# NCX2200

## Low voltage comparator

Rev. 6 — 9 July 2014 Product data sheet

## 1. General description

The NCX2200 provides a single low voltage low power comparator.

The NCX2200 has a very low supply current of 6 μA and is guaranteed to operate at a low voltage of 1.3 V and is fully operational up to 5.5 V which makes this device convenient for use in both 3.0 V and 5.0 V systems.

## 2. Features and benefits

- Wide supply voltage range from 1.3 V to 5.5 V (functional operating range)
- Rail-to-rail input/output performance
- Very low supply current of 6 μA (typical)
- Very low-power consumption
- No phase inversion with overdriven input signals
- Internal hysteresis
- Propagation delay of 0.8 μs (typical)
- ESD protection:
  - HBM JESD22-A114F Class 3A. Exceeds 2000 V
  - CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from −40 °C to +85 °C

## 3. Applications

- Cellular telephones
- Alarm and security systems
- Personal Digital assistants

## 4. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| NCX2200GW | –40 °C to +85 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| NCX2200GM | –40 °C to +85 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |
| NCX2200GF3 | –40 °C to +85 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm | SOT891 |
| NCX2200GS | –40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm | SOT1202 |

## 5. Marking

**Table 2. Marking codes**

| Type number | Marking[1] |
|---|---|
| NCX2200GM | q1 |
| NCX2200GW | q1 |
| NCX2200GF3 | q3 |
| NCX2200GS | q1 |

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 6. Functional diagram

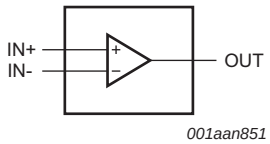



**Fig 1. Logic symbol**

# 7. Pinning information

## 7.1 Pinning

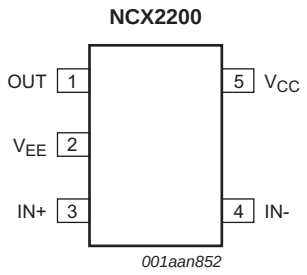



**Fig 2. Pin configuration SOT353-1**

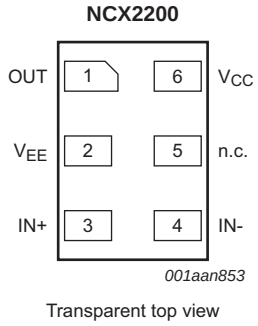



**Fig 3. Pin configuration SOT886**

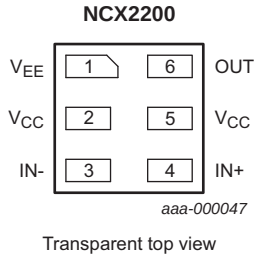



**Fig 4. Pin configuration SOT891 and SOT1202**

## 7.2 Pin description

**Table 3. Pin description**

| Symbol | Pin | | | | Description |
|---|---|---|---|---|---|
| | SOT353-1 | SOT886 | SOT891 | SOT1202 | |
| OUT | 1 | 1 | 6 | 6 | comparator output |
| $V_{EE}$ | 2 | 2 | 1 | 1 | supply voltage |
| IN+ | 3 | 3 | 4 | 4 | comparator input (positive) |
| IN– | 4 | 4 | 3 | 3 | comparator input (negative) |
| n.c. | - | 5 | - | - | not connected |
| $V_{CC}$ | 5 | 6 | 2, 5 | 2, 5 | supply voltage |

# 8. Limiting values

**Table 4. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to $V_{EE}$.*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | - | 7.0 | V |
| $V_I$ | input voltage | IN–, IN+ inputs | –0.5 | $V_{CC}$ + 0.5 | V |
| $t_{sc(o)}$ | output short-circuit time | [1] | - | indefinite | s |
| $T_{j(max)}$ | maximum junction temperature | | - | +150 | °C |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = –40 °C to +85 °C | - | 250 | mW |

[1] The maximum total power dissipation must not be exceeded.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | $V_{CC}$ to $V_{EE}$ | | | | |
| | | full spec operating range | 1.6 | - | 5.5 | V |
| | | functional operating range | 1.3 | - | 5.5 | V |
| $V_I$ | input voltage | | $V_{EE}$ | - | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | –40 | - | +85 | °C |

