

# NCX2220

## Low voltage comparator

Rev. 4 — 27 June 2012

Product data sheet

### 1. General description

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The NCX2220 provides a dual low voltage low power comparator.

The NCX2220 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 this 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 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 3A. Exceeds 2000 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
NCX2220DP	−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
NCX2220GU	−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>
NCX2220GT	−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
NCX2220GF	−40 °C to +85 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1 × 0.5 mm	SOT1089
NCX2220GM	−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.

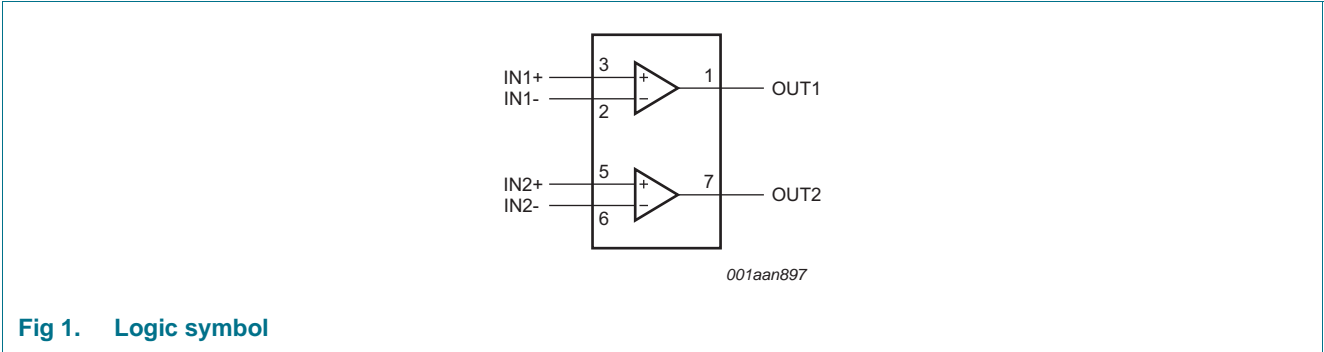
5. Marking

Table 2. Marking codes

Type number	Marking <sup>[1]</sup>
NCX2220DP	q2
NCX2220GU	q2
NCX2220GT	q2
NCX2220GF	q2
NCX2220GM	q2

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

6. Functional diagram



7. Pinning information

7.1 Pinning

NCX2220

OUT1 1 8 V<sub>CC</sub>

IN1- 2 7 OUT2

IN1+ 3 6 IN2-

V<sub>EE</sub> 4 V<sub>EE</sub>(1) 5 IN2+

001aan898

Transparent top view

(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 should remain floating or be connected to V<sub>EE</sub>.

**Fig 2. Pin configuration SOT972-2**

NCX2220

OUT1 1 8 V<sub>CC</sub>

IN1- 2 7 OUT2

IN1+ 3 6 IN2-

V<sub>EE</sub> 4 5 IN2+

001aan899

Transparent top view

**Fig 3. Pin configuration SOT833-1 and SOT1089**

NCX2220

terminal 1 index area

OUT1 1 8 V<sub>CC</sub>

IN1- 2 7 OUT2

IN1+ 3 6 IN2-

V<sub>EE</sub> 4 V<sub>EE</sub> 5 IN2+

001aan900

Transparent top view

**Fig 4. Pin configuration SOT902-2**

NCX2220

OUT1 1 8 V<sub>CC</sub>

IN1- 2 7 OUT2

IN1+ 3 6 IN2-

V<sub>EE</sub> 4 5 IN2+

aaa-003209

**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
t <sub>sc</sub>	short circuit duration 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.

## 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
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
$V_{OH}$	HIGH-level output voltage	$I_O = -0.5\text{ mA}$ ; $V_{CC} = 1.3\text{ V}$	-	1.24	-	-	-	V
		$I_O = -0.5\text{ mA}$ ; $V_{CC} = 1.6\text{ V}$	-	1.55	-	1.35	-	V
		$I_O = -3\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	-	2.85	-	2.7	-	V
		$I_O = -5\text{ mA}$ ; $V_{CC} = 5.5\text{ V}$	-	5.33	-	5.2	-	V
$V_{OL}$	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
$V_{CM}$	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**

