

# 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  $-40$  °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	
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.

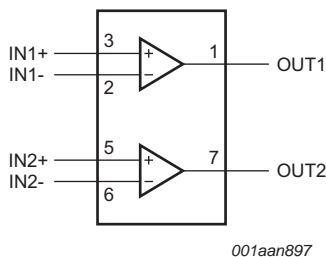
## 5. Marking

**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.

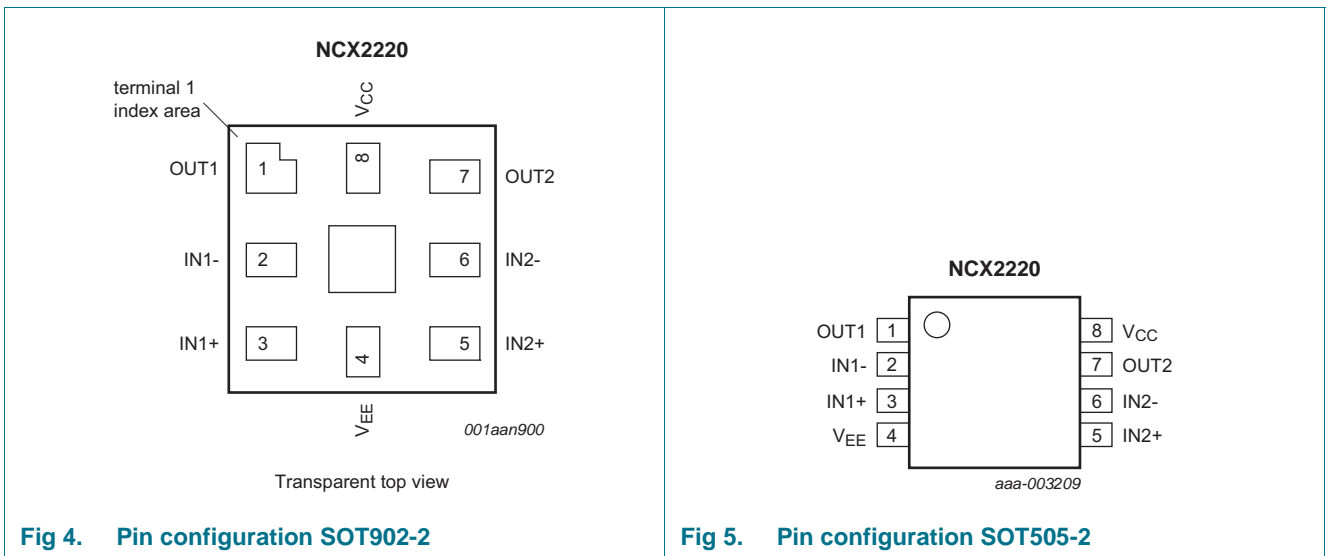
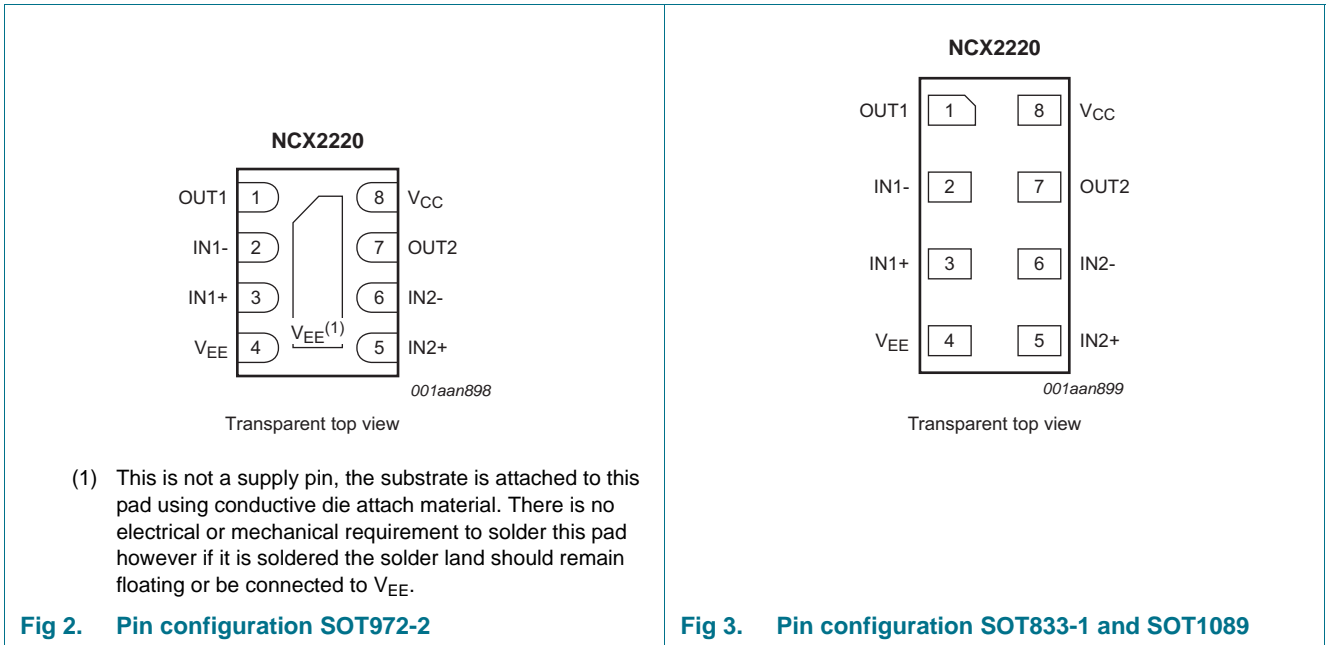
## 6. Functional diagram



