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# NCX2200

## Low voltage comparator

Rev. 6 — 9 July 2014

Product data sheet

### 1. General description

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The NCX2200 provides a single low voltage low power comparator.

The NCX2200 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 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 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 3A. Exceeds 2000 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	Package			Version
	Temperature range	Name	Description	
NCX2200GW	-40 °C to +85 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
NCX2200GM	-40 °C to +85 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
NCX2200GF3	-40 °C to +85 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm	SOT891
NCX2200GS	-40 °C to +85 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202

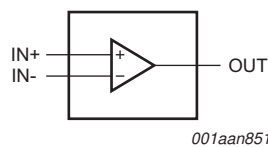
## 5. Marking

**Table 2. Marking codes**

Type number	Marking <sup>[1]</sup>
NCX2200GM	q1
NCX2200GW	q1
NCX2200GF3	q3
NCX2200GS	q1

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

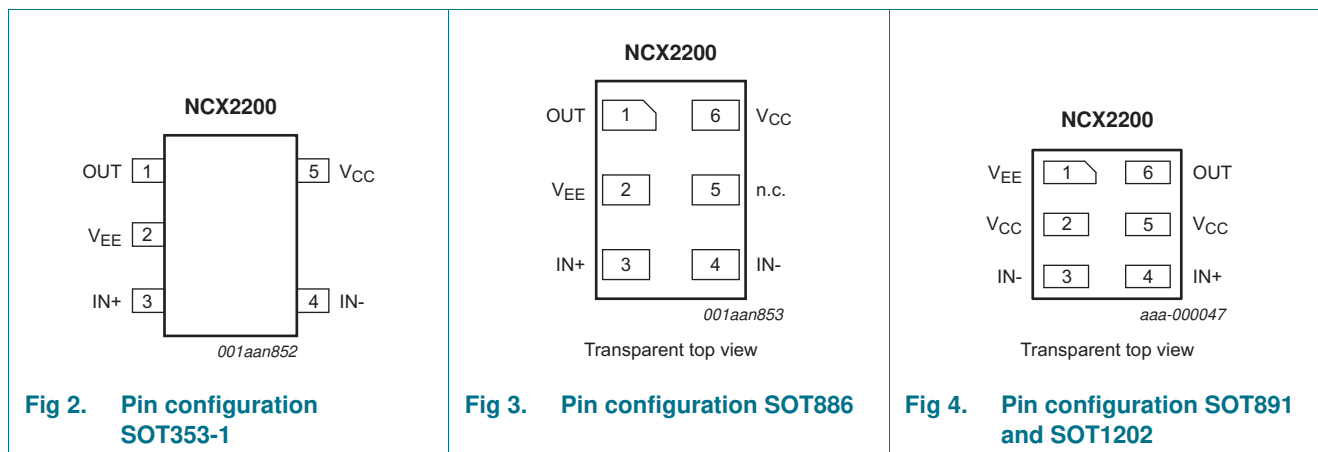
## 6. Functional diagram



**Fig 1. Logic symbol**

## 7. Pinning information

### 7.1 Pinning



### 7.2 Pin description

**Table 3. Pin description**

Symbol	Pin				Description
	SOT353-1	SOT886	SOT891	SOT1202	
OUT	1	1	6	6	comparator output
VEE	2	2	1	1	supply voltage
IN+	3	3	4	4	comparator input (positive)
IN-	4	4	3	3	comparator input (negative)
n.c.	-	5	-	-	not connected
VCC	5	6	2, 5	2, 5	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	IN-, IN+ inputs	-0.5	V <sub>CC</sub> + 0.5	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.



## 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<sub>CC</sub> = 1.6 V to 5.5 V, V<sub>EE</sub> = 0 V; V<sub>CM</sub> = 0.5V<sub>CC</sub> unless otherwise specified.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		Unit
			Min	Typ	Max	Min	Max	
V <sub>H</sub>	hysteresis voltage		6	9	13	-	-	mV
		V <sub>CC</sub> = 1.3 V	-	20	-	-	-	mV
V <sub>I(offset)</sub>	offset input voltage	[1] -	-30	0.5	+30	-30	+30	mV
		V <sub>CC</sub> = 1.3 V [1] -	-	3	-	-	-	mV
V <sub>OH</sub>	HIGH-level output voltage	I <sub>O</sub> = -0.5 mA; V <sub>CC</sub> = 1.3 V	-	1.24	-	-	-	V
		I <sub>O</sub> = -0.5 mA; V <sub>CC</sub> = 1.6 V	-	1.55	-	1.35	-	V
		I <sub>O</sub> = -3 mA; V <sub>CC</sub> = 3.0 V	-	2.85	-	2.7	-	V
		I <sub>O</sub> = -5 mA; V <sub>CC</sub> = 5.5 V	-	5.33	-	5.2	-	V
V <sub>OL</sub>	LOW-level output voltage	I <sub>O</sub> = 0.5 mA; V <sub>CC</sub> = 1.3 V	-	0.05	-	-	-	V
		I <sub>O</sub> = 0.5 mA; V <sub>CC</sub> = 1.6 V	-	0.04	-	-	0.25	V
		I <sub>O</sub> = 3 mA; V <sub>CC</sub> = 3.0 V	-	0.14	-	-	0.3	V
		I <sub>O</sub> = 5 mA; V <sub>CC</sub> = 5.5 V	-	0.20	-	-	0.3	V
V <sub>CM</sub>	common-mode voltage	V <sub>CC</sub> = 1.3 V to 5.5 V	-	V <sub>EE</sub> to V <sub>CC</sub>	-	-	-	V
I <sub>OS</sub>	output short-circuit current	V <sub>CC</sub> = 5.5 V; V <sub>O</sub> = V <sub>EE</sub> or V <sub>CC</sub>	-	68	-	-	-	mA
CMRR	common-mode rejection ratio	ΔV <sub>CM</sub> = V <sub>CC</sub>	-	70	-	-	-	dB
PSRR	power supply rejection ratio	ΔV <sub>CC</sub> = 1.95 V	45	80	-	-	-	dB
I <sub>IB</sub>	input bias current		-	1.0	-	-	-	pA
I <sub>CC</sub>	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.