## 10. Static characteristics

**Table 6. Static characteristics**

*At recommended operating conditions. $V_{CC}$ = 1.6 V to 5.5 V, $V_{EE}$ = 0 V; $V_{CM}$ = 0.5$V_{CC}$ unless otherwise specified.*

| Symbol | Parameter | Conditions | 25 °C | | | –40 °C to +85 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | |
| $V_H$ | hysteresis voltage | | 6 | 9 | 13 | - | - | mV |
| | | $V_{CC}$ = 1.3 V | - | 20 | - | - | - | mV |
| $V_{I(offset)}$ | offset input voltage | [1] | –30 | 0.5 | +30 | –30 | +30 | mV |
| | | $V_{CC}$ = 1.3 V [1] | - | 3 | - | - | - | mV |
| $V_{OH}$ | HIGH-level output voltage | $I_O$ = –0.5 mA; $V_{CC}$ = 1.3 V | - | 1.24 | - | - | - | V |
| | | $I_O$ = –0.5 mA; $V_{CC}$ = 1.6 V | - | 1.55 | - | 1.35 | - | V |
| | | $I_O$ = –3 mA; $V_{CC}$ = 3.0 V | - | 2.85 | - | 2.7 | - | V |
| | | $I_O$ = –5 mA; $V_{CC}$ = 5.5 V | - | 5.33 | - | 5.2 | - | V |
| $V_{OL}$ | LOW-level output voltage | $I_O$ = 0.5 mA; $V_{CC}$ = 1.3 V | - | 0.05 | - | - | - | V |
| | | $I_O$ = 0.5 mA; $V_{CC}$ = 1.6 V | - | 0.04 | - | - | 0.25 | V |
| | | $I_O$ = 3 mA; $V_{CC}$ = 3.0 V | - | 0.14 | - | - | 0.3 | V |
| | | $I_O$ = 5 mA; $V_{CC}$ = 5.5 V | - | 0.20 | - | - | 0.3 | V |
| $V_{CM}$ | common-mode voltage | $V_{CC}$ = 1.3 V to 5.5 V | - | $V_{EE}$ to $V_{CC}$ | - | - | - | V |
| $I_{OS}$ | output short-circuit current | $V_{CC}$ = 5.5 V; $V_O$ = $V_{EE}$ or $V_{CC}$ | - | 68 | - | - | - | mA |
| CMRR | common-mode rejection ratio | $\Delta V_{CM}$ = $V_{CC}$ | - | 70 | - | - | - | dB |
| PSRR | power supply rejection ratio | $\Delta V_{CC}$ = 1.95 V | 45 | 80 | - | - | - | dB |
| $I_{IB}$ | input bias current | | - | 1.0 | - | - | - | pA |
| $I_{CC}$ | supply current | | - | 6.0 | - | - | 9.0 | μA |

[1] Differential input switching level is guaranteed at the minimum or maximum offset voltage, minus or plus half the maximum hysteresis voltage.

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

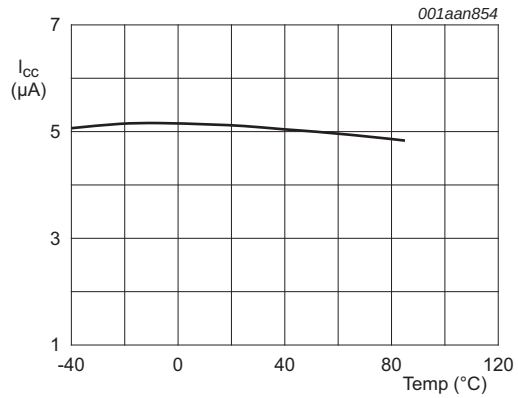
*Voltages are referenced to $V_{EE}$ ($V_{EE}$ = 0 V);$V_{CC}$ = 1.6 V to 5.5 V; $V_{CM}$ = 0.5$V_{CC}$ unless otherwise specified.*

| Symbol | Parameter | Conditions | | 25 °C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| $t_{pd}$ | propagation delay | 20 mV overdrive; $C_L$ = 15 pF | [1] | - | 0.8 | - | µs |
| $t_{THL}$ | HIGH to LOW output transition time | $V_{CC}$ = 5.5 V; $C_L$ = 50 pF | [2] | - | 10 | - | ns |
| $t_{TLH}$ | LOW to HIGH output transition time | $V_{CC}$ = 5.5 V; $C_L$ = 50 pF | [2] | - | 10 | - | ns |

[1] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.