**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
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**

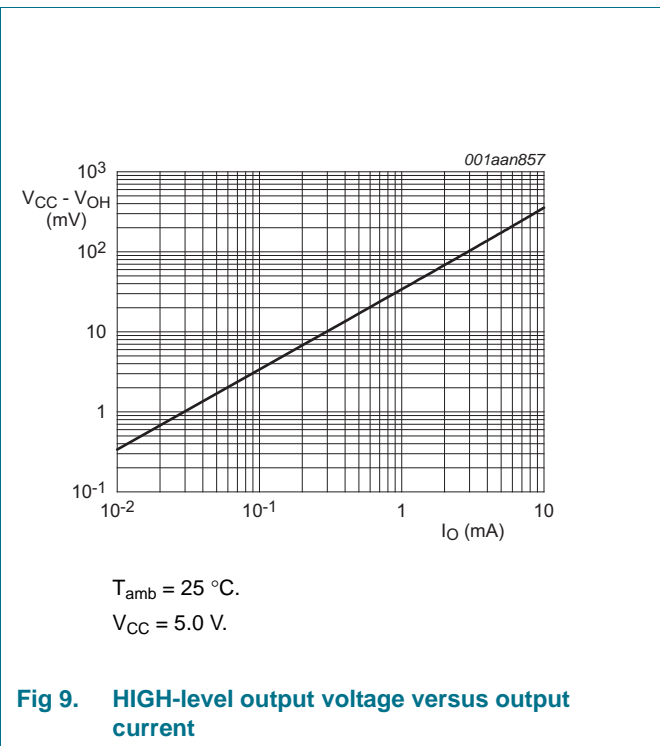
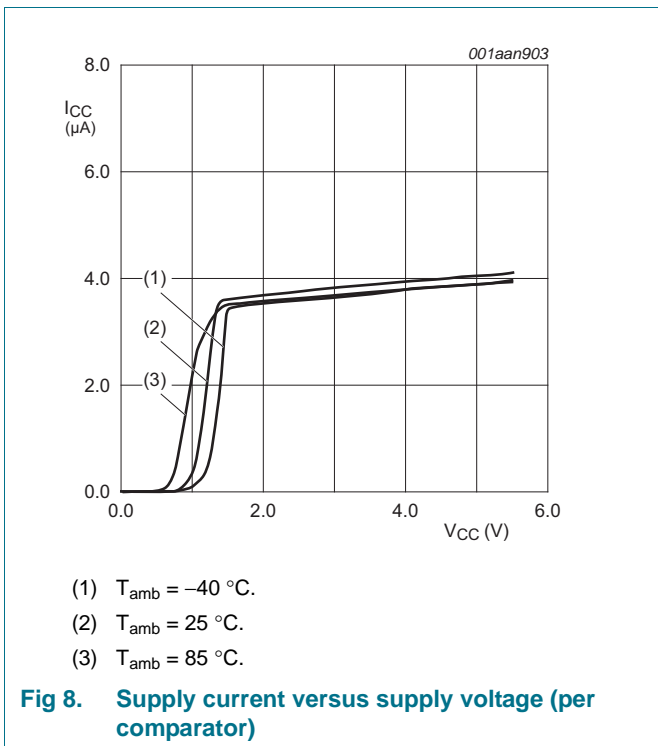
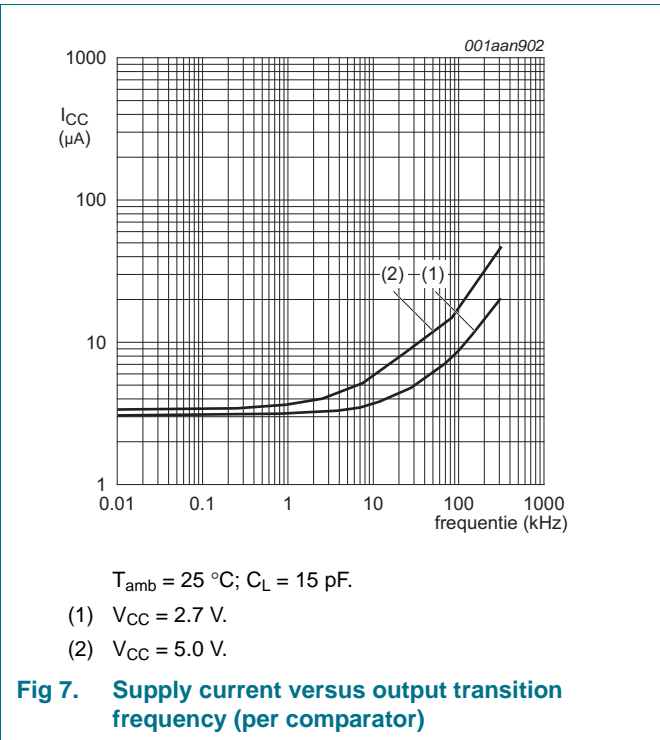
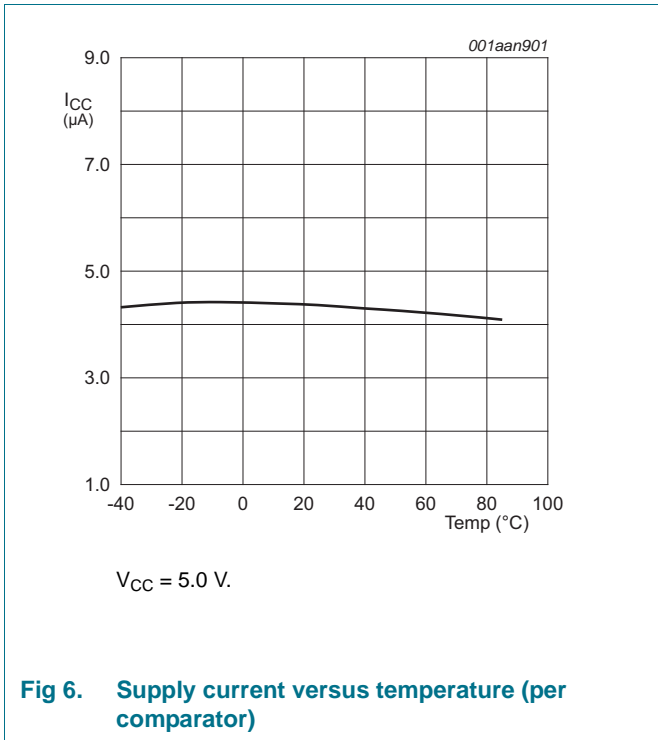
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0\text{ V}$ );  $V_{CC} = 1.6\text{ V to }5.5\text{ V}$ ;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