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

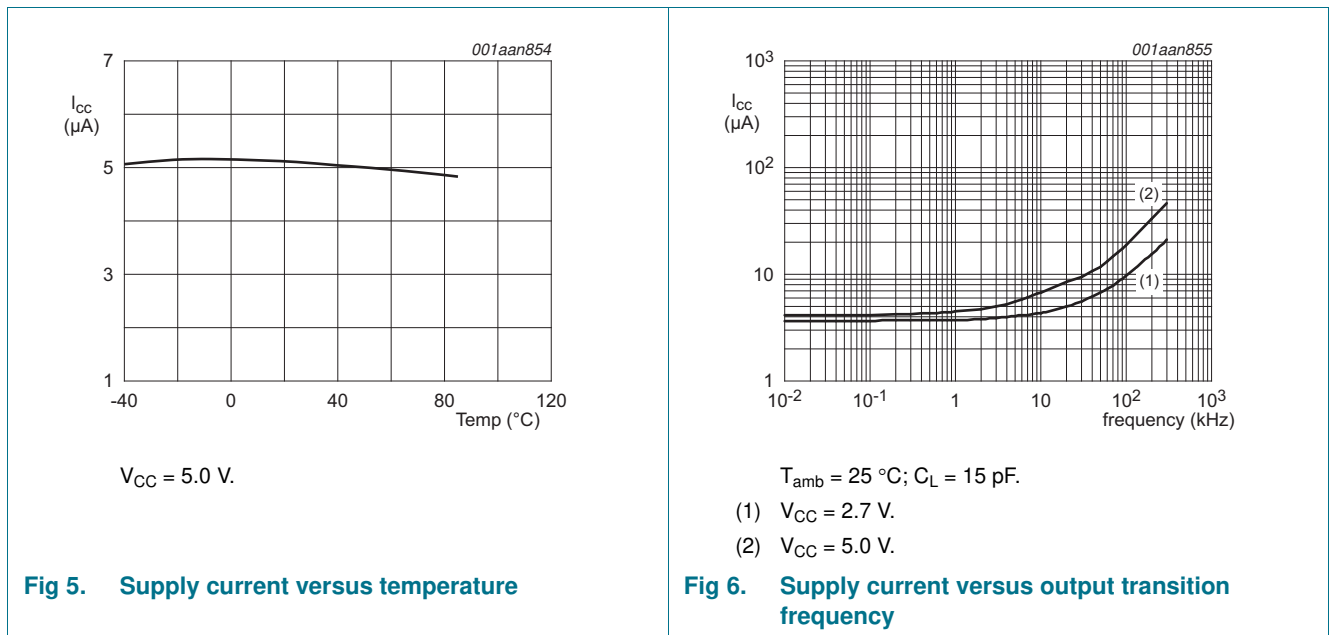
Voltages are referenced to  $V_{EE}$  ( $V_{EE} = 0$  V);  $V_{CC} = 1.6$  V to 5.5 V;  $V_{CM} = 0.5V_{CC}$  unless otherwise specified.

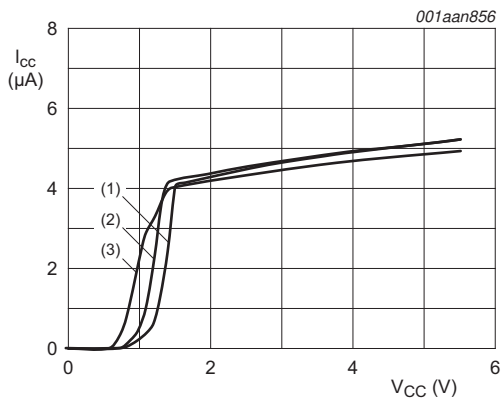
Symbol	Parameter	Conditions	25 °C			Unit
			Min	Typ	Max	
$t_{pd}$	propagation delay	20 mV overdrive; $C_L = 15$ pF	[1]	0.8	-	$\mu$ s
$t_{THL}$	HIGH to LOW output transition time	$V_{CC} = 5.5$ V; $C_L = 50$ pF	[2]	10	-	ns
$t_{TLH}$	LOW to HIGH output transition time	$V_{CC} = 5.5$ V; $C_L = 50$ pF	[2]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