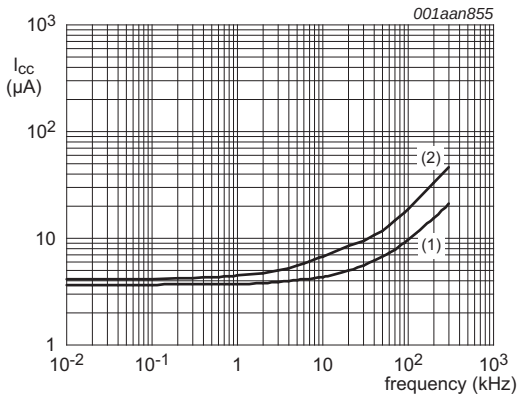
[2] Input signal: 1 kHz, squarewave signal with 10 ns edge rate.

## 12. Graphs




$V_{CC}$ = 5.0 V.

**Fig 5. Supply current versus temperature**

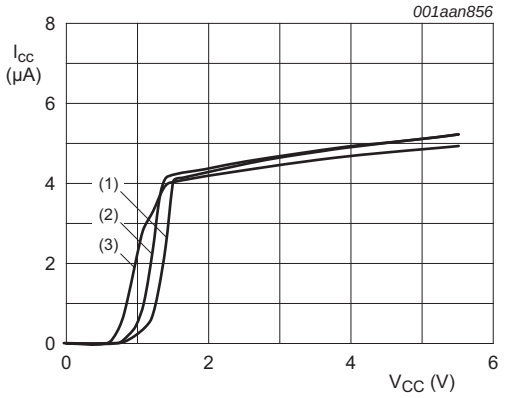



$T_{amb}$ = 25 °C; $C_L$ = 15 pF.

(1) $V_{CC}$ = 2.7 V.

(2) $V_{CC}$ = 5.0 V.

**Fig 6. Supply current versus output transition frequency**

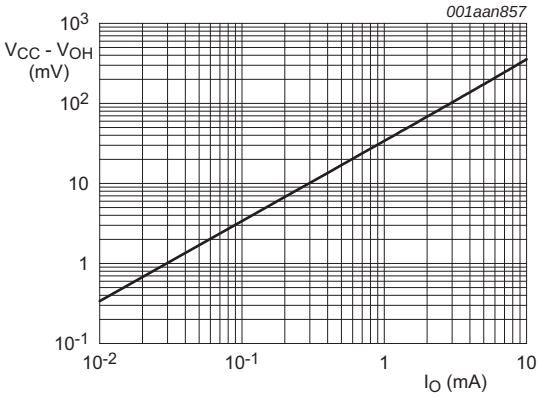



(1) $T_{amb}$ = −40 °C.

(2) $T_{amb}$ = 25 °C.

(3) $T_{amb}$ = 85 °C.

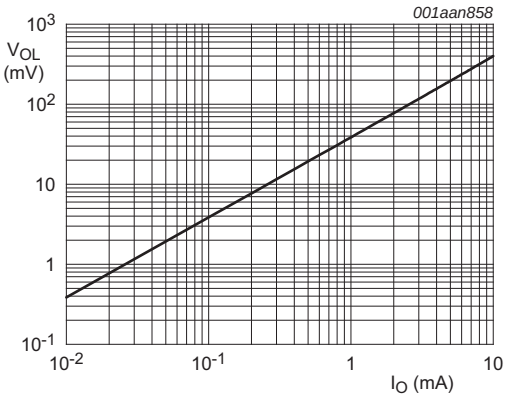
**Fig 7. Supply current versus supply voltage**




$T_{amb}$ = 25 °C.

$V_{CC}$ = 5.0 V.

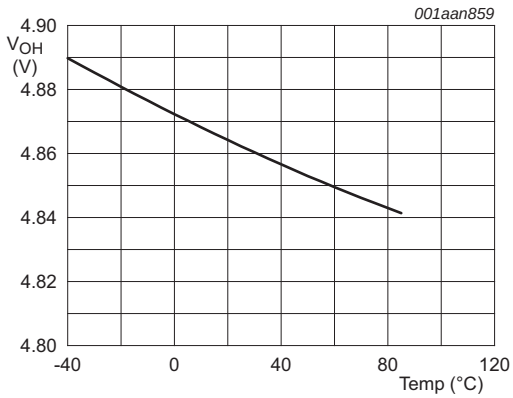
**Fig 8. HIGH-level output voltage versus output current**




$T_{amb}$ = 25 °C.

$V_{CC}$ = 5.0 V.

