



**THE DATASHEET OF  
NCX222GFX**



# NCX2222

Low voltage comparator; open-drain output

Rev. 1 — 20 December 2012

Product data sheet

## 1. General description

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The NCX2222 provides a dual, low voltage, low-power comparator with open-drain outputs.

The NCX2222 has a very low supply current of 5  $\mu$ A per comparator and is guaranteed to operate at a low voltage of 1.3 V. It is fully operational up to 5.5 V which makes it 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 5  $\mu$ A (typical) per comparator
- Very low-power consumption
- No phase inversion with overdriven input signals
- Internal hysteresis
- Propagation delay of 0.8  $\mu$ s (typical)
- ESD protection:
  - ◆ HBM JESD22-A114F Class 1C. Exceeds 1500 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °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 | Package           |        |   | Version                 |
|-------------|-------------------|--------|---|-------------------------|
|             | Temperature range | Name   | Description   |                         |
| NCX2222DP   | -40 °C to +85 °C  | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm                         | SOT505-2                |
| NCX2222GU   | -40 °C to +85 °C  | HXSON8 | plastic, thermal enhanced extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1.7 × 0.5 mm | SOT972-2 <sup>[1]</sup> |
| NCX2222GT   | -40 °C to +85 °C  | XSON8  | plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm                     | SOT833-1                |
| NCX2222GF   | -40 °C to +85 °C  | XSON8  | extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1 × 0.5 mm                             | SOT1089                 |
| NCX2222GM   | -40 °C to +85 °C  | XQFN8  | plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 × 1.6 × 0.5 mm                       | SOT902-2                |

[1] Lead pitch is 0.4 mm.

## 5. Marking

Table 2. Marking codes

| Type number | Marking <sup>[1]</sup> |
|-------------|------------------------|
| NCX2222DP   | gb                     |
| NCX2222GU   | gb                     |
| NCX2222GT   | gb                     |
| NCX2222GF   | gb                     |
| NCX2222GM   | gb                     |

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

## 6. Functional diagram

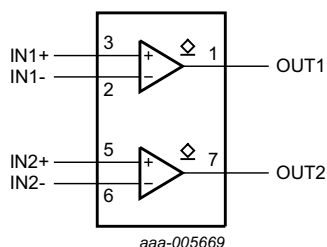
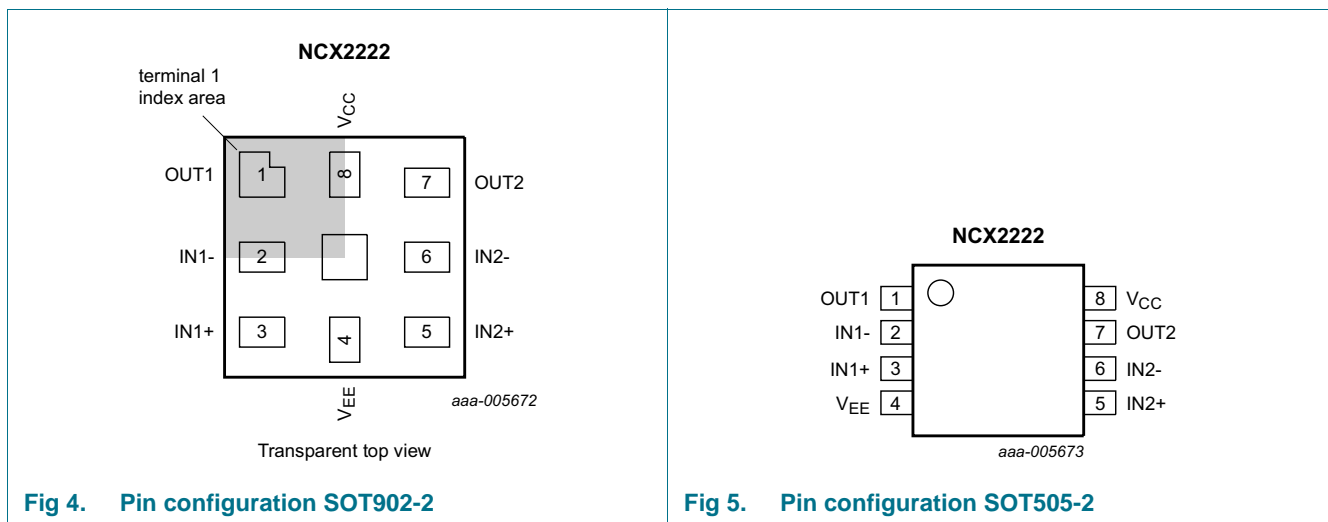
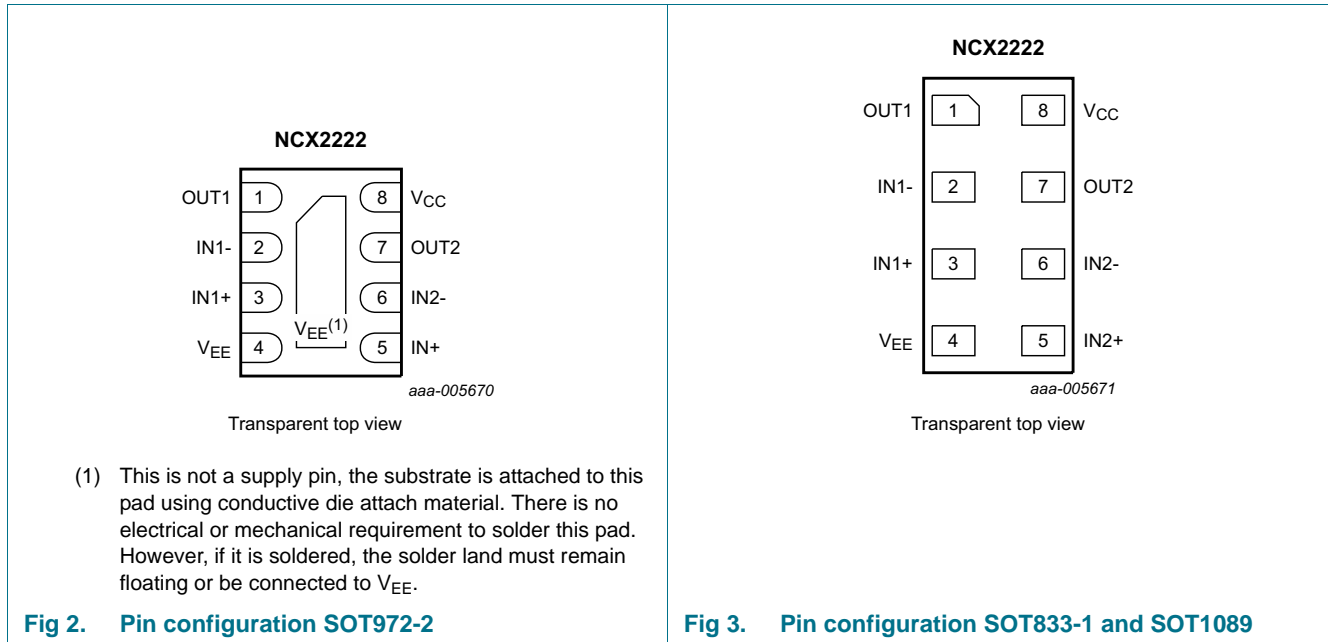


