NCX2220

Low voltage comparator

Rev. 4 — 27 June 2012 Product data sheet

1. General description

The NCX2220 provides a dual low voltage low power comparator.

The NCX2220 has a very low supply current of 5 µA 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

- 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 µA (typical) per comparator
- Very low-power consumption
- No phase inversion with overdriven input signals
- Internal hysteresis
- Propagation delay of 0.8 µs (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

- 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[1]
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[1]
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

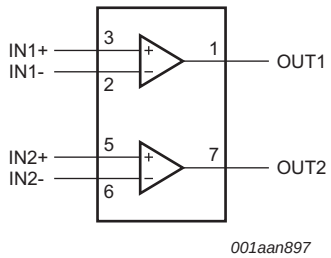
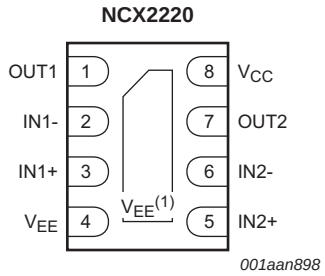


Fig 1. Logic symbol

7. Pinning information

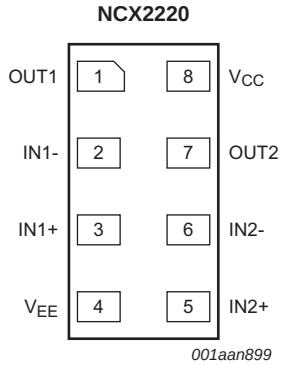
7.1 Pinning



Transparent top view

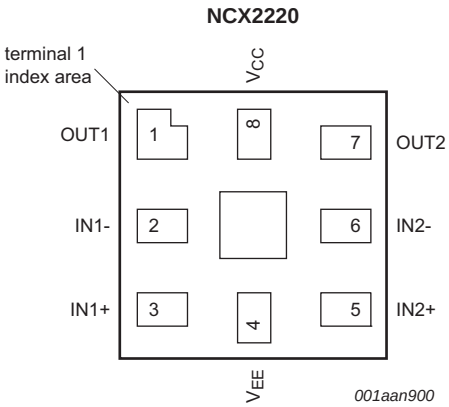
(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad however if it is soldered the solder land should remain floating or be connected to V_{EE}.

Fig 2. Pin configuration SOT972-2



Transparent top view

Fig 3. Pin configuration SOT833-1 and SOT1089



Transparent top view

Fig 4. Pin configuration SOT902-2

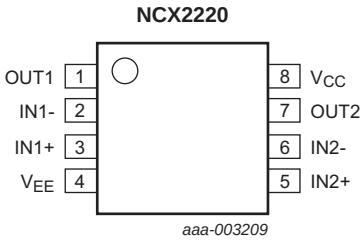


Fig 5. Pin configuration SOT505-2

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_{EE}	4	supply voltage
IN2+	5	comparator input 2 (positive)
IN2–	6	comparator input 2 (negative)
OUT2	7	comparator output 2
V_{CC}	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_{EE}.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-	7.0	V
V_I	input voltage	IN1–, IN1+, IN2–, IN2+ inputs	–0.5	V_{CC} + 0.5	V
t_{sc}	short circuit duration time	[1]	-	indefinite	s
$T_{j(max)}$	maximum junction temperature		-	+150	°C
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	total power dissipation	T_{amb} = –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_{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