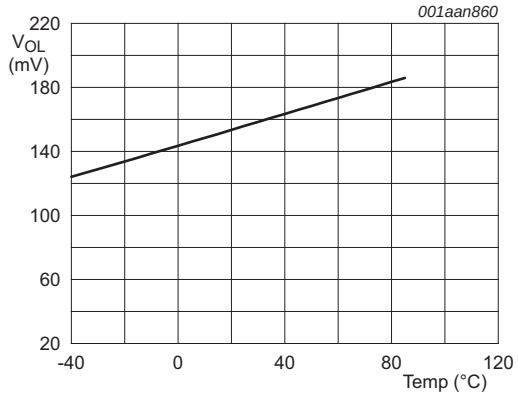
**Fig 9. LOW-level output voltage versus output current**




$I_O$ = −4.0 mA.

$V_{CC}$ = 5.0 V.

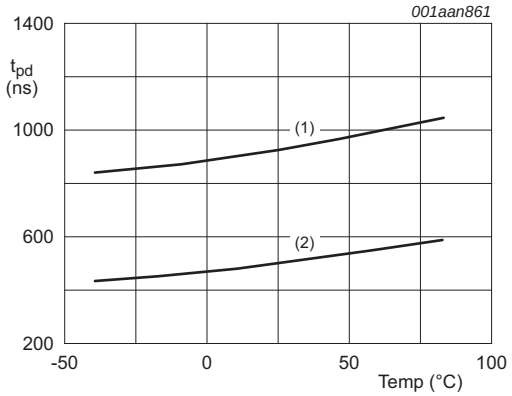
**Fig 10. HIGH-level output voltage versus temperature**




$I_O$ = 4.0 mA.

$V_{CC}$ = 5.0 V.

**Fig 11. LOW-level output voltage versus temperature**

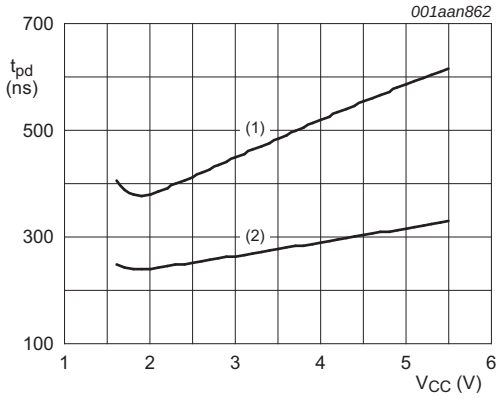



$V_{CC}$ = 5.0 V; input overdrive = 50 mV.

(1) $t_{PLH}$.

(2) $t_{PHL}$.

**Fig 12. Propagation delay versus temperature**




$T_{amb}$ = 25 °C; input overdrive = 100 mV.

(1) $t_{PLH}$.

(2) $t_{PHL}$.

**Fig 13. Propagation delay versus supply voltage.**

# 13. Application information

## 13.1 Operating description

The NCX2200 is a single low voltage low power comparator. This device is designed for rail-to-rail input and output performance. This device consumes only 6 μA of supply current while achieving a typical propagation delay of 0.8 μs at a 20 mV input overdrive. This comparator is guaranteed to operate at a low voltage of 1.3 V up to 5.5 V. The common-mode input voltage range extends 0.1 V beyond the upper and lower rail without phase inversion or other adverse effects. This device has a typical internal hysteresis of 9.0 mV. This allows for greater noise immunity and clean output switching.

## 13.2 Output stage

The NCX2200 has a complementary P and N Channel output stage that has capability of driving a rail-to-rail output swing with a load ranging up to 5.0 mA. It is designed such that shoot-through current is minimized while switching. This feature eliminates the need for bypass capacitors under most circumstances. See Figure 14

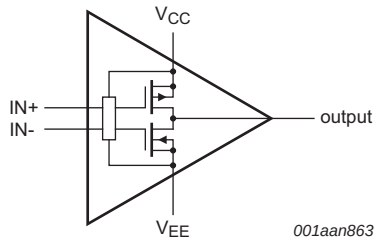
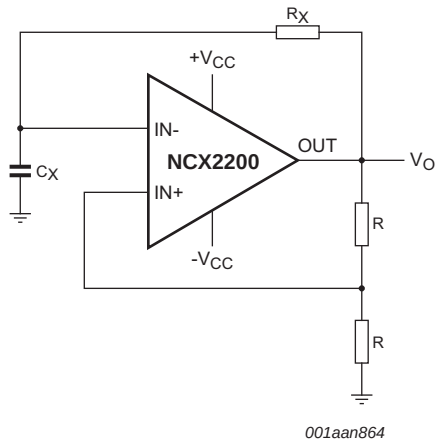



**Fig 14. NCX2200 complementary output configuration**

## 13.3 Schmitt trigger oscillator

Figure 15 shows the NCX2200 configured as a Schmitt trigger oscillator.




