

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

IP3048CX5

Integrated dual channel passive LC-filter network with ESD protection to IEC 61000-4-2 level 4

Rev. 3 — 10 February 2011

Product data sheet

1. Product profile

1.1 General description

The IP3048CX5 is a low-ohmic, dual channel LC low-pass filter array which is designed to provide filtering of undesired RF signals. In addition, IP3048CX5 incorporates diodes to provide protection to downstream components from ElectroStatic Discharge (ESD) voltages as high as ± 15 kV contact discharge according to the IEC 61000-4-2 model, far exceeding standard level 4.

The device is fabricated using monolithic silicon technology and integrates two inductors and four pairs of back-to-back diodes in a 0.5 mm pitch Wafer-Level Chip-Scale Package (WLCSP). These features make the IP3048CX5 ideal for use in applications requiring the utmost in miniaturization such as mobile phone handsets, cordless telephones and other portable electronic devices.

1.2 Features and benefits

- Pb-free, RoHS compliant and free of halogen and antimony (Dark Green compliant)
- Integrated dual channel π -type LC-filter network
- 0.25 Ω series resistance per channel; 190 pF channel capacitance
- Integrated ESD protection withstanding ± 15 kV contact discharge, far exceeding IEC 61000-4-2 level 4
- WLCSP with 0.5 mm pitch

1.3 Applications

Audio line ElectroMagnetic Interference (EMI) filtering and ESD protection in e.g.

- Cellular and Personal Communication System (PCS) mobile handsets
- DECT
- Portable media player



2. Pinning information

2.1 Pinning

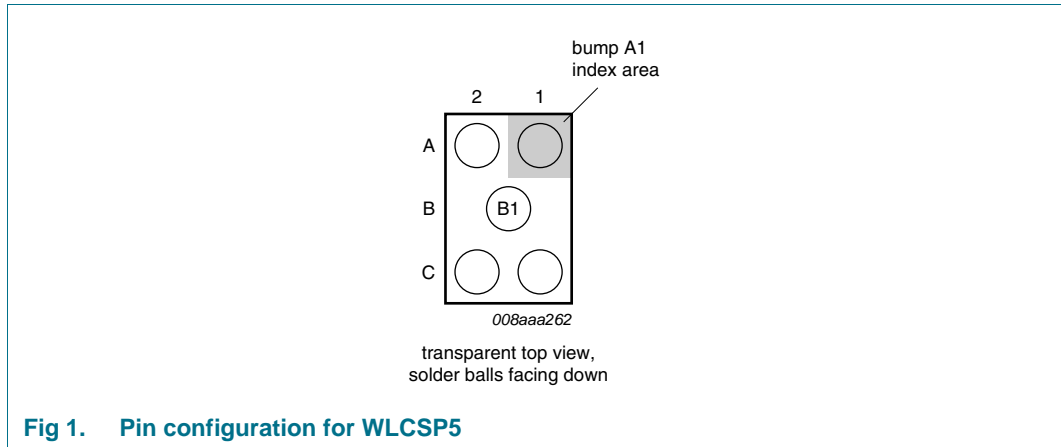


Fig 1. Pin configuration for WLCSP5

2.2 Pin description

Table 1. Pinning

| Pin | Description |
|-----|-------------|
| A1 | channel 1 |
| A2 | channel 2 |
| B1 | ground |
| C1 | channel 1 |
| C2 | channel 2 |

3. Ordering information

Table 2. Ordering information

| Type number | Package | | |
|-------------|---------|--|-----------|
| | Name | Description | Version |
| IP3048CX5 | WLCSP5 | wafer level chip-size package; 5 bumps (2-1-2) | IP3048CX5 |