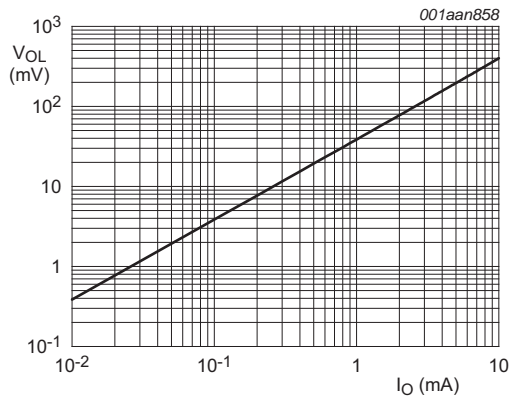
Symbol	Parameter	Conditions	25 °C			Unit
			Min	Typ	Max	
$t_{pd}$	propagation delay	20 mV overdrive; $C_L = 15\text{ pF}$	[1] -	0.8	-	$\mu\text{s}$
$t_{THL}$	HIGH to LOW output transition time	$V_{CC} = 5.5\text{ V}$ ; $C_L = 50\text{ pF}$	[2] -	10	-	ns
$t_{TLH}$	LOW to HIGH output transition time	$V_{CC}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

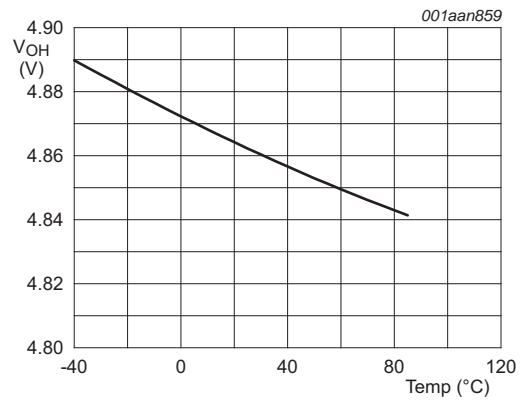
**12. Graphs**





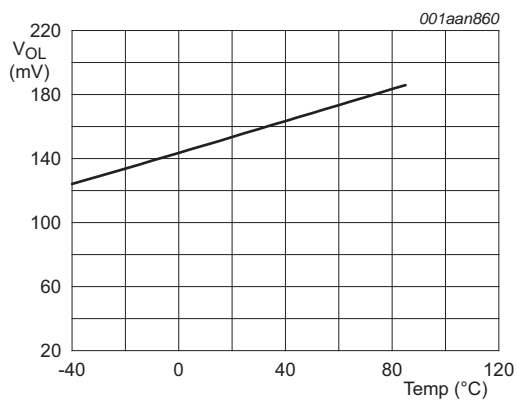
$T_{amb} = 25\text{ }^\circ\text{C}.$   
 $V_{CC} = 5.0\text{ V}.$

**Fig 10. LOW-level output voltage versus output current**



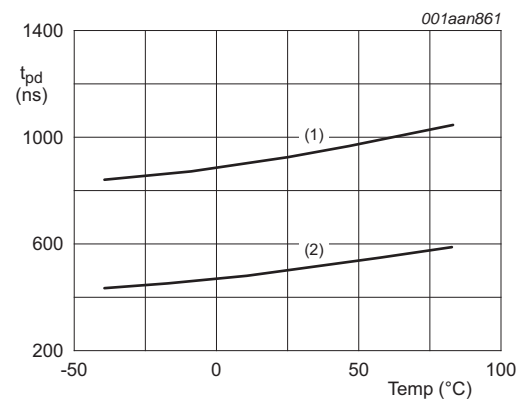
$I_O = -4.0\text{ mA}.$   
 $V_{CC} = 5.0\text{ V}.$

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



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

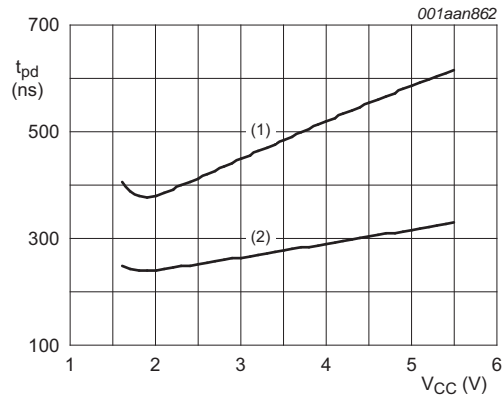
**Fig 12. LOW-level output voltage versus temperature**



$V_{CC} = 5.0\text{ V};$  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](#)