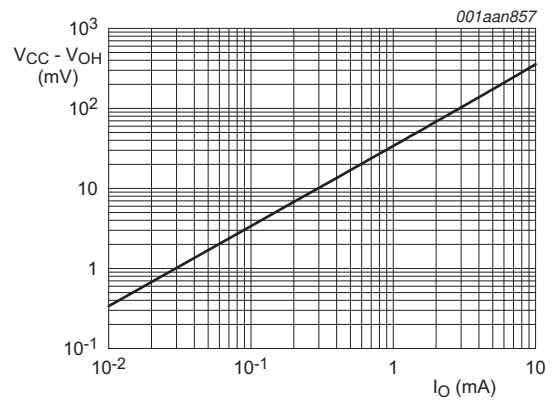
## 12. Graphs





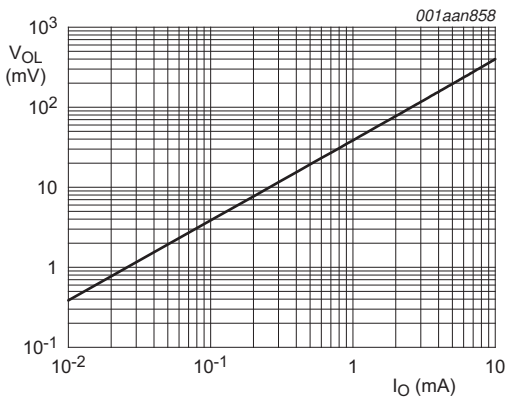
- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$ .
- (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .
- (3)  $T_{amb} = 85\text{ }^{\circ}\text{C}$ .

**Fig 7. Supply current versus supply voltage**



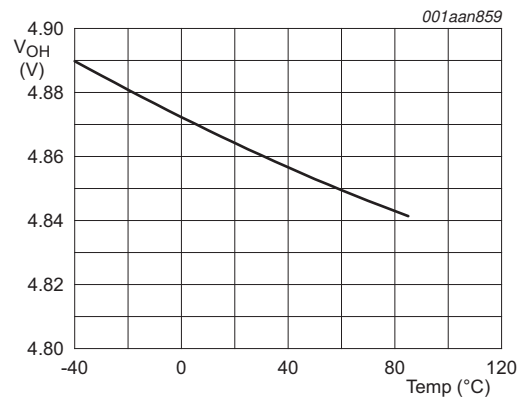
$T_{amb} = 25\text{ }^{\circ}\text{C}$ .  
 $V_{CC} = 5.0\text{ V}$ .

**Fig 8. HIGH-level output voltage versus output current**



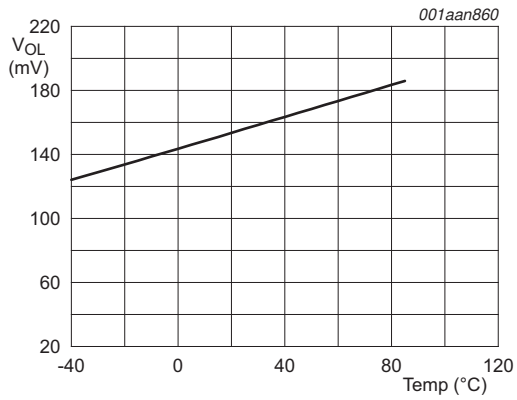
$T_{amb} = 25\text{ }^{\circ}\text{C}$ .  
 $V_{CC} = 5.0\text{ V}$ .

**Fig 9. LOW-level output voltage versus output current**



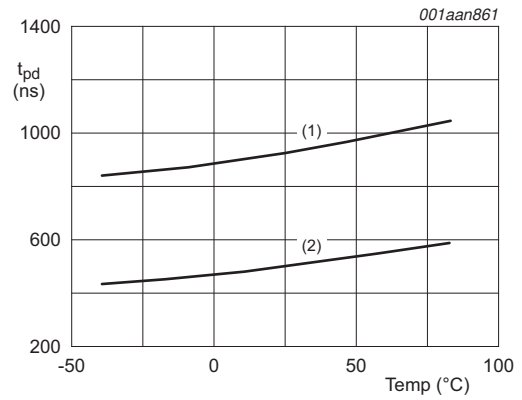
$I_O = -4.0\text{ mA}$ .  
 $V_{CC} = 5.0\text{ V}$ .

**Fig 10. HIGH-level output voltage versus temperature**



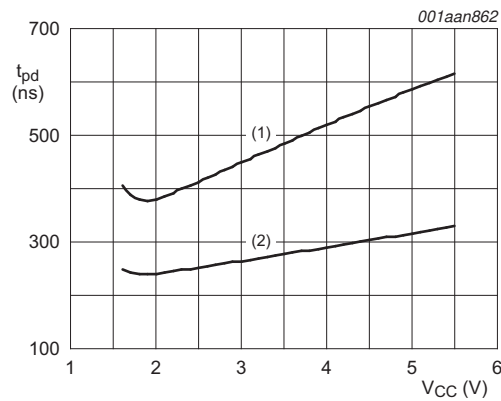
$I_O = 4.0 \text{ mA}$ .  
 $V_{CC} = 5.0 \text{ V}$ .

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



$V_{CC} = 5.0 \text{ V}$ ; input overdrive = 50 mV.  
 (1) t<sub>PLH</sub>.  
 (2) t<sub>PHL</sub>.