4. Functional diagram

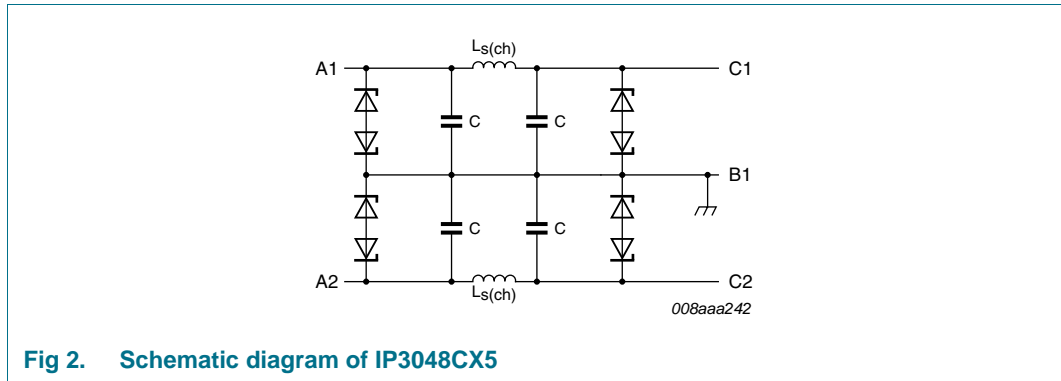


Fig 2. Schematic diagram of IP3048CX5

5. Limiting values

Table 3. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------------|---------------------------------|--|------------|------|------|
| V _{RWM} | reverse standoff voltage | | - | 5 | V |
| I _{ch} | channel current (DC) | | - | 625 | mA |
| V _{ESD} | electrostatic discharge voltage | all pins to ground | | | |
| | | contact discharge | [1][2] -15 | +15 | kV |
| | | air discharge | -15 | +15 | kV |
| | | IEC 61000-4-2 level 4; all pins to ground | | | |
| | | contact discharge | -8 | +8 | kV |
| | air discharge | -15 | +15 | kV | |
| P _{ch} | channel power dissipation | continuous; T _{amb} = 85 °C | - | 135 | mW |
| P _{tot} | total power dissipation | continuous; T _{amb} = 85 °C | - | 270 | mW |
| P _{pp} | peak pulse power | T _{amb} = 85 °C; maximum peak power dissipation < 120 s; δ < 50 % | - | 270 | mW |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| T _{reflow(peak)} | peak reflow temperature | 10 s maximum | - | 260 | °C |
| T _{amb} | ambient temperature | | -40 | +85 | °C |

- [1] Device is qualified with 1000 pulses of ±15 kV contact discharges each, according to the IEC 61000-4-2 model and far exceeds the specified level 4 (8 kV contact discharge).
- [2] A special robust test is performed stressing the devices with ≥ 1000 contact discharges according to the IEC 61000-4-2 model and far exceeds the specified level 4 (8 kV contact discharge).

6. Characteristics

Table 4. Channel characteristics

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------|---------------------------|---|---------|------|------|---------------|
| $R_{s(ch)}$ | channel series resistance | | - | 0.25 | 0.35 | Ω |
| $L_{s(ch)}$ | channel series inductance | | - | 3 | - | nH |
| C_{ch} | channel capacitance | $V_{bias(DC)} = 2.5\text{ V}$; $f = 100\text{ kHz}$ | [1] 150 | 190 | 225 | pF |
| V_{BR} | breakdown voltage | positive clamp; $I_{test} = 1\text{ mA}$ | 6 | - | 10 | V |
| | | negative clamp; $I_{test} = -1\text{ mA}$ | -10 | - | -6 | V |
| I_{LR} | reverse leakage current | per channel; $V_I = 3\text{ V}$ | - | - | 1 | μA |
| | | per channel; $V_I = -3\text{ V}$ | -1 | - | - | μA |

[1] Guaranteed by design.

Table 5. Frequency characteristics

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------|----------------|---|-----|-----|-----|------|
| α_{il} | insertion loss | $R_{gen} = 50\text{ }\Omega$; $800\text{ MHz} < f_i < 2\text{ GHz}$ | | | | |
| | | $R_L = 50\text{ }\Omega$ | - | 35 | - | dB |
| | | $R_L = 4\text{ }\Omega$ | - | 40 | - | dB |

7. Application information

The setup for measuring insertion loss in a 50 Ω system is shown in [Figure 3](#).