10. Static characteristics

Table 6. Static characteristics

At recommended operating conditions. V_{CC} = 1.6 V to 5.5 V, V_{EE} = 0 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 V		-	20	-	-	-	mV
$V_{I(offset)}$	offset input voltage		[1]	–30	0.5	+30	–30	+30	mV
		V_{CC} = 1.3 V	[1]	-	3	-	-	-	mV
V_{OH}	HIGH-level output voltage	I_O = –0.5 mA; V_{CC} = 1.3 V		-	1.24	-	-	-	V
		I_O = –0.5 mA; V_{CC} = 1.6 V		-	1.55	-	1.35	-	V
		I_O = –3 mA; V_{CC} = 3.0 V		-	2.85	-	2.7	-	V
		I_O = –5 mA; V_{CC} = 5.5 V		-	5.33	-	5.2	-	V
V_{OL}	LOW-level output voltage	I_O = 0.5 mA; V_{CC} = 1.3 V		-	0.05	-	-	-	V
		I_O = 0.5 mA; V_{CC} = 1.6 V		-	0.04	-	-	0.25	V
		I_O = 3 mA; V_{CC} = 3.0 V		-	0.14	-	-	0.3	V
		I_O = 5 mA; V_{CC} = 5.5 V		-	0.20	-	-	0.3	V
V_{CM}	common-mode voltage	V_{CC} = 1.3 V to 5.5 V		-	V_{EE} to V_{CC}	-	-	-	V
I_{OS}	output short-circuit current	V_{CC} = 5.5 V; V_O = V_{EE} or V_{CC}		-	68	-	-	-	mA
CMRR	common-mode rejection ratio	ΔV_{CM} = V_{CC}		-	70	-	-	-	dB
PSRR	power supply rejection ratio	ΔV_{CC} = 1.95 V		45	80	-	-	-	dB
I_{IB}	input bias current			-	1.0	-	-	-	pA
I_{CC}	supply current	per comparator		-	5.0	-	-	7.0	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

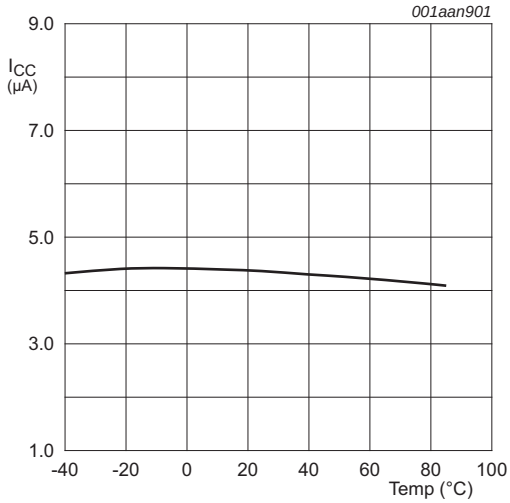
Voltages are referenced to V_{EE} (V_{EE} = 0 V);V_{CC} = 1.6 V to 5.5 V; V_{CM} = 0.5V_{CC} unless otherwise specified.

Symbol	Parameter	Conditions		25 °C			Unit
				Min	Typ	Max	
t_{pd}	propagation delay	20 mV overdrive; C_L = 15 pF	[1]	-	0.8	-	µs
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}.

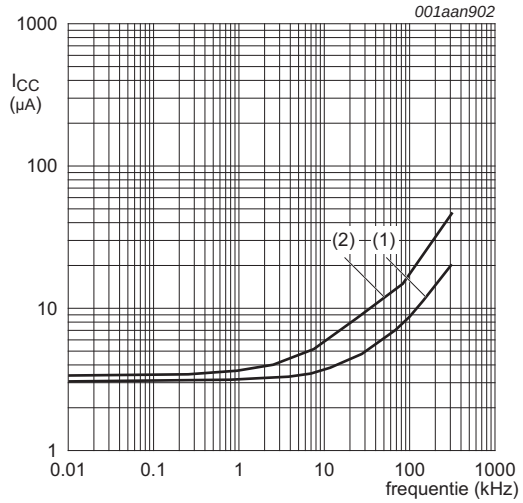
[2] Input signal: 1 kHz, squarewave signal with 10 ns edge rate.

12. Graphs



V_{CC} = 5.0 V.

Fig 6. Supply current versus temperature (per comparator)

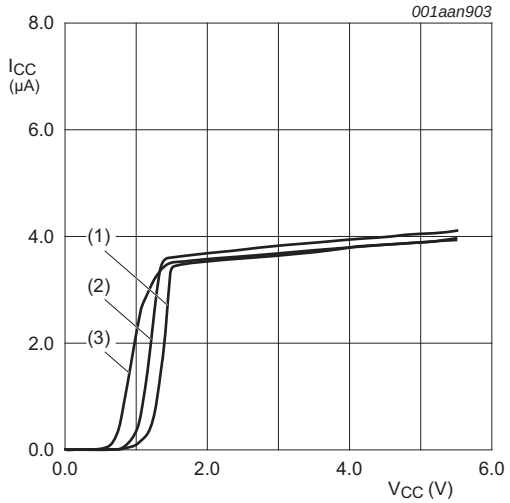


T_{amb} = 25 °C; C_L = 15 pF.