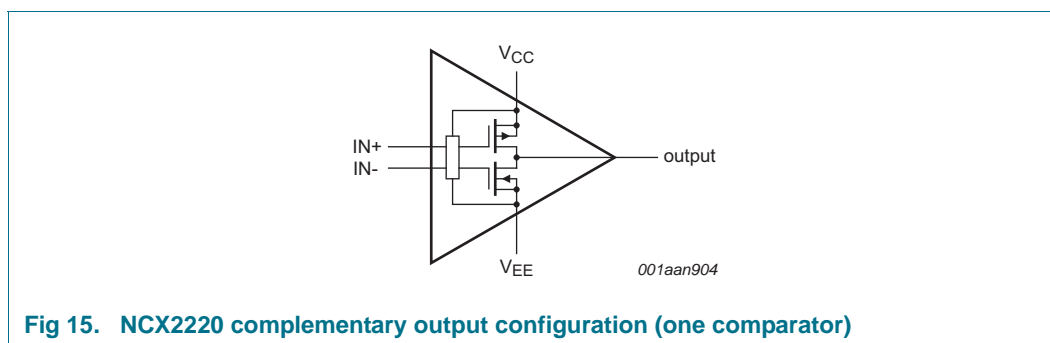
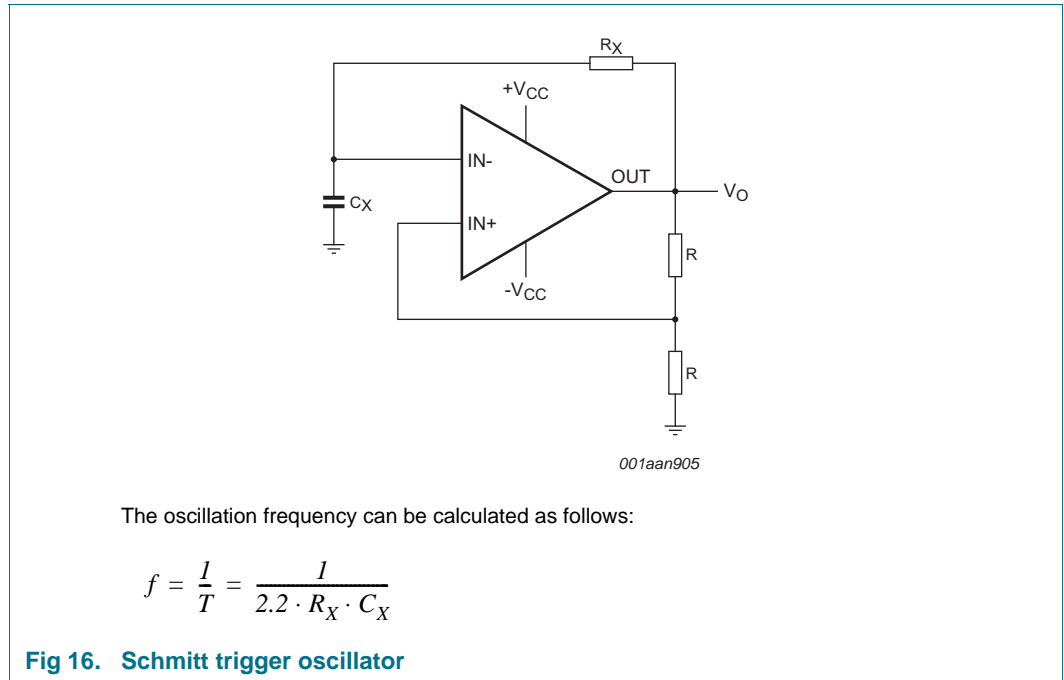


Fig 15. NCX2220 complementary output configuration (one comparator)

