

# PESDxS4UD series

Quadruple ESD protection diode arrays in a SOT457 package

Rev. 02 — 21 August 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Quadruple ElectroStatic Discharge (ESD) protection diode arrays in a SOT457 (SC-74) small Surface-Mounted Device (SMD) plastic package designed to protect up to 4 signal lines from the damage caused by ESD and other transients.

### 1.2 Features

- ESD protection of up to 4 lines
- Max. peak pulse power:  $P_{PP} = 200 \text{ W}$
- Ultra low leakage current:  $I_{RM} = 50 \text{ pA}$
- Low clamping voltage:  $V_{CL} = 12 \text{ V}$  at  $I_{PP} = 20 \text{ A}$
- ESD protection up to 30 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5; (surge);  $I_{PP}$  up to 20 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

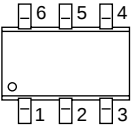
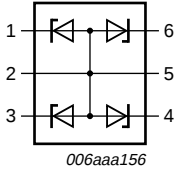
| Symbol           | Parameter                | Conditions | Min | Typ | Max | Unit |
|------------------|--------------------------|------------|-----|-----|-----|------|
| <b>Per diode</b> |                          |            |     |     |     |      |
| $V_{RWM}$        | reverse standoff voltage |            |     |     |     |      |
|                  | PESD3V3S4UD              |            | -   | -   | 3.3 | V    |
|                  | PESD5V0S4UD              |            | -   | -   | 5   | V    |
|                  | PESD12VS4UD              |            | -   | -   | 12  | V    |
|                  | PESD15VS4UD              |            | -   | -   | 15  | V    |
|                  | PESD24VS4UD              |            | -   | -   | 24  | V    |

Table 1. Quick reference data ...continued

| Symbol | Parameter         | Conditions                             | Min | Typ | Max | Unit |
|--------|-------------------|----------------------------------------|-----|-----|-----|------|
| $C_d$  | diode capacitance | $f = 1 \text{ MHz}; V_R = 0 \text{ V}$ |     |     |     |      |
|        | PESD3V3S4UD       |                                        | -   | 215 | 300 | pF   |
|        | PESD5V0S4UD       |                                        | -   | 165 | 220 | pF   |
|        | PESD12VS4UD       |                                        | -   | 73  | 100 | pF   |
|        | PESD15VS4UD       |                                        | -   | 60  | 90  | pF   |
|        | PESD24VS4UD       |                                        | -   | 45  | 70  | pF   |

## 2. Pinning information

Table 2. Pinning

| Pin | Description  | Simplified outline                                                                  | Symbol                                                                               |
|-----|--------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1   | cathode 1    |  |  |
| 2   | common anode |                                                                                     |                                                                                      |
| 3   | cathode 2    |                                                                                     |                                                                                      |
| 4   | cathode 3    |                                                                                     |                                                                                      |
| 5   | common anode |                                                                                     |                                                                                      |
| 6   | cathode 4    |                                                                                     |                                                                                      |

## 3. Ordering information

Table 3. Ordering information

| Type number | Package |                                                     |         |
|-------------|---------|-----------------------------------------------------|---------|
|             | Name    | Description                                         | Version |
| PESD3V3S4UD | SC-74   | plastic surface-mounted package (TSOP6);<br>6 leads | SOT457  |
| PESD5V0S4UD |         |                                                     |         |
| PESD12VS4UD |         |                                                     |         |
| PESD15VS4UD |         |                                                     |         |
| PESD24VS4UD |         |                                                     |         |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PESD3V3S4UD | K4           |
| PESD5V0S4UD | K5           |
| PESD12VS4UD | K6           |
| PESD15VS4UD | K7           |
| PESD24VS4UD | K8           |

