

# NCX2200

## Low voltage comparator

Rev. 6.1 — 21 November 2019

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	Topside mark <sup>[1]</sup>	Package		Version
		Name	Description	
NCX2200GW	q1	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
NCX2200GM	q1	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
NCX2200GM	X0	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm; requires SSB	SOT886
NCX2200GF3	q3	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm	SOT891
NCX2200GS	q1	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202

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

### 4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
NCX2200GW	NCX2200GW,125	TSSOP5	reel 7" q3 ndp	3000	-40 °C to 85 °C
NCX2200GM	NCX2200GM,115 <sup>[1]</sup>	XSON6	reel 7" q1 ndp	5000	-40 °C to 85 °C
NCX2200GM	NCX2200GMAZ	XSON6	reel 7" q1 ndp SSB <sup>[3]</sup>	5000	-40 °C to 85 °C
NCX2200GM	NCX2200GM,132 <sup>[2]</sup>	XSON6	reel 7" q1/q3 ndp	5000	-40 °C to 85 °C
NCX2200GM	NCX2200GMBZ	XSON6	reel 7" q3 ndp SSB <sup>[3]</sup>	5000	-40 °C to 85 °C
NCX2200GF3	NCX2200GF3,132	XSON6	reel 7" q1/q3 ndp	5000	-40 °C to 85 °C
NCX2200GS	NCX2200GSH	XSON6	reel 7" q3 ndp	5000	-40 °C to 85 °C

[1] Will go EOL - migrate to new leadframe orderable part number NCX2200GMAZ.

[2] Will go EOL - migrate to new leadframe orderable part number NCX2200GMBZ.

[3] This packing method uses a Static Shielding Bag (SSB) solution. Material is to be kept in the sealed bag between uses.

## 5. Functional diagram



Fig 1. Logic symbol

## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3. Pin description

Symbol	Pin				Description
	SOT353-1	SOT886	SOT891	SOT1202	
OUT	1	1	6	6	comparator output
V <sub>EE</sub>	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
V <sub>CC</sub>	5	6	2, 5	2, 5	supply voltage

## 7. 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.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	$V_{CC}$ to $V_{EE}$				
		full spec operating range	1.6	-	5.5	V
		functional operating range	1.3	-	5.5	V
$V_I$	input voltage		$V_{EE}$	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+85	°C

## 9. 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] $V_{CC} = 1.3\text{ V}$	-30	0.5	+30	-30	+30	mV
		[1] $V_{CC} = 1.3\text{ V}$	-	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		-	6.0	-	-	9.0	$\mu\text{A}$

[1] Differential input switching level is guaranteed at the minimum or maximum offset voltage, minus or plus half the maximum hysteresis voltage.

## 10. 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.

## 11. Graphs



$V_{CC} = 5.0\text{ V}$ .

**Fig 5. Supply current versus temperature**



$T_{amb} = 25\text{ °C}$ ;  $C_L = 15\text{ pF}$ .

(1)  $V_{CC} = 2.7\text{ V}$ .

(2)  $V_{CC} = 5.0\text{ V}$ .

**Fig 6. Supply current versus output transition frequency**



- (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**



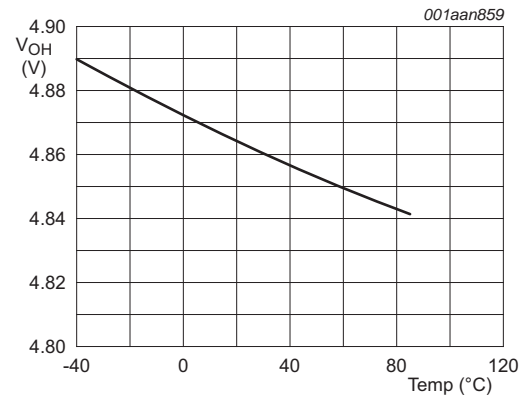
$T_{amb} = 25\text{ }^{\circ}\text{C}$ .  
 $V_{CC} = 5.0\text{ V}$ .

**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**



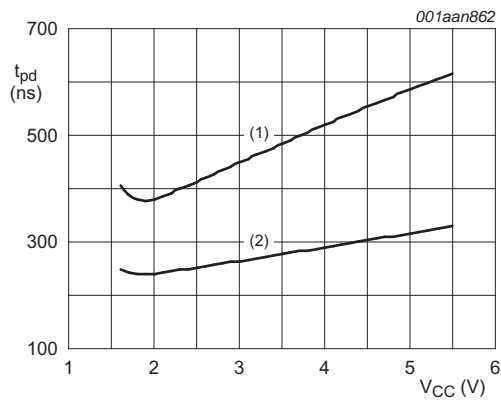
I<sub>O</sub> = 4.0 mA.  
V<sub>CC</sub> = 5.0 V.

