



PRTR5V0U2AX

Ultra low capacitance double rail-to-rail ESD protection diode

Rev. 3 — 15 May 2012

Product data sheet

1. Product profile

1.1 General description

Ultra low capacitance double rail-to-rail ElectroStatic Discharge (ESD) protection diode in a small SOT143B Surface-Mounted Device (SMD) plastic package.

The device is designed to protect two high-speed data lines or high-frequency signal lines from the damage caused by ESD and other transients.

PRTR5V0U2AX integrates two ultra low capacitance rail-to-rail diodes and one additional ESD protection diode to ensure signal line protection even if no supply voltage is available.

1.2 Features and benefits

- ESD protection of two high-speed data lines or high-frequency signal lines
- Ultra low input/output to ground capacitance: $C_{(I/O-GND)} = 1.8 \text{ pF}$
- ESD protection up to 12 kV
- IEC 61000-4-2, level 4 (ESD)
- Very low clamping voltage due to an integrated additional ESD protection diode
- Very low reverse current
- AEC-Q101 qualified
- Small SMD plastic package

1.3 Applications

- USB 2.0 ports
- Digital Video Interface (DVI)
- High-Definition Multimedia Interface (HDMI)
- Mobile phones
- Digital cameras
- WAN/LAN systems
- PC, notebooks, printers and other PC peripherals

1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per channel						
$C_{(I/O-GND)}$	input/output to ground capacitance	$f = 1 \text{ MHz};$ $V_{(I/O-GND)} = 0 \text{ V}$	[1] -	1.8	-	pF



Table 1. Quick reference data ...continued

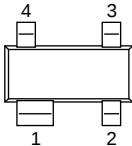
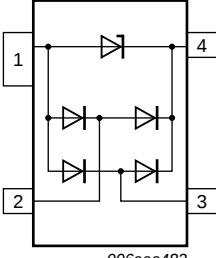
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Zener diode						
V_{RWM}	reverse standoff voltage		-	-	5.5	V
C_{sup}	supply pin to ground capacitance	$f = 1\text{ MHz};$ $V_{CC} = 0\text{ V}$	[2] -	16	-	pF

[1] Measured from pin 2 and 3 to ground.

[2] Measured from pin 4 to ground.

2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND	ground		
2	I/O 1	input/output 1		
3	I/O 2	input/output 2		
4	V_{CC}	supply voltage		

006aaa482

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PRTR5V0U2AX	-	plastic surface-mounted package; 4 leads	SOT143B

4. Marking

Table 4. Marking codes

Type number	Marking code ^[1]
PRTR5V0U2AX	*AE

[1] * = placeholder for manufacturing site code.

5. Limiting values

Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
T _{amb}	ambient temperature		−40	+85	°C
T _{stg}	storage temperature		−55	+125	°C

Table 6. ESD standards compliance

Standard	Conditions
IEC 61000-4-2; level 4 (ESD)	> 12 kV (contact)

