

# NCX2202

## Low voltage comparator; open-drain output

Rev. 5.1 — 21 November 2019

Product data sheet

### 1. General description

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The NCX2202 is a single low voltage, low power, comparator with open-drain output.

The NCX2202 has a very low supply current of 6  $\mu\text{A}$  and is guaranteed to operate at a low voltage of 1.3 V and is fully operational up to 5.5 V. These characteristics make the device convenient for use in both 3.0 V and 5.0 V systems.

### 2. Features and benefits

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- 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  $\mu\text{A}$  (typical)
- Very low-power consumption
- No phase inversion with overdriven input signals
- Internal hysteresis
- Propagation delay of 0.8  $\mu\text{s}$  (typical)
- ESD protection:
  - ◆ HBM JESD22-A114F Class 1C exceeds 1500 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

### 3. Applications

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



## 4. Ordering information

Table 1. Ordering information

| Type number | Topside marking <sup>[1]</sup> | Package |                                                                                                           |          |
|-------------|--------------------------------|---------|-----------------------------------------------------------------------------------------------------------|----------|
|             |                                | Name    | Description                                                                                               | Version  |
| NCX2202GW   | qa                             | TSSOP5  | plastic thin shrink small outline package; 5 leads; body width 1.25 mm                                    | SOT353-1 |
| NCX2202GM   | qa                             | XSON6   | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm               | SOT886   |
| NCX2202GM   | X2                             | XSON6   | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm; requires SSB | SOT886   |

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

### 4.1 Ordering options

Table 2. Ordering options

| Type number | Orderable part number        | Package | Packing method                       | Minimum order quantity | Temperature                         |
|-------------|------------------------------|---------|--------------------------------------|------------------------|-------------------------------------|
| NCX2202GW   | NCX2202GW,125                | TSSOP5  | REEL 7" Q3/T4 NDP                    | 3000                   | T <sub>amb</sub> = -40 °C to +85 °C |
| NCX2202GM   | NCX2202GM,115 <sup>[1]</sup> | XSON6   | REEL 7" Q1/T1 NDP                    | 5000                   | T <sub>amb</sub> = -40 °C to +85 °C |
| NCX2202GM   | NCX2202GMZ                   | XSON6   | REEL 7" Q1/T1 NDP SSB <sup>[2]</sup> | 5000                   | T <sub>amb</sub> = -40 °C to +85 °C |

[1] Will go EOL - migrate to new leadframe orderable part number NCX2202GMZ.

[2] This packing method uses a Static Shielding Bag (SSB) solution. Material is to be kept in the sealed bag between uses.

## 5. Functional diagram

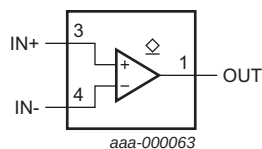
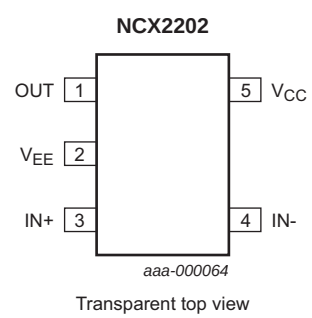
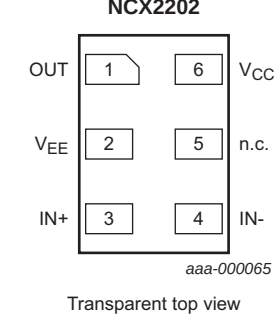


Fig 1. Logic symbol

## 6. Pinning information

### 6.1 Pinning

|                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>NCX2202</p> <p>OUT 1 5 VCC</p> <p>VEE 2</p> <p>IN+ 3 4 IN-</p> <p>aaa-000064</p> <p>Transparent top view</p> <p><b>Fig 2. Pin configuration SOT353-1</b></p> |  <p>NCX2202</p> <p>OUT 1 6 VCC</p> <p>VEE 2 5 n.c.</p> <p>IN+ 3 4 IN-</p> <p>aaa-000065</p> <p>Transparent top view</p> <p><b>Fig 3. Pin configuration SOT886</b></p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 6.2 Pin description

Table 3. Pin description

| Symbol          | Pin      |        | Description                    |
|-----------------|----------|--------|--------------------------------|
|                 | SOT353-1 | SOT886 |                                |
| OUT             | 1        | 1      | comparator output (open-drain) |
| V <sub>EE</sub> | 2        | 2      | supply voltage                 |
| IN+             | 3        | 3      | comparator input (positive)    |
| IN–             | 4        | 4      | comparator input (negative)    |
| n.c.            | -        | 5      | not connected                  |
| V <sub>CC</sub> | 5        | 6      | supply voltage                 |