Fig 1. Logic symbol

## 7. Pinning information

### 7.1 Pinning



## 7.2 Pin description

**Table 3.** Pin description

| Symbol          | Pin | Description                   |
|-----------------|-----|-------------------------------|
| OUT1            | 1   | comparator output 1           |
| IN1-            | 2   | comparator input 1 (negative) |
| IN1+            | 3   | comparator input 1 (positive) |
| V <sub>EE</sub> | 4   | supply voltage                |
| IN2+            | 5   | comparator input 2 (positive) |
| IN2-            | 6   | comparator input 2 (negative) |
| OUT2            | 7   | comparator output 2           |
| V <sub>CC</sub> | 8   | supply voltage                |

## 8. 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                | IN1-, IN1+, IN2-, IN2+ 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] Do not exceed the maximum total power dissipation.

## 9. Recommended operating conditions

**Table 5.** Recommended operating conditions

| Symbol           | Parameter           | Conditions                         | Min             | Typ | Max             | Unit |
|------------------|---------------------|------------------------------------|-----------------|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage      | V <sub>CC</sub> to V <sub>EE</sub> |                 |     |                 |      |
|                  |                     | full spec operating range          | 1.6             | -   | 5.5             | V    |
|                  |                     | functional operating range         | 1.3             | -   | 5.5             | V    |
| V <sub>I</sub>   | input voltage       |                                    | V <sub>EE</sub> | -   | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage      |                                    | V <sub>EE</sub> | -   | 5.5             | V    |
| T <sub>amb</sub> | ambient temperature |                                    | -40             | -   | +85             | °C   |

## 10. 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] -30 | +0.5                 | +30 | -30              | +30  | mV            |
|                        |                              | $V_{CC} = 1.3\text{ V}$                                      | [1] -   | 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     | $I_{N-} = V_{EE}$ ; $I_{N+} = V_{CC}$ ; $V_O = 5.5\text{ V}$ | -       | 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 | $V_{CC} = 5.5\text{ V}$ ; $V_O = V_{EE}$ or $V_{CC}$         | -       | 68                   | -   | -                | -    | mA            |
| CMRR                   | common-mode rejection ratio  | $\Delta V_{CM} = V_{CC}$                                     | -       | 70                   | -   | -                | -    | dB            |
| PSRR                   | power supply rejection ratio | $\Delta V_{CC} = 1.95\text{ V}$                              | 45      | 80                   | -   | -                | -    | dB            |
| $I_{IB}$               | input bias current           |  | -       | 1.0                  | -   | -                | -    | pA            |
| $I_{CC}$               | supply current               | per comparator   | -       | 5.0                  | -   | -                | 7.0  | $\mu\text{A}$ |

