

# 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  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

## 3. Applications

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



4. Ordering information

Table 1. Ordering information

| Type number | Package           |        |                                                                                                                 |                         |
|-------------|-------------------|--------|-----------------------------------------------------------------------------------------------------------------|-------------------------|
|             | Temperature range | Name   | Description                                                                                                     | Version                 |
| 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

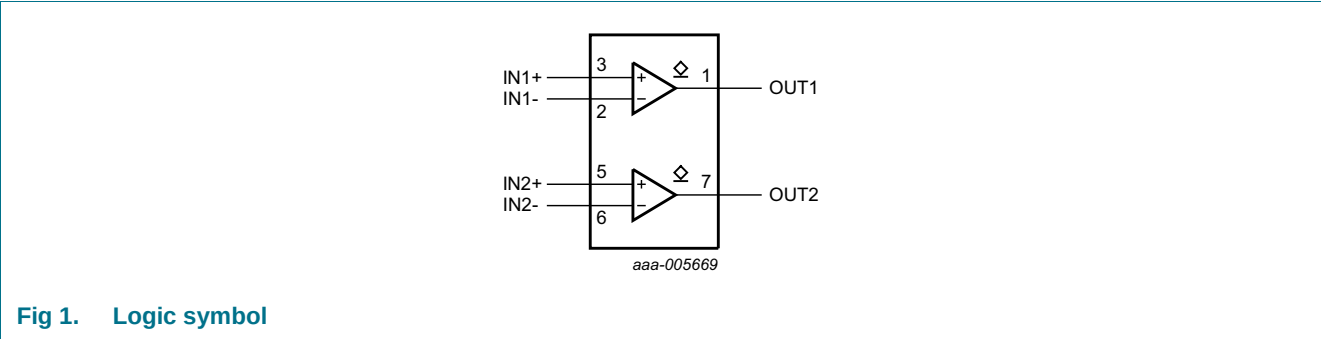


Fig 1. Logic symbol

7. Pinning information

7.1 Pinning

Transparent top view

aaa-005670

(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land must remain floating or be connected to V<sub>EE</sub>.

Fig 2. Pin configuration SOT972-2

Transparent top view

aaa-005671

Fig 3. Pin configuration SOT833-1 and SOT1089

Transparent top view

aaa-005672

Fig 4. Pin configuration SOT902-2

Transparent top view

aaa-005673

Fig 5. Pin configuration SOT505-2

## 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(0)</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     | $IN- = V_{EE}$ ; $IN+ = V_{CC}$ ; $V_O = 5.5\text{ V}$ | -       | 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**