## 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] - | 200  | W    |
| I <sub>PP</sub>  | peak pulse current   | t <sub>p</sub> = 8/20 μs | [1][2]   |      |      |
|                  | PESD3V3S4UD          |                          | -        | 20   | A    |
|                  | PESD5V0S4UD          |                          | -        | 20   | A    |
|                  | PESD12VS4UD          |                          | -        | 10   | A    |
|                  | PESD15VS4UD          |                          | -        | 6    | A    |
|                  | PESD24VS4UD          |                          | -        | 4    | 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, 3, 4 or 6 to 2 or 5

**Table 6. ESD maximum ratings**

| Symbol           | Parameter                       | Conditions                           | Min    | Max | Unit |
|------------------|---------------------------------|--------------------------------------|--------|-----|------|
| V <sub>ESD</sub> | electrostatic discharge voltage | IEC 61000-4-2<br>(contact discharge) | [1][2] |     |      |
|                  | PESD3V3S4UD                     |                                      | -      | 30  | kV   |
|                  | PESD5V0S4UD                     |                                      | -      | 30  | kV   |
|                  | PESD12VS4UD                     |                                      | -      | 30  | kV   |
|                  | PESD15VS4UD                     |                                      | -      | 30  | kV   |
|                  | PESD24VS4UD                     |                                      | -      | 23  | kV   |
|                  | PESDxS4UD series                | HBM MIL-STD-883                      | -      | 10  | kV   |

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

[2] Measured from pin 1, 3, 4 or 6 to 2 or 5

**Table 7. ESD standards compliance**

| Standard                     | Conditions                      |
|------------------------------|---------------------------------|
| IEC 61000-4-2; level 4 (ESD) | > 15 kV (air); > 8 kV (contact) |
| HBM MIL-STD-883; class 3     | > 10 kV                         |