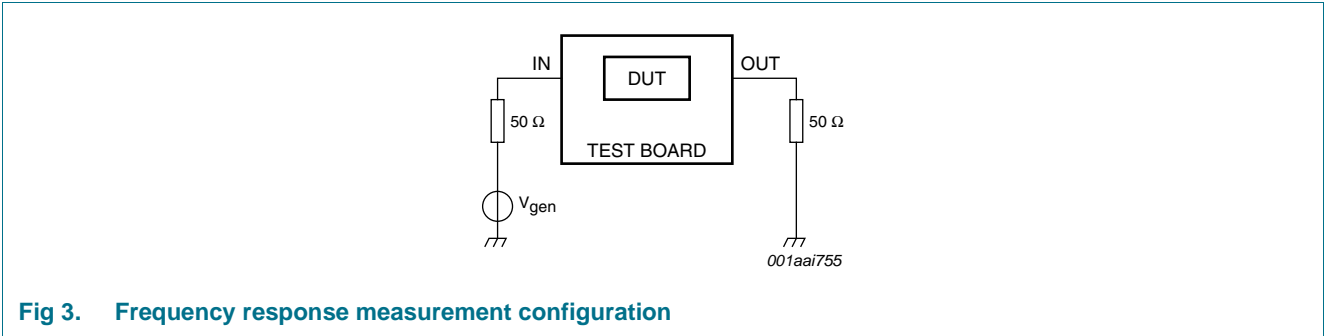


Fig 3. Frequency response measurement configuration

The insertion loss in a 50 Ω system for the two channels of the IP3048CX5 is shown in [Figure 4](#). The insertion loss is measured directly on the wafer with coplanar probes. Unused pins are connected to ground with 50 Ω.