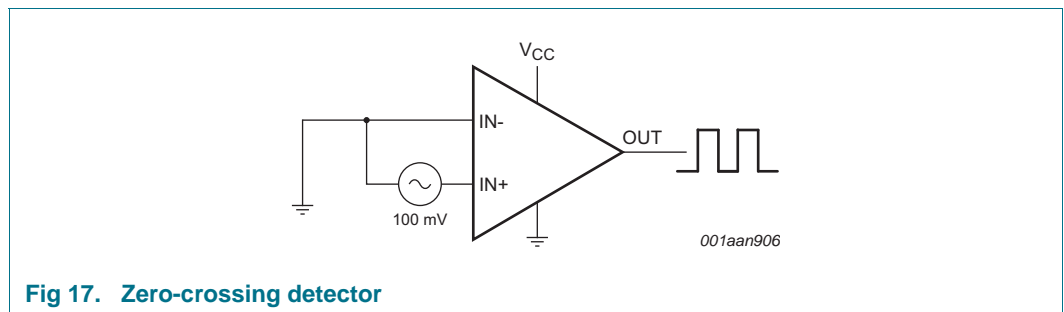
### 13.3 Schmitt trigger oscillator

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



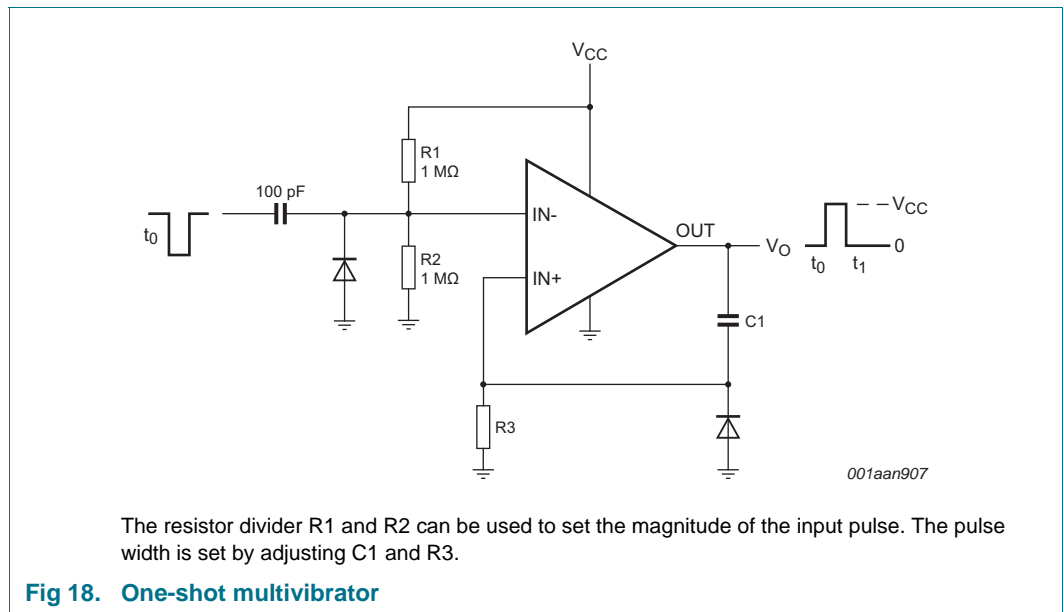
### 13.4 Zero-crossing detector

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



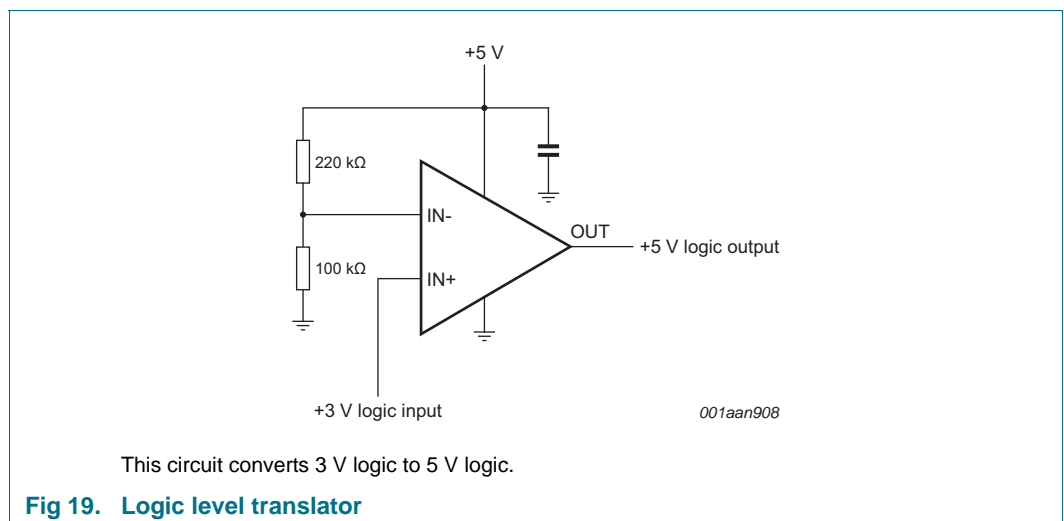