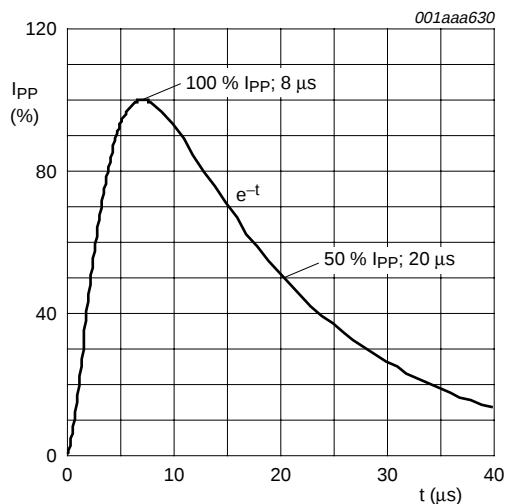


Fig 1. 8/20  $\mu$ s pulse waveform according to IEC 61000-4-5

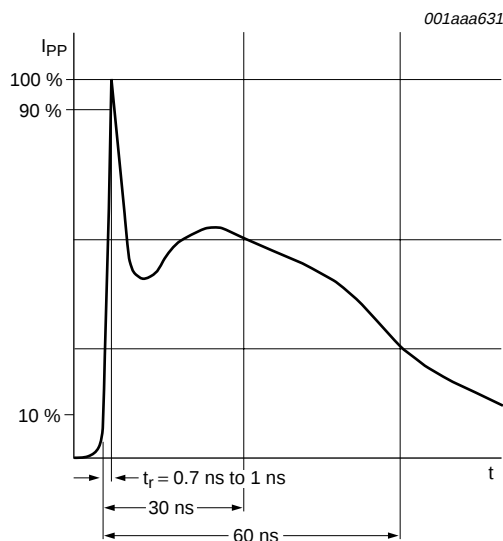


Fig 2. ESD pulse waveform according to IEC 61000-4-2

## 6. Characteristics

Table 8. Characteristics

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

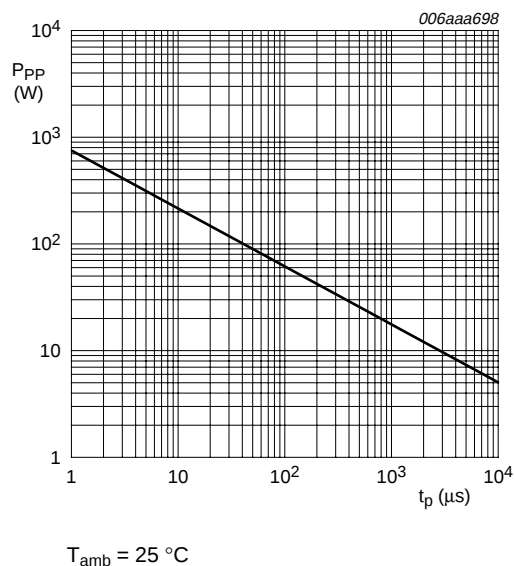
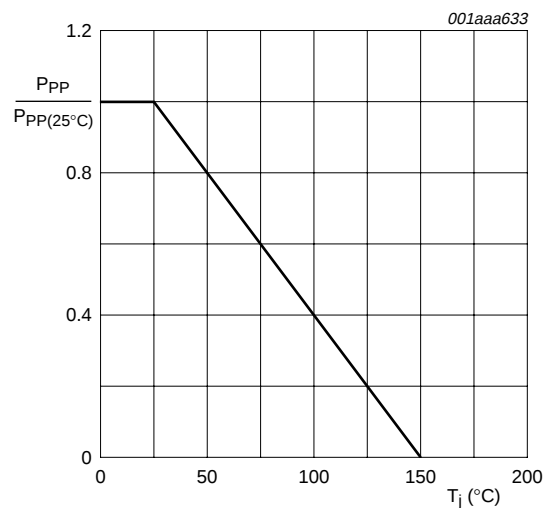
| Symbol           | Parameter                | Conditions               | Min  | Typ  | Max  | Unit |
|------------------|--------------------------|--------------------------|------|------|------|------|
| <b>Per diode</b> |                          |                          |      |      |      |      |
| $V_{RWM}$        | reverse standoff voltage |                          |      |      |      |      |
|                  | PESD3V3S4UD              |                          | -    | -    | 3.3  | V    |
|                  | PESD5V0S4UD              |                          | -    | -    | 5    | V    |
|                  | PESD12VS4UD              |                          | -    | -    | 12   | V    |
|                  | PESD15VS4UD              |                          | -    | -    | 15   | V    |
|                  | PESD24VS4UD              |                          | -    | -    | 24   | V    |
| $I_{RM}$         | reverse leakage current  |                          |      |      |      |      |
|                  | PESD3V3S4UD              | $V_{RWM} = 3.3\text{ V}$ | -    | 300  | 800  | nA   |
|                  | PESD5V0S4UD              | $V_{RWM} = 5\text{ V}$   | -    | 80   | 200  | nA   |
|                  | PESD12VS4UD              | $V_{RWM} = 12\text{ V}$  | -    | 0.05 | 15   | nA   |
|                  | PESD15VS4UD              | $V_{RWM} = 15\text{ V}$  | -    | 0.05 | 15   | nA   |
|                  | PESD24VS4UD              | $V_{RWM} = 24\text{ V}$  | -    | 0.05 | 15   | nA   |
| $V_{BR}$         | breakdown voltage        | $I_R = 1\text{ mA}$      |      |      |      |      |
|                  | PESD3V3S4UD              |                          | 5.3  | 5.6  | 5.9  | V    |
|                  | PESD5V0S4UD              |                          | 6.4  | 6.8  | 7.2  | V    |
|                  | PESD12VS4UD              |                          | 12.5 | 14.5 | 16   | V    |
|                  | PESD15VS4UD              |                          | 15.5 | 18   | 20.5 | V    |
|                  | PESD24VS4UD              |                          | 25.5 | 27   | 29   | V    |