The oscillation frequency can be calculated as follows:

$$f = \frac{1}{T} = \frac{1}{2.2 \cdot R_X \cdot C_X}$$

**Fig 15. Schmitt trigger oscillator**

## 13.4 Zero-crossing detector

Figure 16 shows the NCX2200 configured as a zero-crossing detector.

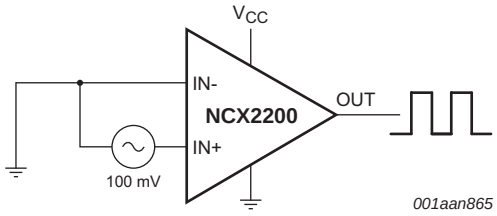
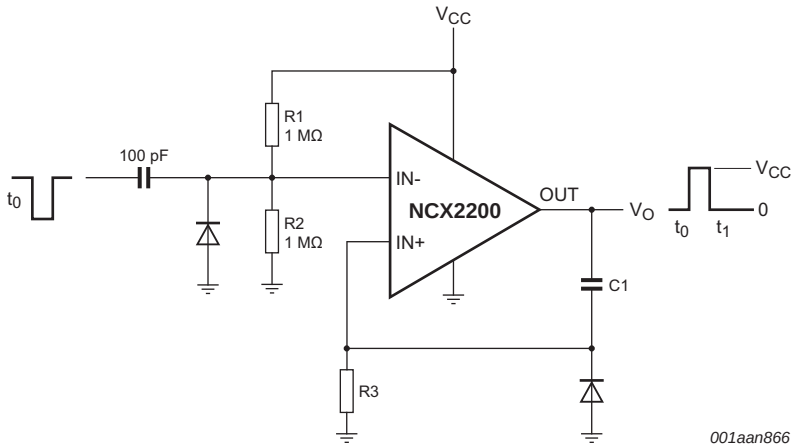



**Fig 16. Zero-crossing detector**

## 13.5 One-shot multivibrator

Figure 17 shows the NCX2200 configured as a one-shot multivibrator.

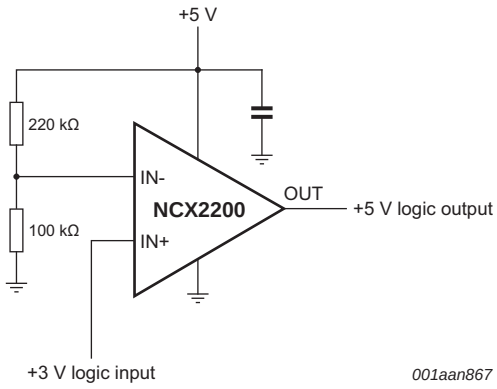



The resistor divider R1 and R2 can be used to set the magnitude of the input pulse. The pulse width is set by adjusting C1 and R3.

**Fig 17. One-shot multivibrator**

## 13.6 Logic level translator

Figure 18 shows the NCX2200 configured as a logic level translator.

