

IP4220CZ6

Dual USB 2.0 integrated ESD protection to IEC 61000-4-2 level 4

Rev. 04 — 12 September 2005

Product data sheet

1. Product profile

1.1 General description

The IP4220CZ6 is designed to protect I/O lines sensitive to capacitive load, such as USB 2.0, ethernet, DVI etc. from damage due to ElectroStatic Discharge (ESD). It incorporates four pairs of ultra-low capacitance rail-to-rail diodes plus an additional Zener diode to provide protection to signal and supply components from ESD voltages as high as ± 8 kV contact discharge. Protection is supply voltage independent due to the rail-to-rail diodes being connected to the Zener diode. The IP4220CZ6 integrates four pairs of ultra-low capacitance rail-to-rail ESD protection diodes in a miniature 6-lead SOT457 package.

1.2 Features

- ESD IEC 61000-4-2 level 4, ± 8 kV contact discharge compliant protection
- Four pairs of ultra-low input capacitance (1 pF typ.) ESD rail-to-rail protection diodes
- Low voltage clamping due to integrated Zener diode
- Small 6 lead SO6 (SOT457) package
- IEC 61000-4-5 15A Lightning (8/20 μ s)

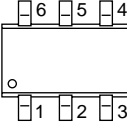
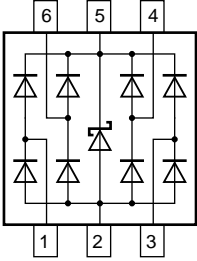
1.3 Applications

- General-purpose downstream ESD protection for high frequency analog signal ports and high-speed serial data transmission ports in:
 - ◆ Cellular and PCS mobile handsets
 - ◆ PC-/notebook USB 2.0/IEEE1394 ports
 - ◆ DVI interfaces
 - ◆ Cordless telephones
 - ◆ Wireless data (WAN/LAN) systems
 - ◆ PDAs
 - ◆ HDMI

PHILIPS

2. Pinning information

Table 1: Pinning

| Pin | Description | Simplified outline | Symbol |
|-----|----------------------|---|---|
| 1 | ESD protection I/O 1 |  |  |
| 2 | GND | | |
| 3 | ESD protection I/O 2 | | |
| 4 | ESD protection I/O 3 | | |
| 5 | Supply voltage V_P | | |
| 6 | ESD protection I/O 4 | | |

001aac379

3. Ordering information

Table 2: Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| IP4220CZ6 | - | plastic surface mounted package; 6 leads | SOT457 |

4. Limiting values

Table 3: Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-----------------------------------|---------------------------------|-----|------|------|
| $V_{I/O}$ | I/O DC input voltage | | 0 | 5.5 | V |
| V_{esd} | electrostatic discharge; all pins | IEC 61000-4-2, level 4, contact | -8 | +8 | kV |
| T_{stg} | storage temperature | | -55 | +125 | °C |

5. Recommended operating conditions

Table 4: Operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|---------------------|------------|-----|-----|-----|------|
| T_{amb} | ambient temperature | | -40 | - | +85 | °C |