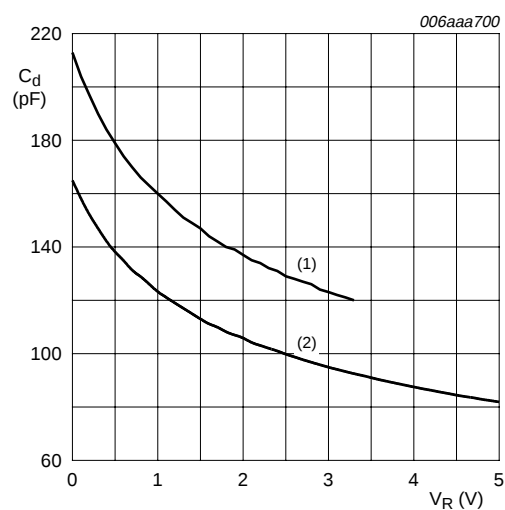
**Table 8. Characteristics ...continued** $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

| Symbol    | Parameter               | Conditions                           | Min | Typ | Max | Unit     |
|-----------|-------------------------|--------------------------------------|-----|-----|-----|----------|
| $C_d$     | diode capacitance       | $f = 1\text{ MHz}; V_R = 0\text{ V}$ |     |     |     |          |
|           | PESD3V3S4UD             |                                      | -   | 215 | 300 | pF       |
|           | PESD5V0S4UD             |                                      | -   | 165 | 220 | pF       |
|           | PESD12VS4UD             |                                      | -   | 73  | 100 | pF       |
|           | PESD15VS4UD             |                                      | -   | 60  | 90  | pF       |
|           | PESD24VS4UD             |                                      | -   | 45  | 70  | pF       |
| $V_{CL}$  | clamping voltage        |                                      |     |     |     |          |
|           | PESD3V3S4UD             | $I_{PP} = 1\text{ A}$                | -   | -   | 8   | V        |
|           |                         | $I_{PP} = 20\text{ A}$               | -   | -   | 12  | V        |
|           | PESD5V0S4UD             | $I_{PP} = 1\text{ A}$                | -   | -   | 8   | V        |
|           |                         | $I_{PP} = 20\text{ A}$               | -   | -   | 13  | V        |
|           | PESD12VS4UD             | $I_{PP} = 1\text{ A}$                | -   | -   | 17  | V        |
|           |                         | $I_{PP} = 10\text{ A}$               | -   | -   | 24  | V        |
|           | PESD15VS4UD             | $I_{PP} = 1\text{ A}$                | -   | -   | 22  | V        |
|           |                         | $I_{PP} = 6\text{ A}$                | -   | -   | 33  | V        |
|           | PESD24VS4UD             | $I_{PP} = 1\text{ A}$                | -   | -   | 33  | V        |
|           |                         | $I_{PP} = 4\text{ A}$                | -   | -   | 52  | V        |
| $r_{dif}$ | differential resistance | $I_R = 5\text{ mA}$                  | -   | -   | 25  | $\Omega$ |

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

[2] Measured from pin 1, 3, 4 or 6 to 2 or 5

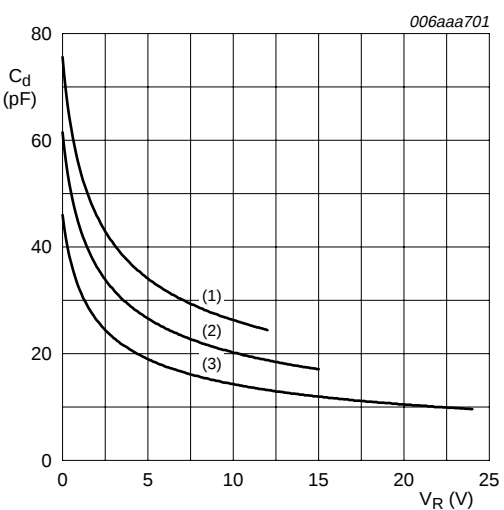
**Fig 3. Peak pulse power as a function of exponential pulse duration; typical values****Fig 4. Relative variation of peak pulse power as a function of junction temperature; typical values**



