# IP4286CZ6-TBF; IP4286CZ6-TTY

## Integrated 4-channel ESD protection

Rev. 2 — 1 September 2010 Product data sheet

## 1. Product profile

### 1.1 General description

The devices are designed to protect the capacitive loads of Input/Output (I/O) ports (such as USB 2.0, Ethernet, Digital Visual Interface (DVI), etc.) from being damaged by ElectroStatic Discharge (ESD).

To provide ESD protection to downstream signal and supply components, the devices incorporate four pairs of ultra low capacitance rail-to-rail diodes plus two Zener diodes. This provides protection against contact discharge voltages as high as ±8 kV in accordance with IEC 61000-4-2, level 4.

The ESD protection is independent of the supply voltage due to the rail-to-rail diodes being connected to a Zener diode.

The devices are fabricated using monolithic silicon technology and integrate four ultra low capacitance rail-to-rail ESD protection diodes plus two Zener diodes.

### 1.2 Features and benefits

- Pb-free and Restriction of Hazardous Substances (RoHS) compliant
- IEC 61000-4-2, level 4, ±8 kV contact discharge compliant ESD protection
- Four input ESD rail-to-rail protection diodes with ultra low input capacitance of 0.6 pF maximum
- Low-voltage clamping due to integrated Zener diodes

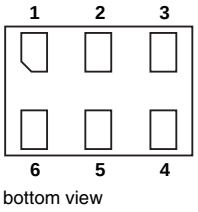
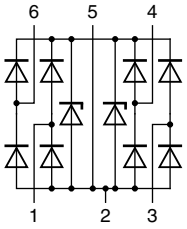
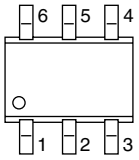
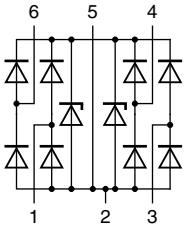
### 1.3 Applications

General-purpose downstream ESD protection high-frequency analog signals and high-speed serial data transmission for ports inside:

- PC/Notebook USB 2.0/IEEE 1394 ports
- Cellular phone and Personal Communication System (PCS) mobile handsets
- Digital Visual Interface (DVI)
- High-Definition Multimedia Interfaces (HDMI)
- Cordless telephones
- Wireless data (WAN/LAN) systems
- MID (Mobile Internet Device) and PMP (Portable Media Player)

## 2. Pinning information

**Table 1. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| **IP4286CZ6-TBF (SOT886)** | | | |
| 1 | ESD protection for I/O signals |  **XSON6** |  *018aaa046* |
| 2 | ground | | |
| 3 | ESD protection for I/O signals | | |
| 4 | ESD protection for I/O signals | | |
| 5 | ground | | |
| 6 | ESD protection for I/O signals | | |
| **IP4286CZ6-TTY (SOT363)** | | | |
| 1 | ESD protection for I/O signals |  **SC-88** |  *018aaa046* |
| 2 | ground | | |
| 3 | ESD protection for I/O signals | | |
| 4 | ESD protection for I/O signals | | |
| 5 | ground | | |
| 6 | ESD protection for I/O signals | | |

## 3. Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| IP4286CZ6-TBF | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |
| IP4286CZ6-TTY | SC-88 | plastic surface-mounted package; 6 leads | SOT363 |

## 4. Limiting values

**Table 3. Limiting values**

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{ESD}$ | electrostatic discharge voltage | IEC 61000-4-2, level 4, contact discharge | - | ±8 | kV |
| $T_{stg}$ | storage temperature | | –55 | +125 | °C |
| $V_I$ | input voltage | | –0.5 | +5.5 | V |

## 5. Characteristics

**Table 4. Characteristics**

*$T_{amb}$ = 25 °C unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{(I/O-GND)}$ | input/output to ground capacitance | $V_I$ = 3.3 V; f = 1 MHz | [1][2][3] | - | 0.6 | - | pF |
| $I_{LR}$ | reverse leakage current | $V_I$ = 3.0 V | [4] | - | - | 100 | nA |
| $C_{(zd-GND)}$ | Zener diode to ground capacitance | | [1] | - | 20 | - | pF |
| $V_{BRzd}$ | Zener diode breakdown voltage | $I_{test}$ = 1 mA | [1] | 6 | - | 9 | V |
| $V_F$ | forward voltage | | | - | 0.7 | - | V |

[1] Guaranteed by design.