[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**

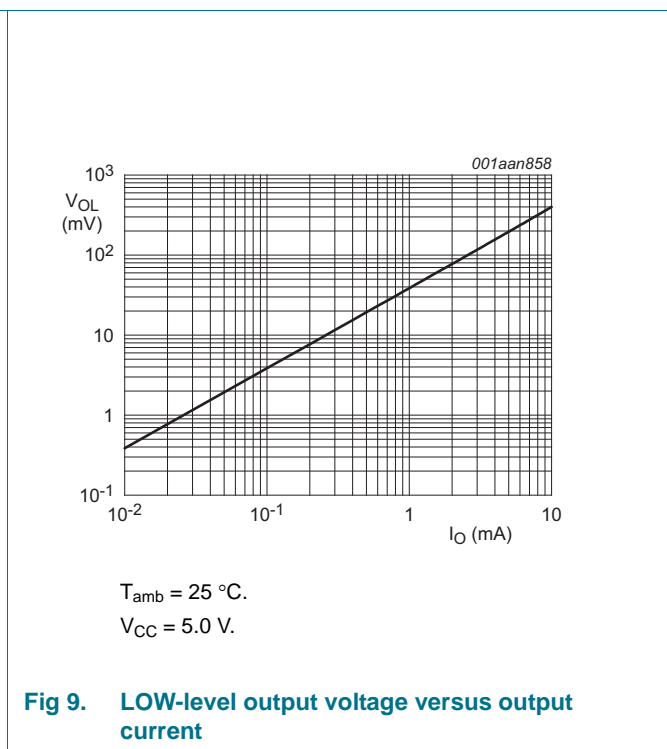
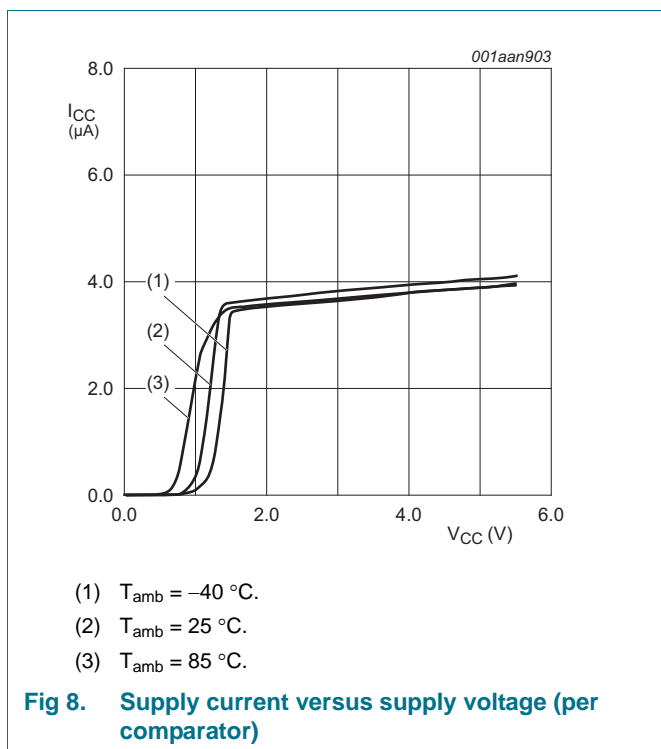
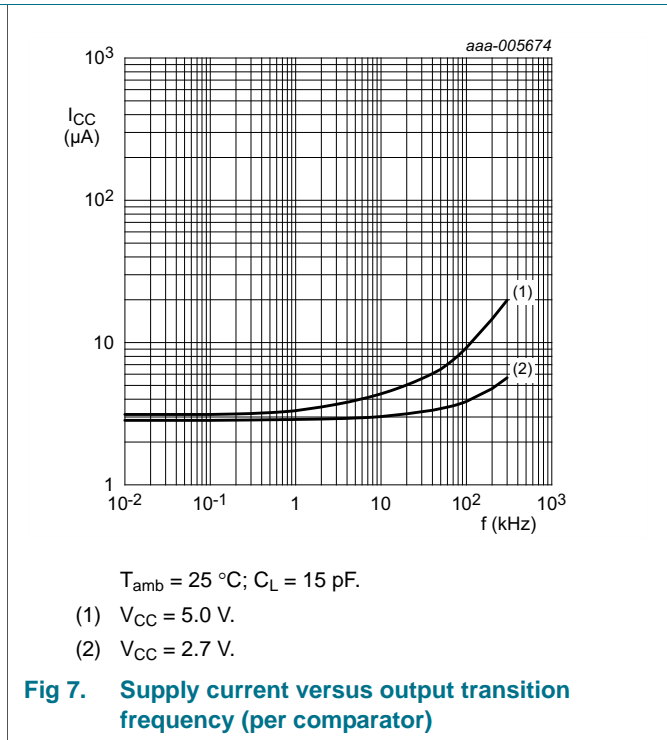
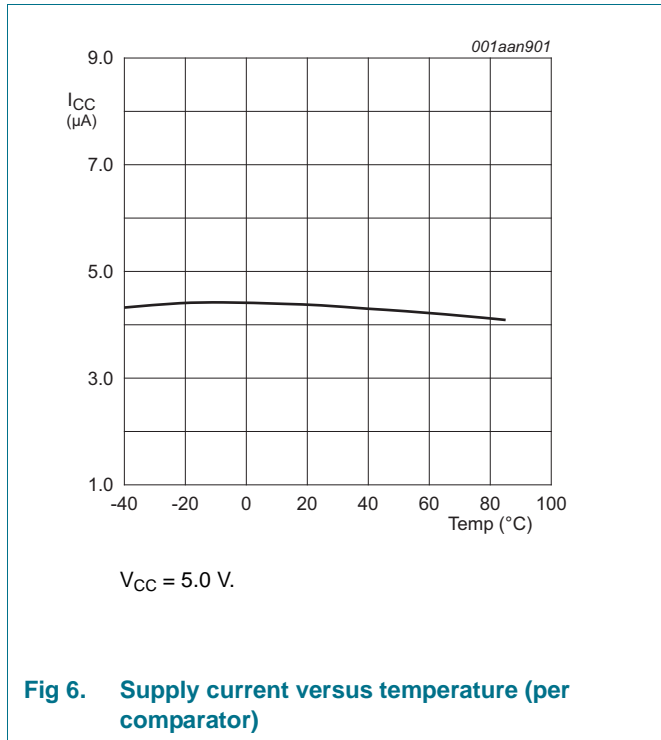
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0\text{ V}$ );  $V_{CC} = 1.6\text{ V to }5.5\text{ V}$ ;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