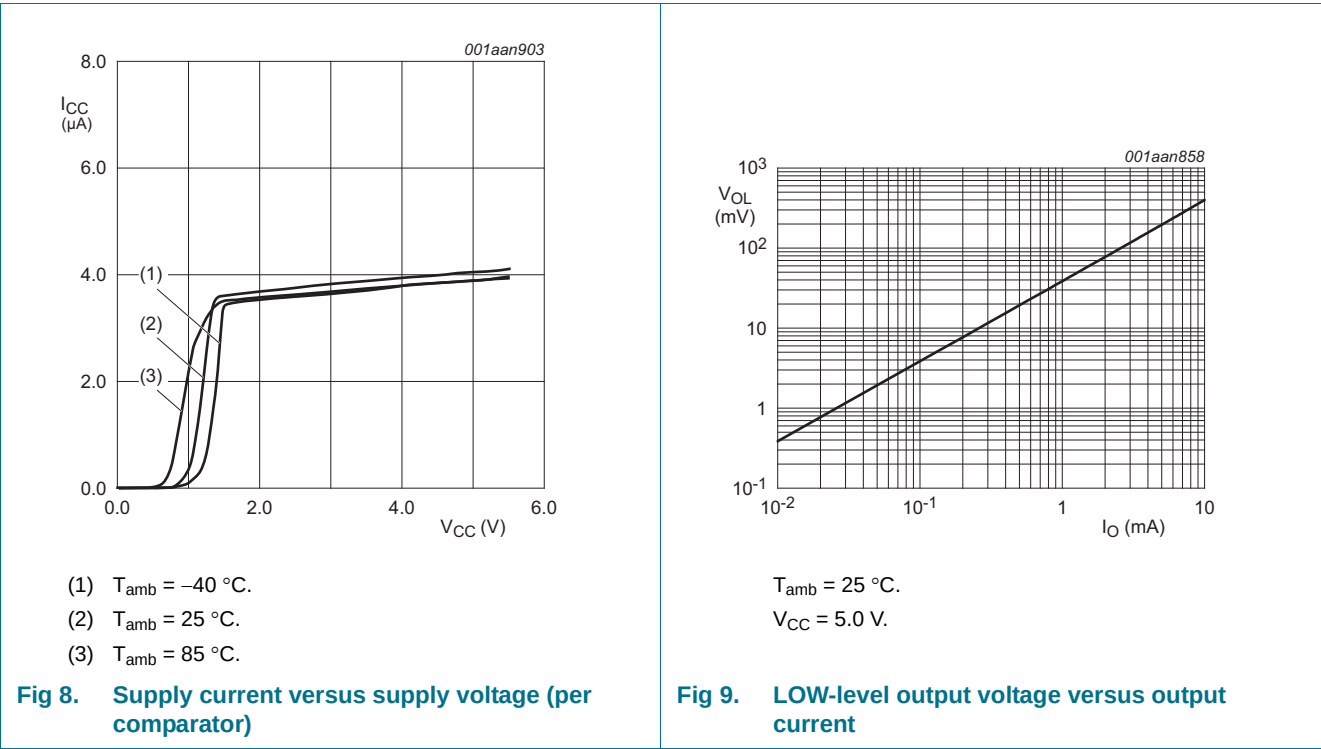
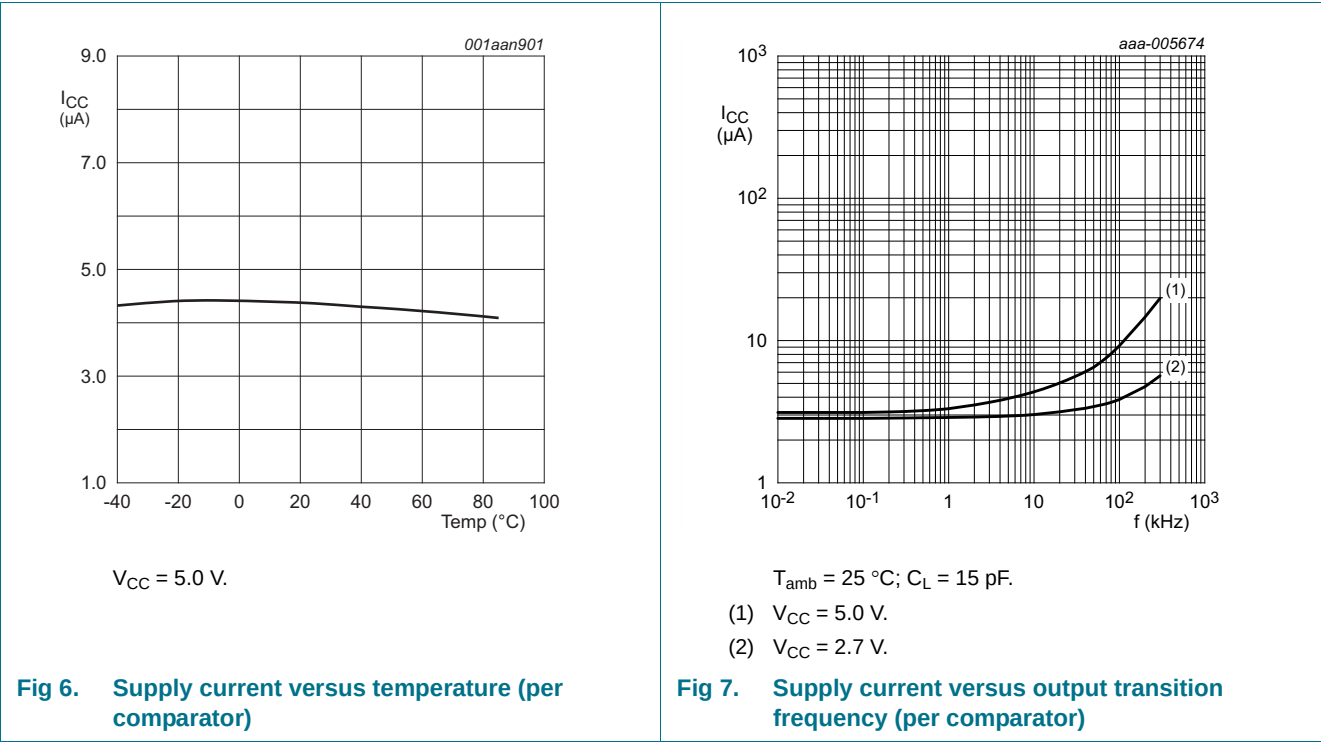
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0\text{ V}$ );  $V_{CC} = 1.6\text{ V to }5.5\text{ V}$ ;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