[2] Route differential pairs to pins 1 and 6, and to pins 3 and 4 for optimal parasitic symmetry.

[3] Pins 1 and 6, and pins 3 and 4 to ground.

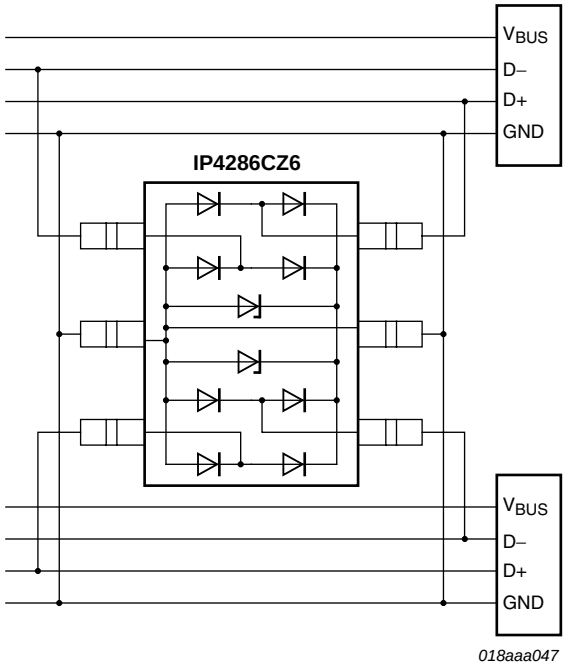
[4] Pins 1, 3, 4 and 6 to ground.

# 6. Application information

## 6.1 Typical application

The devices are capable of protecting both USB data lines of a USB 2.0 port from ESD, and are optimized to protect two USB 2.0 ports simultaneously.

A typical application is shown in Figure 1.

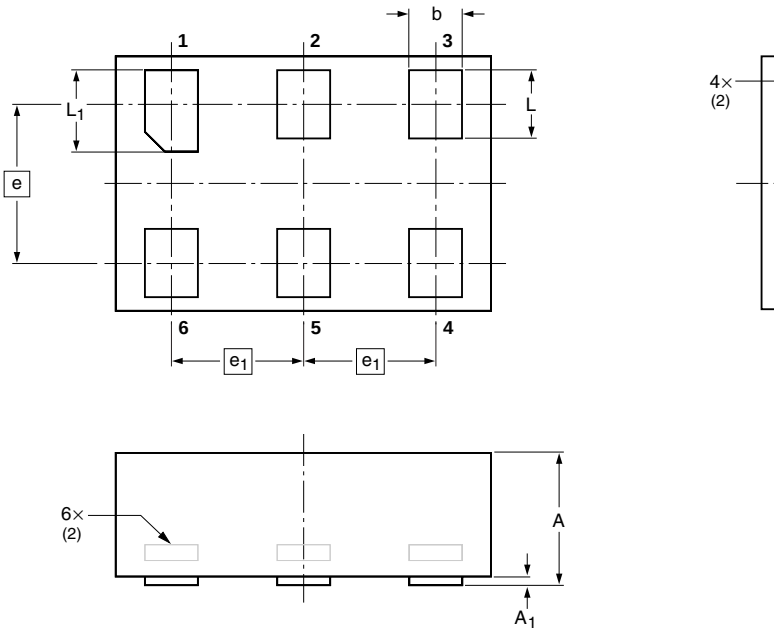



All protection pins (1, 3, 4 and 6) can be swapped to protect any signal line.