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

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

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

12. Graphs



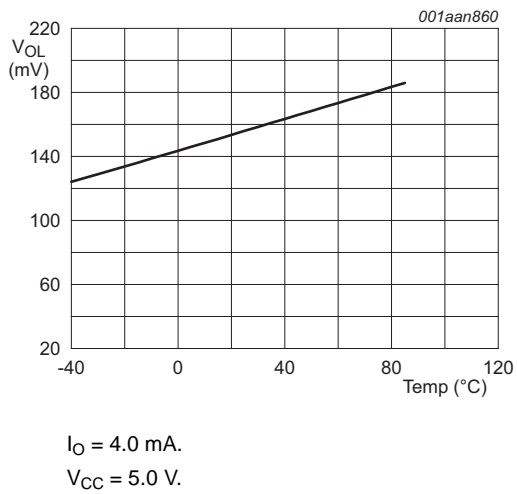


Fig 10. LOW-level output voltage versus temperature

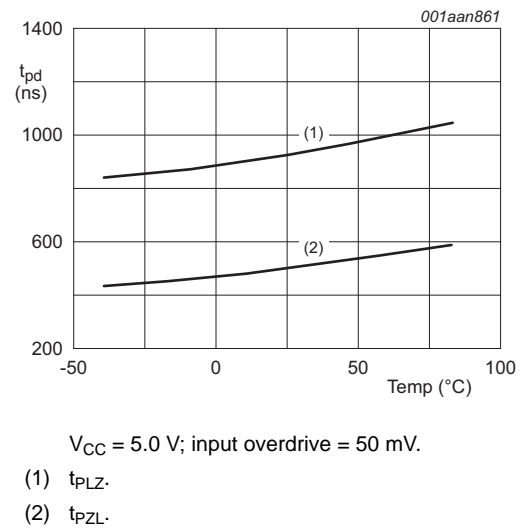


Fig 11. Propagation delay versus temperature

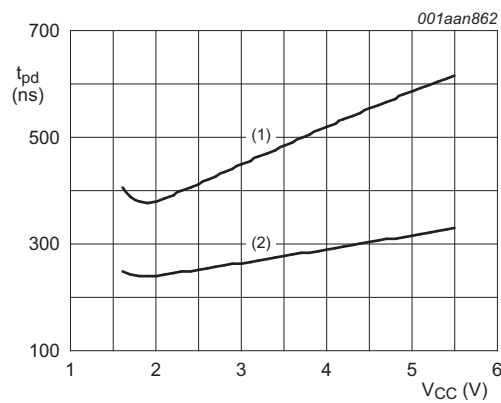


Fig 12. Propagation delay versus supply voltage.

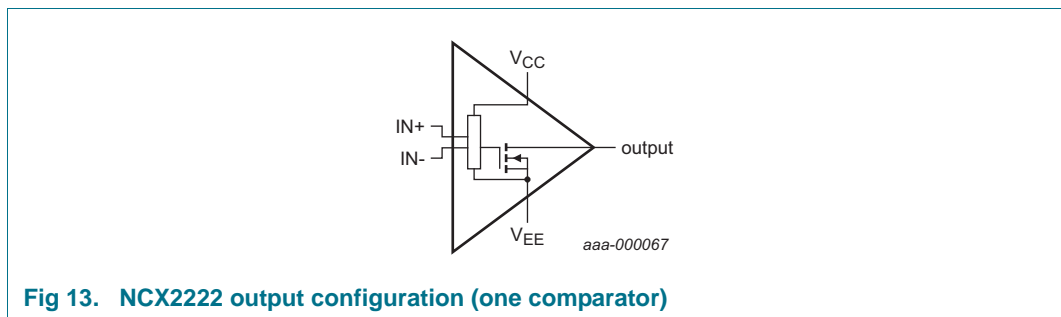
### 13. Application information

#### 13.1 Operating description

The NCX2222 is a dual, 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 5  $\mu$ A per comparator of supply current while achieving a typical propagation delay of 0.8  $\mu$ s at a 20 mV input overdrive. [Figure 11](#) and [Figure 12](#) 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 which allows for greater noise immunity and clean output switching.

#### 13.2 Output stage

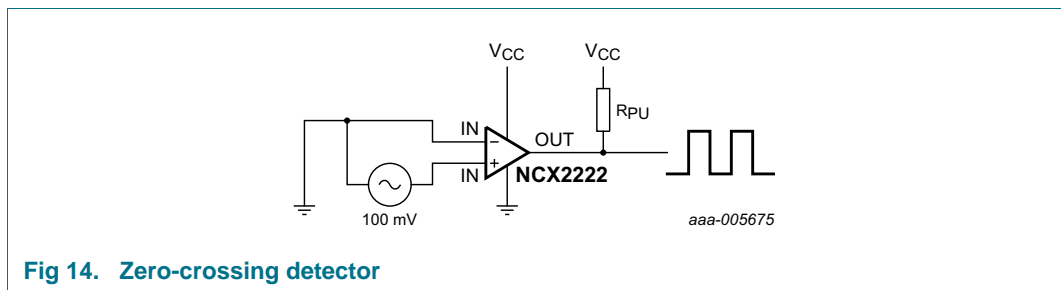
The NCX2222 has an N-channel output stage that has the capability of sinking the output to  $V_{EE}$  with a load ranging up to 5.0 mA (see [Figure 13](#)).