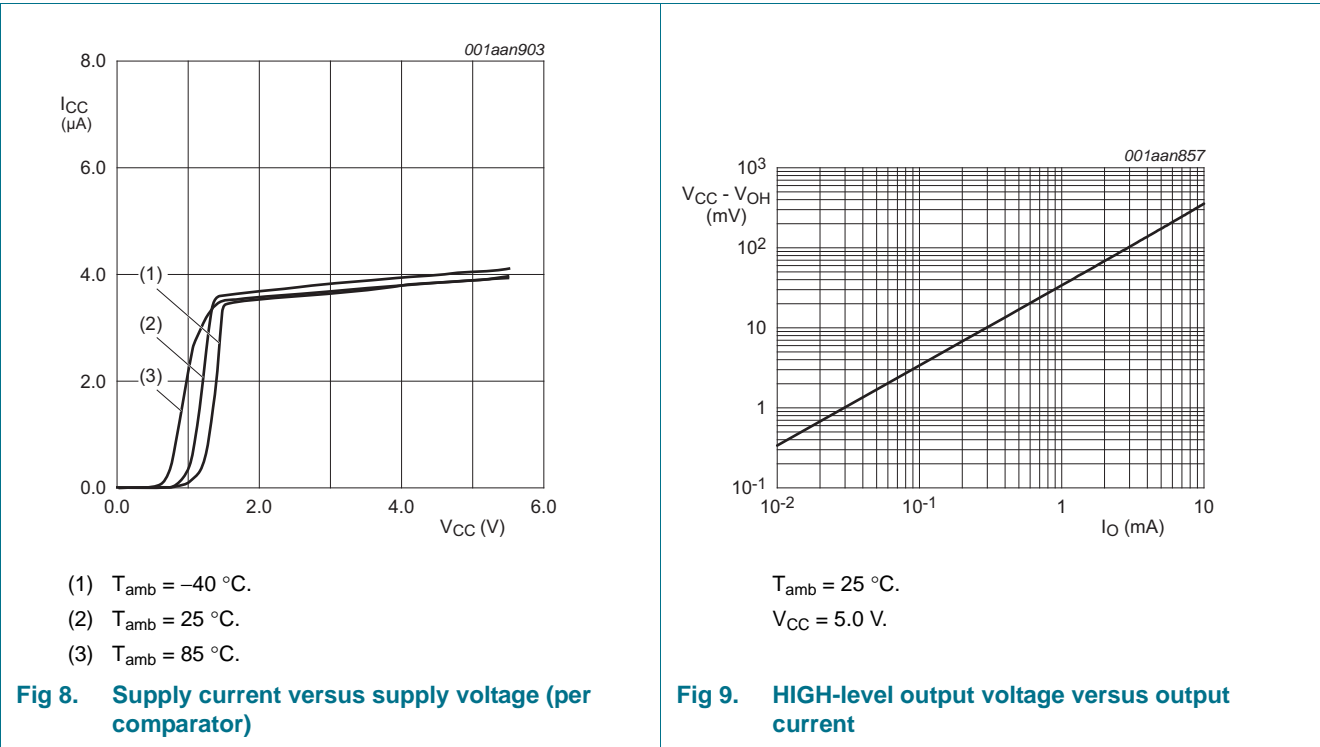
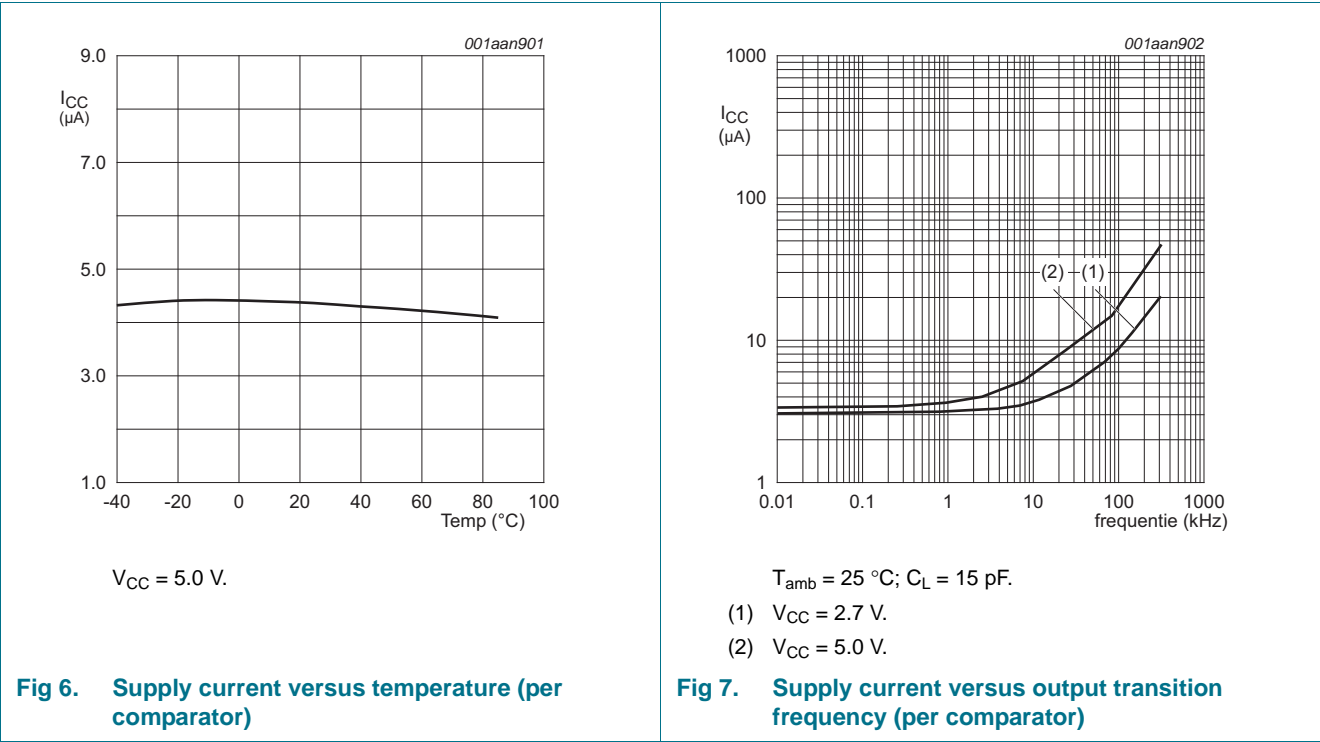
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0\text{ V}$ );  $V_{CC} = 1.6\text{ V to }5.5\text{ V}$ ;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