| 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



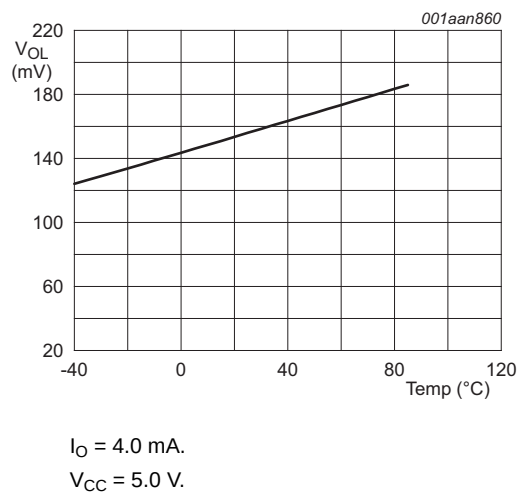


Fig 10. LOW-level output voltage versus temperature

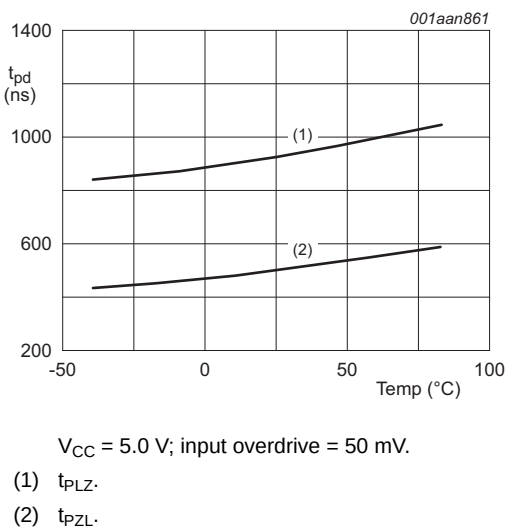


Fig 11. Propagation delay versus temperature

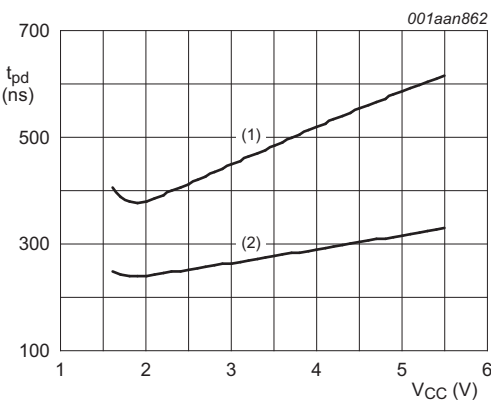


Fig 12. Propagation delay versus supply voltage.

## 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  $\mu\text{A}$  per comparator of supply current while achieving a typical propagation delay of 0.8  $\mu\text{s}$  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](#)).

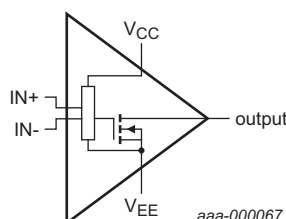


Fig 13. NCX2222 output configuration (one comparator)