**Fig 13. NCX2222 output configuration (one comparator)**

#### 13.3 Zero-crossing detector

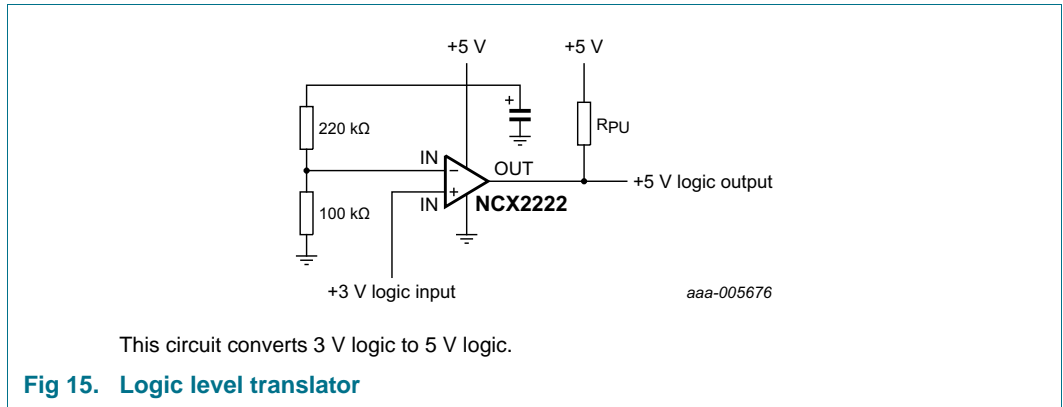
[Figure 14](#) shows the NCX2222 configured as a zero-crossing detector.



**Fig 14. Zero-crossing detector**

**13.4 Logic level translator**

Figure 15 shows the NCX2222 configured as a logic level translator.



**Fig 15. Logic level translator**

14. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

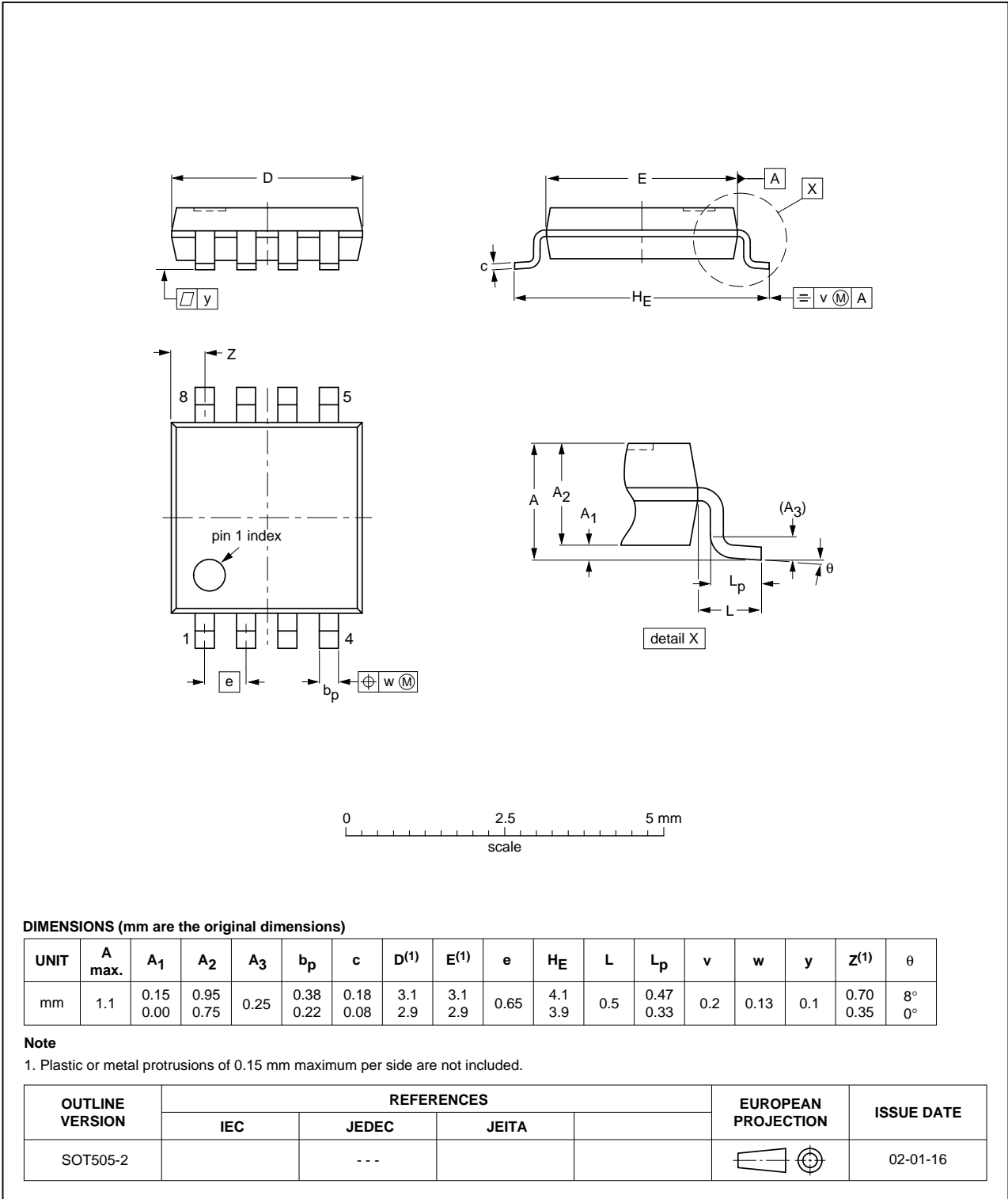


Fig 16. Package outline SOT505-2 (TSSOP8)