Fig 11. LOW-level output voltage versus temperature



V<sub>CC</sub> = 5.0 V; input overdrive = 50 mV.  
(1) t<sub>PLH</sub>.  
(2) t<sub>PHL</sub>.

Fig 12. 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 13. Propagation delay versus supply voltage.

## 12. Application information

### 12.1 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.

### 12.2 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](#)

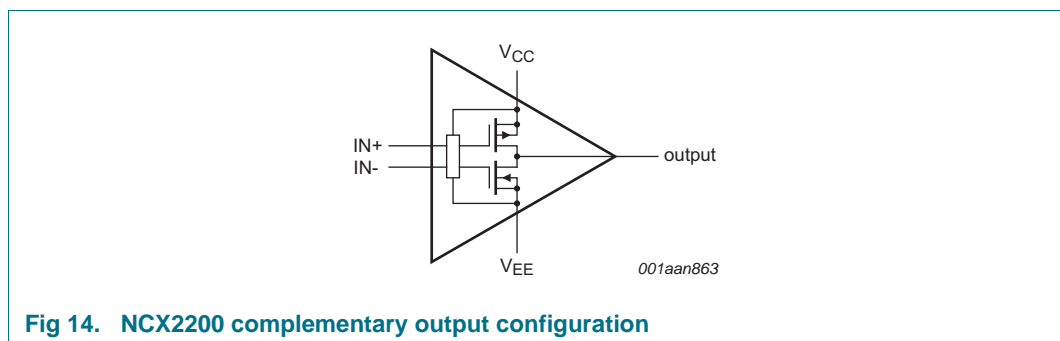


Fig 14. NCX2200 complementary output configuration