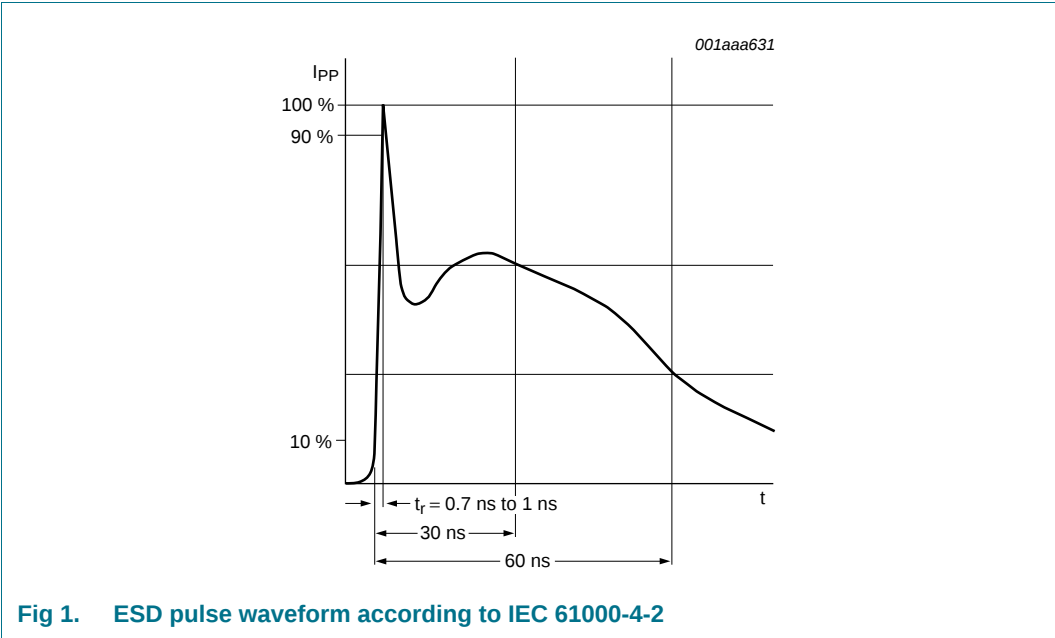


Fig 1. ESD pulse waveform according to IEC 61000-4-2

6. Characteristics

Table 7. Characteristics

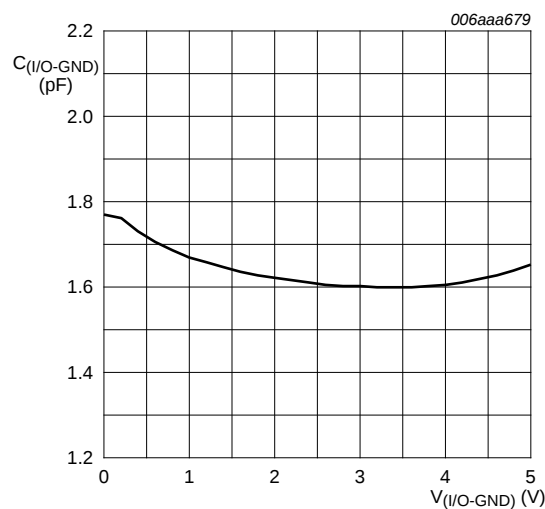
$T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per channel						
I_R	reverse current	$V_R = 3\text{ V}$	[1] -	< 1	100	nA
$C_{(I/O-GND)}$	input/output to ground capacitance	$f = 1\text{ MHz};$ $V_{(I/O-GND)} = 0\text{ V}$	[3] -	1.8	-	pF
V_F	forward voltage	$I_F = 1\text{ mA}$	-	0.7	-	V
Zener diode						
V_{RWM}	reverse standoff voltage		-	-	5.5	V
V_{BR}	breakdown voltage		[2] 6	-	9	V
C_{sup}	supply pin to ground capacitance	$f = 1\text{ MHz};$ $V_{CC} = 0\text{ V}$	[2] -	16	-	pF

[1] Measured from pin 2, 3 and 4 to ground

[2] Measured from pin 4 to ground

[3] Measured from pin 2 and 3 to ground



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

Fig 2. Input/output to ground capacitance as a function of input/output to ground voltage; typical values