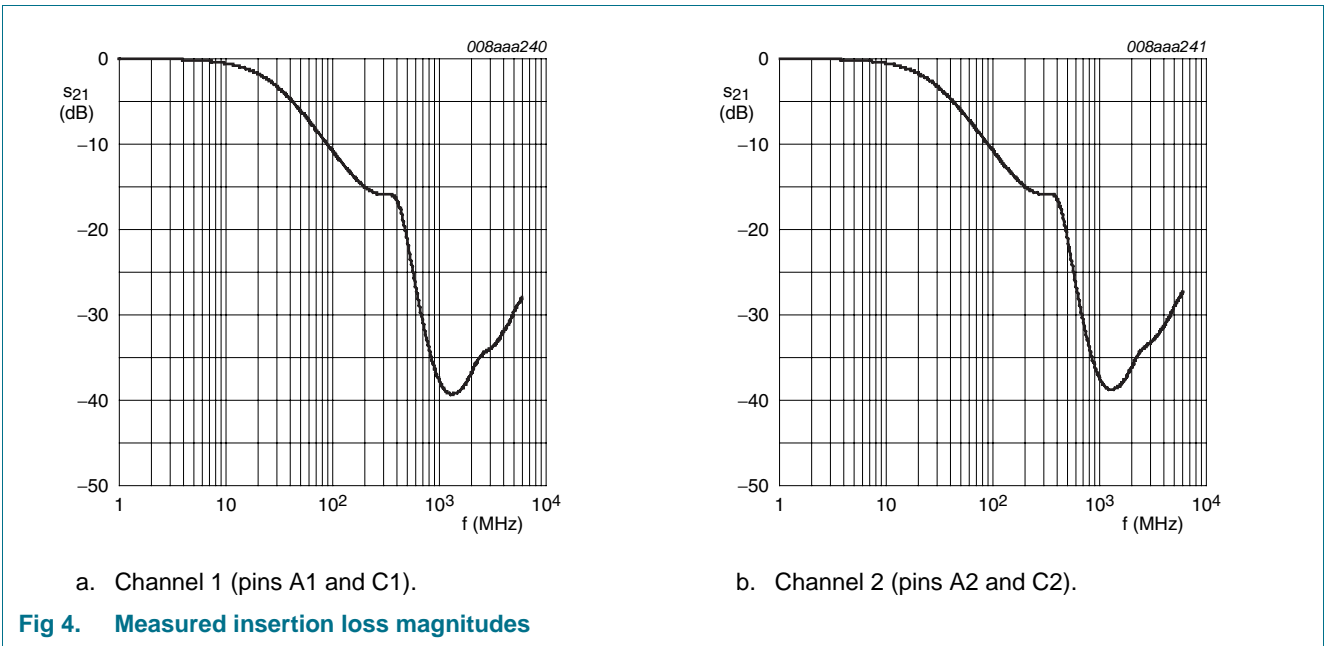


Fig 4. Measured insertion loss magnitudes

8. Package outline

WLCSP5: wafer level chip-size package; 5 bumps (2-1-2)