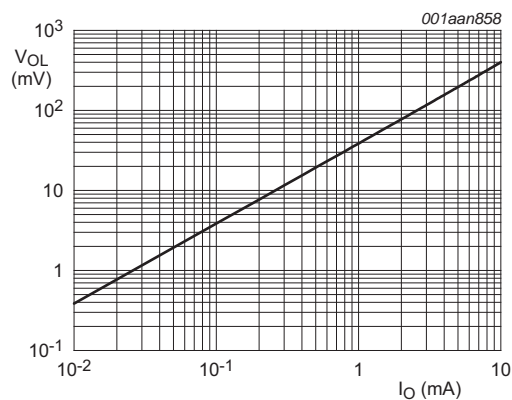
Symbol	Parameter	Conditions	25 °C			Unit
			Min	Typ	Max	
$t_{pd}$	propagation delay	20 mV overdrive; $C_L = 15\text{ pF}$	[1] -	0.8	-	$\mu\text{s}$
$t_{THL}$	HIGH to LOW output transition time	$V_{CC} = 5.5\text{ V}$ ; $C_L = 50\text{ pF}$	[2] -	10	-	ns
$t_{TLH}$	LOW to HIGH output transition time	$V_{CC}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

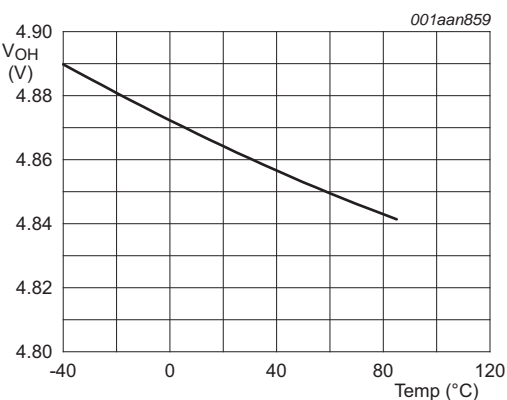
12. Graphs





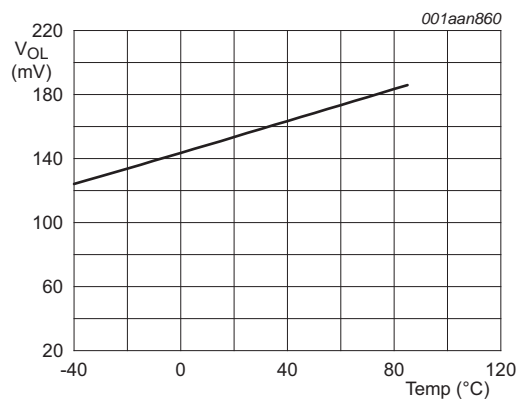
$T_{amb} = 25\text{ }^{\circ}\text{C}.$   
 $V_{CC} = 5.0\text{ V}.$

Fig 10. LOW-level output voltage versus output current



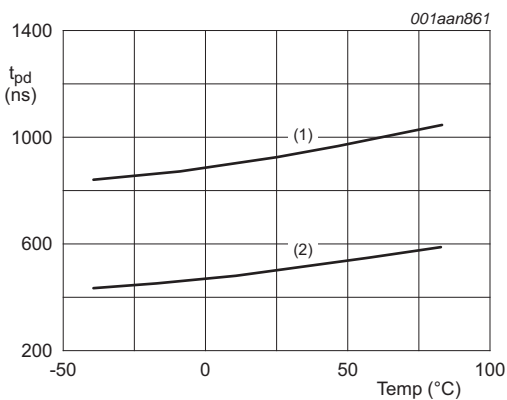
$I_O = -4.0\text{ mA}.$   
 $V_{CC} = 5.0\text{ V}.$

Fig 11. HIGH-level output voltage versus temperature



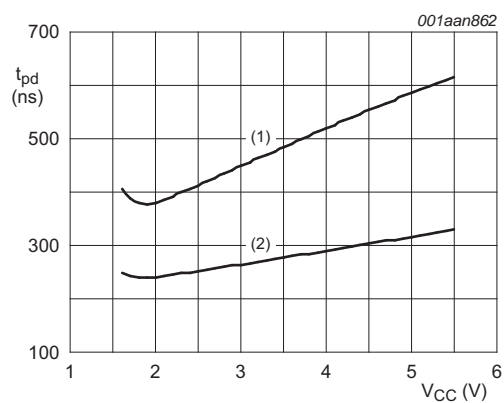
$I_O = 4.0\text{ mA}.$   
 $V_{CC} = 5.0\text{ V}.$

