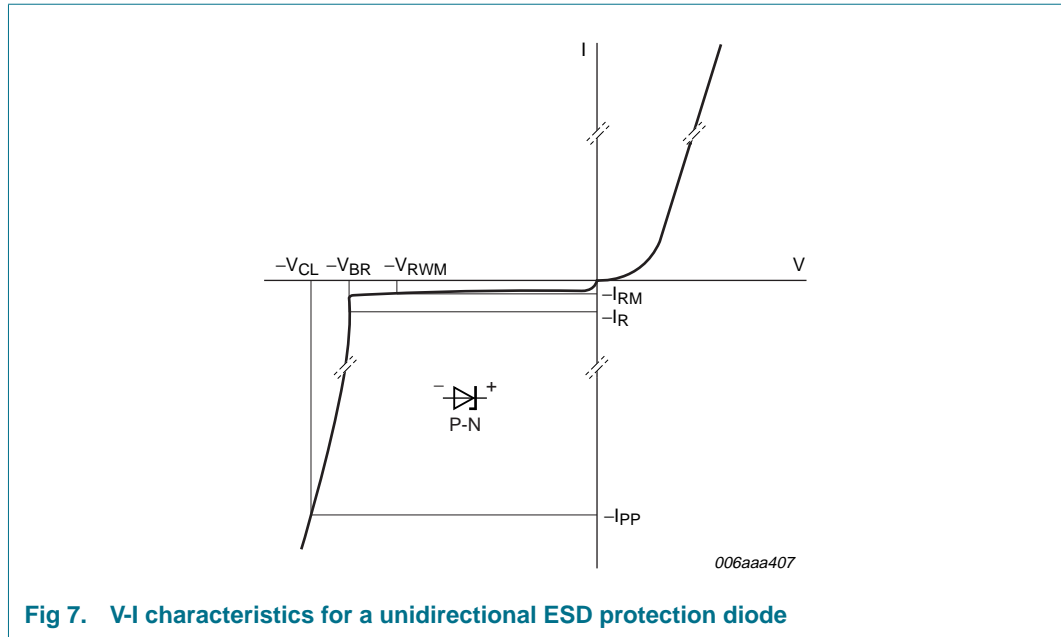


Fig 7. V-I characteristics for a unidirectional ESD protection diode



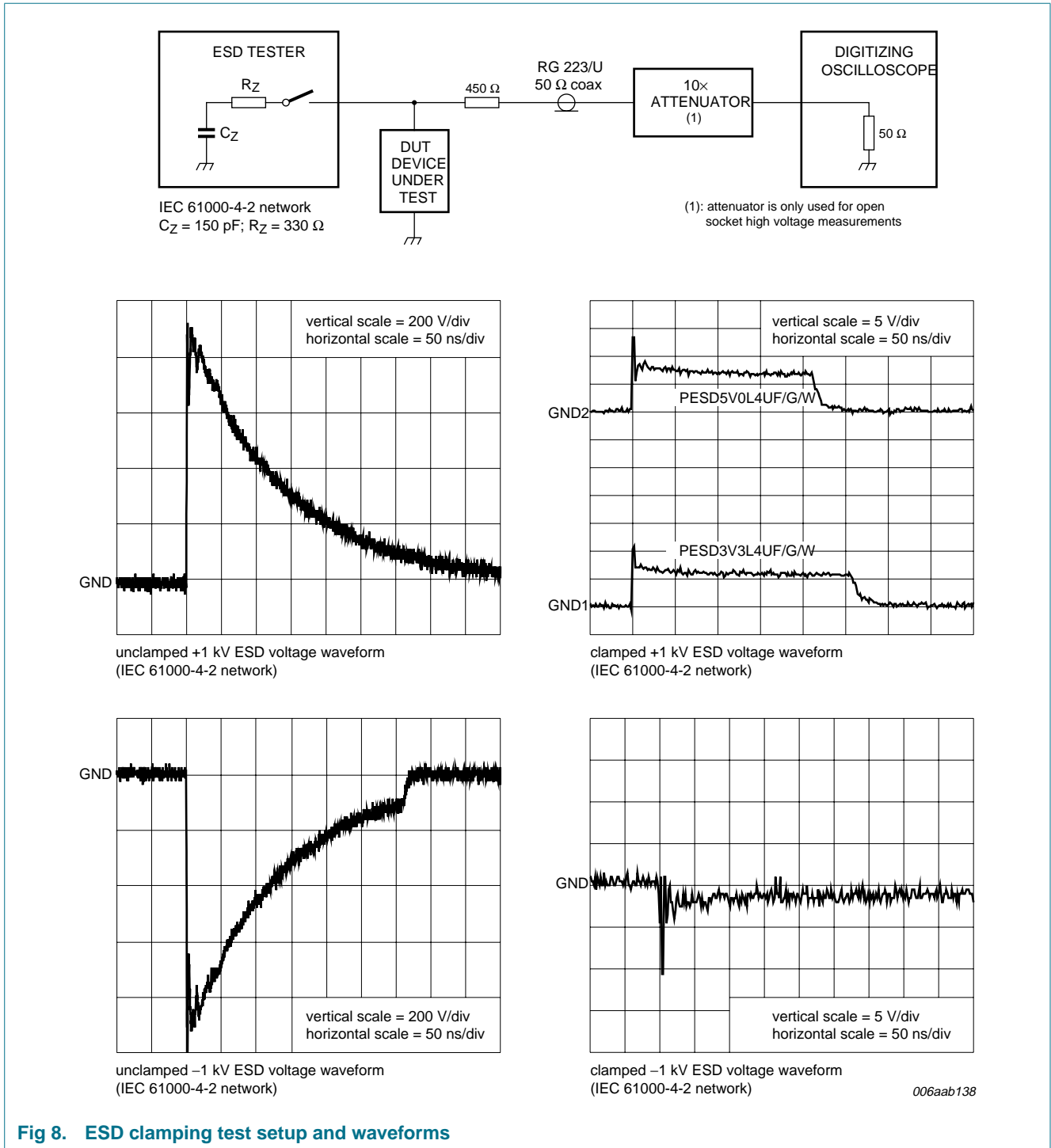


Fig 8. ESD clamping test setup and waveforms

## 7. Application information

The devices are designed for the protection of up to four unidirectional data or signal lines from the damage caused by ESD and surge pulses. The devices may be used on lines where the signal polarities are both, positive and negative with respect to ground. The devices provide a surge capability of 30 W per line for an 8/20  $\mu$ s waveform each.