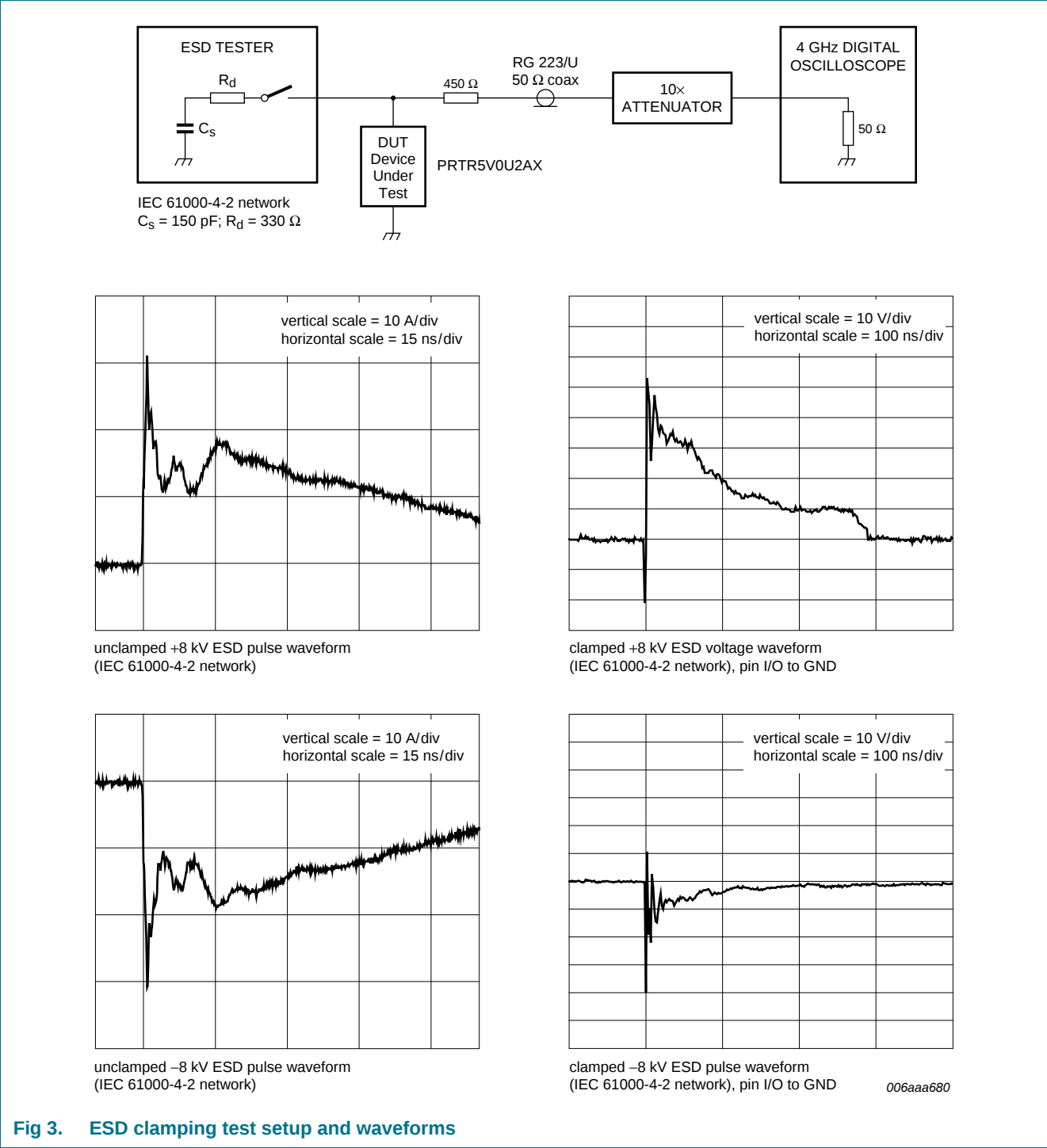


Fig 3. ESD clamping test setup and waveforms

7. Application information

Handling data rates up to 480 Mbit/s, USB 2.0 interfaces require ESD protection devices with an extremely low line capacitance in order to avoid signal distortion.

With a capacitance of only 1.8 pF, the NXP PRTR5V0U2AX offers IEC 61000-4-2, level 4 compliant ESD protection.

The PRTR5V0U2AX integrates two ultra-low capacitance rail-to-rail ESD protection diodes and an additional ESD protection diode in a small 4-lead SOT143B package.

The additional ESD protection diode connected between ground and V_{CC} prevents charging of the supply.

To achieve the maximum ESD protection level, no additional external capacitors are required.