### 13.5 One-shot multivibrator

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



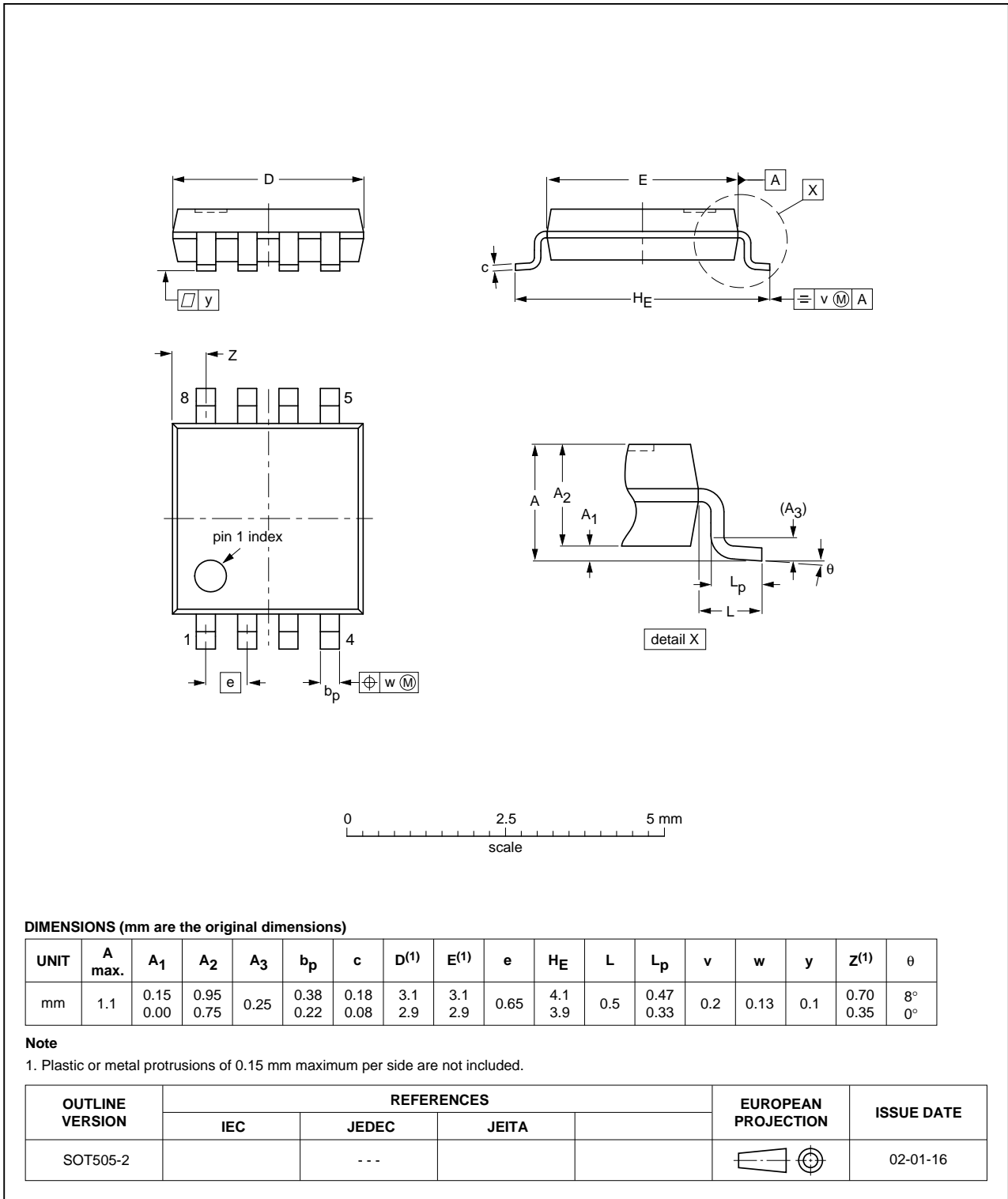
### 13.6 Logic level translator

Figure 19 shows the NCX2220 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 20. 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

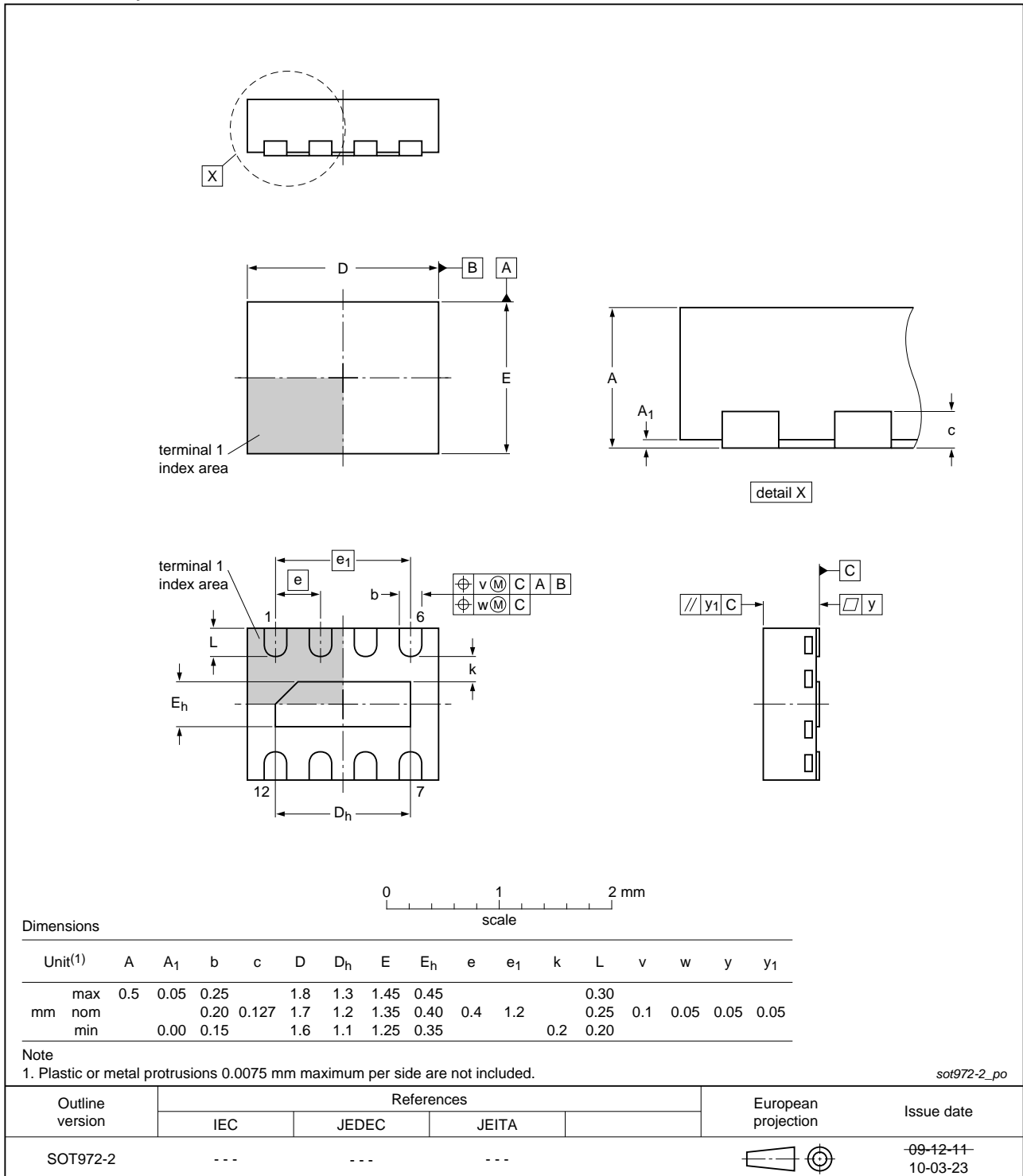


Fig 21. Package outline SOT972-2 (HXSON8)