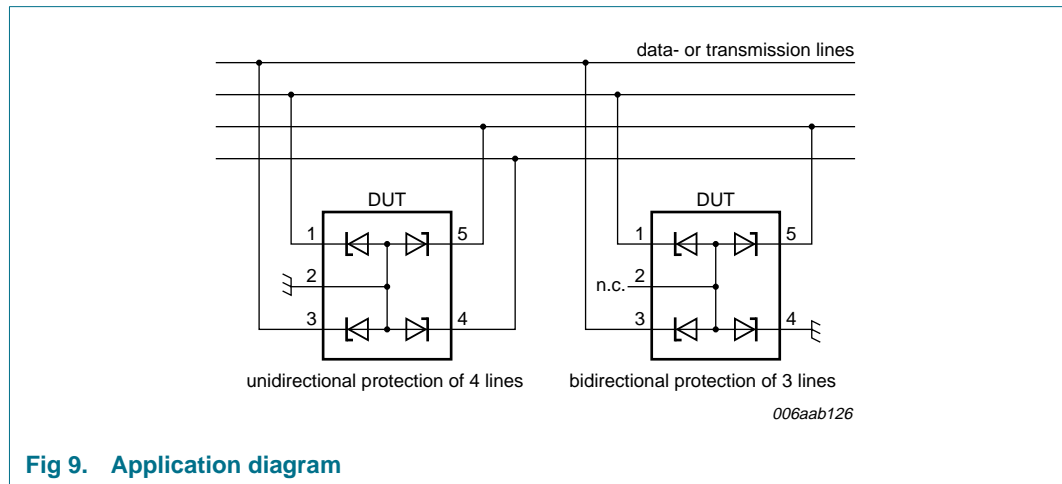


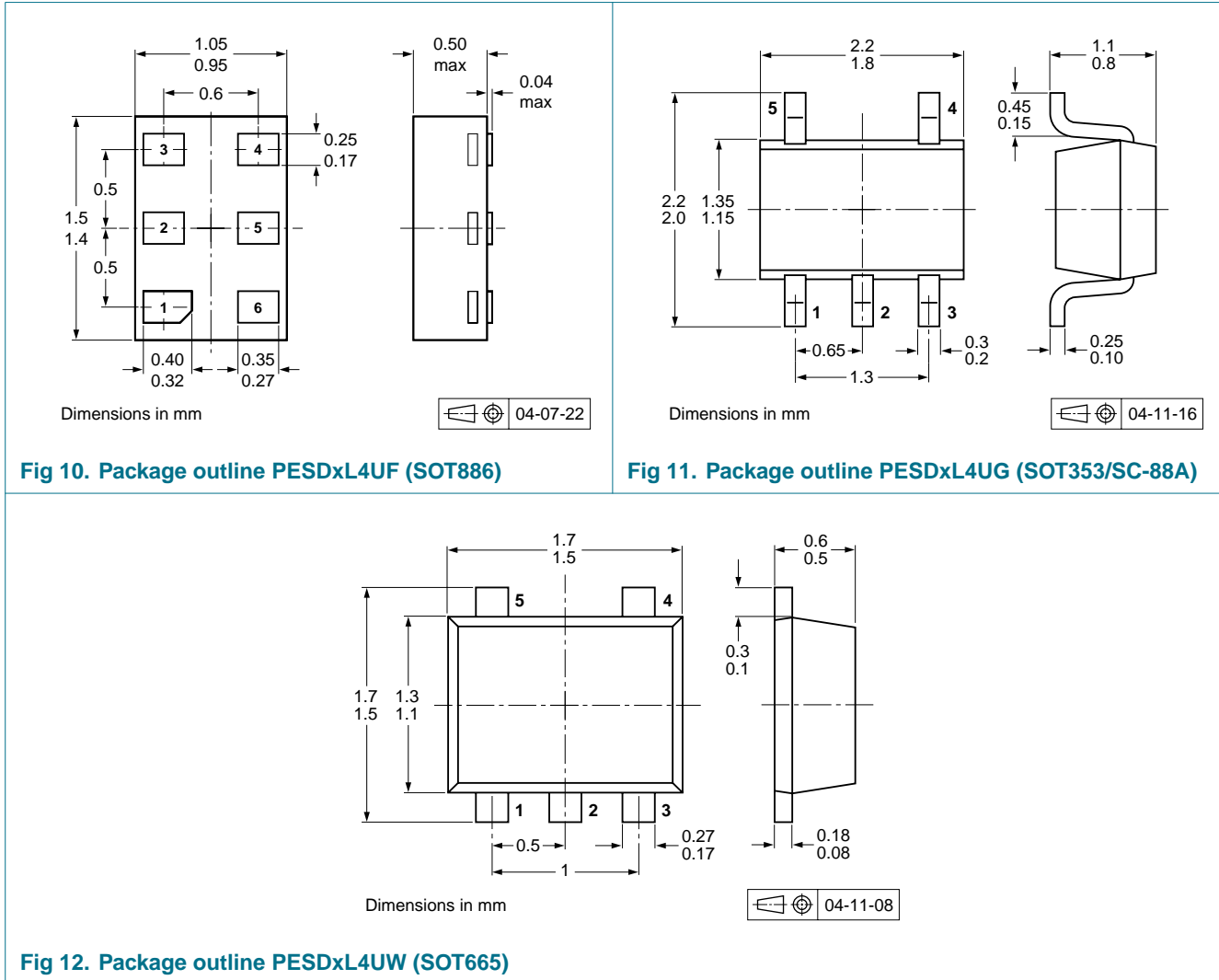
Fig 9. Application diagram

### 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 device as close to the input terminal or connector as possible.
2. The path length between the 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 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 10. 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             | 4000 | 5000 | 8000 | 10000 |      |
| PESD3V3L4UF | SOT886  | 4 mm pitch, 8 mm tape and reel; T1 | [2]              | -    | -    | -115 | -     | -    |
|             |         | 4 mm pitch, 8 mm tape and reel; T4 | [3]              | -    | -    | -132 | -     | -    |
| PESD5V0L4UF | SOT886  | 4 mm pitch, 8 mm tape and reel; T1 | [2]              | -    | -    | -115 | -     | -    |
|             |         | 4 mm pitch, 8 mm tape and reel; T4 | [3]              | -    | -    | -132 | -     | -    |
| PESD3V3L4UG | SOT353  | 4 mm pitch, 8 mm tape and reel; T1 | [2]              | -115 | -    | -    | -     | -135 |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 | [4]              | -125 | -    | -    | -     | -165 |
| PESD5V0L4UG | SOT353  | 4 mm pitch, 8 mm tape and reel; T1 | [2]              | -115 | -    | -    | -     | -135 |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 | [4]              | -125 | -    | -    | -     | -165 |
| PESD3V3L4UW | SOT665  | 2 mm pitch, 8 mm tape and reel     | -                | -    | -    | -    | -315  | -    |
|             |         | 4 mm pitch, 8 mm tape and reel     | -                | -115 | -    | -    | -     | -    |
| PESD5V0L4UW | SOT665  | 2 mm pitch, 8 mm tape and reel     | -                | -    | -    | -    | -315  | -    |
|             |         | 4 mm pitch, 8 mm tape and reel     | -                | -115 | -    | -    | -     | -    |