Fig 12. LOW-level output voltage versus temperature



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

Fig 13. Propagation delay versus temperature



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

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

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

**Fig 14. Propagation delay versus supply voltage.**



## 13. Application information

### 13.1 Operating description

The NCX2220 is a dual low voltage low power comparator. This device is designed for rail-to-rail input and output performance. 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. 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 NCX2220 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 15](#)

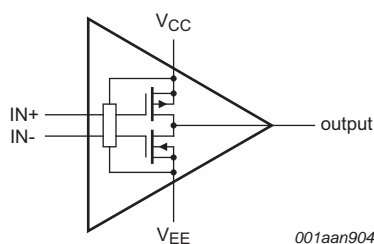
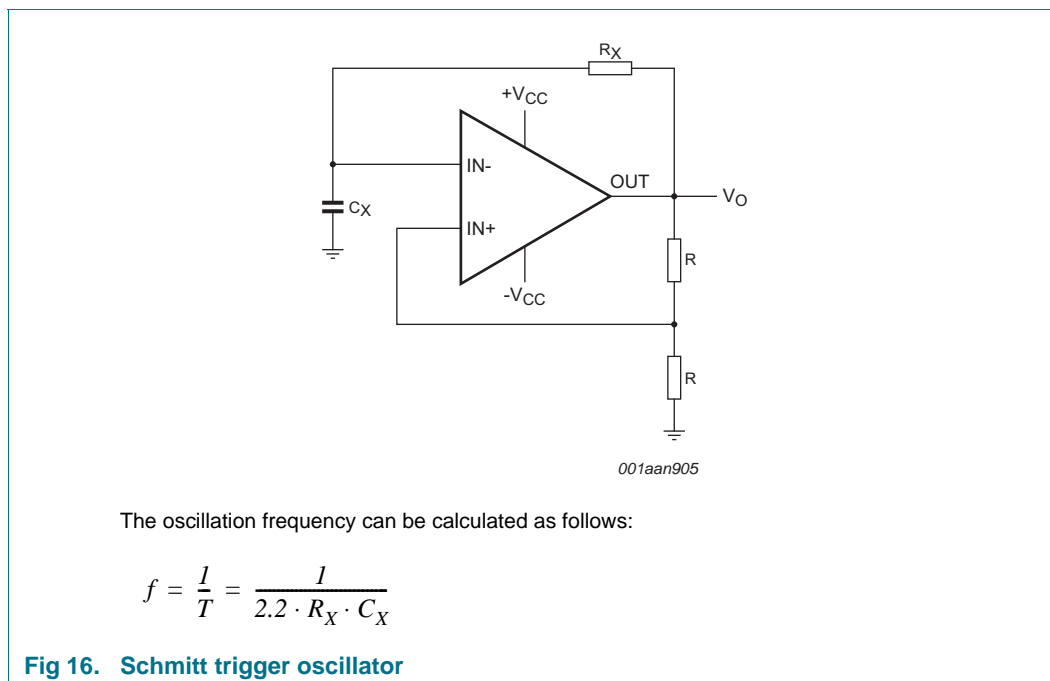


Fig 15. NCX2220 complementary output configuration (one comparator)

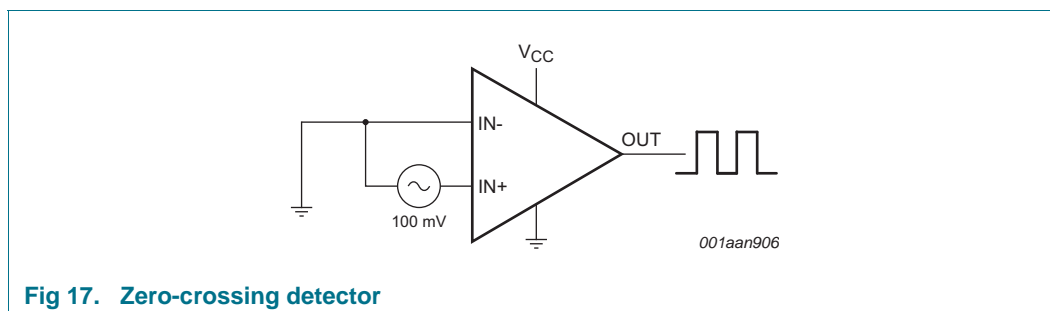
### 13.3 Schmitt trigger oscillator

Figure 16 shows the NCX2220 configured as a Schmitt trigger oscillator.



### 13.4 Zero-crossing detector

Figure 17 shows the NCX2220 configured as a zero-crossing detector.



### 13.5 One-shot multivibrator

Figure 18 shows the NCX2220 configured as a one-shot multivibrator.