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

- (1) PESD3V3S4UD
- (2) PESD5V0S4UD

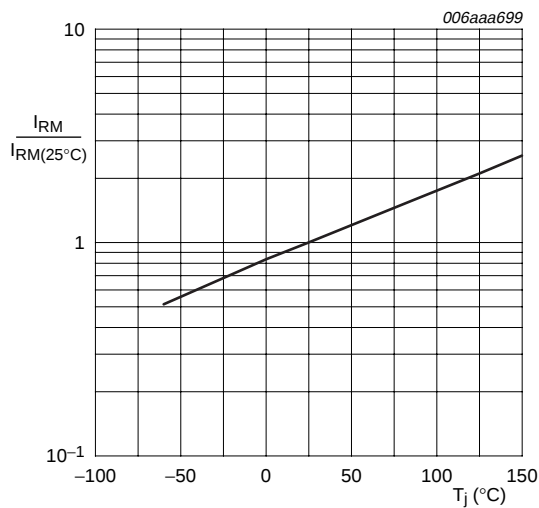
Fig 5. Diode capacitance as a function of reverse voltage; typical values



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

- (1) PESD12VS4UD
- (2) PESD15VS4UD
- (3) PESD24VS4UD

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



PESD3V3S4UD  
PESD5V0S4UD  
 $I_R$  is less than 5 nA at 150  $^\circ\text{C}$   
PESD12VS4UD  
PESD15VS4UD  
PESD24VS4UD

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

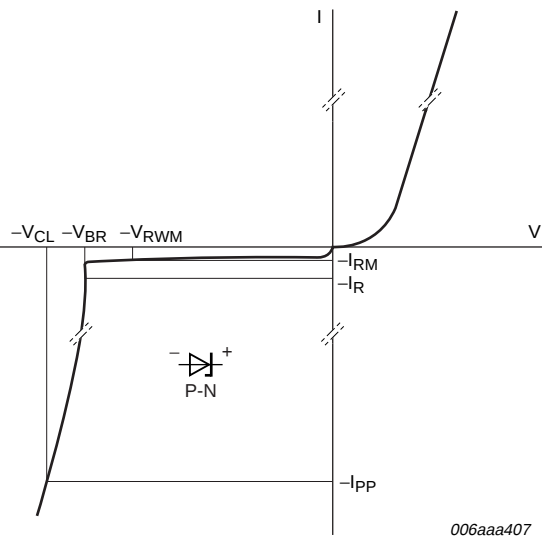
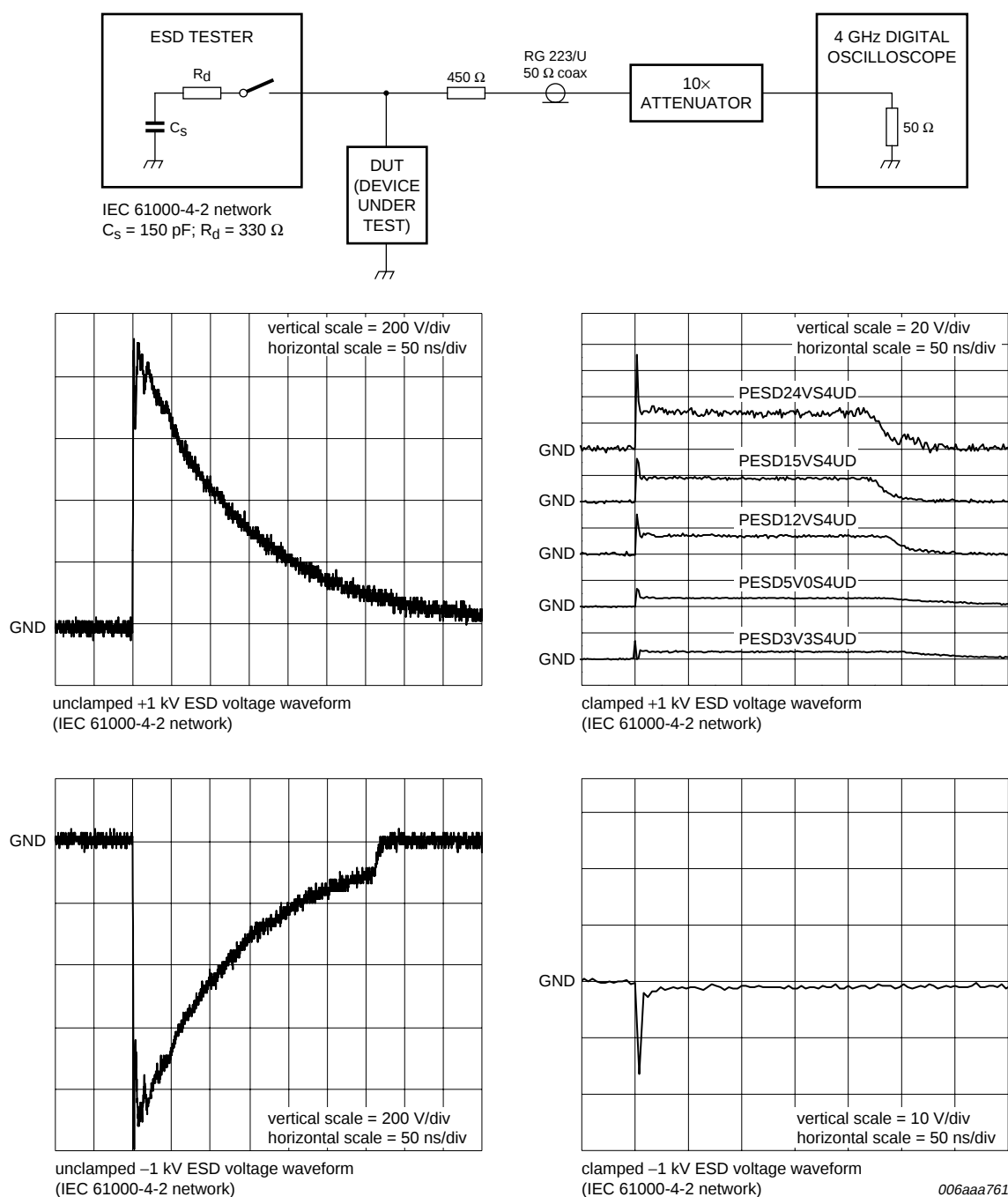