**Fig 12. Propagation delay versus temperature**



$T_{amb} = 25 \text{ °C}$ ; input overdrive = 100 mV.  
 (1) t<sub>PLH</sub>.  
 (2) t<sub>PHL</sub>.

**Fig 13. Propagation delay versus supply voltage.**



## 13. Application information

### 13.1 Operating description

The NCX2200 is a single low voltage low power comparator. This device is designed for rail-to-rail input and output performance. 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. 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 NCX2200 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 14](#)

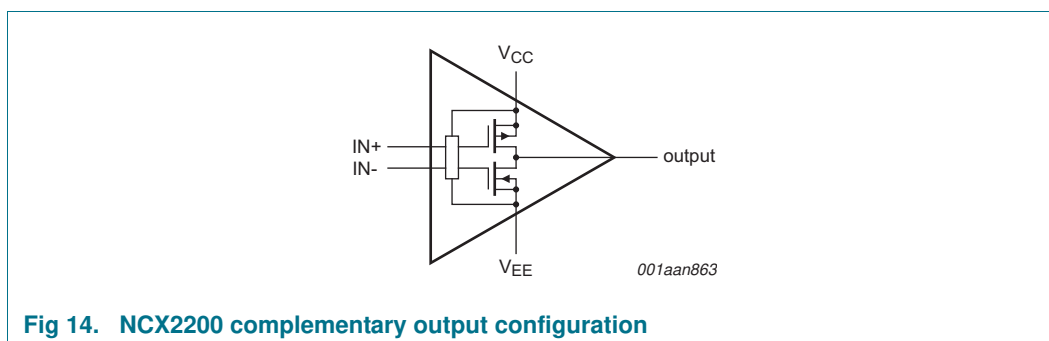
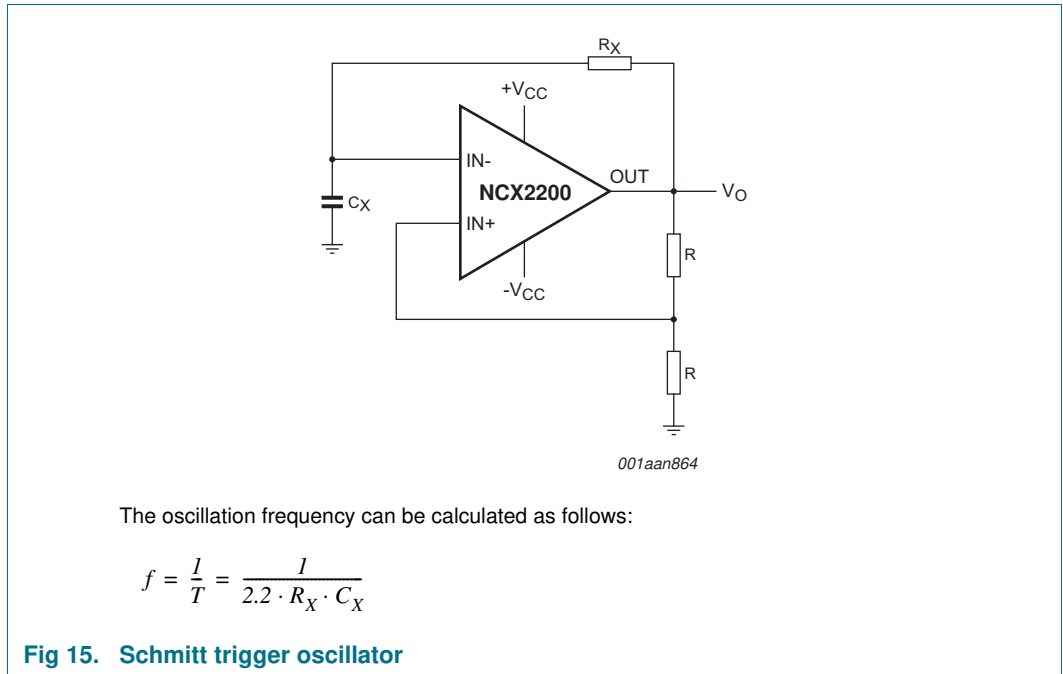


Fig 14. NCX2200 complementary output configuration

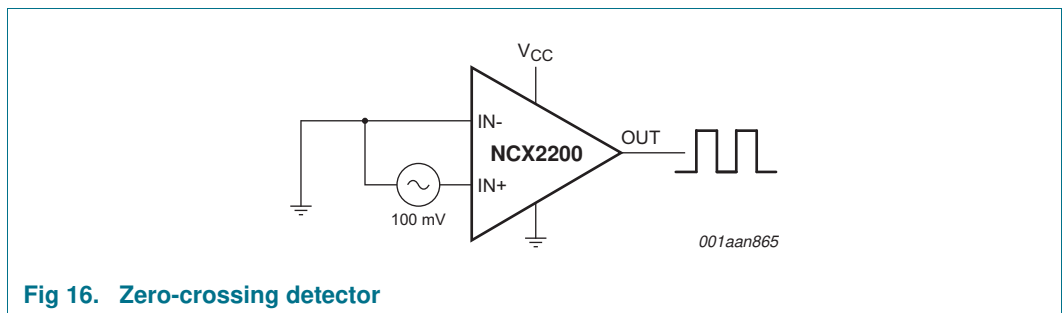
### 13.3 Schmitt trigger oscillator

Figure 15 shows the NCX2200 configured as a Schmitt trigger oscillator.