### 12.3 Schmitt trigger oscillator

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



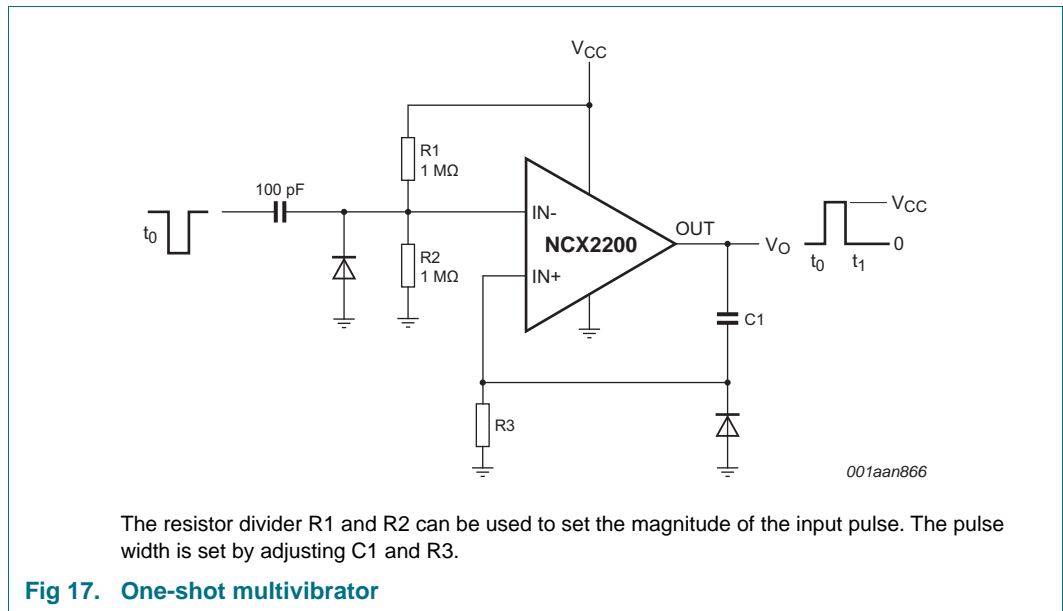
### 12.4 Zero-crossing detector

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



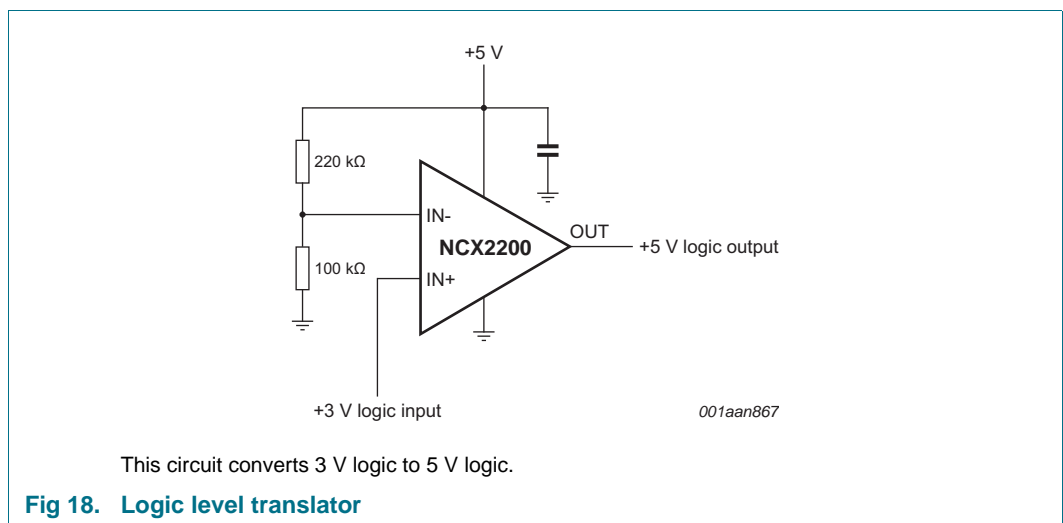
### 12.5 One-shot multivibrator

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



### 12.6 Logic level translator

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



### 13. 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

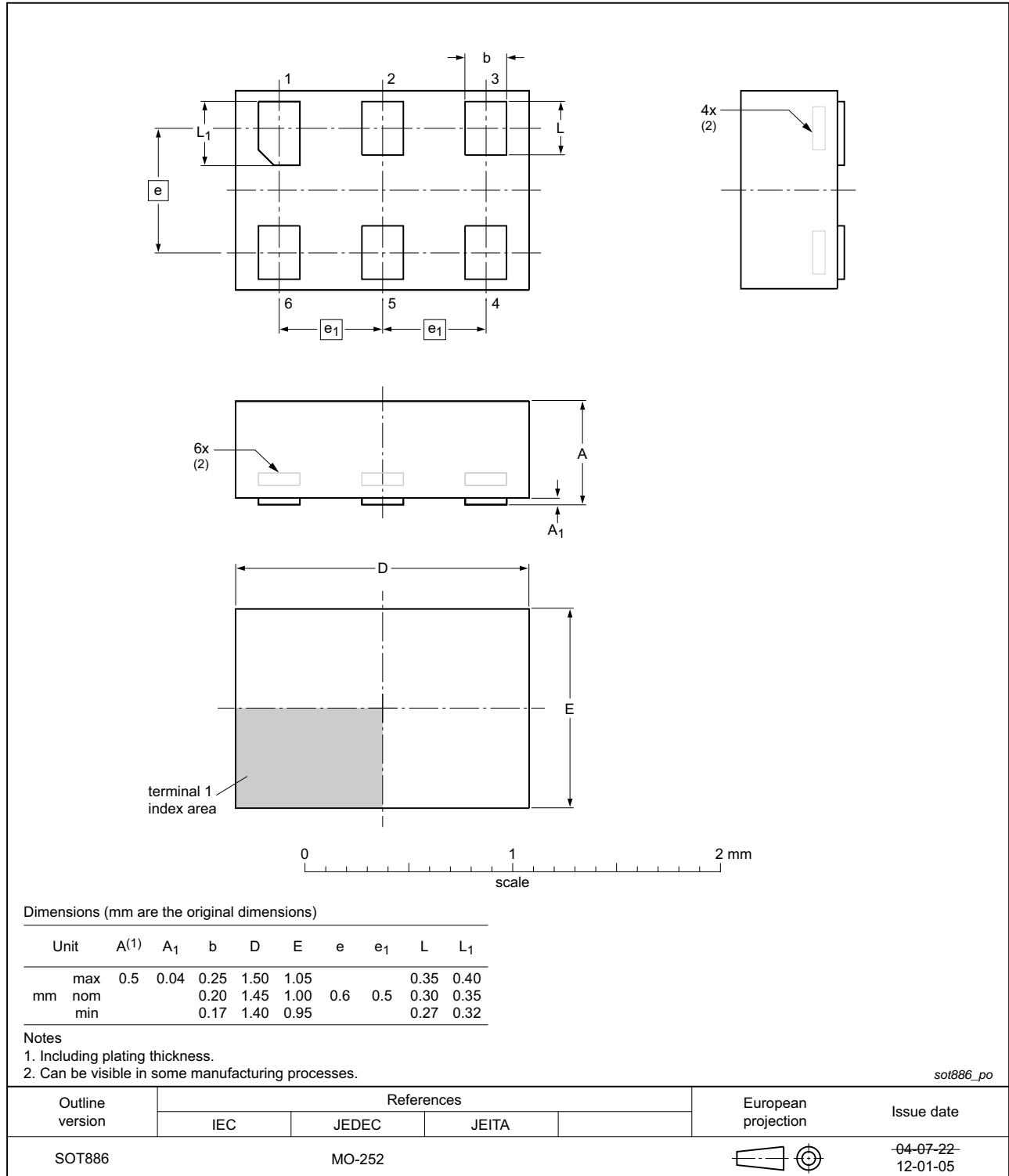


Fig 20. Package outline SOT886 (XSON6)

