nexperia

Important notice

Dear Customer,

On 7 February 2017 the former NXP Standard Product business became a new company with the tradename **Nexperia**. Nexperia is an industry leading supplier of Discrete, Logic and PowerMOS semiconductors with its focus on the automotive, industrial, computing, consumer and wearable application markets

In data sheets and application notes which still contain NXP or Philips Semiconductors references, use the references to Nexperia, as shown below.

Instead of http://www.nxp.com, http://www.philips.com/ or http://www.semiconductors.philips.com/, use **http://www.nexperia.com**

Instead of sales.addresses@www.nxp.com or sales.addresses@www.semiconductors.philips.com, use **salesaddresses@nexperia.com** (email)

Replace the copyright notice at the bottom of each page or elsewhere in the document, depending on the version, as shown below:
- © NXP N.V. (year). All rights reserved or © Koninklijke Philips Electronics N.V. (year). All rights reserved
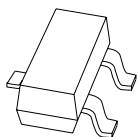Should be replaced with:
- **© Nexperia B.V. (year). All rights reserved**.

If you have any questions related to the data sheet, please contact our nearest sales office via e-mail or telephone (details via **salesaddresses@nexperia.com**). Thank you for your cooperation and understanding,

Kind regards,

Team Nexperia

PESDxU1UT series
Ultra low capacitance ESD protection diode in SOT23 package
Rev. 02 — 20 August 2009   **Product data sheet**

1. Product profile

1.1 General description

Ultra low capacitance ElectroStatic Discharge (ESD) protection diode in a SOT23 (TO-236AB) small SMD plastic package designed to protect one high-speed data line from the damage caused by ESD and other transients.

1.2 Features

- Unidirectional ESD protection of one line
- Ultra low diode capacitance: C_d = 0.6 pF
- Max. peak pulse power: P_{PP} up to 200 W
- Low clamping voltage
- ESD protection > 23 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5; (surge)

1.3 Applications

- 10/100/1000 Ethernet
- FireWire
- Communication systems
- Local Area Network (LAN) equipment
- Computers and peripherals
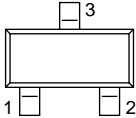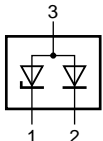- High-speed data lines

1.4 Quick reference data

Table 1.   **Quick reference data**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{RWM}	reverse stand-off voltage					
	PESD3V3U1UT		-	-	3.3	V
	PESD5V0U1UT		-	-	5.0	V
	PESD12VU1UT		-	-	12	V
	PESD15VU1UT		-	-	15	V
	PESD24VU1UT		-	-	24	V
C_d	diode capacitance	f = 1 MHz; V_R = 0 V [1]	-	0.6	1.5	pF

[1] Measured from pin 1 to 2

2. Pinning information

Table 2.   Pinning

Pin	Description	Simplified outline	Symbol
1	cathode ESD protection diode		
2	cathode compensation diode		
3	common anode		

006aaa441

3. Ordering information

Table 3.   Ordering information

Type number	Package		
	Name	**Description**	**Version**
PESD3V3U1UT	-	plastic surface mounted package; 3 leads	SOT23
PESD5V0U1UT			
PESD12VU1UT			
PESD15VU1UT			
PESD24VU1UT			

4. Marking

Table 4.   Marking codes

Type number	Marking code[1]
PESD3V3U1UT	*AP
PESD5V0U1UT	*AQ
PESD12VU1UT	*AR
PESD15VU1UT	*AS
PESD24VU1UT	*AT

[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_{PP}	peak pulse power	8/20 µs	[1]		
	PESD3V3U1UT		-	80	W
	PESD5V0U1UT		-	80	W
	PESD12VU1UT		-	200	W
	PESD15VU1UT		-	200	W
	PESD24VU1UT		-	200	W
I_{PP}	peak pulse current	8/20 µs	[1]		
	PESD3V3U1UT		-	5	A
	PESD5V0U1UT		-	5	A
	PESD12VU1UT		-	5	A
	PESD15VU1UT		-	5	A
	PESD24VU1UT		-	3	A
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 µs exponential decay waveform according to IEC 61000-4-5.