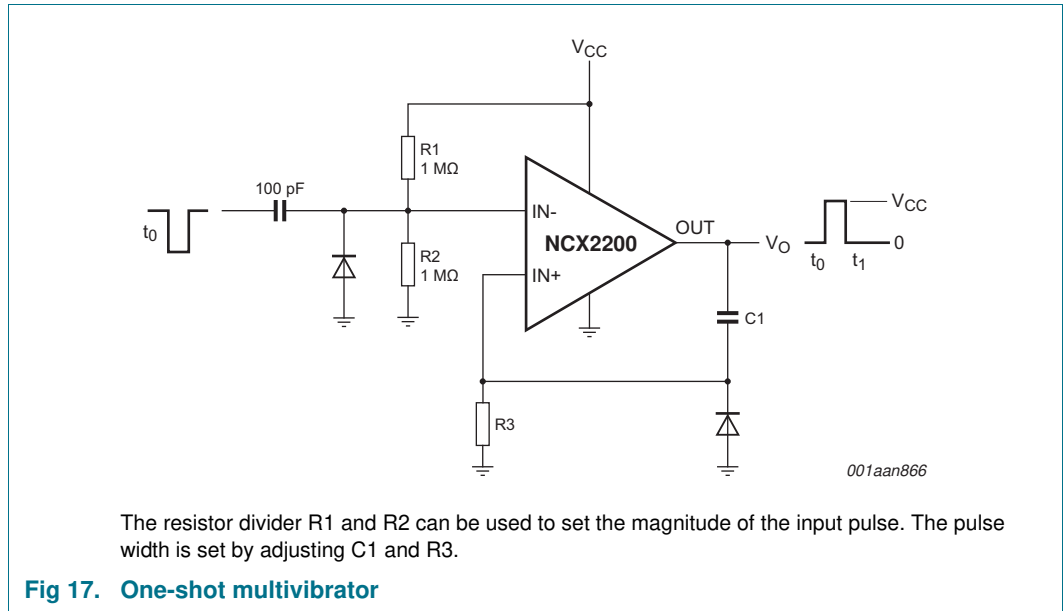
### 13.4 Zero-crossing detector

Figure 16 shows the NCX2200 configured as a zero-crossing detector.



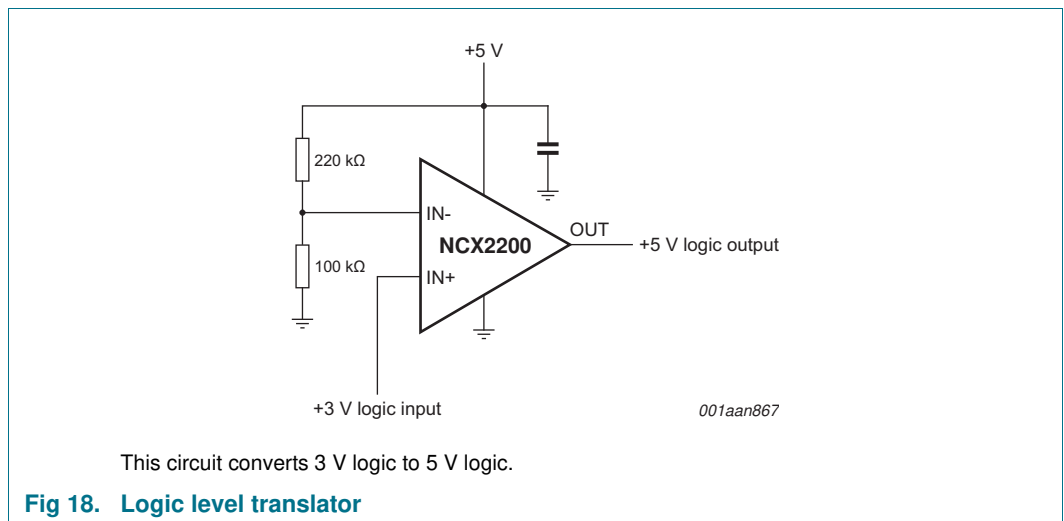
**13.5 One-shot multivibrator**

Figure 17 shows the NCX2200 configured as a one-shot multivibrator.