**Fig 1. Application diagram for protection of two USB ports**

## 7. Package outline

**XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm** **SOT886**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A(1) max | A1 max | b | D | E | e | e1 | L | L1 |
|---|---|---|---|---|---|---|---|---|---|
| mm | 0.5 | 0.04 | 0.25<br>0.17 | 1.5<br>1.4 | 1.05<br>0.95 | 0.6 | 0.5 | 0.35<br>0.27 | 0.40<br>0.32 |

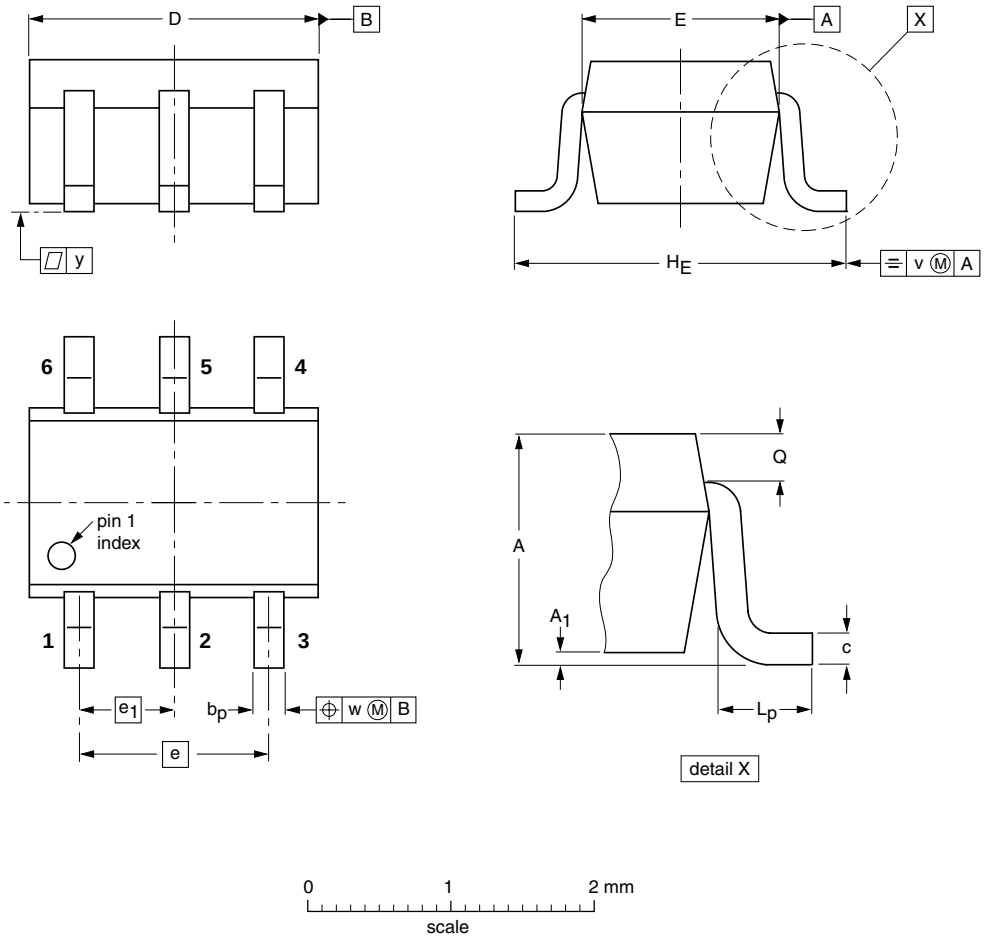
**Notes**

1. Including plating thickness.
2. Can be visible in some manufacturing processes.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT886 | | MO-252 | | | | ~~04-07-15~~<br>04-07-22 |

**Fig 2. Package outline SOT886 (XSON6/MO-252)**

**Plastic surface-mounted package; 6 leads** **SOT363**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.8 | 0.1 | 0.30<br>0.20 | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15 | 1.3 | 0.65 | 2.2<br>2.0 | 0.45<br>0.15 | 0.25<br>0.15 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT363 | | | SC-88 | | | ~~04-11-08~~<br>06-03-16 |

**Fig 3. Package outline SOT363 (SC-88)**

# 8. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

## 8.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

## 8.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

## 8.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

## 8.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 4) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 5 and 6