6. Characteristics

Table 5: Characteristics

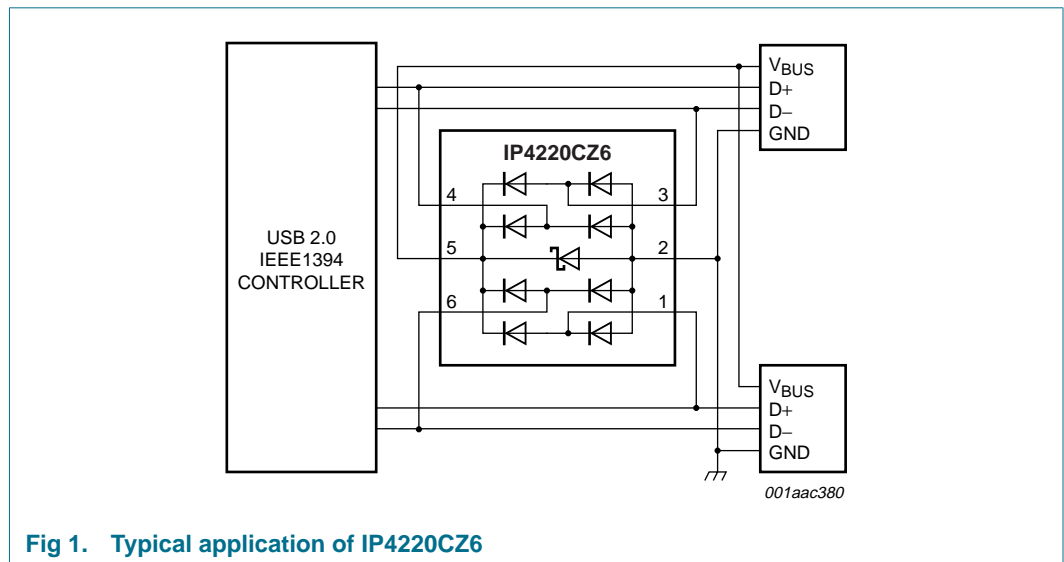
$T_{case} = 25\text{ }^{\circ}\text{C}$; unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------------|---|--|-----|-----|-----|------|
| $C_{I/O(n)}$ | pin capacitance to ground, pins 1, 3, 4 and 6 | $V_{I/O(n)} = 0\text{ V}$; $f = 1\text{ MHz}$; $V_P = +3.0\text{ V}$ | - | 1.0 | - | pF |
| $I_{L(n)}$ | diode reverse leakage current, pins 1, 3, 4 and 6 to ground | $V_{I/O(n)} = +3.0\text{ V}$ | - | - | 100 | nA |
| $C_{d(\text{Zener})}$ | Zener diode capacitance to ground, pin 5 to pin 2 | $V_{I/O(n)} = 0\text{ V}$; $f = 1\text{ MHz}$; $V_P = +3.0\text{ V}$ | - | 40 | - | pF |
| $V_{BR(\text{Zener})}$ | Zener diode breakdown voltage, pin 5 to pin 2 | $I = 1\text{ mA}$ | 6 | - | 9 | V |
| V_F | forward voltage | | - | 0.7 | - | V |

7. Application information

7.1 Universal serial bus 2.0 protection

The IP4220CZ6 is optimized to protect, for example, two USB 2.0 ports from ESD. Each device is capable of protecting both USB data lines and the V_{BUS} supply. A typical application is shown in [Figure 1](#).



7.2 IP4220CZ6 spice model

Table 6: Diodes spice parameters

| Symbol | Parameter | Value | | | | | | | | | Unit | |
|--------|--------------------------------|-------|------|------|------|------|------|------|------|------|------|----|
| | | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | DZ | | |
| CJO | zero-bias junction capacitance | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 27 | pF |
| VJ | junction potential | 650 | 778 | 650 | 778 | 650 | 778 | 650 | 778 | 640 | | mV |
| M | grading coefficient | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | | - |
| BV | reverse breakdown voltage | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 7.3 | | V |