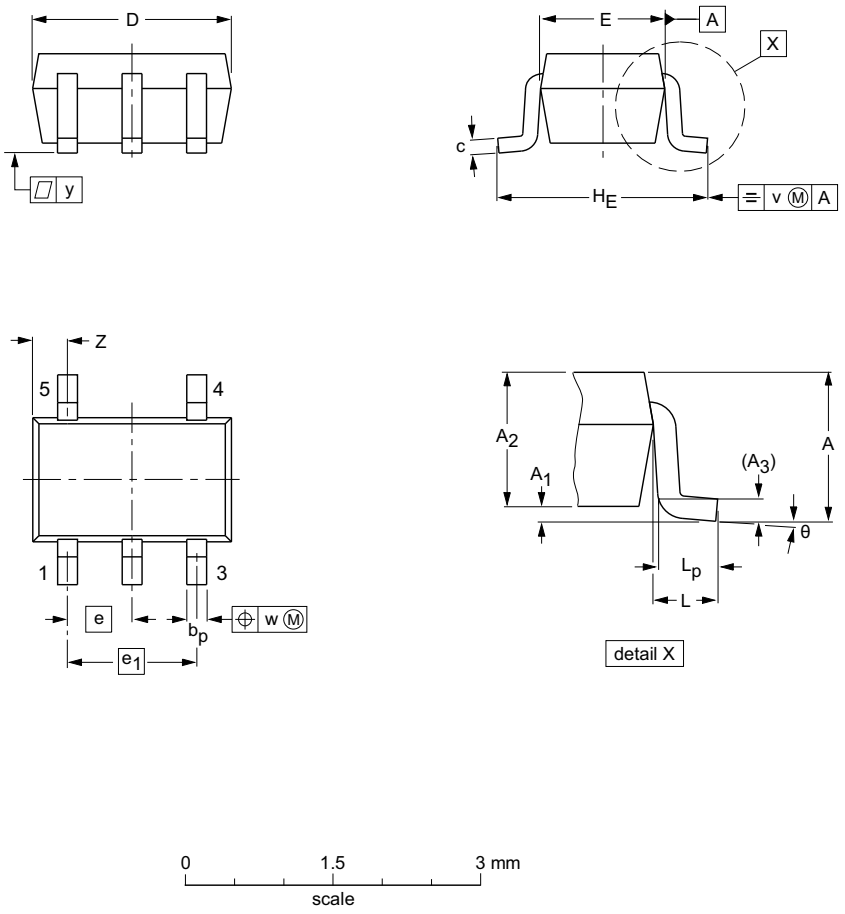



This circuit converts 3 V logic to 5 V logic.

**Fig 18. Logic level translator**

## 14. Package outline

**TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm** **SOT353-1**




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

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $e_1$ | $H_E$ | L | $L_p$ | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.1<br>0 | 1.0<br>0.8 | 0.15 | 0.30<br>0.15 | 0.25<br>0.08 | 2.25<br>1.85 | 1.35<br>1.15 | 0.65 | 1.3 | 2.25<br>2.0 | 0.425 | 0.46<br>0.21 | 0.3 | 0.1 | 0.1 | 0.60<br>0.15 | 7°<br>0° |

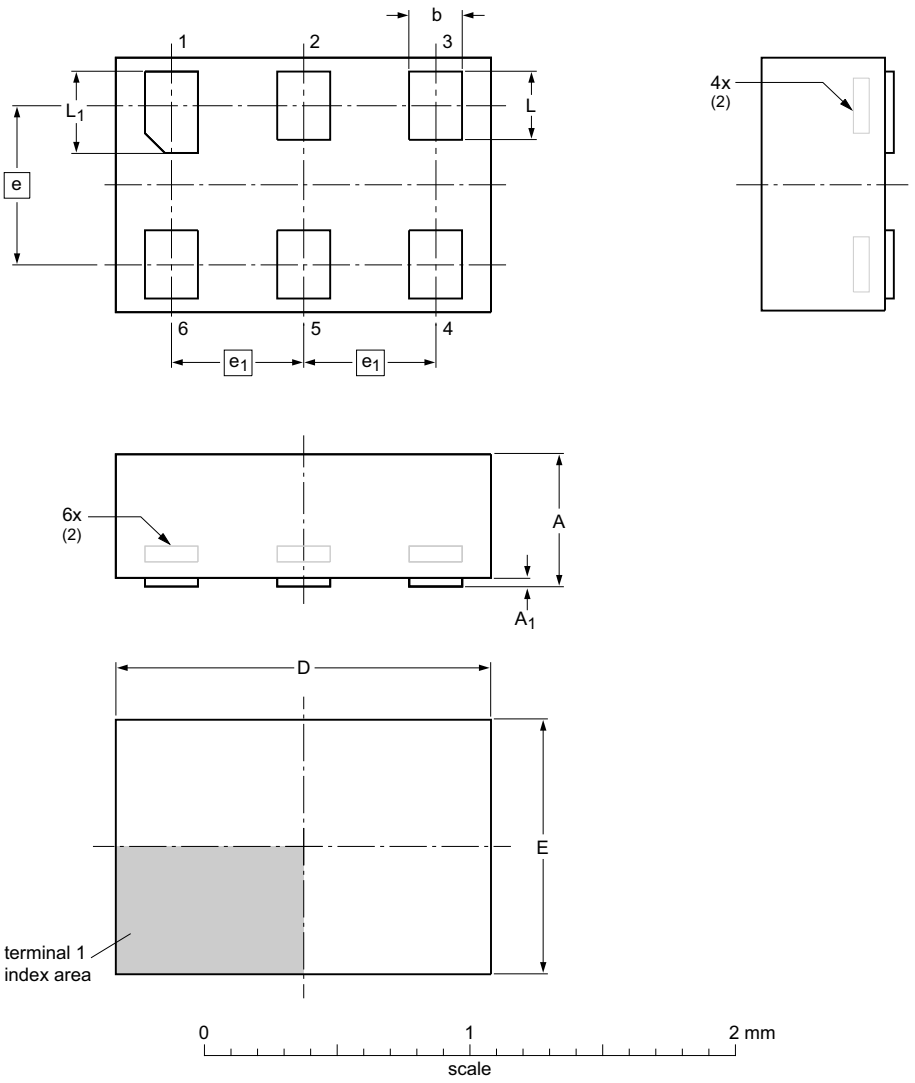
**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT353-1 | | MO-203 | SC-88A | | | ~~00-09-01~~<br>03-02-19 |