**13.6 Logic level translator**

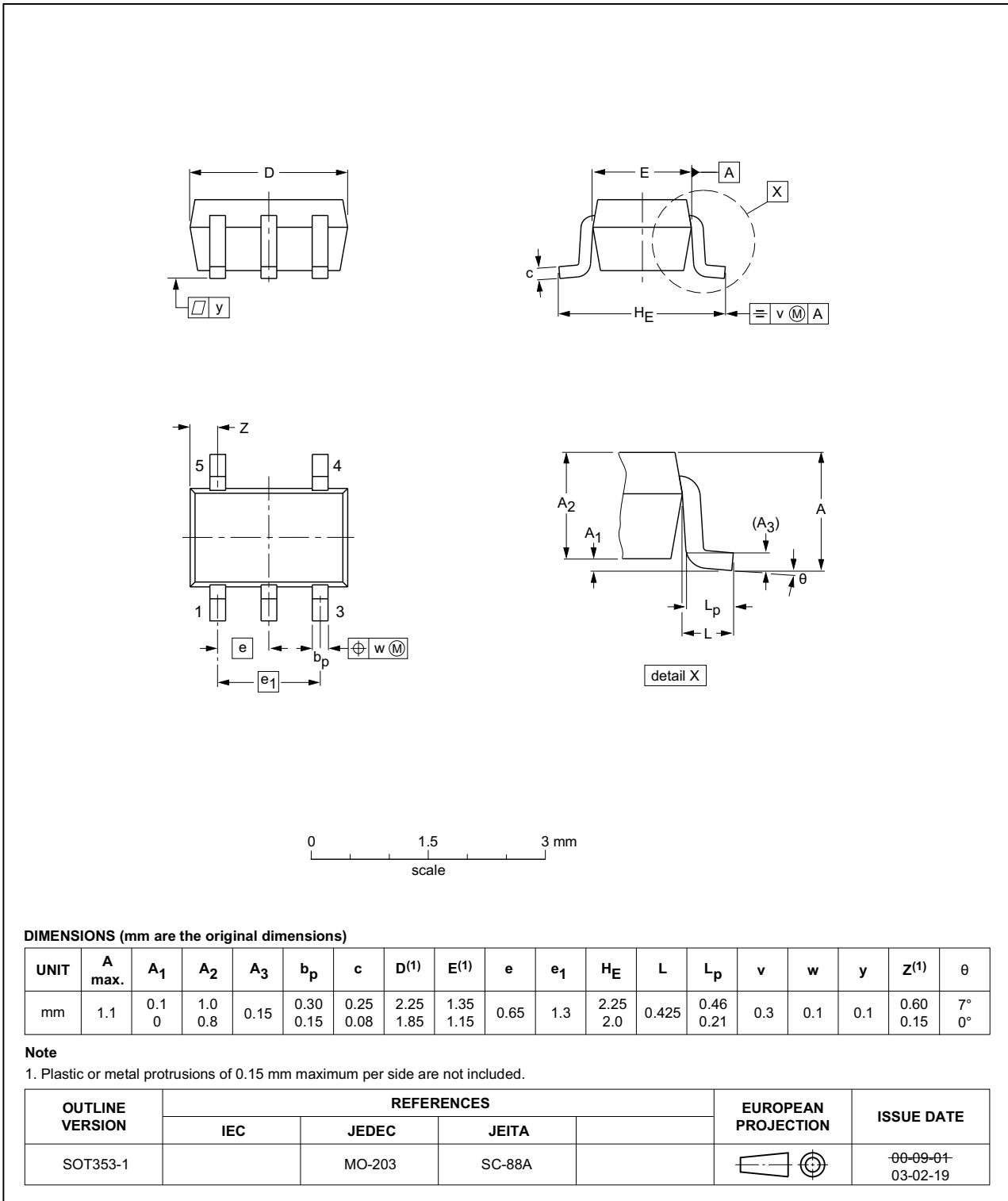
Figure 18 shows the NCX2200 configured as a logic level translator.