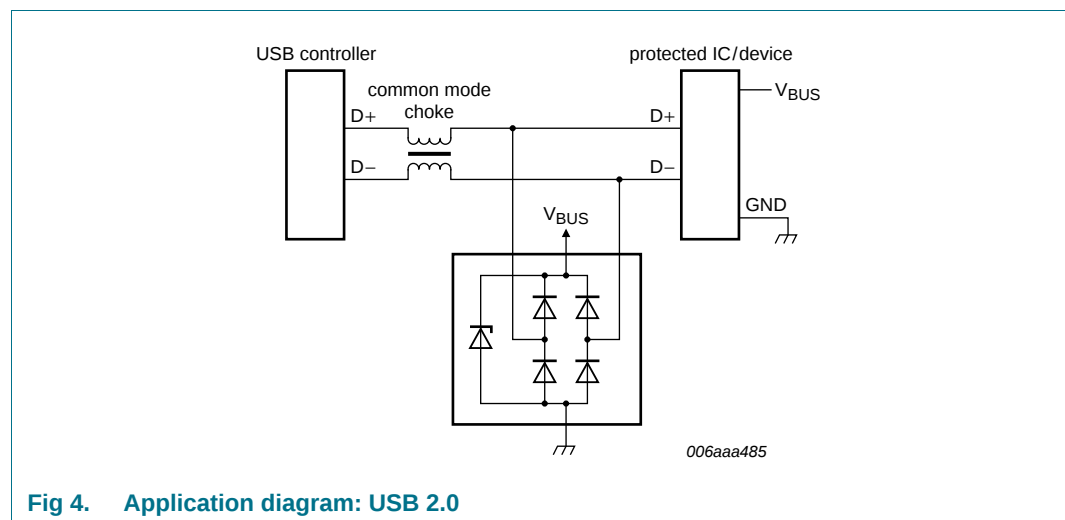


Fig 4. Application diagram: USB 2.0

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:

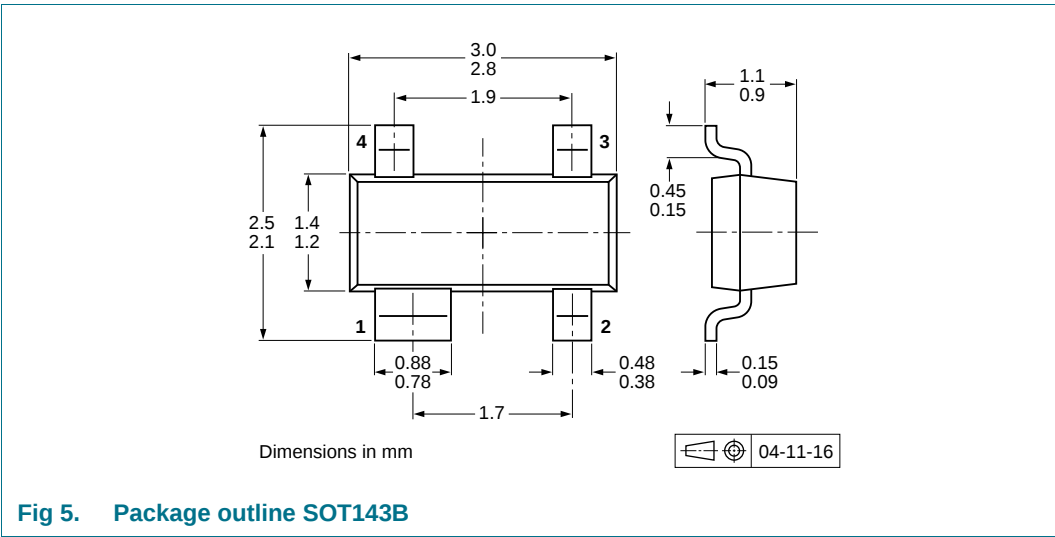
1. Place the device as close to the input terminal or connector as possible.
2. Minimize the path length between the device and the protected line.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit 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. Use ground planes whenever possible. For multilayer PCBs, use ground vias.