**Fig 19. Package outline SOT353-1 (TSSOP5)**

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) | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.5 | 0.04 | 0.25 | 1.50 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.20 | 1.45 | 1.00 | 0.6 | 0.5 | 0.30 | 0.35 |
| | min | | | 0.17 | 1.40 | 0.95 | | | 0.27 | 0.32 |

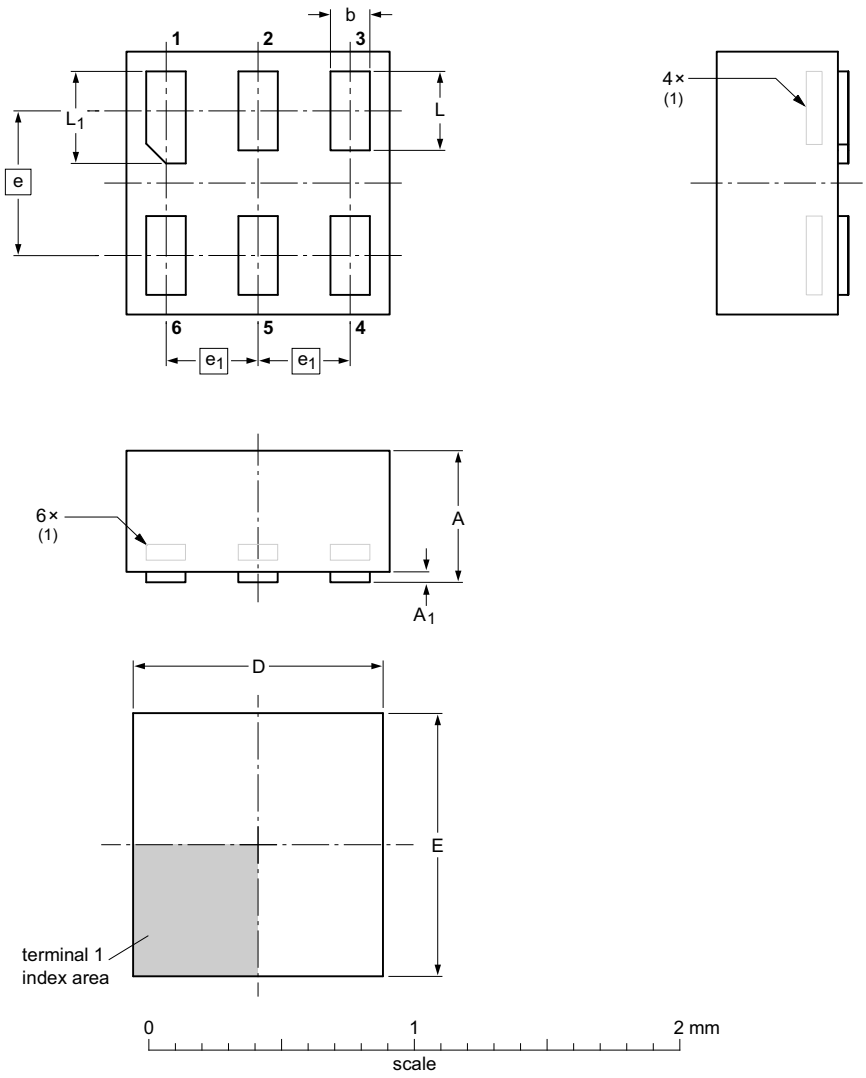
Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

*sot886_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT886 | | MO-252 | | | | ~~04-07-22~~ 12-01-05 |