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

SOT833-1

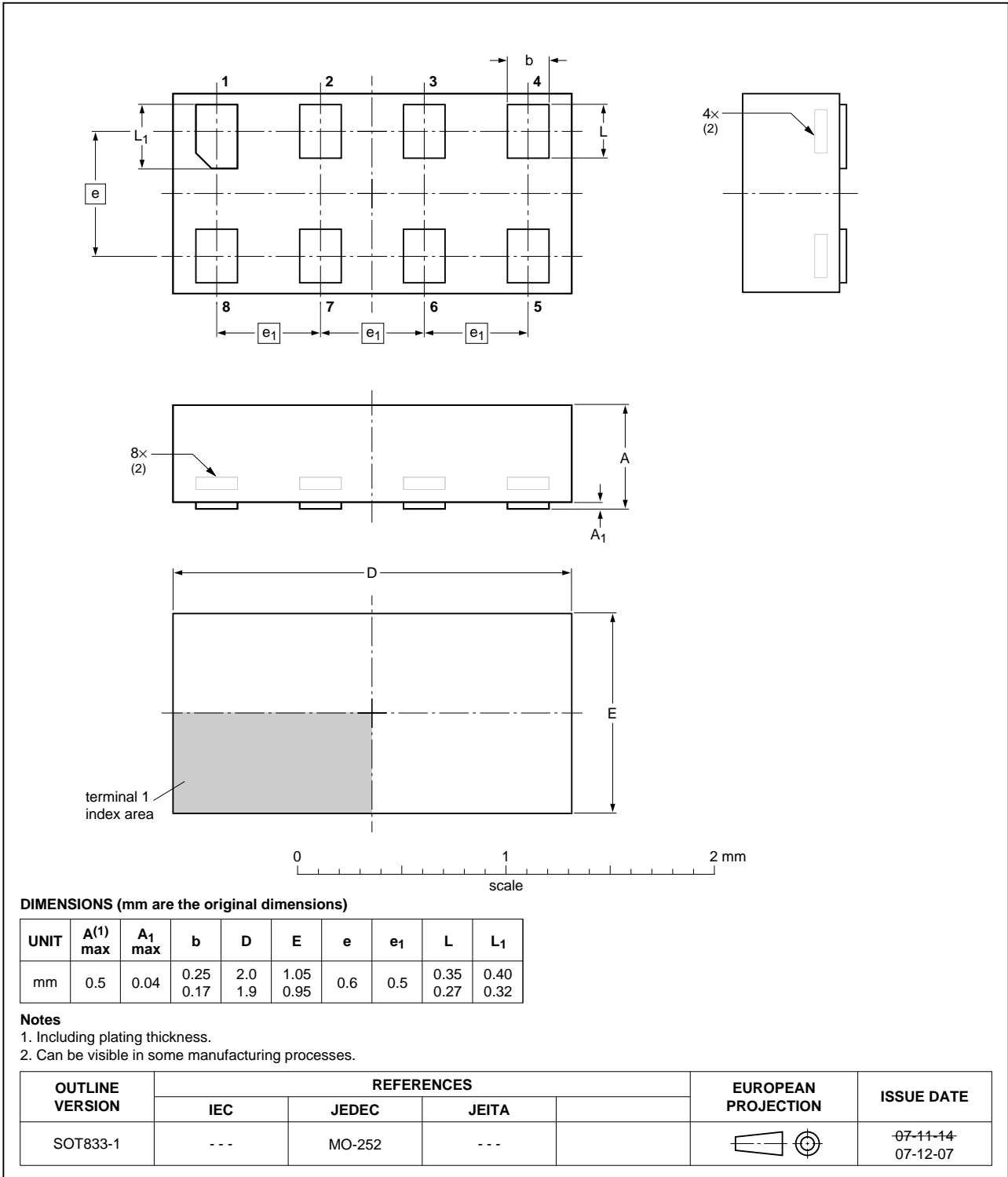


Fig 22. Package outline SOT833-1 (XSON8)