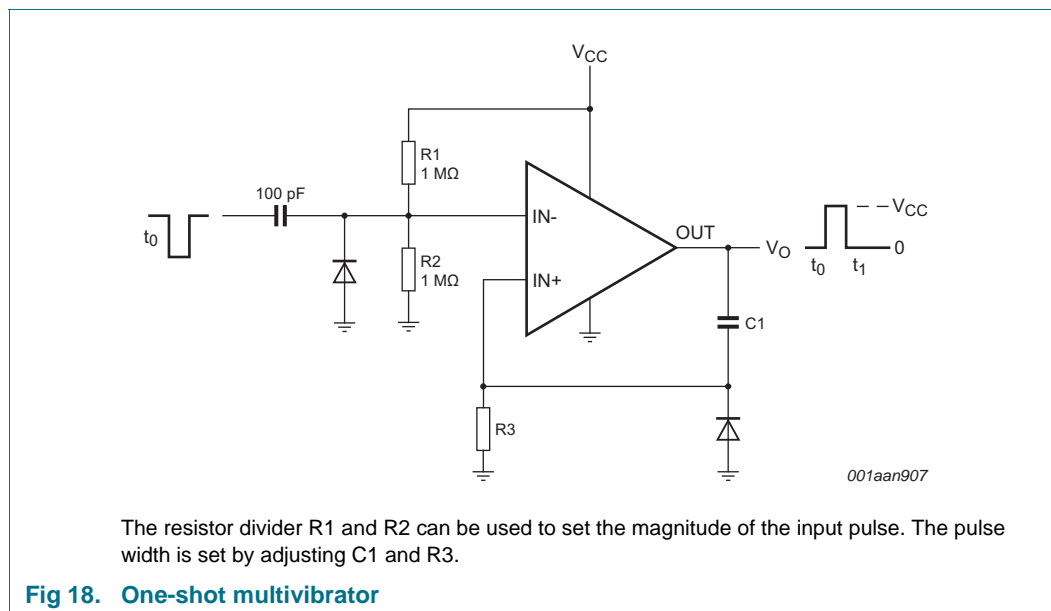


Fig 18. One-shot multivibrator

### 13.6 Logic level translator

Figure 19 shows the NCX2220 configured as a logic level translator.