### 13.3 Zero-crossing detector

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

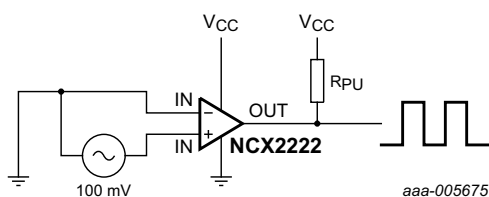
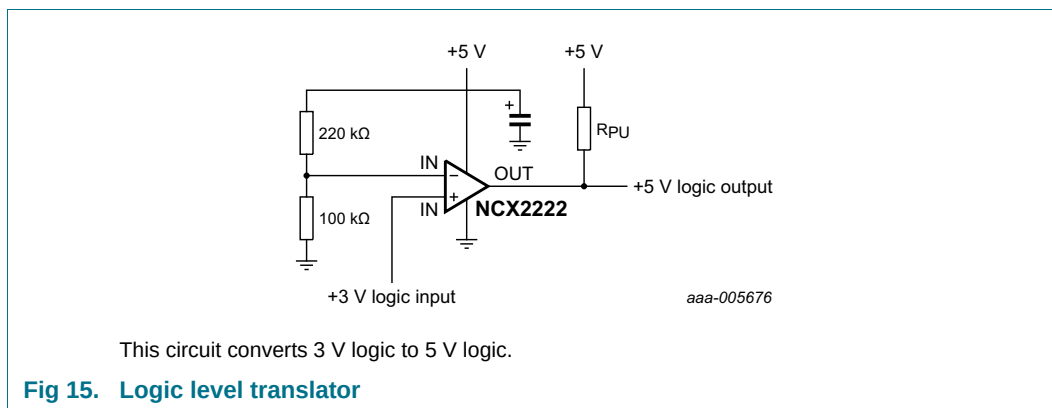