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

SOT1089

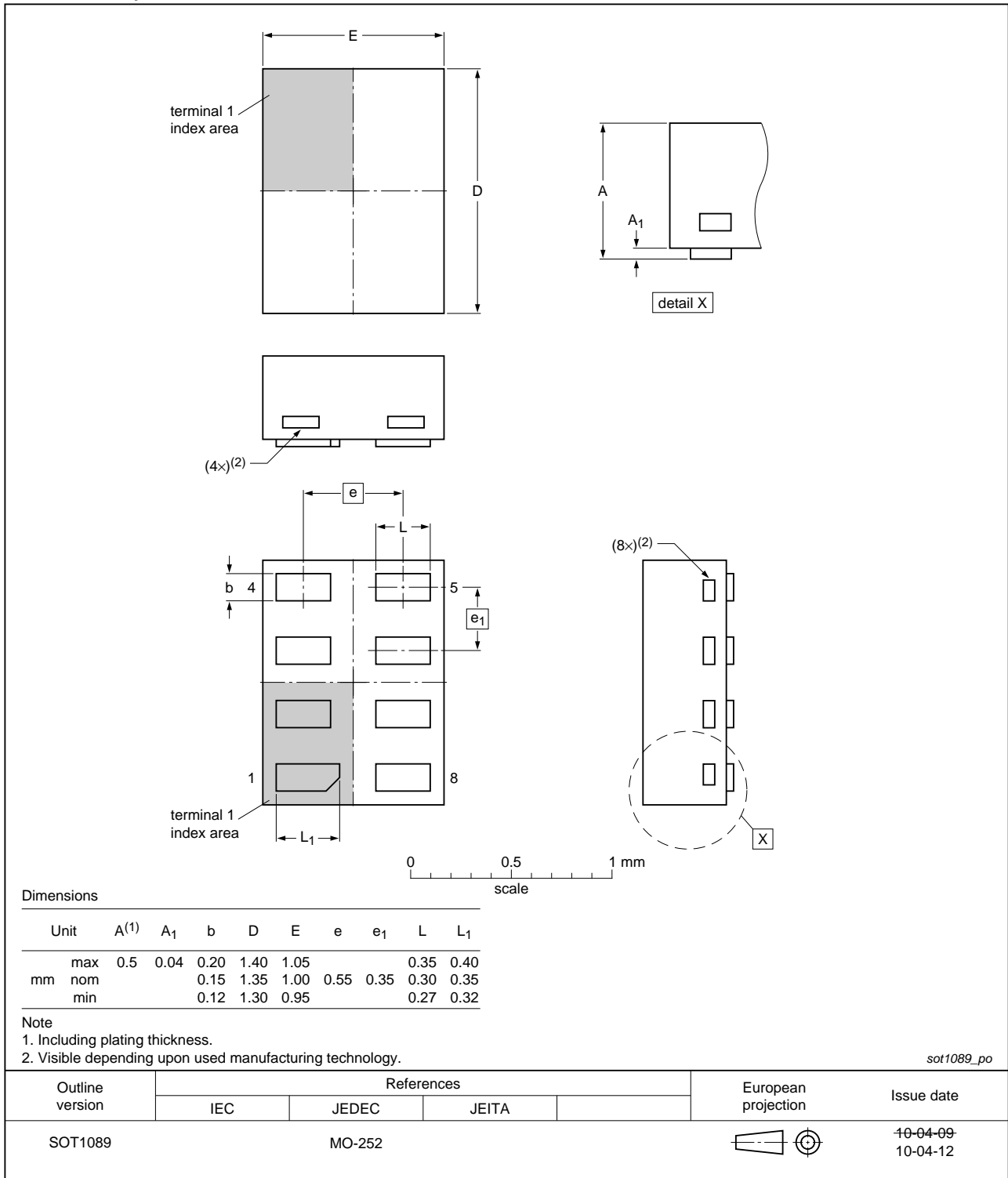


Fig 23. Package outline SOT1089 (XSON8)

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

SOT902-2

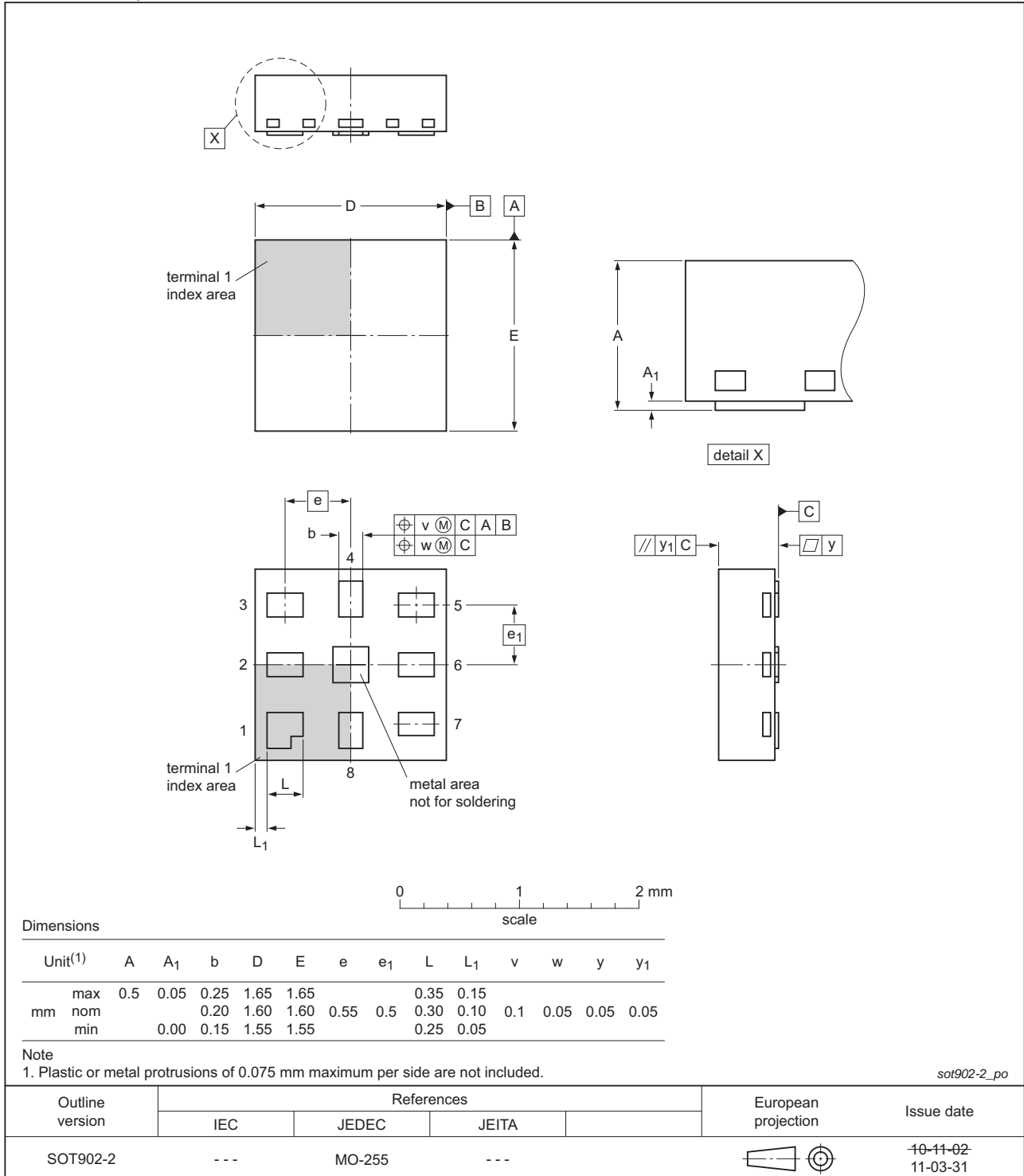


Fig 24. Package outline SOT902-2 (XQFN8)



## 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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