PESDXU1UT_SER_2

Product data sheet   **Rev. 02 — 20 August 2009**   3 of 13

Table 6. **ESD maximum ratings**

Symbol	Parameter	Conditions	Min	Max	Unit
V_{ESD}	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge) [1][2]			
	PESD3V3U1UT		-	30	kV
	PESD5V0U1UT		-	30	kV
	PESD12VU1UT		-	30	kV
	PESD15VU1UT		-	30	kV
	PESD24VU1UT		-	23	kV
	PESDxU1UT	HBM MIL-STD-883	-	10	kV

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

[2] Measured from pin 1 to 2

Table 7. **ESD standards compliance**

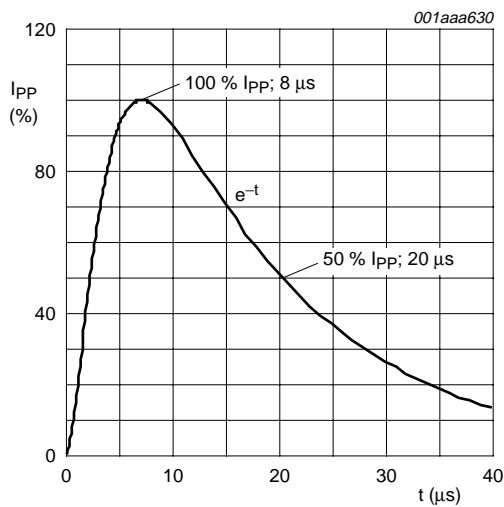| Standard	Conditions
IEC 61000-4-2; level 4 (ESD)	> 15 kV (air); > 8 kV (contact)
HBM MIL-STD-883; class 3	> 4 kV

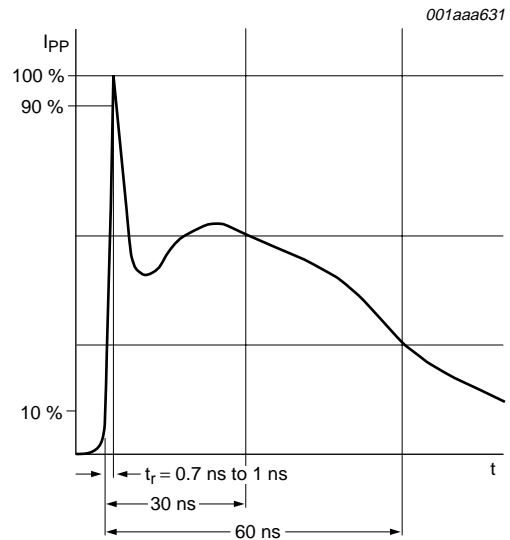**Fig 1.** **8/20 μs pulse waveform according to IEC 61000-4-5**

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

6. Characteristics

Table 8. **Characteristics**

T$_{amb}$ = 25 °C unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V$_{RWM}$	reverse stand-off voltage					
	PESD3V3U1UT		-	-	3.3	V
	PESD5V0U1UT		-	-	5.0	V
	PESD12VU1UT		-	-	12	V
	PESD15VU1UT		-	-	15	V
	PESD24VU1UT		-	-	24	V
I$_{RM}$	reverse leakage current					
	PESD3V3U1UT	V$_{RWM}$ = 3.3 V	-	0.25	2	μA
	PESD5V0U1UT	V$_{RWM}$ = 5.0 V	-	0.03	1	μA
	PESD12VU1UT	V$_{RWM}$ = 12 V	-	< 1	50	nA
	PESD15VU1UT	V$_{RWM}$ = 15 V	-	< 1	50	nA
	PESD24VU1UT	V$_{RWM}$ = 24 V	-	< 1	50	nA
V$_{BR}$	breakdown voltage	I$_R$ = 5 mA	[2]			
	PESD3V3U1UT		5.8	6.4	6.9	V
	PESD5V0U1UT		7.0	7.6	8.2	V
	PESD12VU1UT		14.2	15.0	16.7	V
	PESD15VU1UT		17.1	18.9	20.3	V
	PESD24VU1UT		25.4	27.8	30.3	V
C$_d$	diode capacitance	f = 1 MHz; V$_R$ = 0 V	[2] -	0.6	1.5	pF
V$_{CL}$	clamping voltage		[1][2]			
	PESD3V3U1UT	I$_{PP}$ = 1 A	-	-	9	V
		I$_{PP}$ = 5 A	-	-	20	V
	PESD5V0U1UT	I$_{PP}$ = 1 A	-	-	12	V
		I$_{PP}$ = 5 A	-	-	21	V
	PESD12VU1UT	I$_{PP}$ = 1 A	-	-	23	V
		I$_{PP}$ = 5 A	-	-	39	V
	PESD15VU1UT	I$_{PP}$ = 1 A	-	-	28	V
		I$_{PP}$ = 5 A	-	-	53	V
	PESD24VU1UT	I$_{PP}$ = 1 A	-	-	40	V
		I$_{PP}$ = 3 A	-	-	76	V
r$_{dif}$	differential resistance	I$_R$ = 1 mA				
	PESD3V3U1UT		-	-	400	Ω
	PESD5V0U1UT		-	-	80	Ω
	PESD12VU1UT		-	-	200	Ω
	PESD15VU1UT		-	-	225	Ω
	PESD24VU1UT		-	-	300	Ω