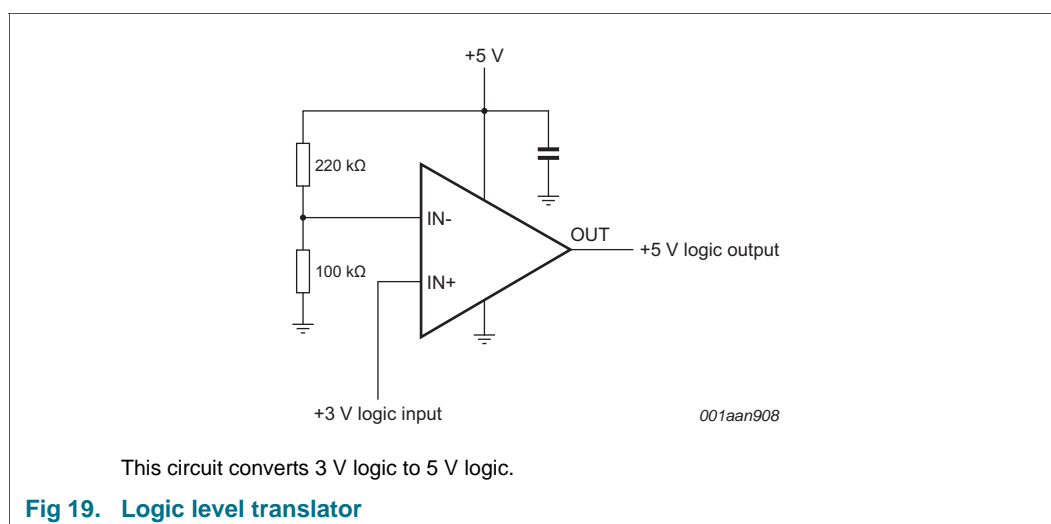


Fig 19. Logic level translator

14. Package outline

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

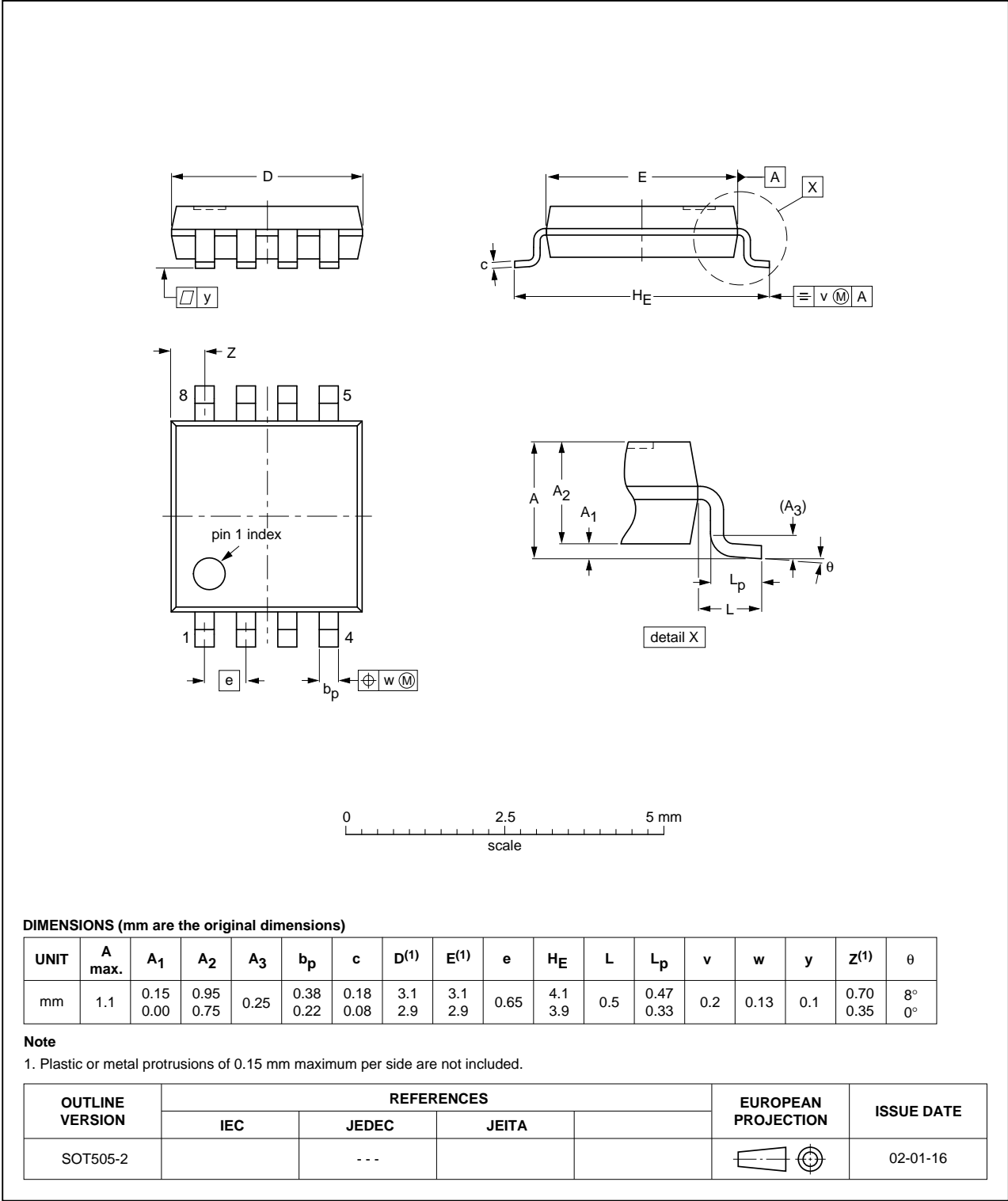


Fig 20. Package outline SOT505-2 (TSSOP8)