**Table 5. SnPb eutectic process (from J-STD-020C)**

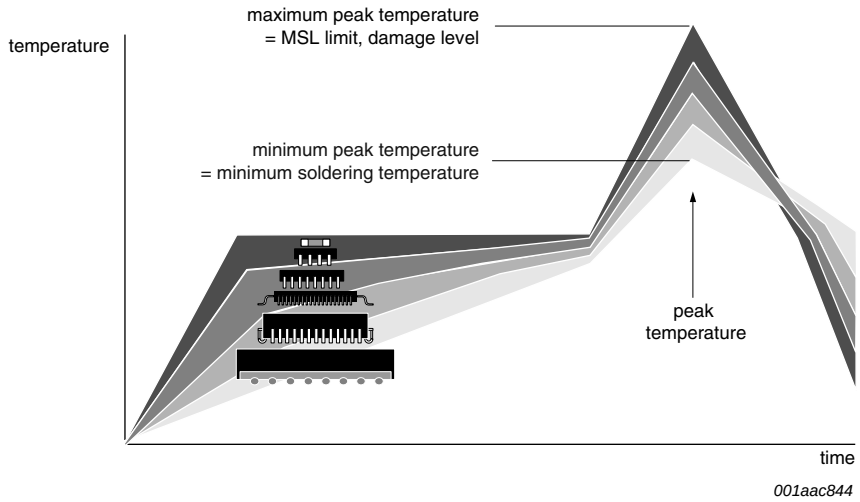
| Package thickness (mm) | Package reflow temperature (°C) | |
|---|---|---|
| | Volume ($mm^3$) | |
| | < 350 | ≥ 350 |
| < 2.5 | 235 | 220 |
| ≥ 2.5 | 220 | 220 |

**Table 6. Lead-free process (from J-STD-020C)**

| Package thickness (mm) | Package reflow temperature (°C) | | |
|---|---|---|---|
| | Volume ($mm^3$) | | |
| | < 350 | 350 to 2000 | > 2000 |
| < 1.6 | 260 | 260 | 260 |
| 1.6 to 2.5 | 260 | 250 | 245 |
| > 2.5 | 250 | 245 | 245 |

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 4.




MSL: Moisture Sensitivity Level

**Fig 4. Temperature profiles for large and small components**

For further information on temperature profiles, refer to Application Note *AN10365 "Surface mount reflow soldering description"*.

## 9. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| IP4286CZ6-TBF_TTY v.2 | 20100901 | Product data sheet | - | IP4286CZ6_1 |
| Modifications: | • Type number IP4286CZ6-TTD deleted.<br>• Table 1 “Pinning”: amended.<br>• Table 3 “Limiting values”: amended.<br>• Table 4 “Characteristics”: amended.<br>• Figure 1: updated.<br>• Section 10 “Legal information”: updated. | | | |
| IP4286CZ6_1 | 20090420 | Objective data sheet | - | - |

# 10. Legal information

## 10.1 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.

## 10.2 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.

## 10.3 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.

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 —** NXP Semiconductors products are 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 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.

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 national authorities.

**Non-automotive qualified products —** Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

### 10.4 Trademarks

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

## 11. Contact information

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

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

## 12. Contents


**1 Product profile . . . . . 1**
1.1 General description . . . . . 1
1.2 Features and benefits . . . . . 1
1.3 Applications . . . . . 1
**2 Pinning information . . . . . 2**
**3 Ordering information . . . . . 2**
**4 Limiting values . . . . . 3**
**5 Characteristics . . . . . 3**
**6 Application information . . . . . 4**
6.1 Typical application . . . . . 4
**7 Package outline . . . . . 5**
**8 Soldering of SMD packages . . . . . 7**
8.1 Introduction to soldering . . . . . 7
8.2 Wave and reflow soldering . . . . . 7
8.3 Wave soldering . . . . . 7
8.4 Reflow soldering . . . . . 8
**9 Revision history . . . . . 10**
**10 Legal information . . . . . 11**
10.1 Data sheet status . . . . . 11
10.2 Definitions . . . . . 11
10.3 Disclaimers . . . . . 11
10.4 Trademarks . . . . . 12
**11 Contact information . . . . . 12**
**12 Contents . . . . . 13**




For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 1 September 2010
Document identifier: IP4286CZ6-TBF_TTY