[1] Non-repetitive current pulse 8/20 μs exponential decay waveform according to IEC 61000-4-5.
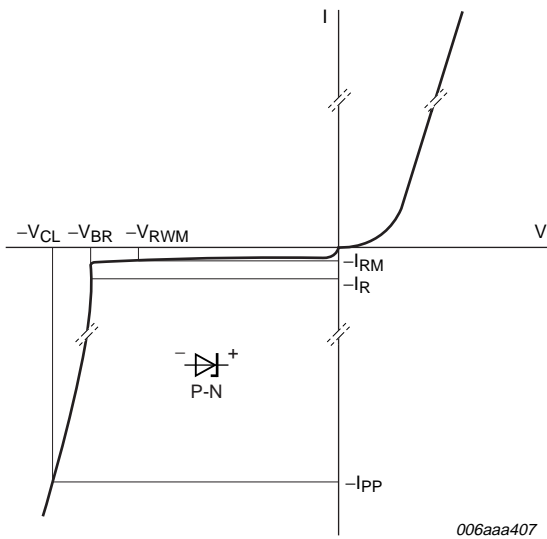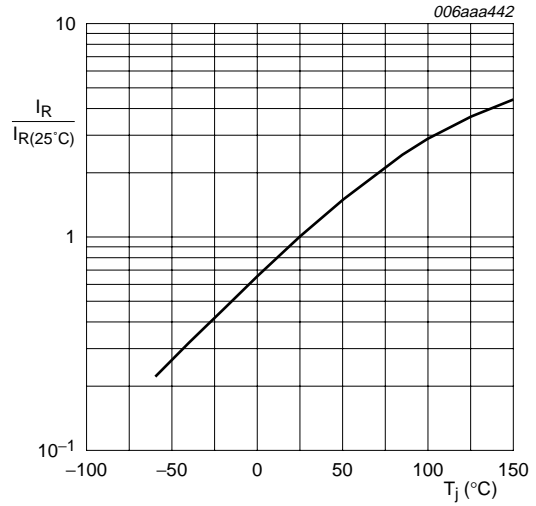
[2] Measured from pin 1 to 2

PESDXU1UT_SER_2

Product data sheet **Rev. 02 — 20 August 2009** **5 of 13**

Fig 3.   V-I characteristics

006aaa407

006aaa442

PESD3V3U1UT; PESD5V0U1UT

I_R is less than 10 nA at 150 °C for:

PESD12VU1UT; PESD15VU1UT; PESD24VU1UT

Fig 4.   Relative variation of reverse leakage current as a function of junction temperature; typical values

PESDXU1UT_SER_2

Product data sheet   **Rev. 02 — 20 August 2009**   6 of 13

7. Application information

The PESDxU1UT series is designed for protection of high-speed datalines from damage caused by ESD and surge pulses. PESDxU1UT devices combine an ESD protection diode and an ultra low capacitance compensation diode to ensure an effective device capacitance as low as 0.6 pF. The PESDxU1UT series provides a surge capability of up to 200 W per line for an 8/20 μs waveform.
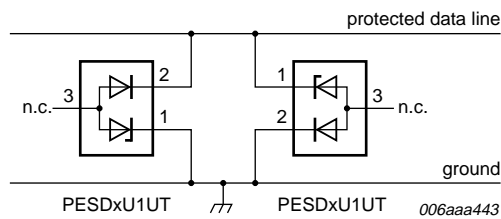
Two PESDxU1UT devices in anti-parallel configuration provide ESD protection in a common-mode application.