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

SOT833-1

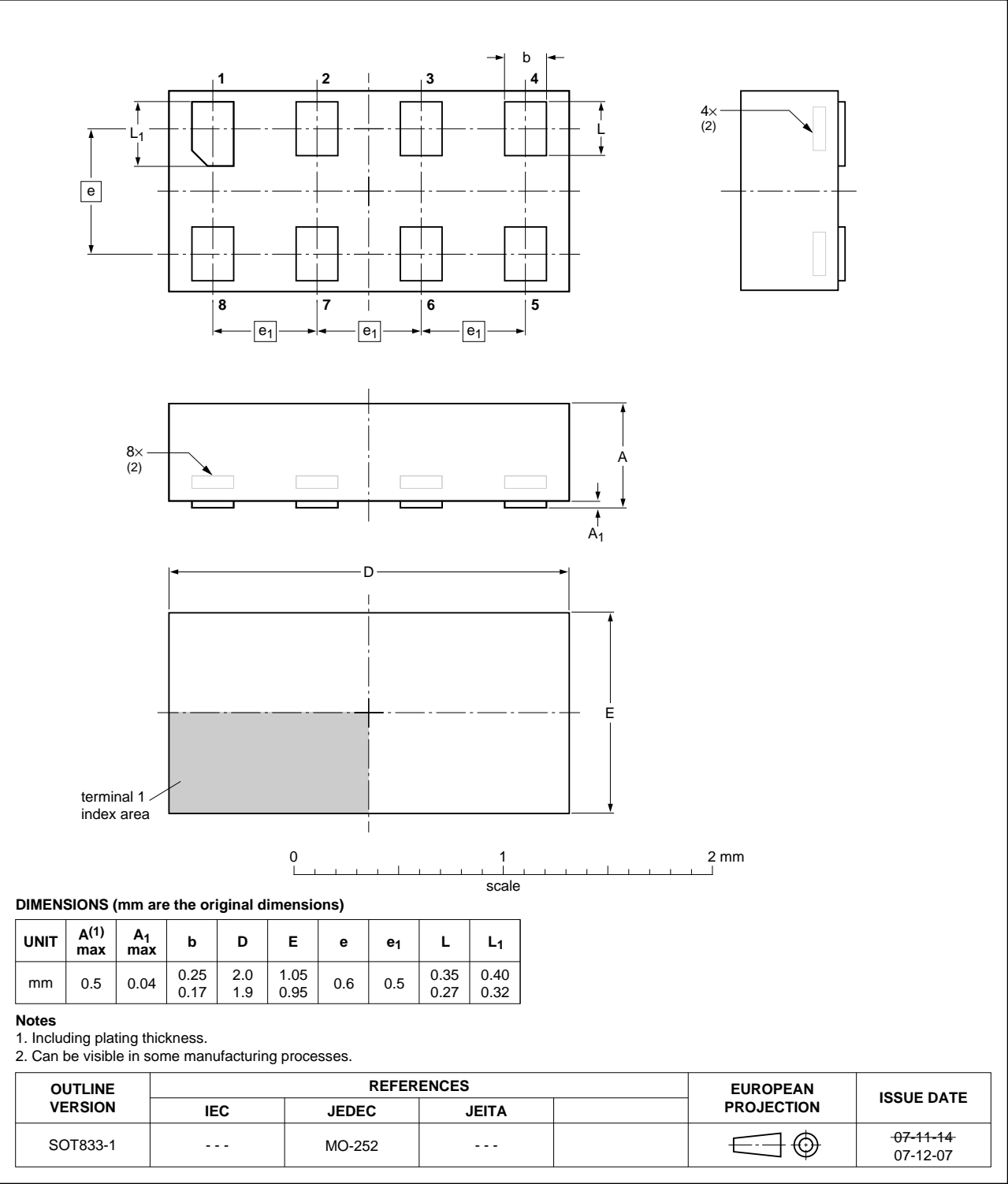


Fig 22. Package outline SOT833-1 (XSON8)

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

SOT1089

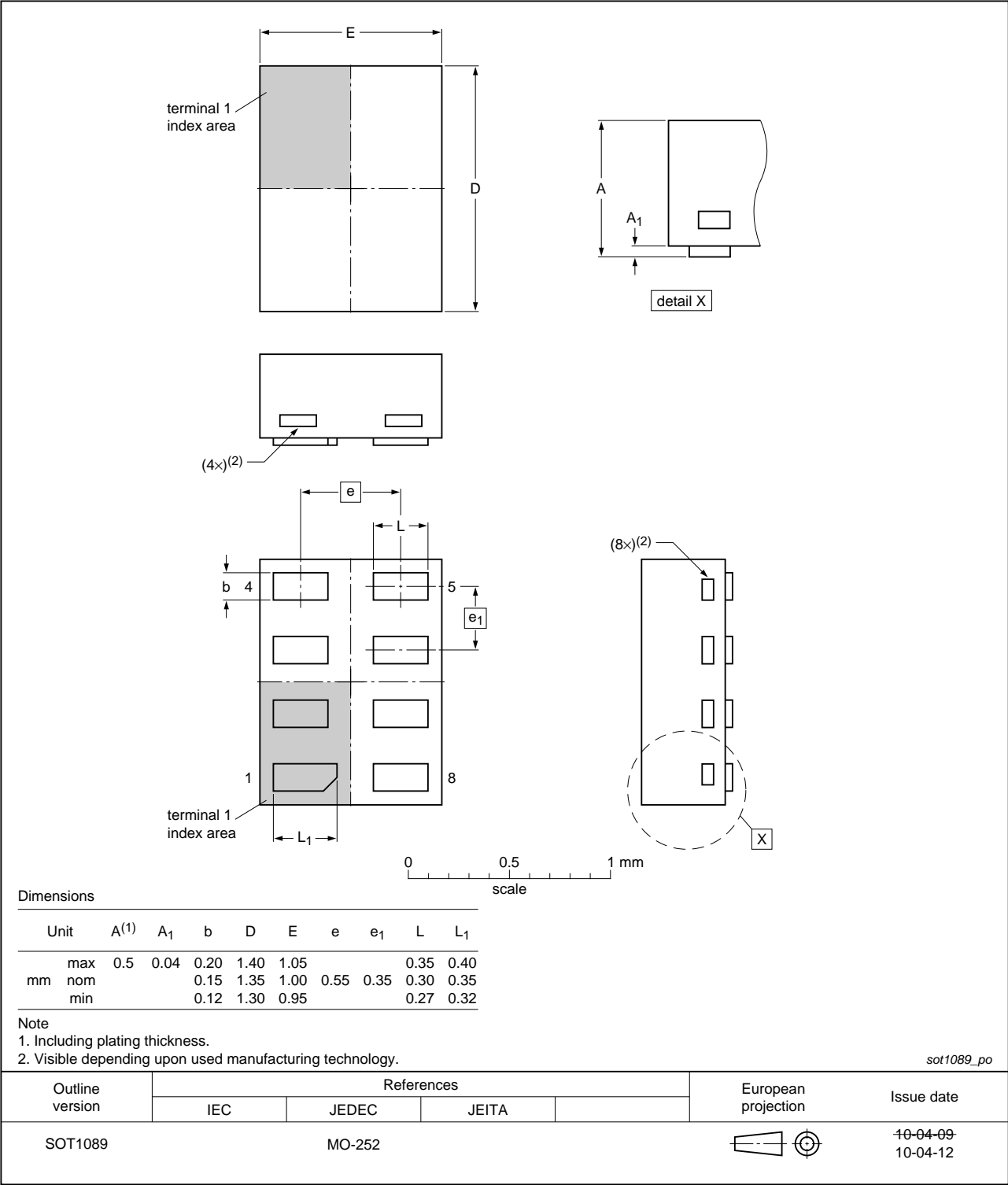


Fig 23. Package outline SOT1089 (XSON8)