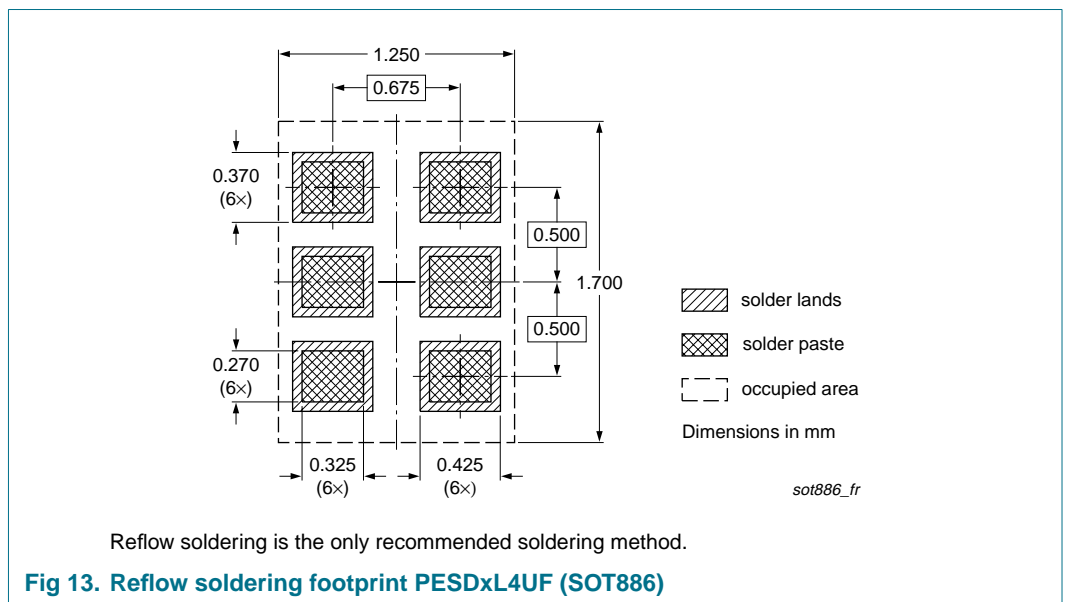
[1] For further information and the availability of packing methods, see [Section 13](#).

[2] T1: normal taping

[3] T4: 90° rotated reverse taping

[4] T2: reverse taping

## 10. Soldering



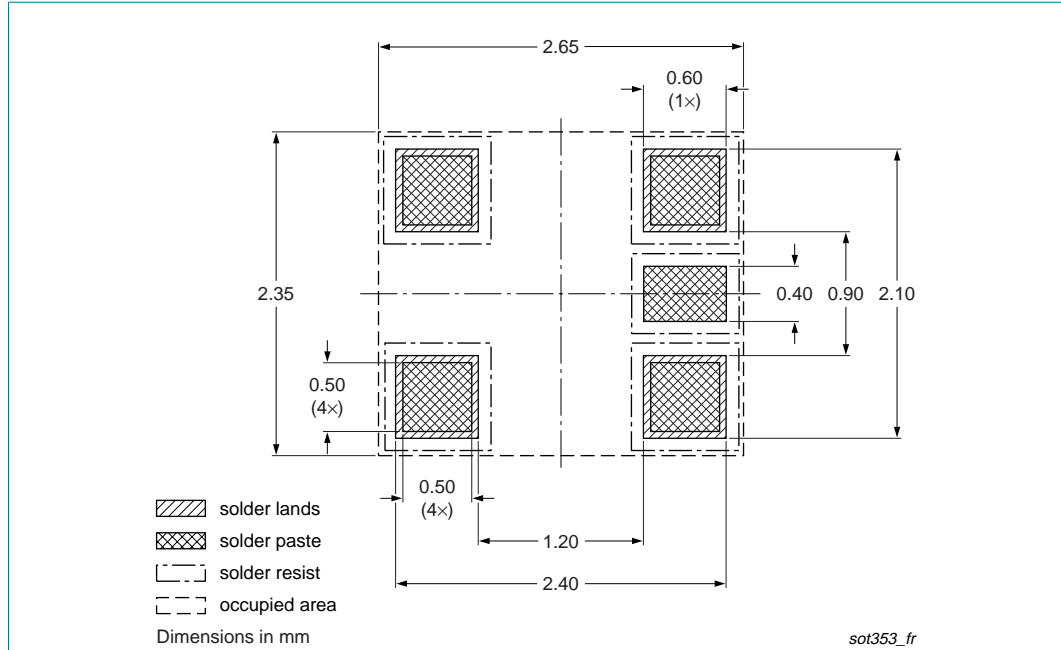


Fig 14. Reflow soldering footprint PESDxL4UG (SOT353/SC-88A)