The two PESDxU1UT devices should be connected as follows:

protected data line is connected to

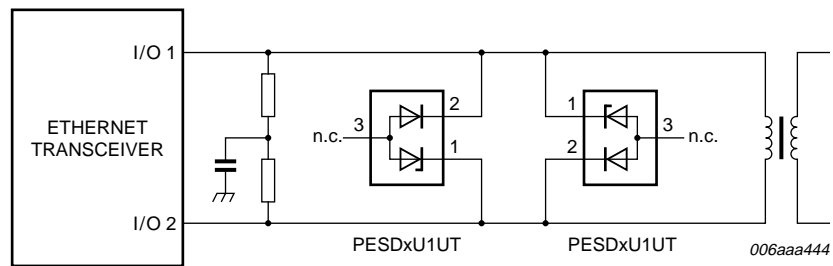device 1 / pin 2

device 2 / pin 1

Ground is connected to

device 1 / pin 1

device 2 / pin 2

pin 3 is not connected for both devices

Fig 5.   Bidirectional ESD protection of one line, common mode

Two PESDxU1UT devices in anti-parallel configuration provide ESD protection in a differential-mode configuration as e.g. for Ethernet applications.

The two PESDxU1UT should be connected as follows:

I/O line 1 is connected to

device 1 / pin 2

device 2 / pin 1

I/O line 2 is connected to

device 1 / pin 1

device 2 / pin 2

pin 3 is not connected for both devices

Fig 6.   Differential mode Ethernet protection

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 PESDxU1UT as close to the input terminal or connector as possible.
2. The path length between the PESDxU1UT 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 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.
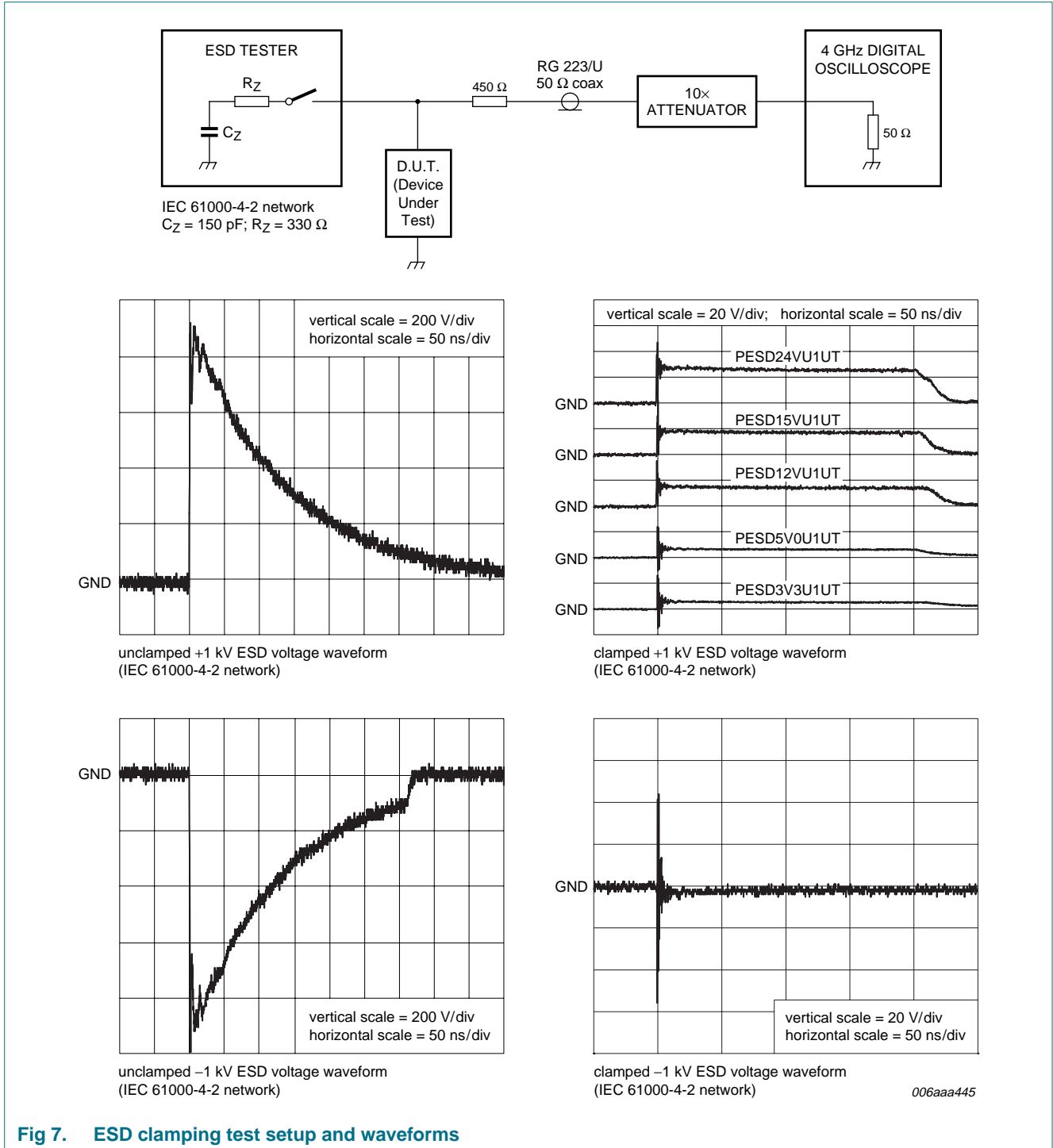
8. Test information