**14. Package outline**

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

SOT353-1



**Fig 19. 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

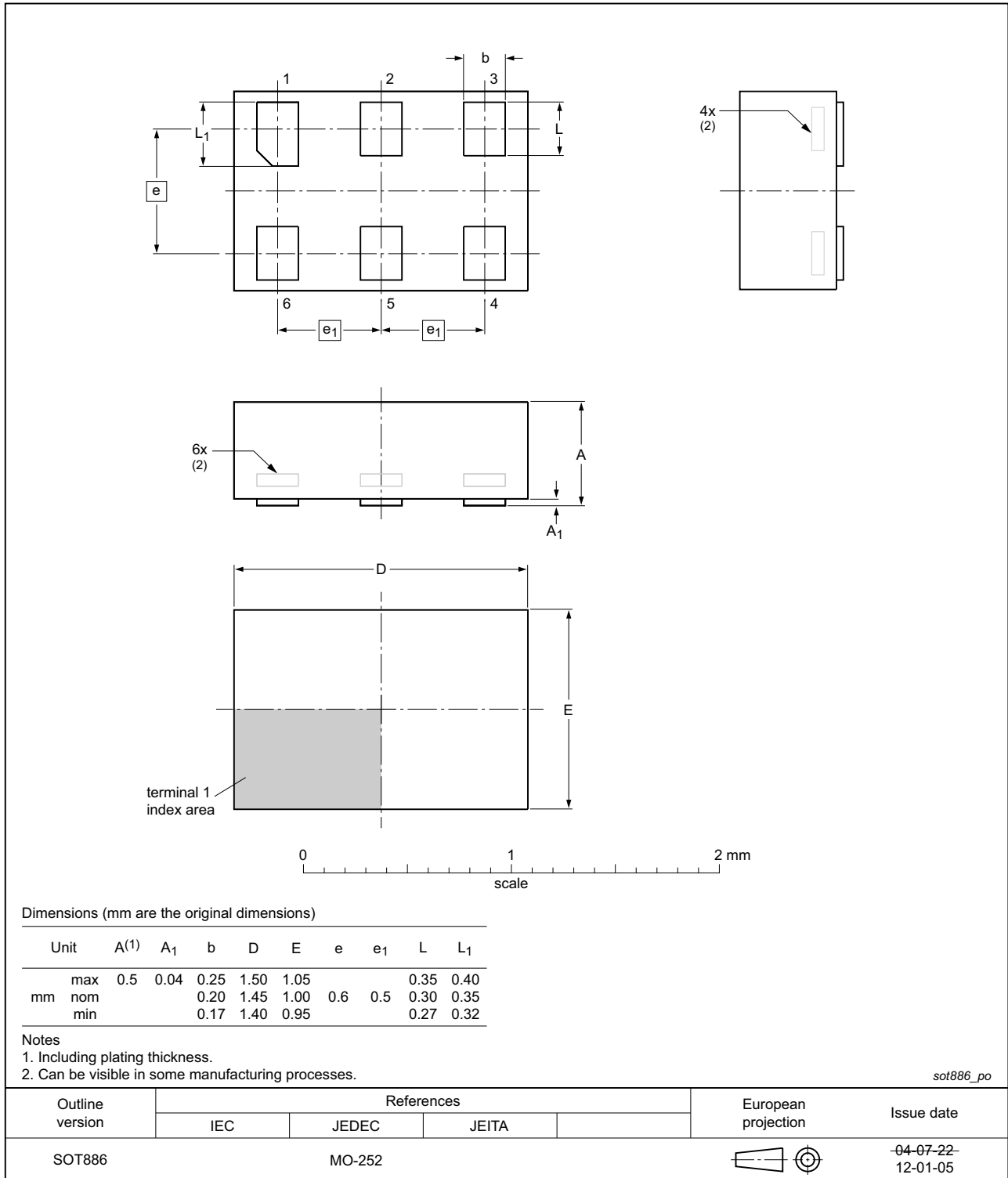


Fig 20. Package outline SOT886 (XSON6)