Fig 14. Zero-crossing detector



### 13.4 Logic level translator

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



14. Package outline

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

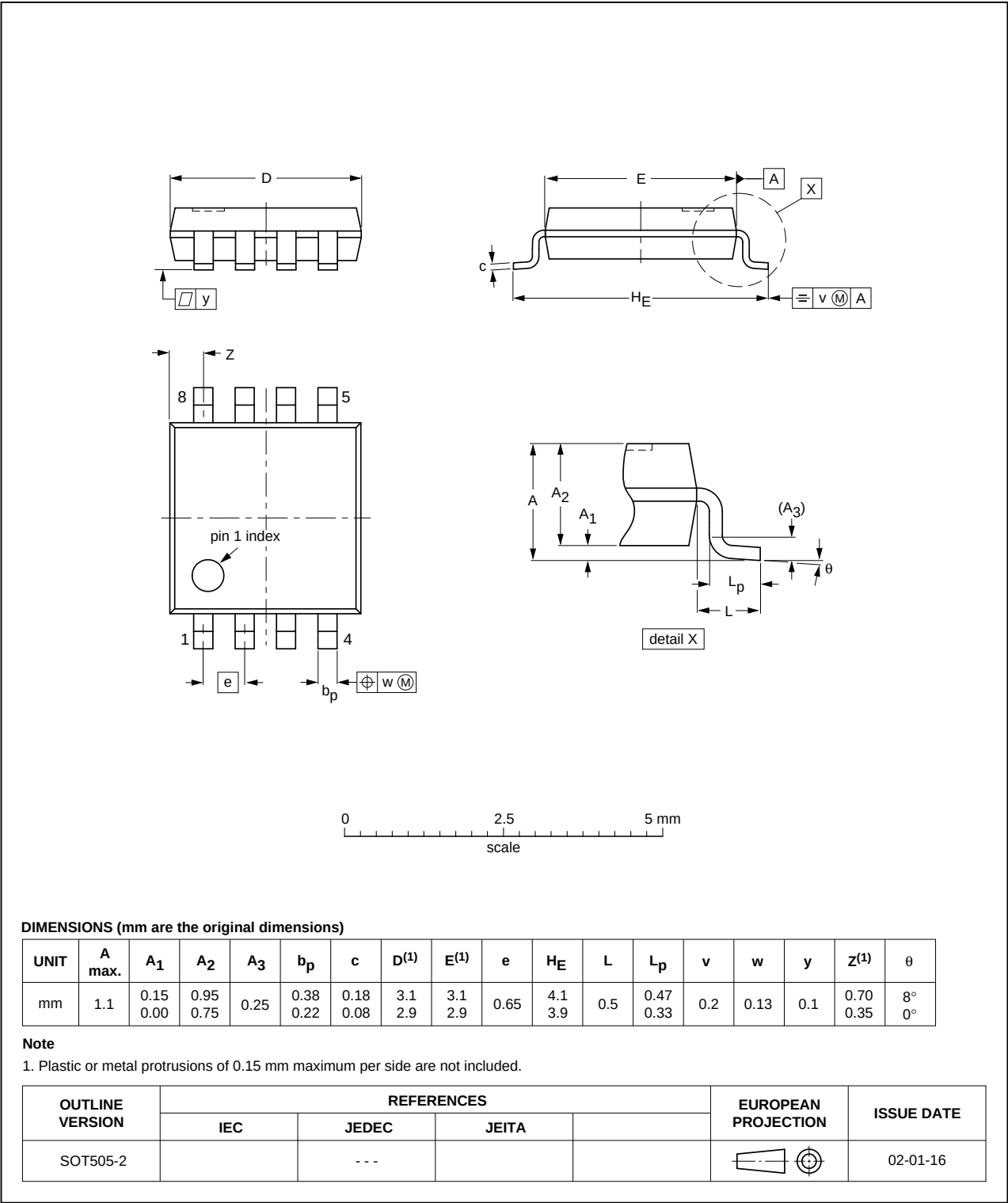


Fig 16. Package outline SOT505-2 (TSSOP8)