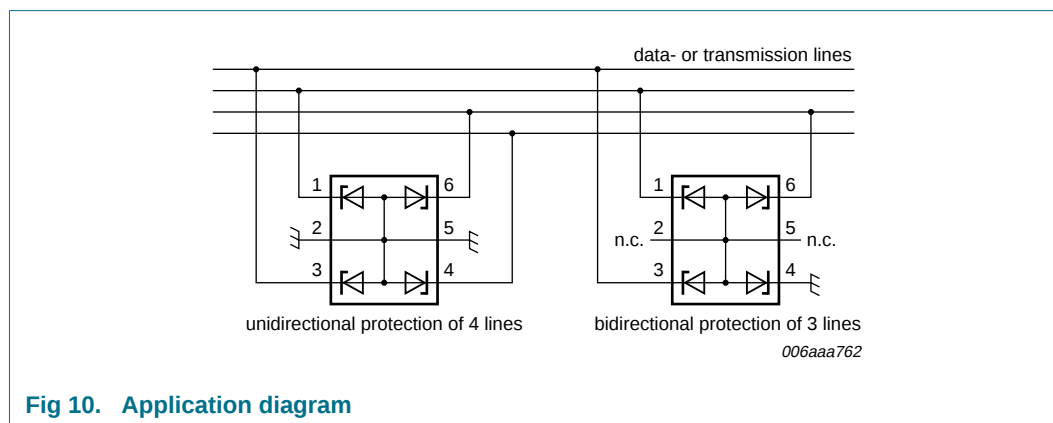
Fig 8. V-I characteristics for a unidirectional ESD protection diode



**Fig 9. ESD clamping test setup and waveforms**

## 7. Application information

The PESDxS4UD series is designed for protection of up to 4 unidirectional data lines from the damage caused by ESD and surge pulses. The PESDxS4UD series may be used on lines where the signal polarities are above or below ground. The PESDxS4UD series provides a surge capability of 200 W per line for an 8/20  $\mu$ s waveform.