## 7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to V<sub>EE</sub>.

| Symbol              | Parameter                    | Conditions                          | Min                   | Max                   | Unit |
|---------------------|------------------------------|-------------------------------------|-----------------------|-----------------------|------|
| V <sub>CC</sub>     | supply voltage               |                                     | -                     | 7.0                   | V    |
| V <sub>I</sub>      | input voltage                | IN–, IN+ inputs                     | –0.5                  | V <sub>CC</sub> + 0.5 | V    |
| V <sub>O</sub>      | output voltage               |                                     | V <sub>EE</sub> – 0.5 | 7.0                   | V    |
| t <sub>sc(o)</sub>  | output short-circuit time    |                                     | [1]                   | indefinite            | s    |
| T <sub>j(max)</sub> | maximum junction temperature |                                     | -                     | +150                  | °C   |
| T <sub>stg</sub>    | storage temperature          |                                     | –65                   | +150                  | °C   |
| P <sub>tot</sub>    | total power dissipation      | T <sub>amb</sub> = –40 °C to +85 °C | -                     | 250                   | mW   |

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

## 8. 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    |
| $V_O$     | output voltage      |                            | $V_{EE}$ | -   | 5.5      | V    |
| $T_{amb}$ | ambient temperature |                            | -40      | -   | +85      | °C   |

## 9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions.  $V_{CC} = 1.6\text{ V}$  to  $5.5\text{ V}$ ,  $V_{EE} = 0\text{ V}$ ;  $V_{CM} = 0.5V_{CC}$  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   |
|                        |                              | $V_{CC} = 1.3\text{ V}$                                         | -     | 20                   | -   | -                | -    | mV   |
| $V_{I(\text{offset})}$ | offset input voltage         | [1] $V_{CC} = 1.3\text{ V}$                                     | -30   | 0.5                  | +30 | -30              | +30  | mV   |
|                        |                              | [1] $V_{CC} = 1.3\text{ V}$                                     | -     | 3                    | -   | -                | -    | mV   |
| $V_{OL}$               | LOW-level output voltage     | $I_O = 0.5\text{ mA}$ ; $V_{CC} = 1.3\text{ V}$                 | -     | 0.05                 | -   | -                | -    | V    |
|                        |                              | $I_O = 0.5\text{ mA}$ ; $V_{CC} = 1.6\text{ V}$                 | -     | 0.04                 | -   | -                | 0.25 | V    |
|                        |                              | $I_O = 3\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$                   | -     | 0.14                 | -   | -                | 0.3  | V    |
|                        |                              | $I_O = 5\text{ mA}$ ; $V_{CC} = 5.5\text{ V}$                   | -     | 0.20                 | -   | -                | 0.3  | V    |
| $I_{OZ}$               | OFF-state output current     | $I_{N-} = V_{EE}$ ; $I_{N+} = V_{CC}$ ;<br>$V_O = 5.5\text{ V}$ | -     | 3                    | -   | -                | -    | nA   |
| $V_{CM}$               | common-mode voltage          | $V_{CC} = 1.3\text{ V}$ to $5.5\text{ V}$                       | -     | $V_{EE}$ to $V_{CC}$ | -   | -                | -    | V    |
| $I_{OS}$               | output short-circuit current | $V_{CC} = 5.5\text{ V}$ ; $V_O = V_{CC}$                        | -     | 68                   | -   | -                | -    | mA   |
| CMRR                   | common-mode rejection ratio  | $\Delta V_{CM} = V_{CC}$                                        | -     | 70                   | -   | -                | -    | dB   |
| PSRR                   | power supply rejection ratio | $\Delta V_{CC} = 1.95\text{ V}$                                 | 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.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

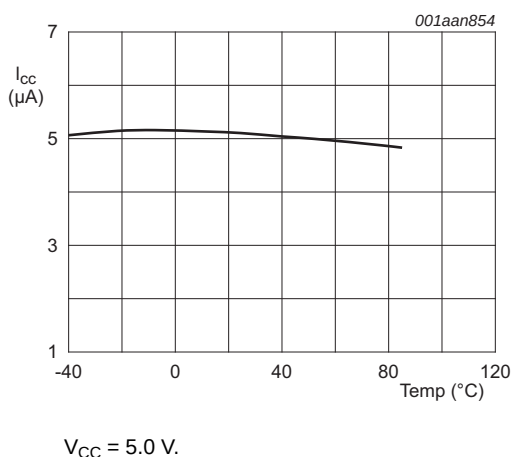
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0$  V);  $V_{CC} = 1.6$  V to 5.5 V;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