unclamped +1 kV ESD voltage waveform
(IEC 61000-4-2 network)

vertical scale = 200 V/div
horizontal scale = 50 ns/div

clamped +1 kV ESD voltage waveform
(IEC 61000-4-2 network)

vertical scale = 20 V/div;   horizontal scale = 50 ns/div

unclamped −1 kV ESD voltage waveform
(IEC 61000-4-2 network)

vertical scale = 200 V/div
horizontal scale = 50 ns/div

clamped −1 kV ESD voltage waveform
(IEC 61000-4-2 network)

vertical scale = 20 V/div
horizontal scale = 50 ns/div

006aaa445

Fig 7.   ESD clamping test setup and waveforms
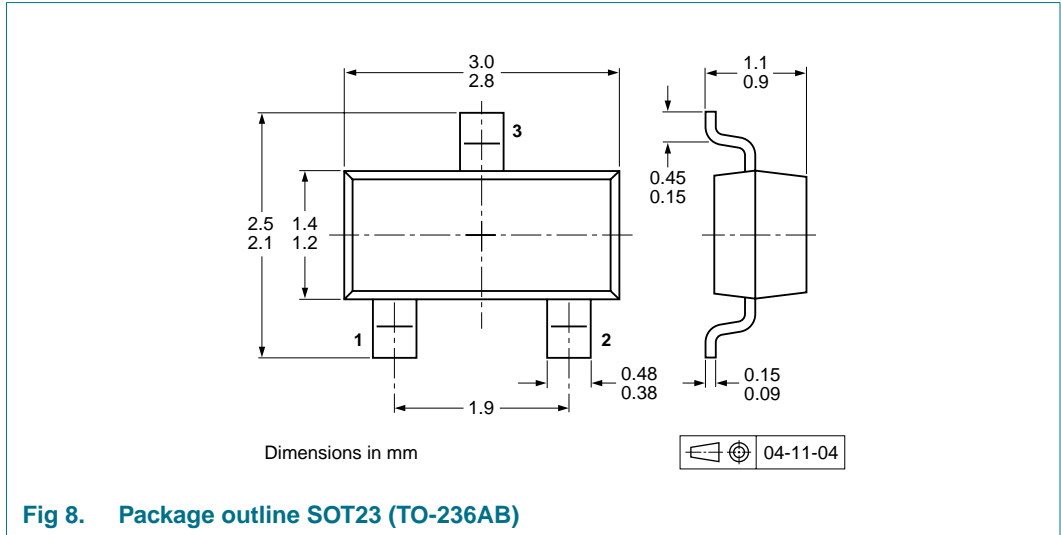
9. Package outline

| Fig 8. | Package outline SOT23 (TO-236AB) |

10. Packing information

Table 9.   Packing methods
The -xxx numbers are the last three digits of the 12NC ordering code.[1]

Type number	Package	Description	Packing quantity	
			3000	**10000**
PESD3V3U1UT	SOT23	4 mm pitch, 8 mm tape and reel	-215	-235
PESD5V0U1UT				
PESD12VU1UT				
PESD15VU1UT				
PESD24VU1UT				

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

PESDXU1UT_SER_2

Product data sheet   **Rev. 02 — 20 August 2009**   **10 of 13**

11. Revision history

Table 10.   Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PESDXU1UT_SER_2	20090820	Product data sheet	-	PESDXU1UT_SER_1
Modifications:	• 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.			
PESDXU1UT_SER_1	20050511	Product data sheet	-	-

PESDXU1UT_SER_2

Product data sheet   **Rev. 02 — 20 August 2009**   **11 of 13**

12. Legal information

12.1 Data sheet status

Document status[1][2]	Product status[3]	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.

12.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

12.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

12.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

13. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**