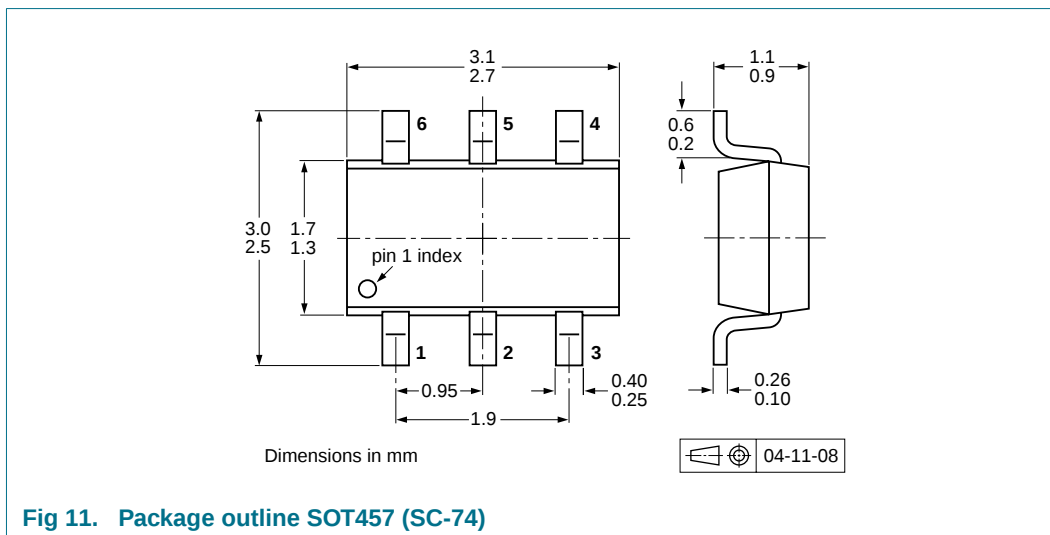


### Circuit board layout and protection device placement

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 PESDxS4UD as close to the input terminal or connector as possible.
2. The path length between the PESDxS4UD 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 |
| PESD3V3S4UD | SOT457  | 4 mm pitch, 8 mm tape and reel; T1 <a href="#">[2]</a> | -115             | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 <a href="#">[3]</a> | -125             | -165  |
| PESD5V0S4UD | SOT457  | 4 mm pitch, 8 mm tape and reel; T1 <a href="#">[2]</a> | -115             | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 <a href="#">[3]</a> | -125             | -165  |
| PESD12VS4UD | SOT457  | 4 mm pitch, 8 mm tape and reel; T1 <a href="#">[2]</a> | -115             | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 <a href="#">[3]</a> | -125             | -165  |
| PESD15VS4UD | SOT457  | 4 mm pitch, 8 mm tape and reel; T1 <a href="#">[2]</a> | -115             | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 <a href="#">[3]</a> | -125             | -165  |
| PESD24VS4UD | SOT457  | 4 mm pitch, 8 mm tape and reel; T1 <a href="#">[2]</a> | -115             | -135  |
|             |         | 4 mm pitch, 8 mm tape and reel; T2 <a href="#">[3]</a> | -125             | -165  |

[1] For further information and the availability of packing methods, see [Section 12](#).

[2] T1: normal taping

[3] T2: reverse taping

## 10. Revision history

**Table 10. Revision history**

| Document ID     | Release date                                                                                                                                                                                                                    | Data sheet status  | Change notice | Supersedes      |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-----------------|
| PESDXS4UD_SER_2 | 20090821                                                                                                                                                                                                                        | Product data sheet | -             | PESDXS4UD_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></ul> |                    |               |                 |
| PESDXS4UD_SER_1 | 20060704                                                                                                                                                                                                                        | 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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## 12. Contact information

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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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