HXSON8: plastic, thermal enhanced extremely thin small outline package; no leads;  
8 terminals; body 1.35 x 1.7 x 0.5 mm

SOT972-2

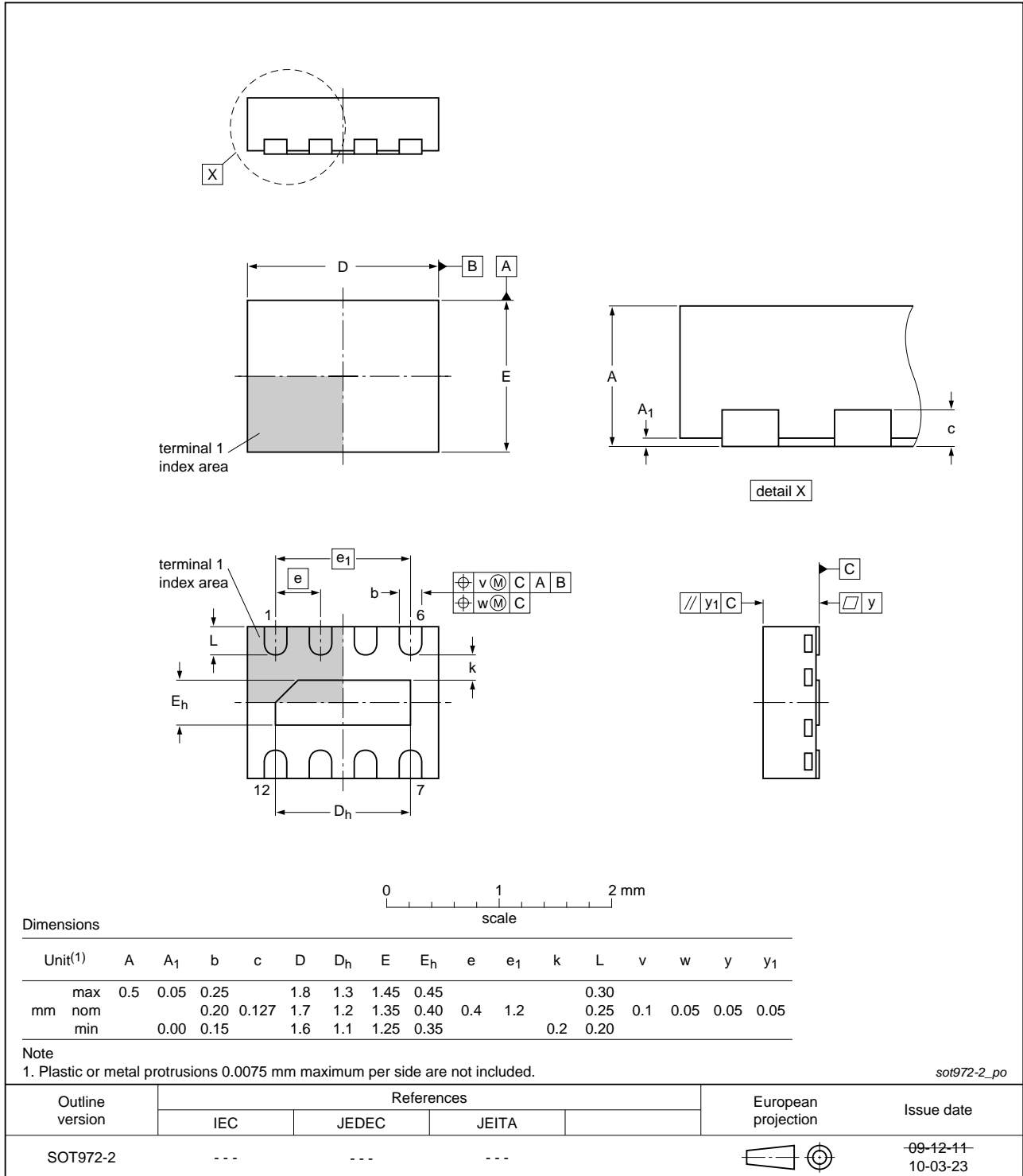


Fig 17. Package outline SOT972-2 (HXSON8)