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

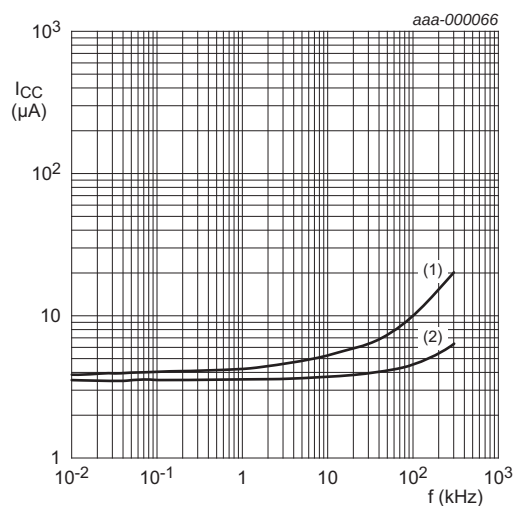
[1]  $t_{pd}$  is the same as  $t_{PLZ}$  and  $t_{PZL}$ ;  $t_{PLZ}$  is the time that the output is disabled.

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

## 11. Graphs



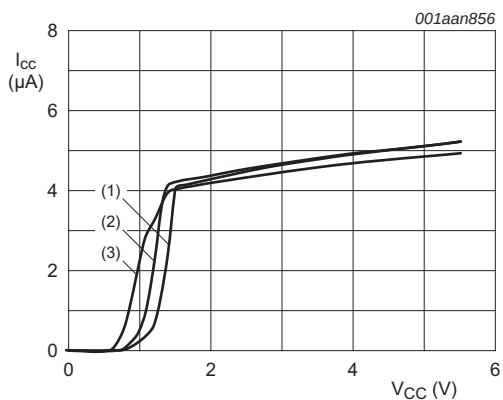
**Fig 4. Supply current versus temperature**



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

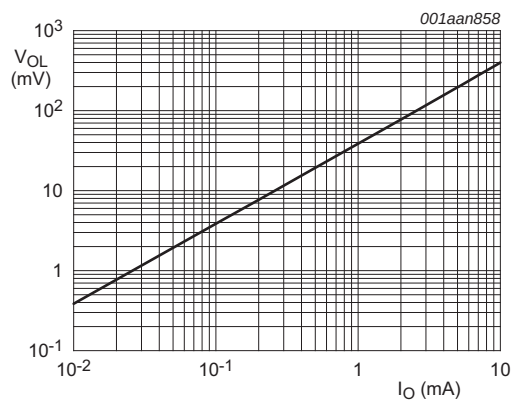
(2)  $V_{CC} = 2.7$  V.

**Fig 5. Supply current versus output transition frequency**



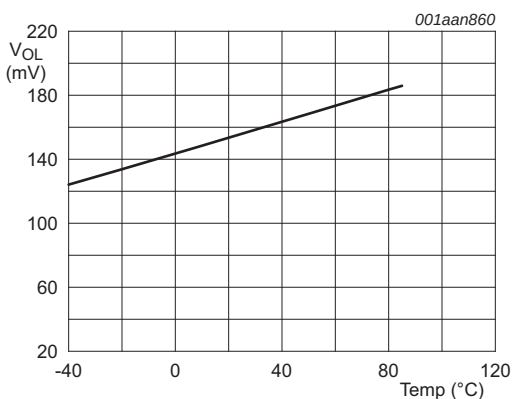
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$

**Fig 6. Supply current versus supply voltage**



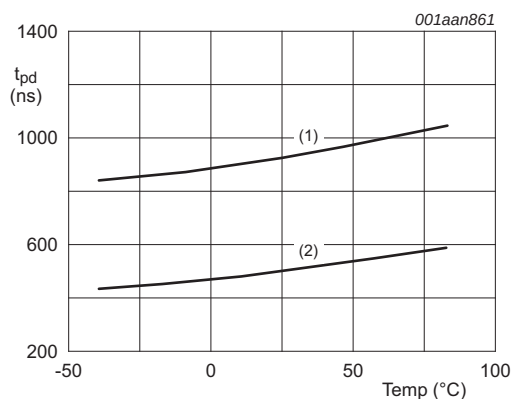
$T_{amb} = 25\text{ }^{\circ}\text{C}.$   
 $V_{CC} = 5.0\text{ V}.$