**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

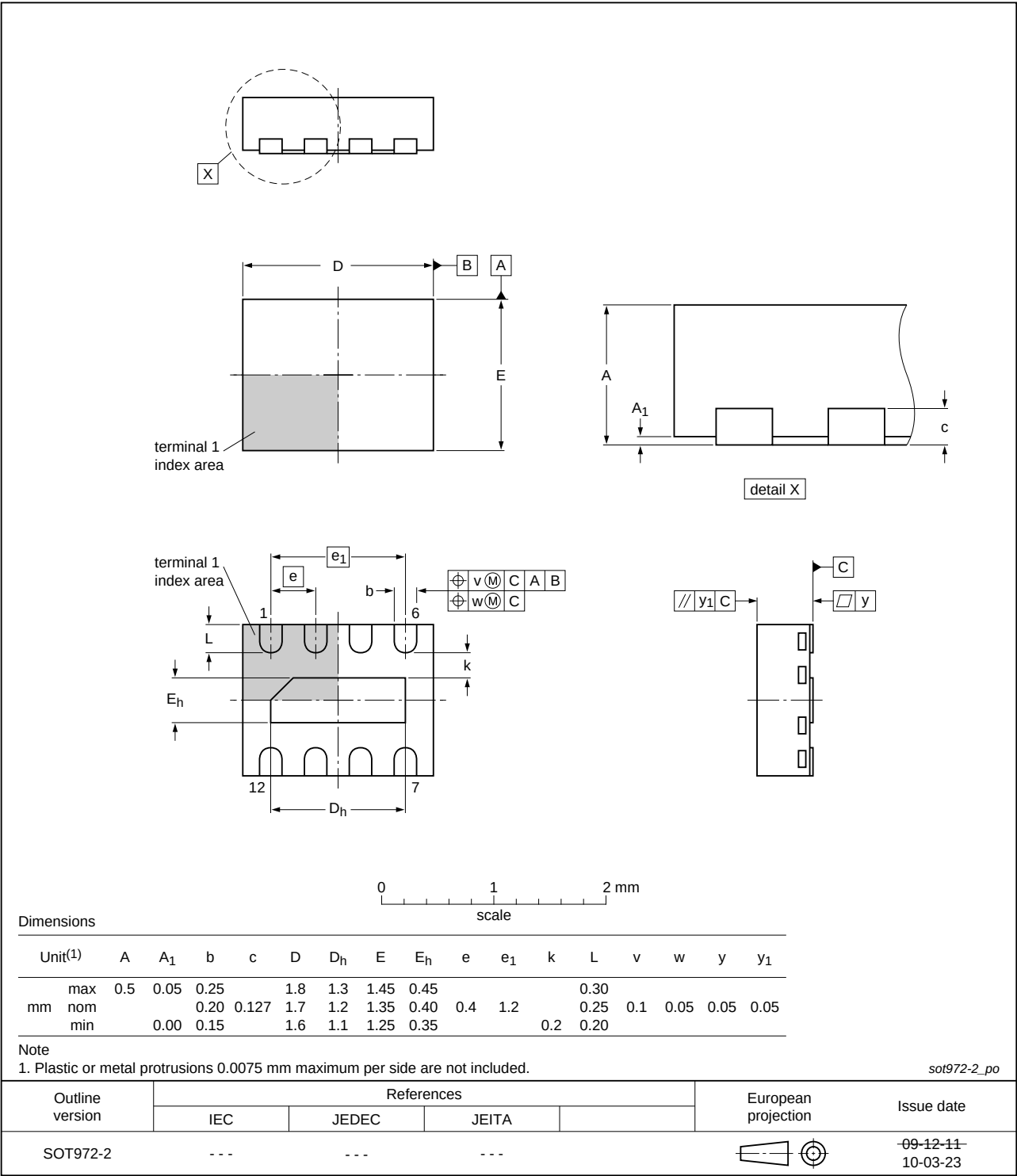


Fig 17. Package outline SOT972-2 (HXSON8)

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

SOT833-1

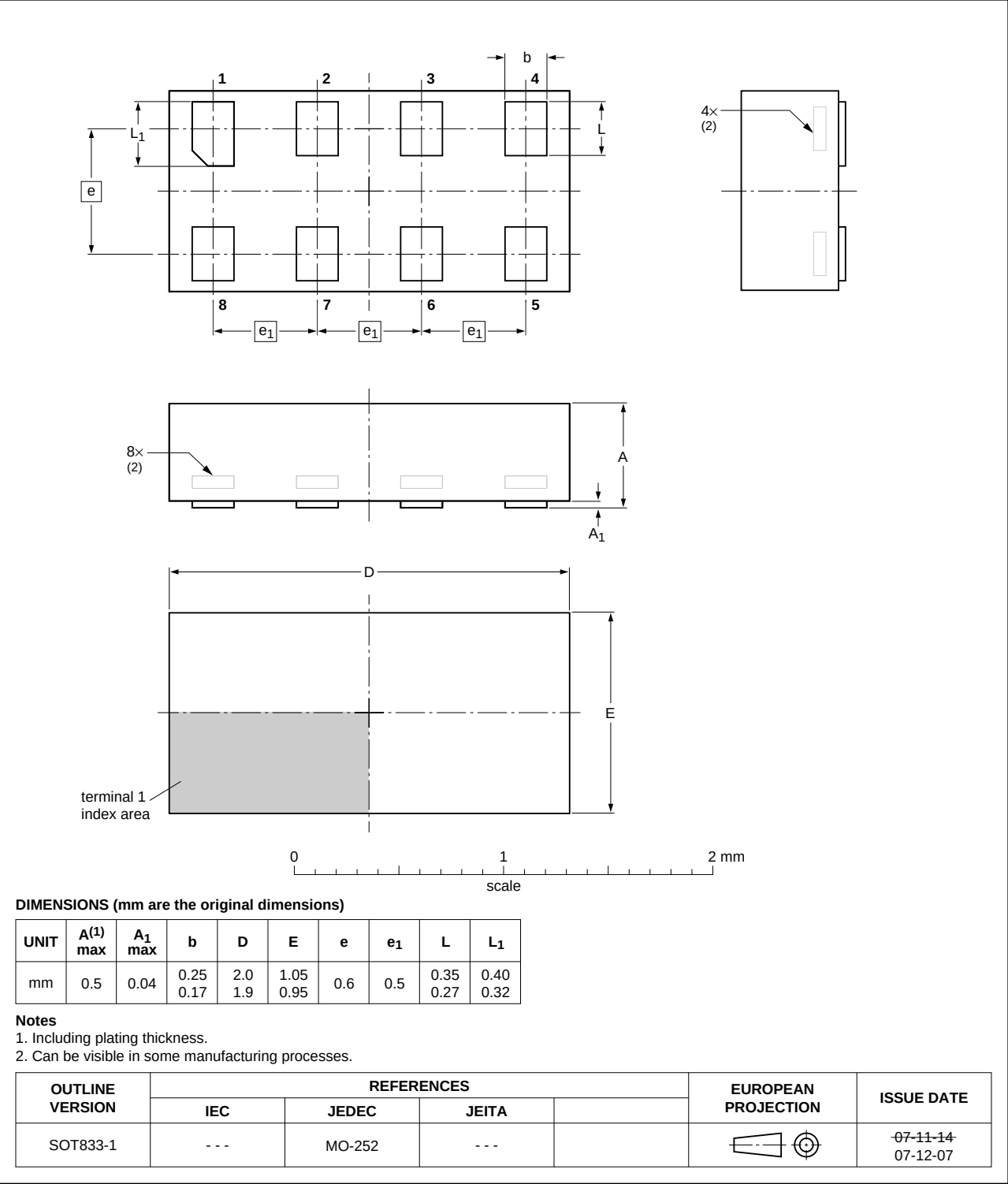


Fig 18. Package outline SOT833-1 (XSON8)