**Fig 20. Package outline SOT886 (XSON6)**

**XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1 x 0.5 mm** **SOT891**




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

| UNIT | A max | $A_1$ max | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|
| mm | 0.5 | 0.04 | 0.20<br>0.12 | 1.05<br>0.95 | 1.05<br>0.95 | 0.55 | 0.35 | 0.35<br>0.27 | 0.40<br>0.32 |

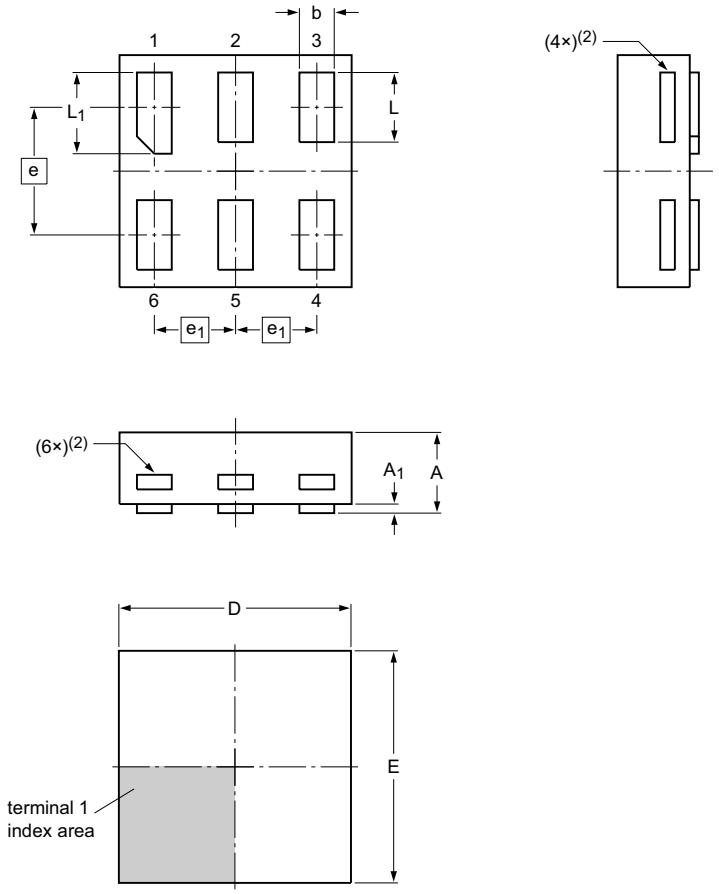
**Note**

1. Can be visible in some manufacturing processes.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT891 | | | | | | ~~05-04-06~~<br>07-05-15 |

**Fig 21. Package outline SOT891 (XSON6)**

**XSON6: extremely thin small outline package; no leads;**
**6 terminals; body 1.0 x 1.0 x 0.35 mm** **SOT1202**




Dimensions

| Unit | | $A^{(1)}$ | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.35 | 0.04 | 0.20 | 1.05 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.15 | 1.00 | 1.00 | 0.55 | 0.35 | 0.30 | 0.35 |
| | min | | | 0.12 | 0.95 | 0.95 | | | 0.27 | 0.32 |

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

*sot1202_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1202 | | | | | | ~~10-04-02~~ 10-04-06 |

**Fig 22. Package outline SOT1202 (XSON6)**

## 15. Abbreviations

**Table 8. Abbreviations**

| Acronym | Description |
|---|---|
| CDM | Charged Device Model |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |

## 16. Revision history

**Table 9. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| NCX2200 v6 | 20140709 | Product data sheet | - | NCX2200 v.5 |
| Modifications: | • Package SOT1202 added. | | | |
| NCX2200 v5 | 20120806 | Product data sheet | - | NCX2200 v.4 |
| Modifications: | • Package outline drawing of SOT886 (Figure 20) modified. | | | |
| NCX2200 v4 | 20111110 | Product data sheet | - | NCX2200 v.3 |
| Modifications: | • Legal pages updated. | | | |
| NCX2200 v.3 | 20111014 | Product data sheet | - | NCX2200 v.2 |
| NCX2200 v.2 | 20110706 | Product data sheet | - | NCX2200 v.1 |
| NCX2200 v.1 | 20110322 | Product data sheet | - | - |

# 17. Legal information

## 17.1 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.

## 17.2 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.

## 17.3 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 —** 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 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.

**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.

**Translations —** A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

### 17.4 Trademarks

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

## 18. Contact information

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

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

## 19. Contents





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

**Date of release: 9 July 2014**
**Document identifier: NCX2200**