**Fig 7. LOW-level output voltage versus output current**



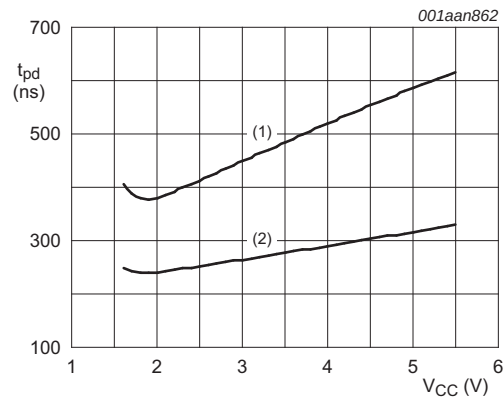
$I_O = 4.0\text{ mA}.$   
 $V_{CC} = 5.0\text{ V}.$

**Fig 8. LOW-level output voltage versus temperature**



$V_{CC} = 5.0\text{ V};$  input overdrive = 50 mV.  
 (1)  $t_{PLZ}.$   
 (2)  $t_{PZL}.$

**Fig 9. Propagation delay versus temperature**



T<sub>amb</sub> = 25 °C; input overdrive = 100 mV.

(1) t<sub>PLZ</sub>.

(2) t<sub>PZL</sub>.

**Fig 10. Propagation delay versus supply voltage.**

## 12. Application information

### 12.1 Operating description

The NCX2202 is a single low voltage, low power, comparator with open-drain output. This device is designed for use with a pull-up resistor to define the output switching levels. This device consumes only 6  $\mu\text{A}$  of supply current while achieving a typical propagation delay of 0.8  $\mu\text{s}$  at a 20 mV input overdrive. [Figure 9](#) and [Figure 10](#) show propagation delay with various input overdrives. 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.

### 12.2 Output stage

The NCX2202 has an N-channel output stage that has capability of sinking the output to  $V_{EE}$  with a load ranging up to 5.0 mA. See [Figure 11](#)

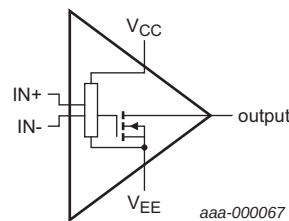


Fig 11. NCX2202 output configuration

### 12.3 Zero-crossing detector

[Figure 12](#) shows the NCX2202 configured as a zero-crossing detector.

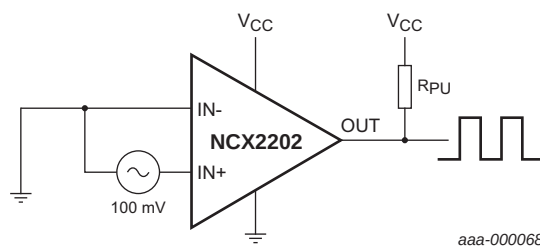
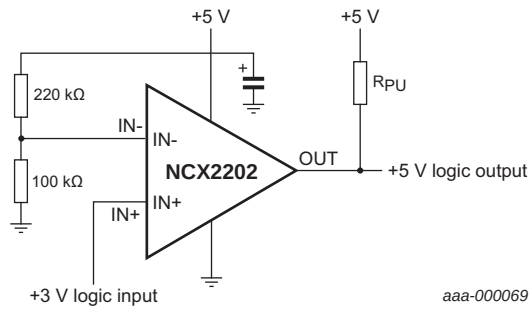


Fig 12. Zero-crossing detector

### 12.4 Logic level translator

[Figure 13](#) shows the NCX2202 configured as a logic level translator.





This circuit converts 3 V logic to 5 V logic.