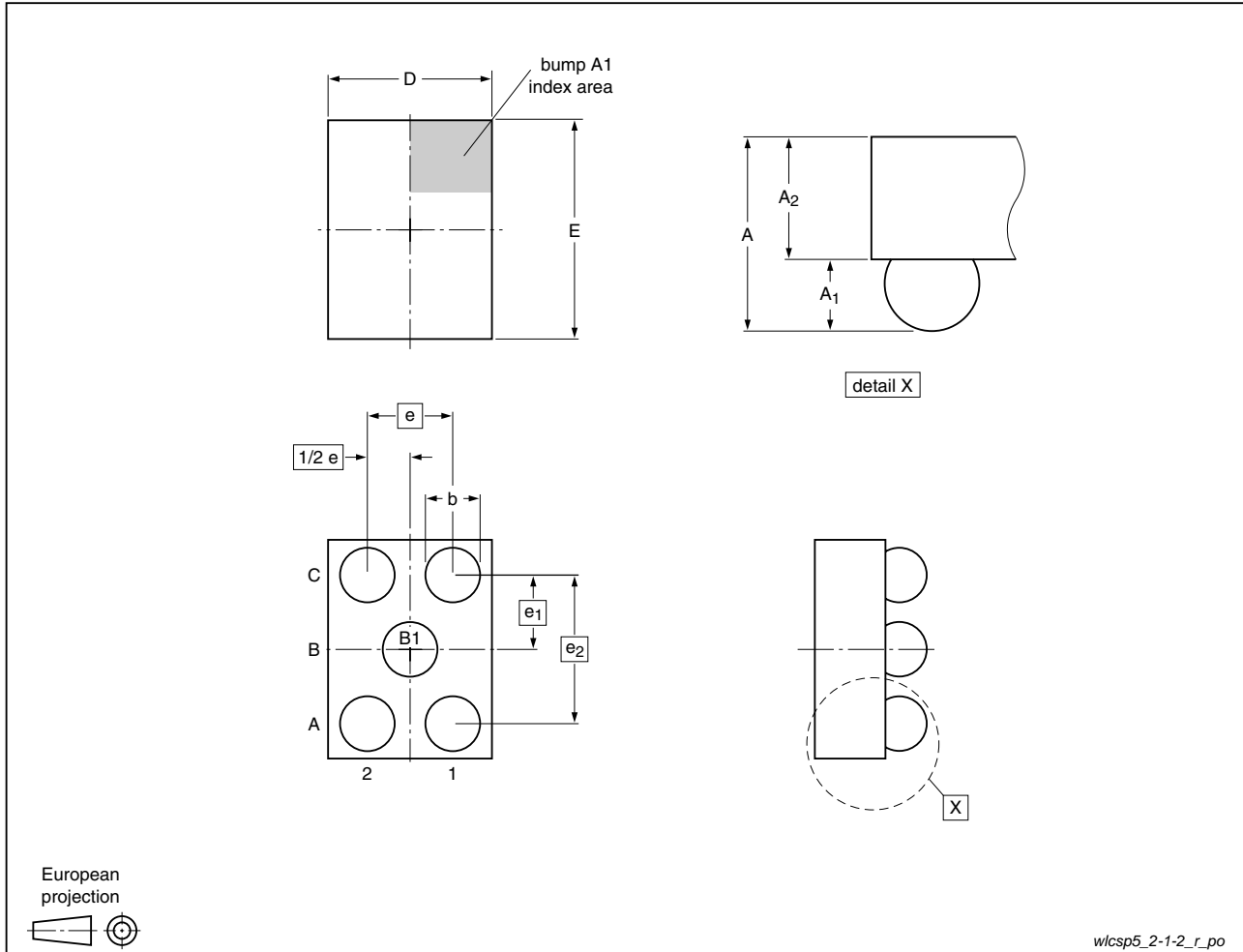


Fig 5. Package outline IP3048CX5 (WLCSP5)

Table 6. Dimensions for Figure 5

| Symbol | Min | Typ | Max | Unit |
|----------------|------|-------|------|------|
| A | 0.61 | 0.65 | 0.69 | mm |
| A ₁ | 0.22 | 0.24 | 0.26 | mm |
| A ₂ | 0.39 | 0.41 | 0.43 | mm |
| b | 0.27 | 0.32 | 0.37 | mm |
| D | 1.09 | 1.14 | 1.19 | mm |
| E | 1.46 | 1.51 | 1.56 | mm |
| e | - | 0.5 | - | mm |
| e ₁ | - | 0.435 | - | mm |
| e ₂ | - | 0.87 | - | mm |

9. Design and assembly recommendations

9.1 PCB design guidelines

It is recommended, for optimum performance, to use a Non-Solder Mask Defined (NSMD), also known as a copper-defined design, incorporating laser-drilled micro-vias connecting the ground pads to a buried ground-plane layer. This results in the lowest possible ground inductance and provides the best high frequency and ESD performance. Refer to [Table 7](#) for the recommended PCB design parameters.

Table 7. Recommended PCB design parameters

| Parameter | Value or specification |
|-------------------------------|--------------------------------------|
| PCB pad diameter | 275 μm |
| Micro-via diameter | 100 μm (0.004 inch) |
| Solder mask aperture diameter | 375 μm |
| Copper thickness | 20 μm to 40 μm |
| Copper finish | AuNi |
| PCB material | FR4 |

9.2 PCB assembly guidelines for Pb-free soldering

Table 8. Assembly recommendations

| Parameter | Value or specification |
|---------------------------------|--|
| Solder screen aperture diameter | 330 μm |
| Solder screen thickness | 100 μm (0.004 inch) |
| Solder paste: Pb-free | SnAg (3 % to 4 %); Cu (0.5 % to 0.9 %) |
| Solder to flux ratio | 50 : 50 |
| Solder reflow profile | see Figure 6 |