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

SOT1089

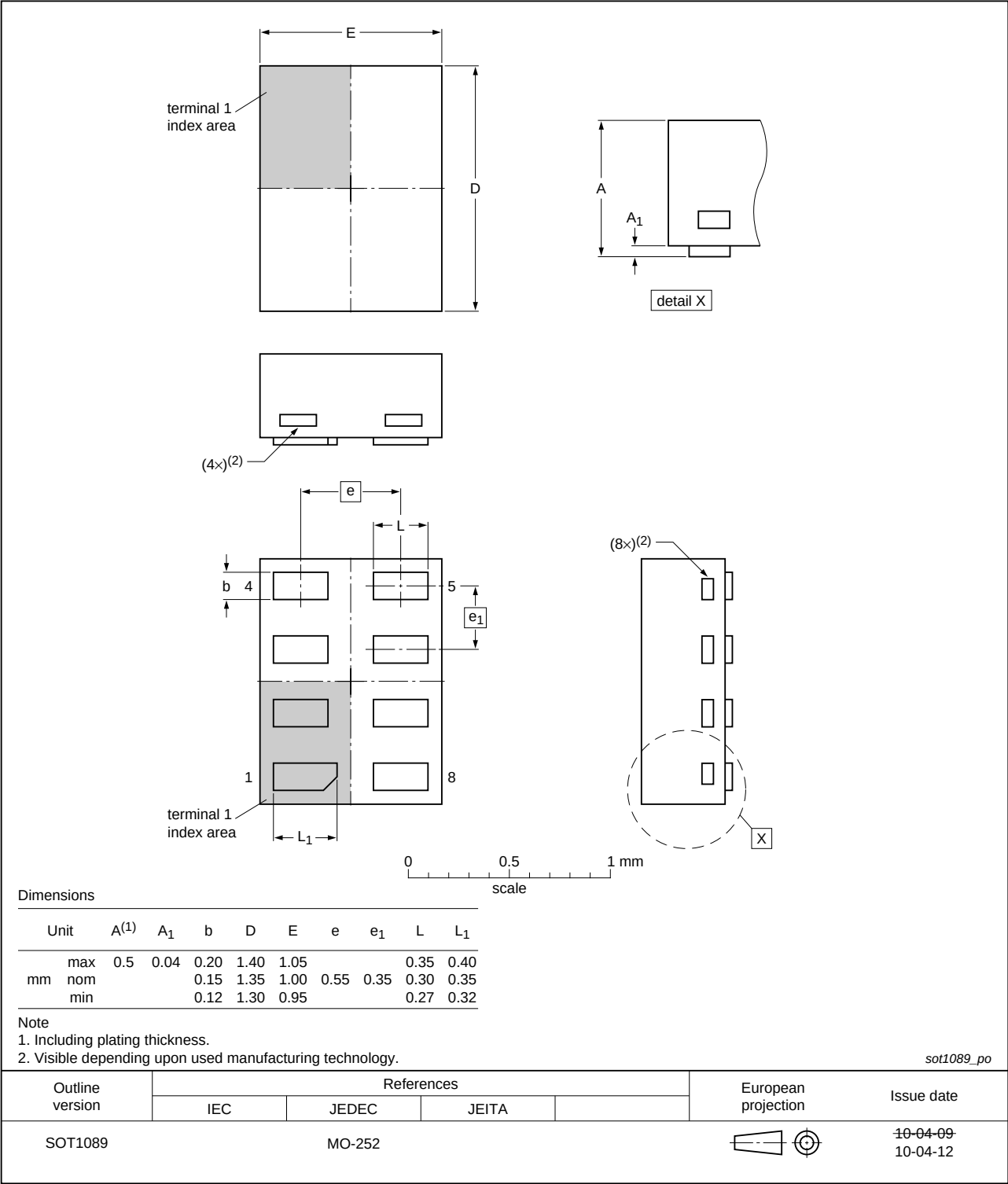


Fig 19. Package outline SOT1089 (XSON8)