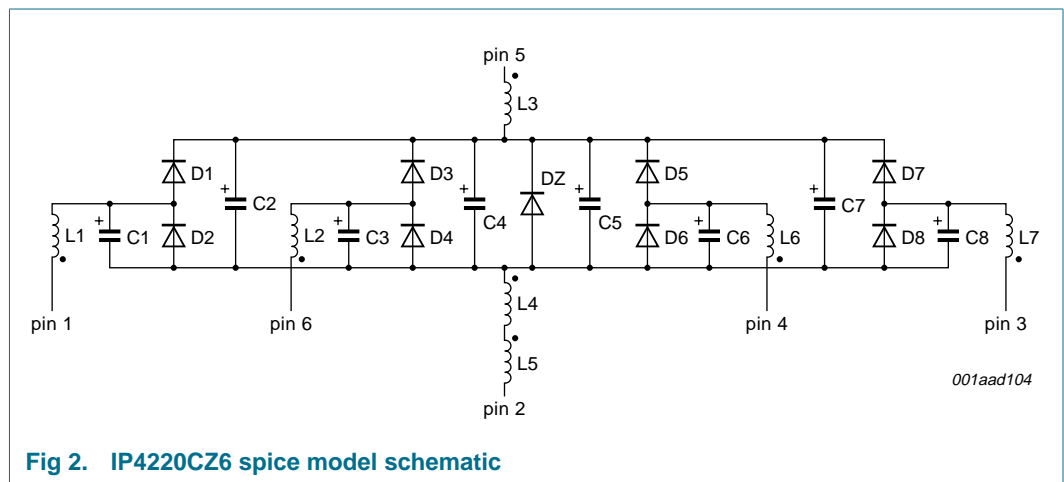


Fig 2. IP4220CZ6 spice model schematic

Table 7: Spice model list of components; see Figure 2

| Component | Parameter | Value | Unit |
|-----------|------------|-------|------|
| L1 | inductance | 880 | pH |
| | resistance | 200 | mΩ |
| L2 | inductance | 800 | pH |
| | resistance | 200 | mΩ |
| L3 | inductance | 440 | pH |
| | resistance | 200 | mΩ |
| L4 | inductance | 480 | pH |
| | resistance | 200 | mΩ |
| L5 | inductance | 800 | pH |
| | resistance | 200 | mΩ |
| L6 | inductance | 640 | pH |
| | resistance | 200 | mΩ |
| L7 | inductance | 640 | pH |
| | resistance | 200 | mΩ |
| C1 | | 160 | fF |
| C2 | | 160 | fF |
| C3 | | 160 | fF |

Table 7: Spice model list of components; see [Figure 2](#) ...continued

| Component | Parameter | Value | Unit |
|-----------|-----------|-------|------|
| C4 | | 160 | fF |
| C5 | | 160 | fF |
| C6 | | 160 | fF |
| C7 | | 160 | fF |