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

SOT891

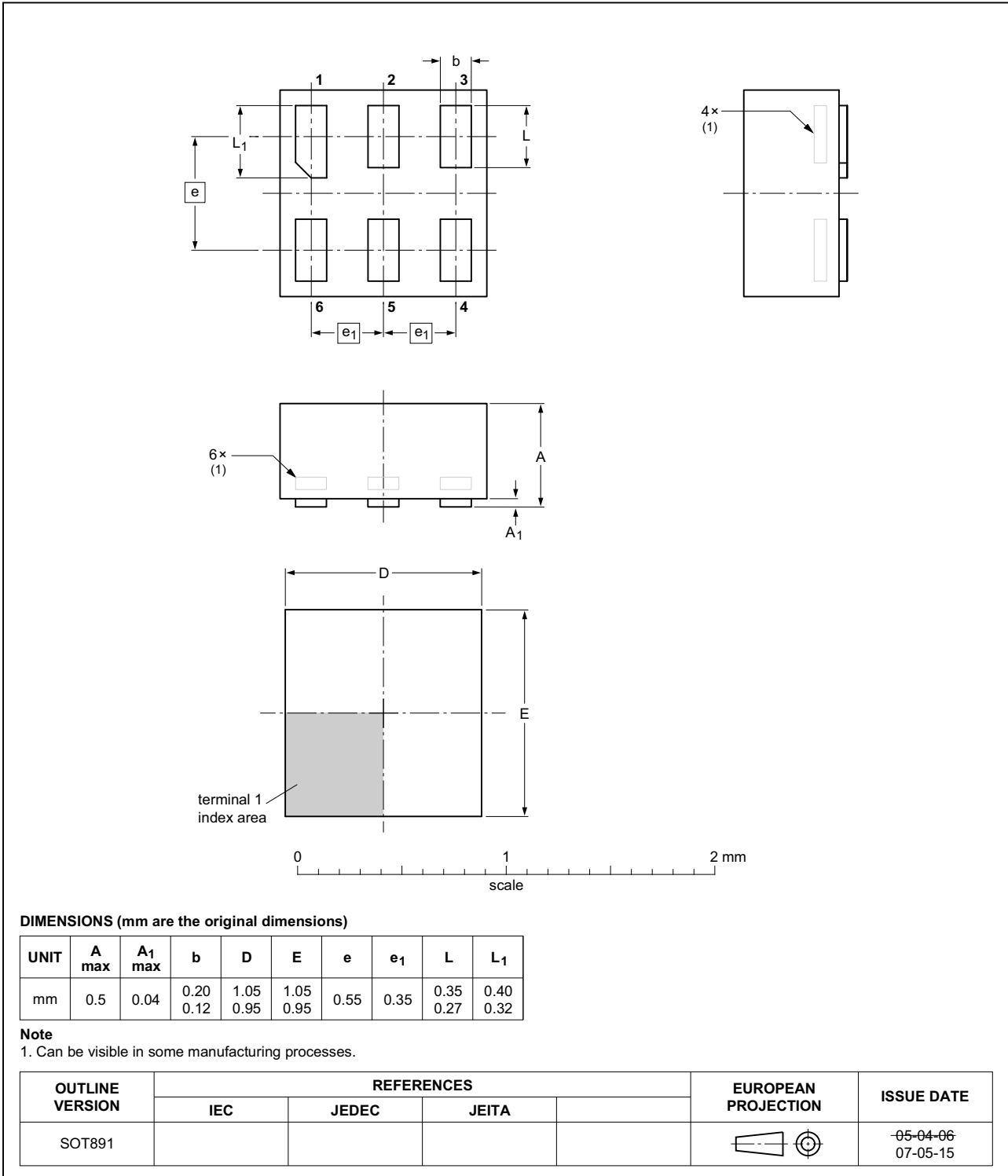
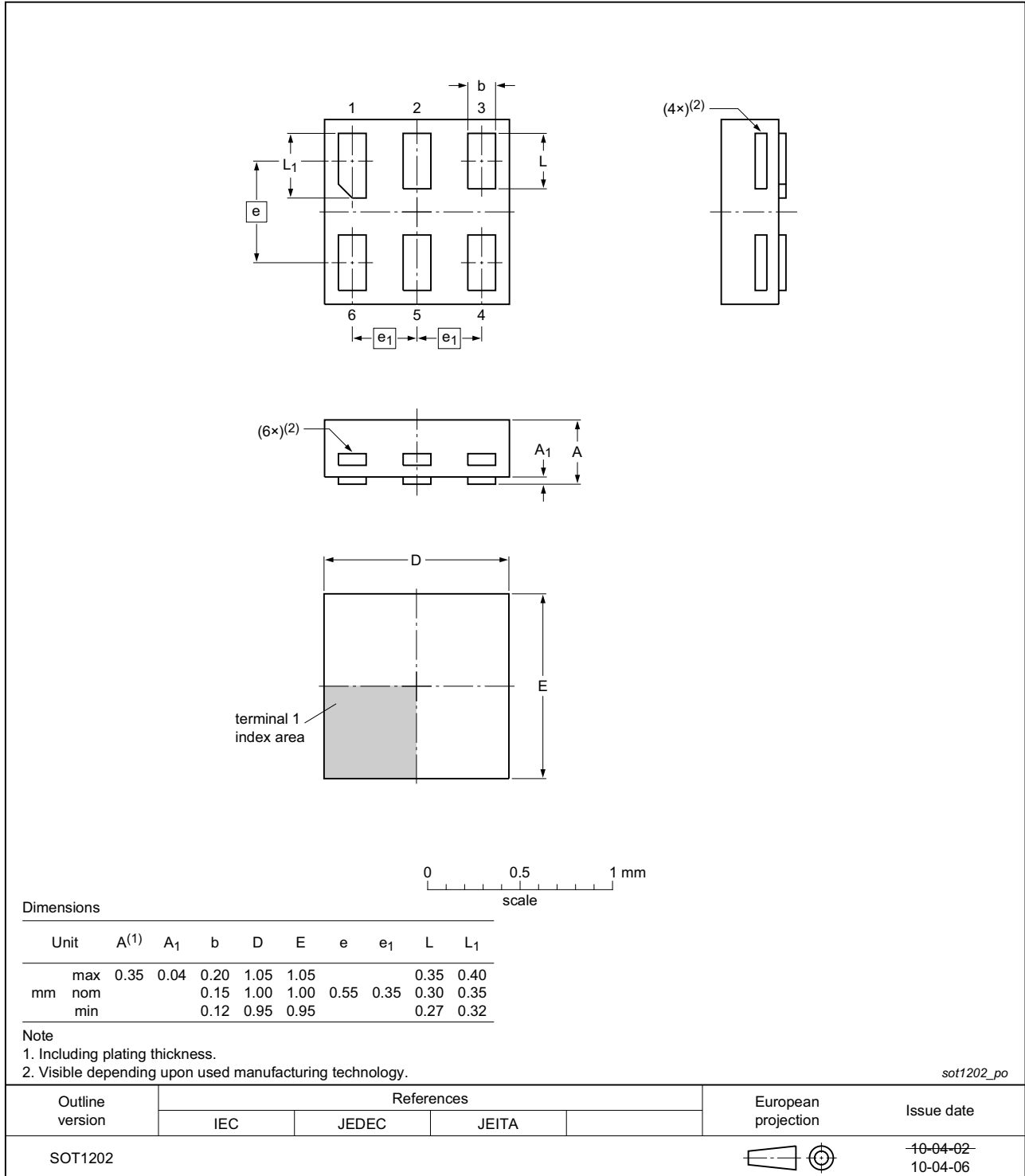


Fig 21. Package outline SOT891 (XSON6)



**XSON6: extremely thin small outline package; no leads;  
6 terminals; body 1.0 x 1.0 x 0.35 mm**

**SOT1202**



**Fig 22. Package outline SOT1202 (XSON6)**

## 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
NCX2200 v6	20140709	Product data sheet	-	NCX2200 v.5
Modifications:	<ul style="list-style-type: none"> <li>Package SOT1202 added.</li> </ul>			
NCX2200 v5	20120806	Product data sheet	-	NCX2200 v.4
Modifications:	<ul style="list-style-type: none"> <li>Package outline drawing of SOT886 (<a href="#">Figure 20</a>) modified.</li> </ul>			
NCX2200 v4	20111110	Product data sheet	-	NCX2200 v.3
Modifications:	<ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>			
NCX2200 v.3	20111014	Product data sheet	-	NCX2200 v.2
NCX2200 v.2	20110706	Product data sheet	-	NCX2200 v.1
NCX2200 v.1	20110322	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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