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

SOT902-2

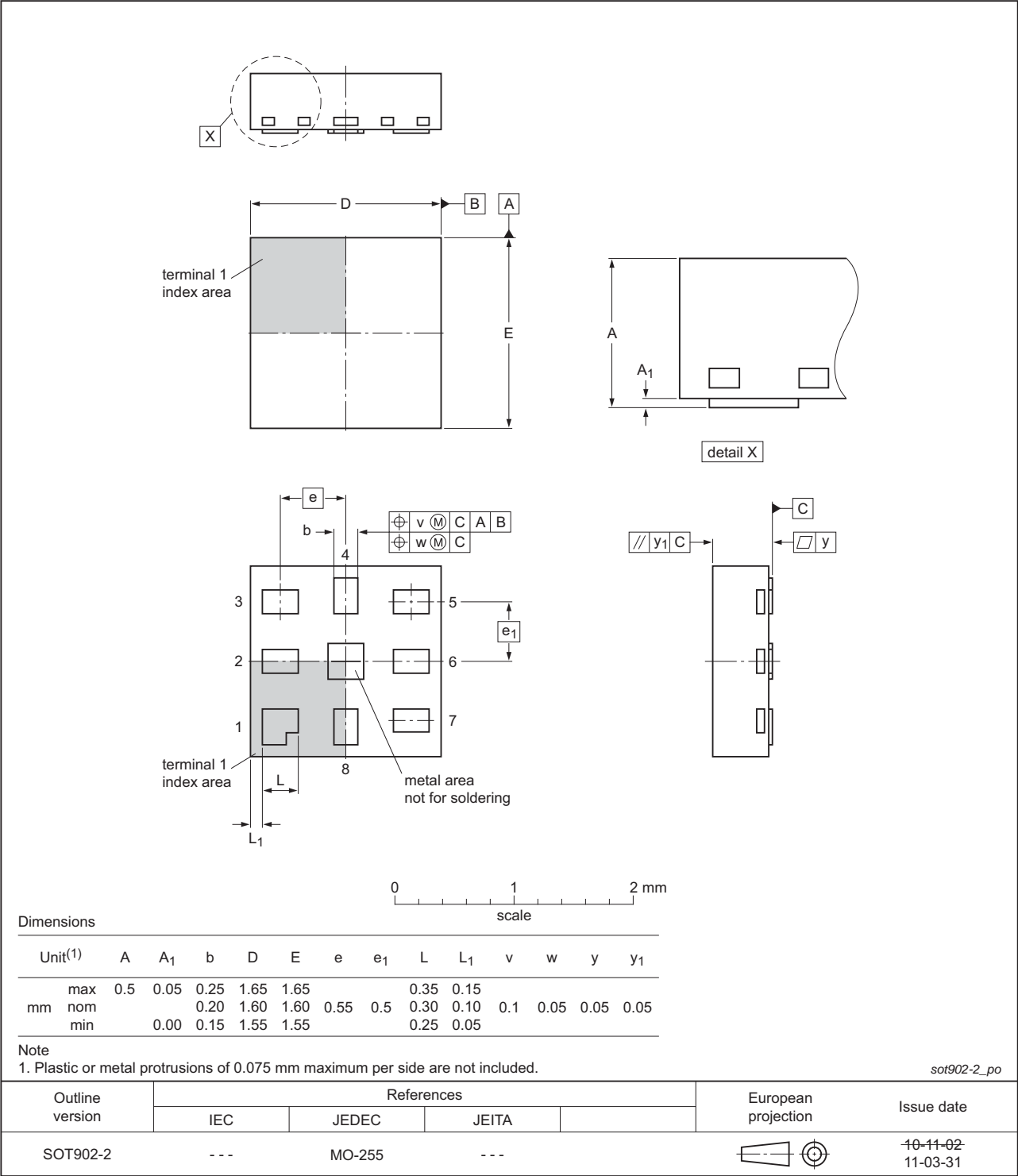


Fig 24. Package outline SOT902-2 (XQFN8)



## 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
NCX2220 v.4	20120627	Product data sheet	-	NCX2220 v.3
Modifications:	<ul style="list-style-type: none"><li>For type number NCX2220GM the SOT code has changed to SOT902-2.</li><li>NCX2220DP added.</li></ul>			
NCX2220 v.3	20111110	Product data sheet	-	NCX2220 v.2
Modifications:	<ul style="list-style-type: none"><li>Legal pages updated.</li></ul>			
NCX2220 v.2	20111012	Product data sheet	-	NCX2220 v.1
NCX2220 v.1	20110405	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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