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm

SOT833-1

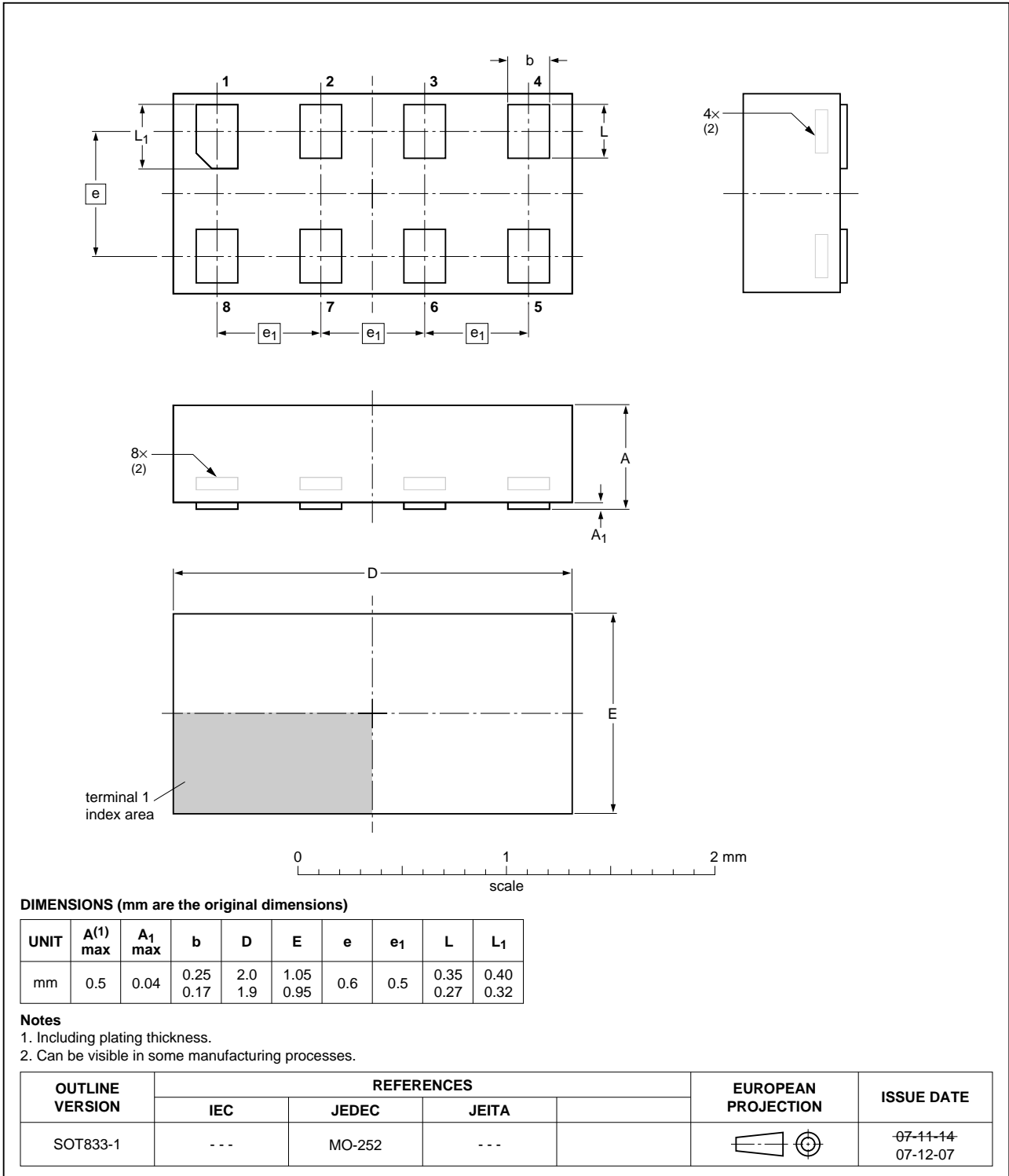
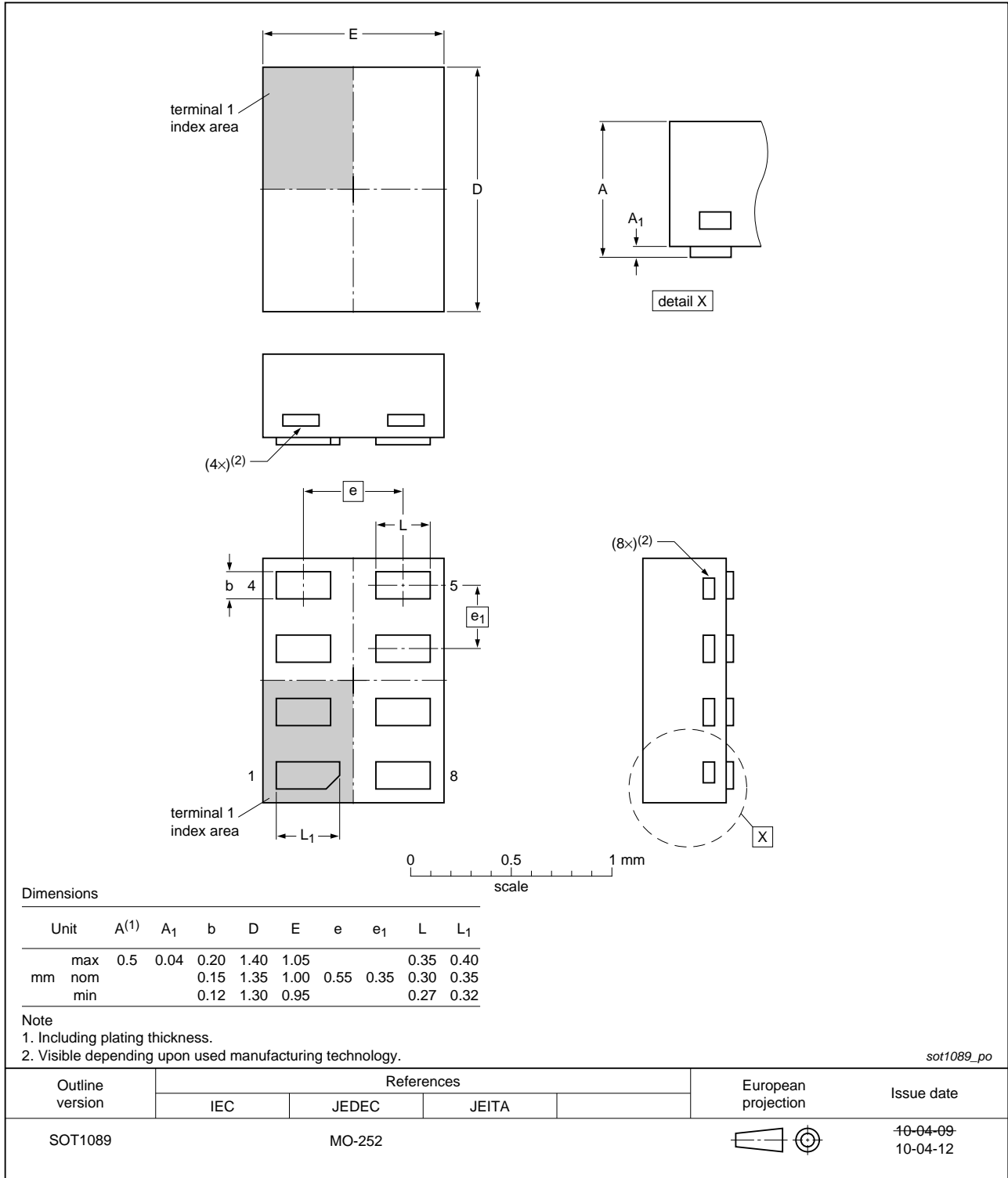