8. Package outline

Plastic surface mounted package; 6 leads

SOT457

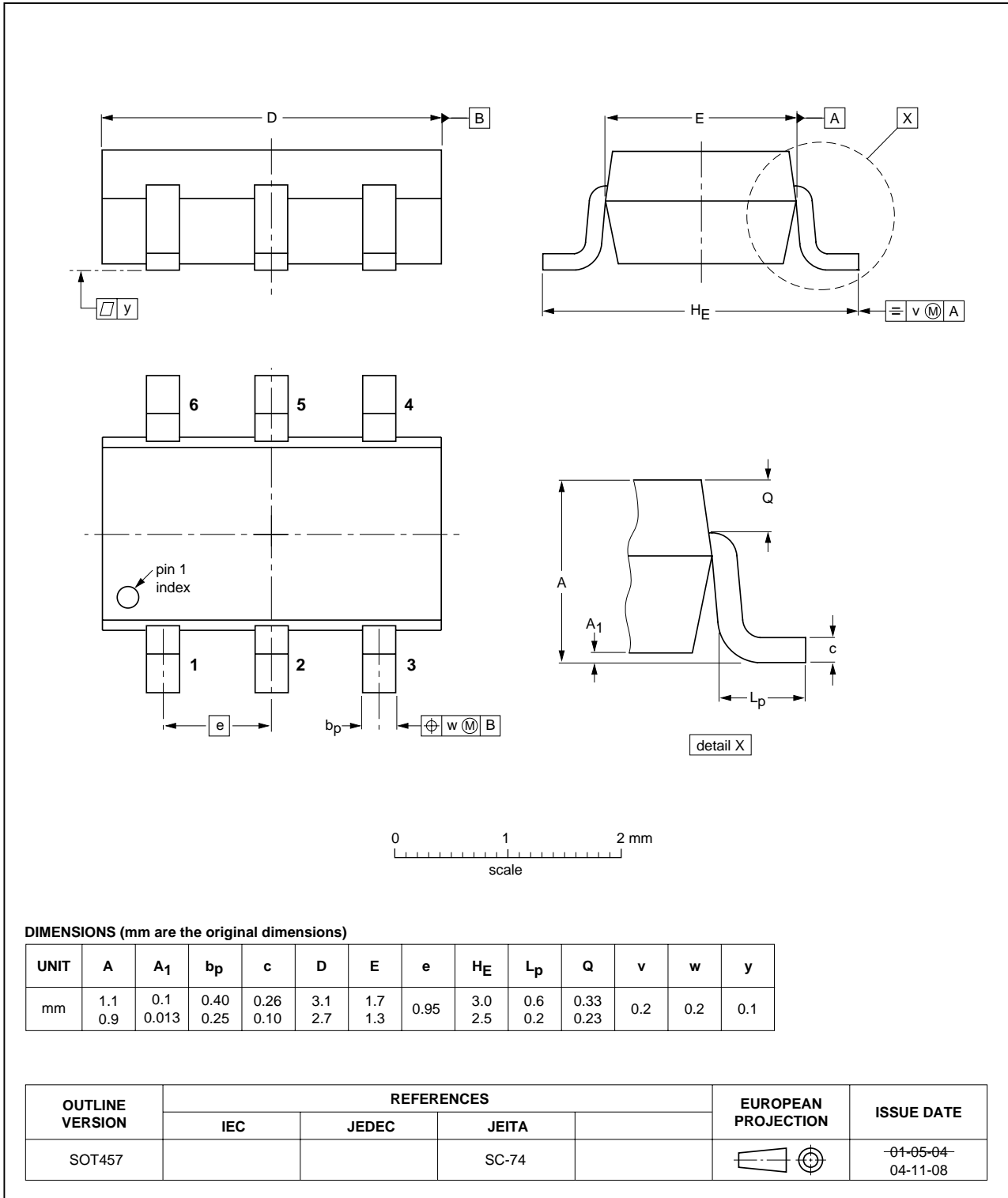


Fig 3. Package outline SOT457

9. Abbreviations

Table 8: Abbreviations

| Acronym | Description |
|----------------|--------------------------------------|
| DVI | Digital Video Interface |
| HDMI | High Definition Multimedia Interface |
| LAN | Local Area Network |
| PCS | Personal Communication System |
| PDA | Personal Digital Assistant |
| USB 2.0 | Universal Serial Bus 2.0 |
| WAN | Wide Area Network |

10. Revision history

Table 9: Revision history

| Document ID | Release date | Data sheet status | Change notice | Doc. number | Supersedes |
|----------------|--|---------------------------|---------------|----------------|---------------|
| IP4220CZ6_4 | 20050912 | Product data sheet | - | - | IP4220CZ6_3 |
| Modifications: | • Section 7.2 "IP4220CZ6 spice model" : units of C1 to C7 in spice model list changed from nF to fF. | | | | |
| IP4220CZ6_3 | 20050712 | Product data sheet | - | - | IP4220CZ6_2 |
| IP4220CZ6_2 | 20050608 | Product data sheet | - | 9397 750 14555 | IP4220CZ6_N_1 |
| IP4220CZ6_N_1 | 20040917 | Preliminary specification | - | n.a. | - |

11. Data sheet status

| Level | Data sheet status ^[1] | Product status ^{[2] [3]} | Definition |
|-------|----------------------------------|-----------------------------------|--|
| I | Objective data | Development | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice. |
| II | Preliminary data | Qualification | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product. |
| III | Product data | Production | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

12. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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

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

13. Disclaimers

Life support — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors

15. Contact information

For additional information, please visit: <http://www.semiconductors.philips.com>

For sales office addresses, send an email to: sales.addresses@www.semiconductors.philips.com

customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status 'Production'), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

14. Trademarks

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

16. Contents

| | | |
|-----------|---|----------|
| 1 | Product profile | 1 |
| 1.1 | General description | 1 |
| 1.2 | Features | 1 |
| 1.3 | Applications | 1 |
| 2 | Pinning information | 2 |
| 3 | Ordering information | 2 |
| 4 | Limiting values | 2 |
| 5 | Recommended operating conditions | 2 |
| 6 | Characteristics | 3 |
| 7 | Application information | 3 |
| 7.1 | Universal serial bus 2.0 protection | 3 |
| 7.2 | IP4220CZ6 spice model | 4 |
| 8 | Package outline | 6 |
| 9 | Abbreviations | 7 |
| 10 | Revision history | 8 |
| 11 | Data sheet status | 9 |
| 12 | Definitions | 9 |
| 13 | Disclaimers | 9 |
| 14 | Trademarks | 9 |
| 15 | Contact information | 9 |



© Koninklijke Philips Electronics N.V. 2005

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Date of release: 12 September 2005
Document number: IP4220CZ6_4

Published in The Netherlands