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

SOT891

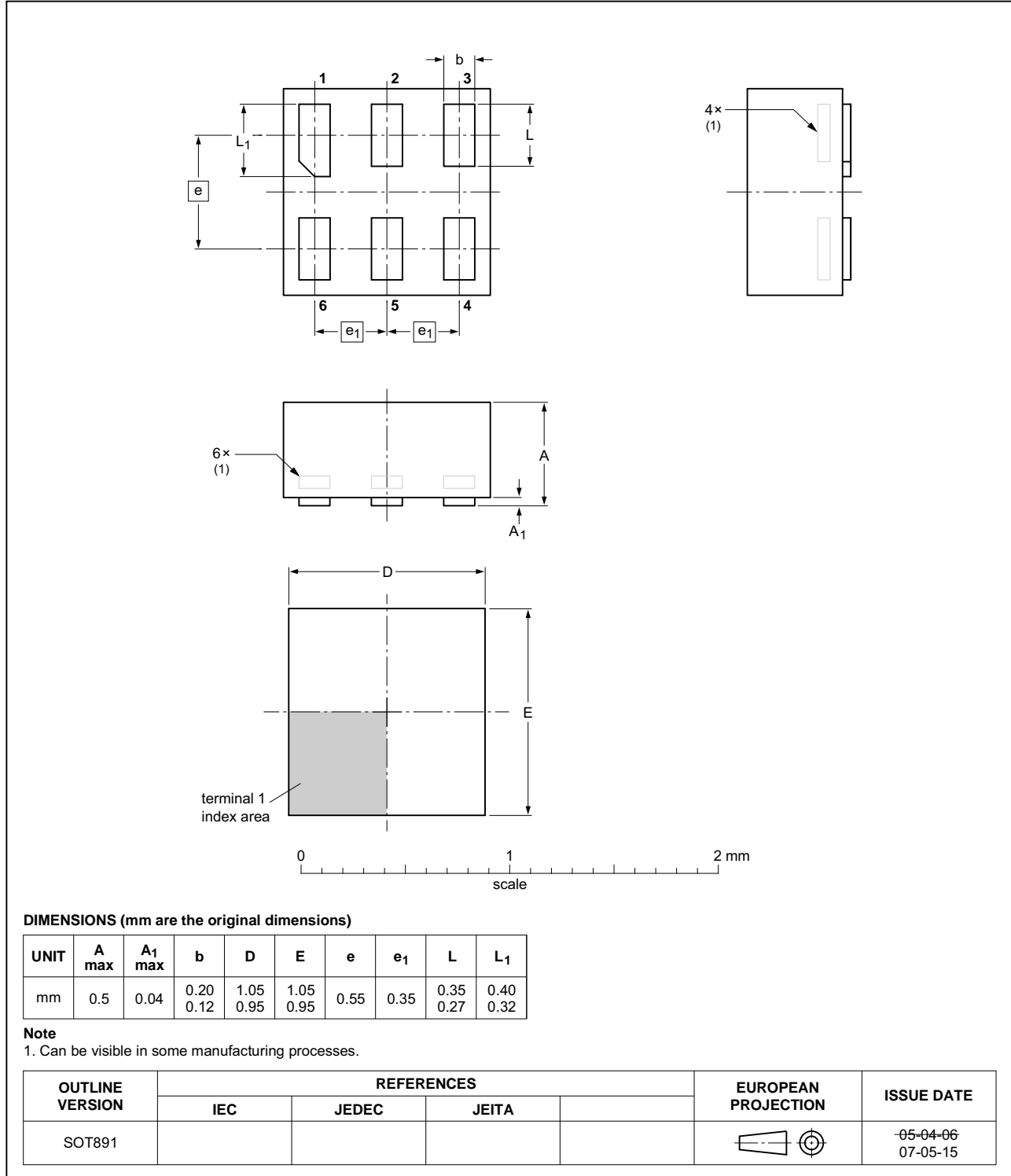


Fig 21. Package outline SOT891 (XSON6)