Fig 18. Package outline SOT833-1 (XSON8)

**XSON8: extremely thin small outline package; no leads;  
8 terminals; body 1.35 x 1 x 0.5 mm**

**SOT1089**



**Fig 19. Package outline SOT1089 (XSON8)**

XQFN8: plastic, extremely thin quad flat package; no leads;  
8 terminals; body 1.6 x 1.6 x 0.5 mm

SOT902-2

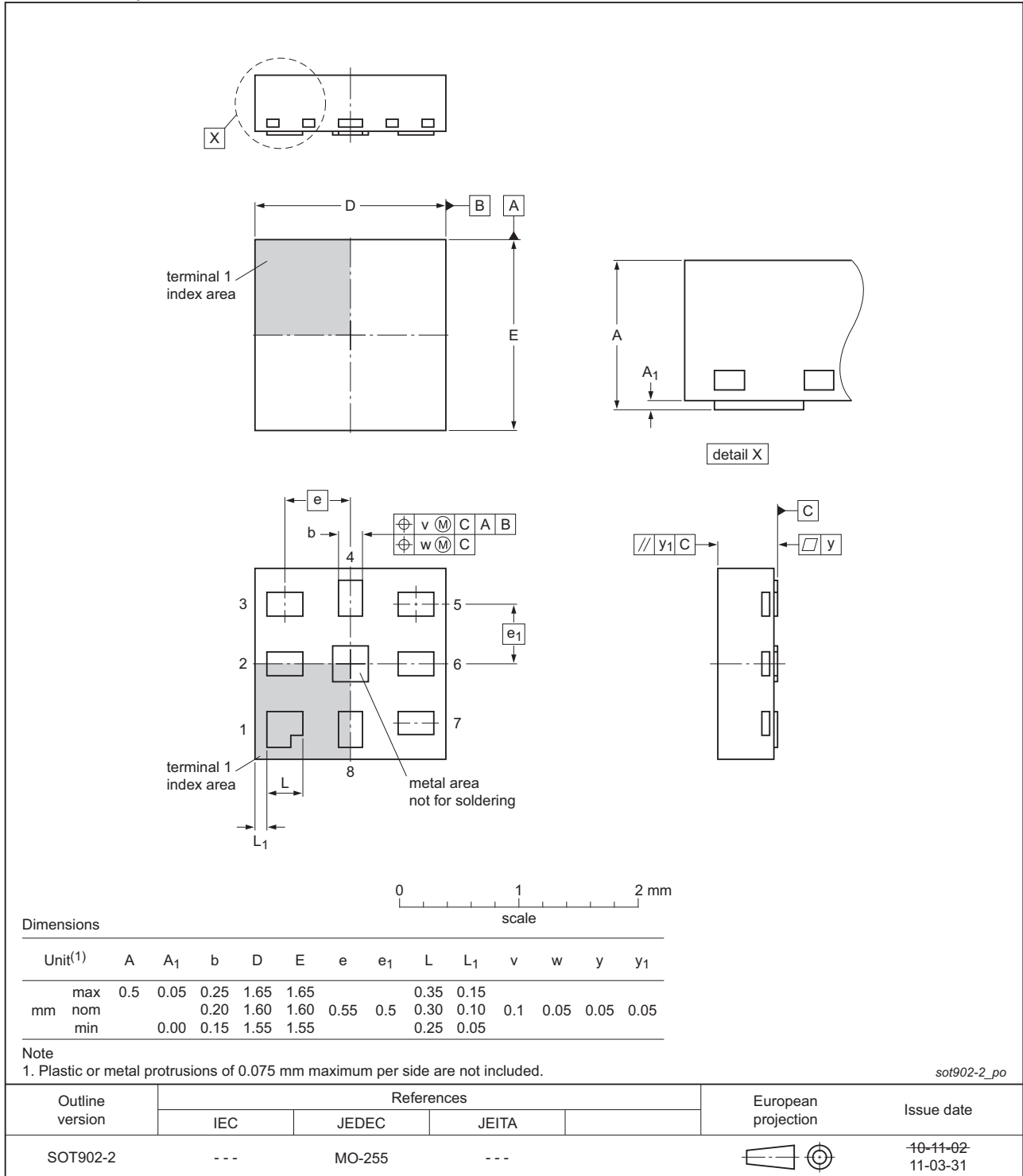


Fig 20. Package outline SOT902-2 (XQFN8)

## 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 |
|-------------|--------------|--------------------|---------------|------------|
| NCX2222 v.1 | 20121220     | Product data sheet | -             | -          |

## 17. Legal information

### 17.1 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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