**Fig 13. Logic level translator**

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1

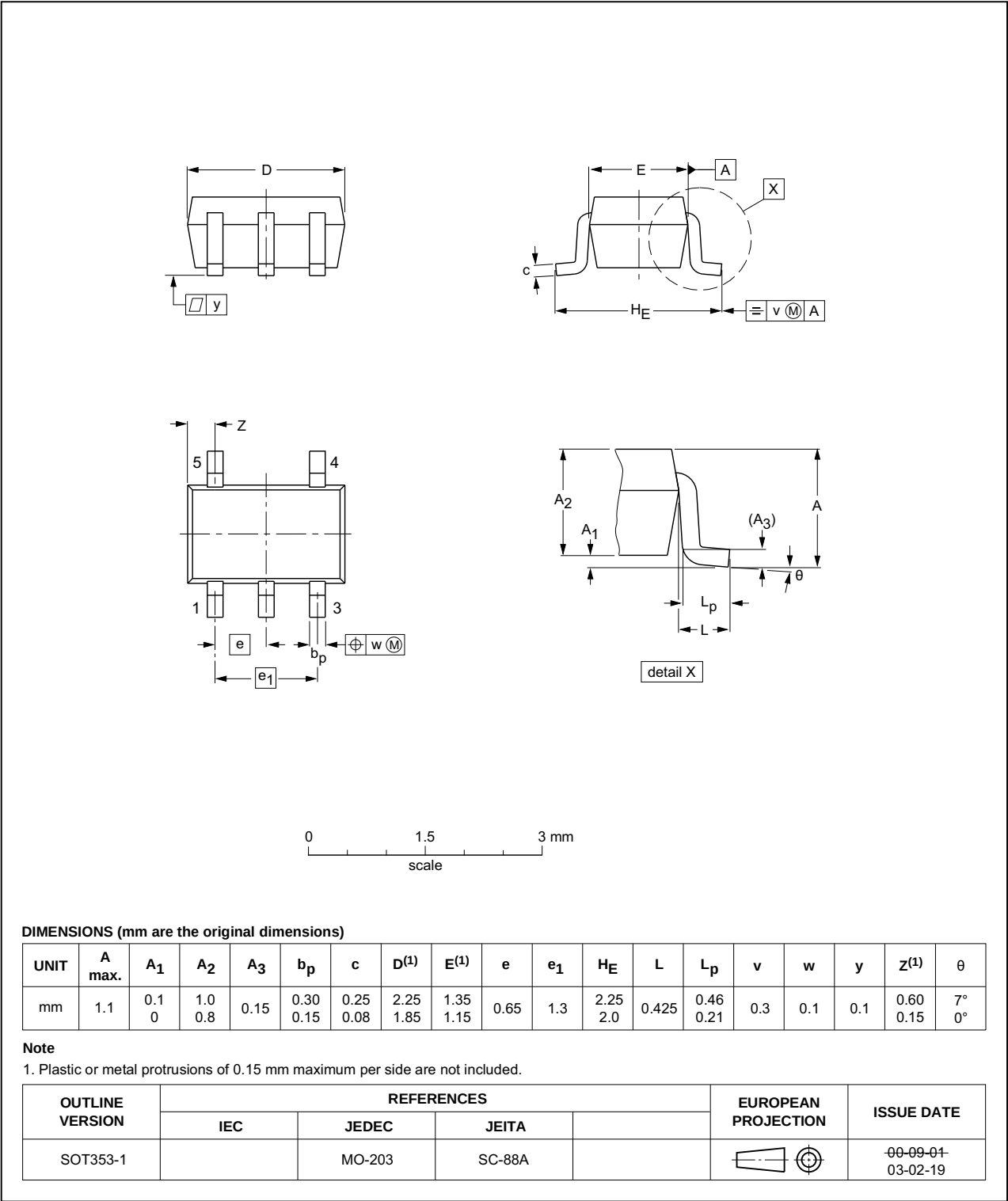


Fig 14. Package outline SOT353-1 (TSSOP5)