8. Test information

8.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

9. Package outline



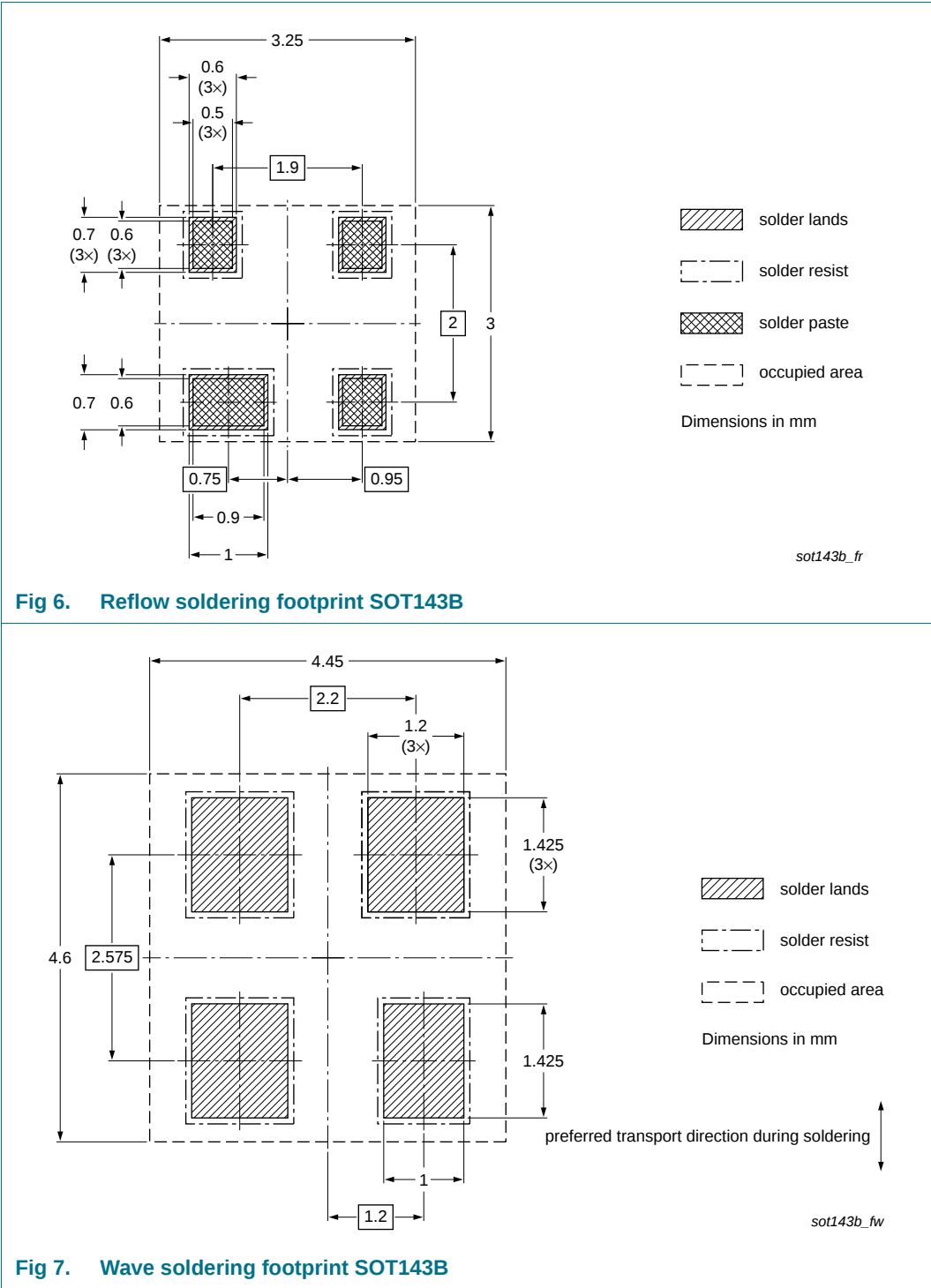
10. Packing information

Table 8. Packing methods
The indicated -xxx are the last three digits of the 12NC ordering code.^[1]

Type number	Package	Description	Packing quantity	
			3000	10000
PRTR5V0U2AX	SOT143B	4 mm pitch, 8 mm tape and reel	-215	-235

[1] For further information and the availability of packing methods, see [Section 14](#).

11. Soldering



12. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PRTR5V0U2AX v.3	20120515	Product data sheet	-	PRTR5V0U2AX v.2
Modifications:	• Section 1 "Product profile": editorial update • Section 4 "Marking": updated • Section 6 "Characteristics": editorial update; added condition to V_F • Section 8.1 "Quality information": added • Section 11 "Soldering": added • Section 13 "Legal information": updated			
PRTR5V0U2AX v.2	20061221	Product data sheet	-	PRTR5V0U2AX v.1
PRTR5V0U2AX v.1	20060522	Product data sheet	-	-

13. Legal information

13.1 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>.

13.2 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.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

13.3 Disclaimers

Limited warranty and liability — 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. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

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 in automotive applications — This NXP Semiconductors product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or 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 and its suppliers accept 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.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial 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>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

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 competent 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.

13.4 Trademarks

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

14. Contact information

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

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

15. Contents

1	Product profile	1
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
2	Pinning information	2
3	Ordering information	2
4	Marking	2
5	Limiting values	3
6	Characteristics	4
7	Application information	6
8	Test information	7
8.1	Quality information	7
9	Package outline	7
10	Packing information	7
11	Soldering	8
12	Revision history	9
13	Legal information	10
13.1	Data sheet status	10
13.2	Definitions	10
13.3	Disclaimers	10
13.4	Trademarks	11
14	Contact information	11
15	Contents	12

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

© NXP B.V. 2012.

All rights reserved.

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

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

Date of release: 15 May 2012

Document identifier: PRTR5V0U2AX