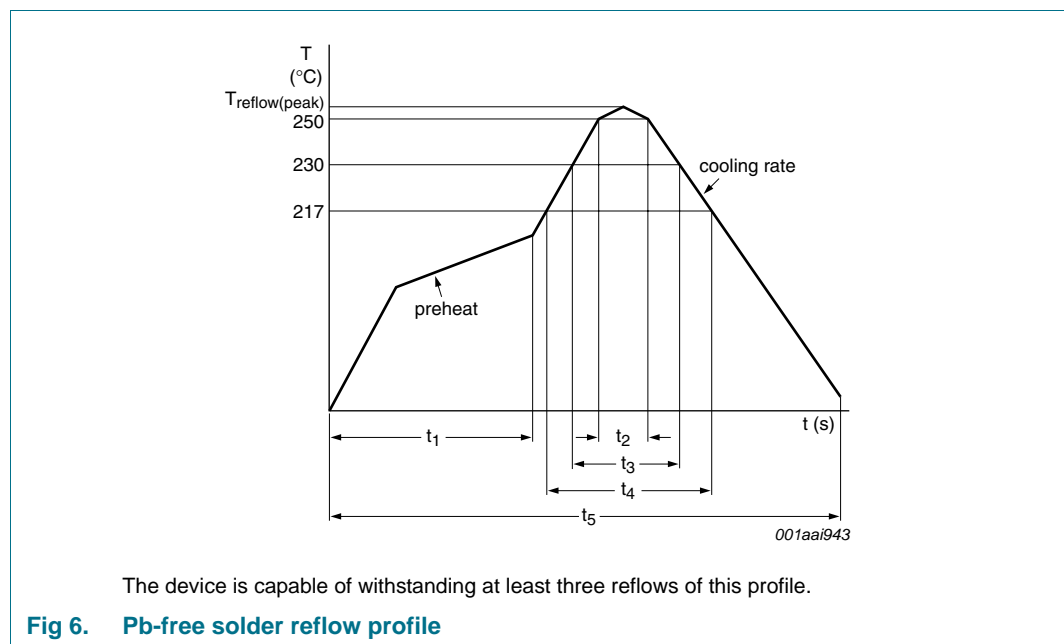


Table 9. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|-------------------------------|-----------------------------|-----|-----|-----|------|
| $T_{\text{reflow(peak)}}$ | peak reflow temperature | | 230 | - | 260 | °C |
| t_1 | time 1 | soak time | 60 | - | 180 | s |
| t_2 | time 2 | time during $T \geq 250$ °C | - | - | 30 | s |
| t_3 | time 3 | time during $T \geq 230$ °C | 10 | - | 50 | s |
| t_4 | time 4 | time during $T > 217$ °C | 30 | - | 150 | s |
| t_5 | time 5 | | - | - | 540 | s |
| dT/dt | rate of change of temperature | cooling rate | - | - | -6 | °C/s |
| | | preheat | 2.5 | - | 4.0 | °C/s |

10. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|-------------------------------------|
| DUT | Device Under Test |
| EMI | ElectroMagnetic Interference |
| ESD | ElectroStatic Discharge |
| FR4 | Flame Retard 4 |
| NSMD | Non-Solder Mask Defined |
| PCB | Printed-Circuit Board |
| PCS | Personal Communication System |
| RF | Radio Frequency |
| RoHS | Restriction of Hazardous Substances |
| WLCSP | Wafer-Level Chip-Scale Package |

11. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|---------------|
| IP3048CX5 v.3 | 20110210 | Product data sheet | - | IP3048CX5 v.2 |
| Modifications: | <ul style="list-style-type: none"> • Figure 1 and Figure 5: changed | | | |
| IP3048CX5 v.2 | 20101104 | Product data sheet | - | IP3048CX5 v.1 |
| IP3048CX5 v.1 | 20101018 | Product data sheet | - | - |

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.

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.

12.3 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.

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

14. Contents

| | | |
|-----------|---|-----------|
| 1 | Product profile | 1 |
| 1.1 | General description | 1 |
| 1.2 | Features and benefits | 1 |
| 1.3 | Applications | 1 |
| 2 | Pinning information | 2 |
| 2.1 | Pinning | 2 |
| 2.2 | Pin description | 2 |
| 3 | Ordering information | 2 |
| 4 | Functional diagram | 3 |
| 5 | Limiting values | 3 |
| 6 | Characteristics | 4 |
| 7 | Application information | 5 |
| 8 | Package outline | 6 |
| 9 | Design and assembly recommendations | 7 |
| 9.1 | PCB design guidelines | 7 |
| 9.2 | PCB assembly guidelines for Pb-free soldering | 7 |
| 10 | Abbreviations | 8 |
| 11 | Revision history | 8 |
| 12 | Legal information | 9 |
| 12.1 | Data sheet status | 9 |
| 12.2 | Definitions | 9 |
| 12.3 | Disclaimers | 9 |
| 12.4 | Trademarks | 10 |
| 13 | Contact information | 10 |
| 14 | Contents | 11 |

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. 2011.

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: 10 February 2011

Document identifier: IP3048CX5