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

SOT1202

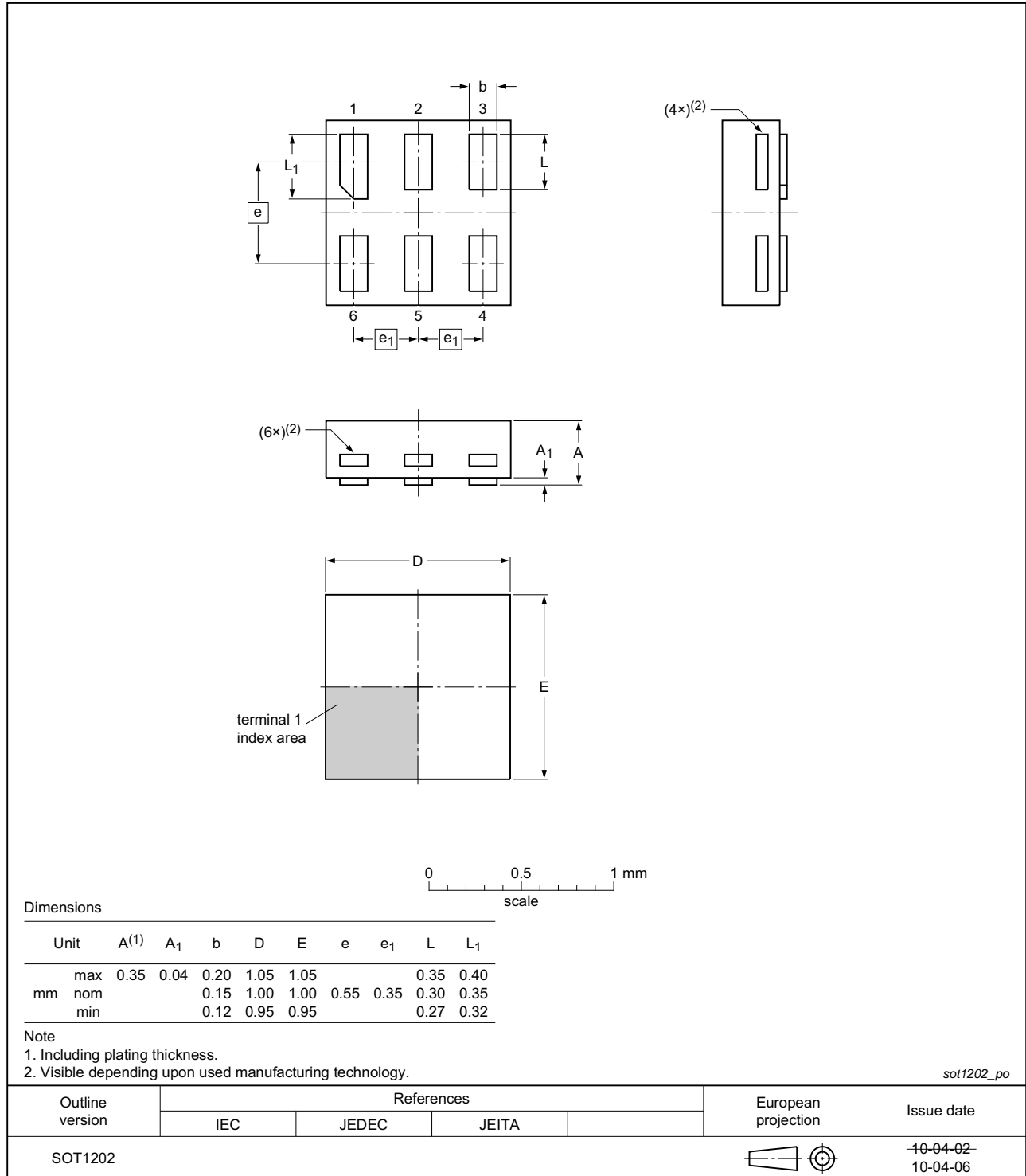


Fig 22. Package outline SOT1202 (XSON6)

## 14. Abbreviations

Table 8. Abbreviations

Acronym	Description
CDM	Charged Device Model
ESD	ElectroStatic Discharge
HBM	Human Body Model

## 15. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NCX2200 v6.1	20191121	Product data sheet	201909001A; 201909026A	NCX2200 v.6
Modifications:	<ul style="list-style-type: none"> <li>Package SOT886 requiring SSB added. Refer to PCN number 201909001A XSON6 (SOT886) Assembly/Test Transfer from ATGD and ATSN to ATBK</li> </ul>			
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	-	-

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Product [short] data sheet	Production	This document contains the product specification.

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