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

SOT902-2

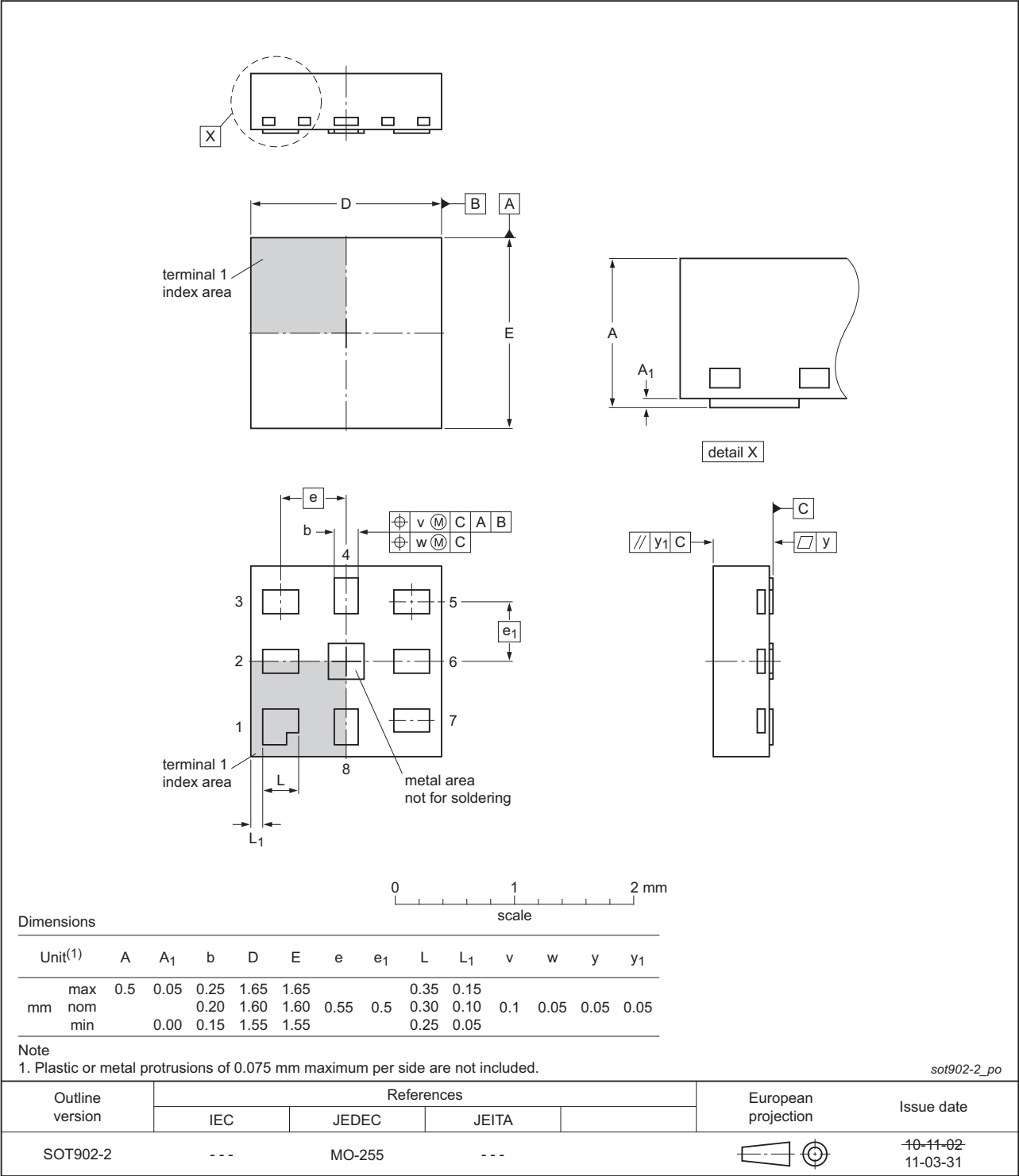


Fig 20. Package outline SOT902-2 (XQFN8)

## 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.

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