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

SOT886

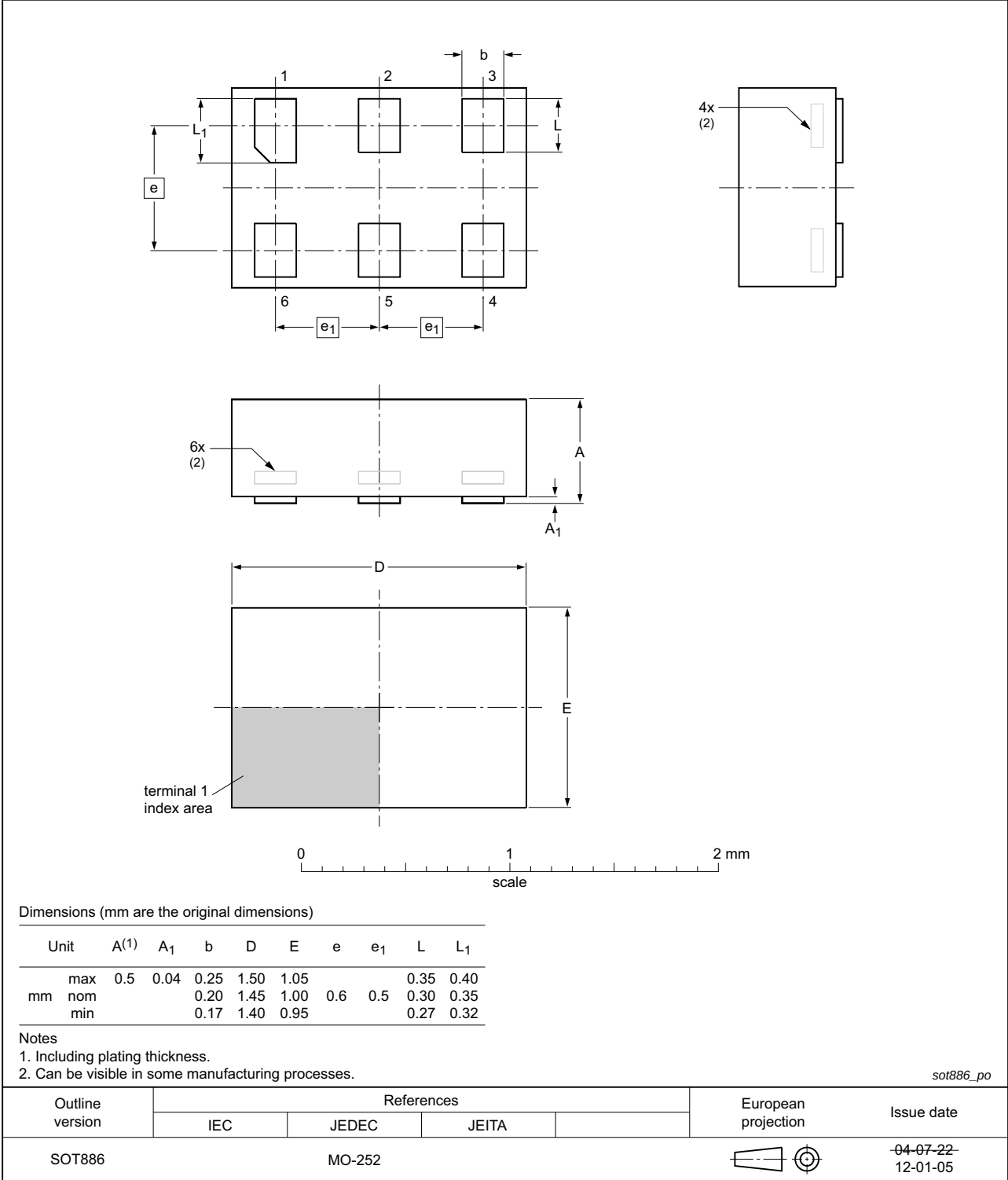


Fig 15. Package outline SOT886 (XSON6)

## 14. Abbreviations

Table 8. Abbreviations

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

## 15. Revision history

Table 9. Revision history

| Document ID    | Release date                                                                                                                                                                         | Data sheet status  | Change notice | Supersedes    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|---------------|
| NCX2202 v.5.1  | 20191121                                                                                                                                                                             | Product data sheet | 201909001A    | NCX2202 v.5.1 |
| Modifications: | <ul style="list-style-type: none"><li>Package SOT886 requiring SSB added. Refer to PCN number 201909001A XSON6 (SOT886) Assembly/Test Transfer from ATGD and ATSN to ATBK.</li></ul> |                    |               |               |
| NCX2202 v.5    | 20121030                                                                                                                                                                             | Product data sheet | -             | NCX2202 v.4   |
| Modifications: | <ul style="list-style-type: none"><li>Class 3A changed into Class 1C (errata) in <a href="#">Section 2</a>.</li></ul>                                                                |                    |               |               |
| NCX2202 v.4    | 20120806                                                                                                                                                                             | Product data sheet | -             | NCX2202 v.3   |
| Modifications: | <ul style="list-style-type: none"><li>Package outline drawing of SOT886 (<a href="#">Figure 15</a>) modified.</li></ul>                                                              |                    |               |               |
| NCX2202 v.3    | 20111110                                                                                                                                                                             | Product data sheet | -             | NCX2202 v.2   |
| Modifications: | <ul style="list-style-type: none"><li>Legal pages updated.</li></ul>                                                                                                                 |                    |               |               |
| NCX2202 v.2    | 20111020                                                                                                                                                                             | Product data sheet | -             | NCX2202 v.1   |
| NCX2202 v.1    | 20110720                                                                                                                                                                             | Product data sheet | -             | -             |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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".

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