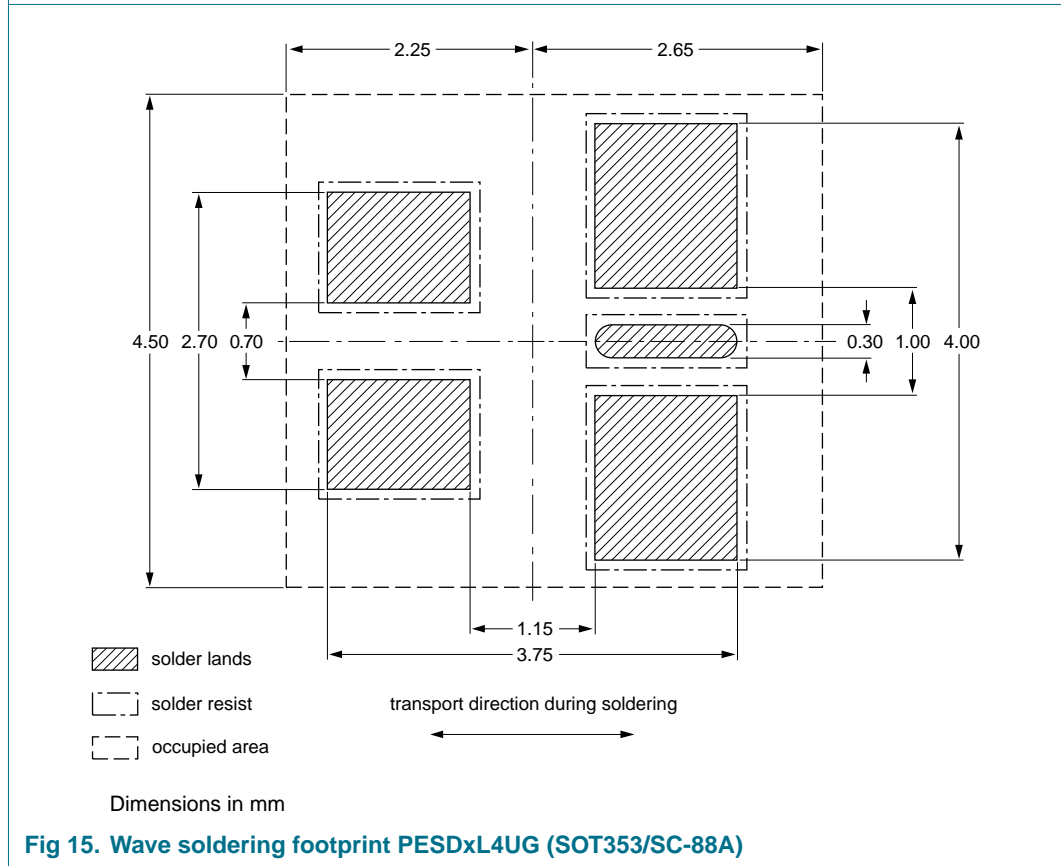


Fig 15. Wave soldering footprint PESDxL4UG (SOT353/SC-88A)



## 11. Revision history

Table 11. Revision history

| Document ID        | Release date   | Data sheet status     | Change notice | Supersedes                            |
|--------------------|--|-----------------------|---------------|---------------------------------------|
| PESDXL4UF_G_W_4    | 20080228   | Product data sheet    | -             | PESDXL4UF_G_W_3                       |
| Modifications:     | • <a href="#">Figure 8 “ESD clamping test setup and waveforms”</a> : amended |                       |               |                                       |
| PESDXL4UF_G_W_3    | 20080114   | Product data sheet    | -             | PESDXL4UW_SER_2<br>PESDXL4UG_SERIES_1 |
| PESDXL4UW_SER_2    | 20040406   | Product specification | -             | PESDXL4UW_SERIES_1                    |
| PESDXL4UG_SERIES_1 | 20040323   | Product specification | -             | -                                     |

## 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.                       |
| 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.nexperia.com>.

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