(1) V_{CC} = 2.7 V.

(2) V_{CC} = 5.0 V.

Fig 7. Supply current versus output transition frequency (per comparator)

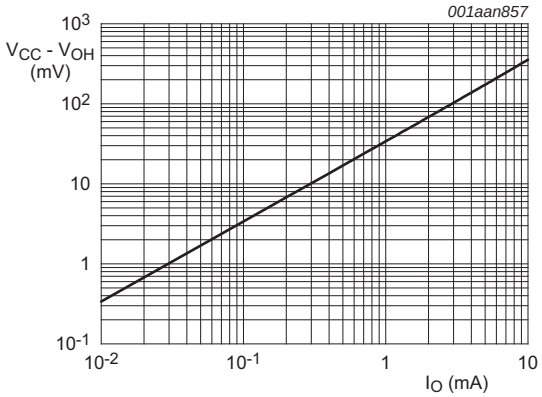


(1) T_{amb} = –40 °C.

(2) T_{amb} = 25 °C.

(3) T_{amb} = 85 °C.

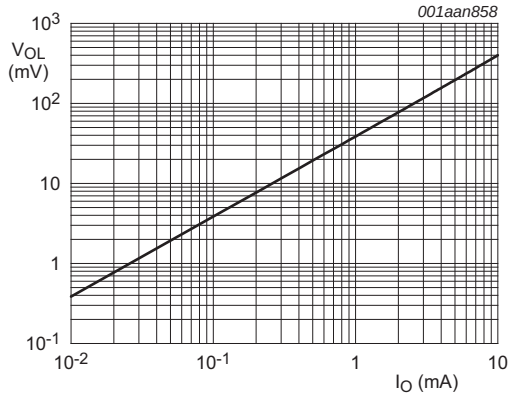
Fig 8. Supply current versus supply voltage (per comparator)



T_{amb} = 25 °C.

V_{CC} = 5.0 V.

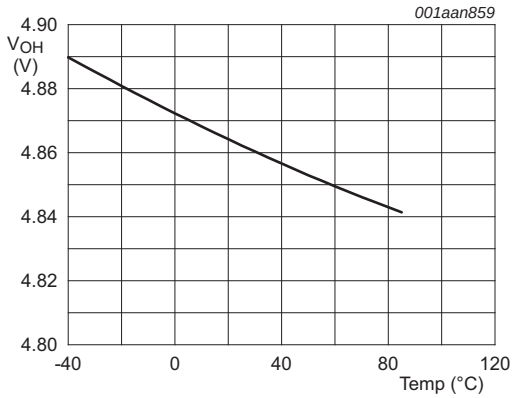
Fig 9. HIGH-level output voltage versus output current



T_{amb} = 25 °C.

V_{CC} = 5.0 V.

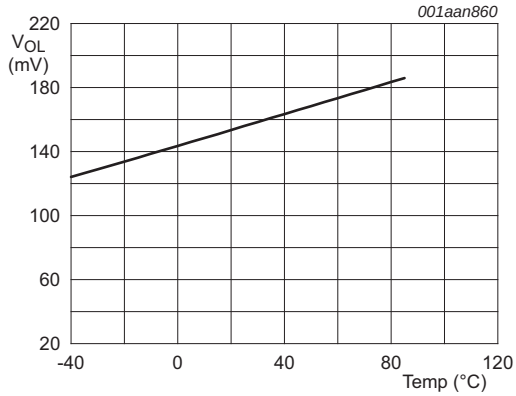
Fig 10. LOW-level output voltage versus output current



I_O = –4.0 mA.

V_{CC} = 5.0 V.

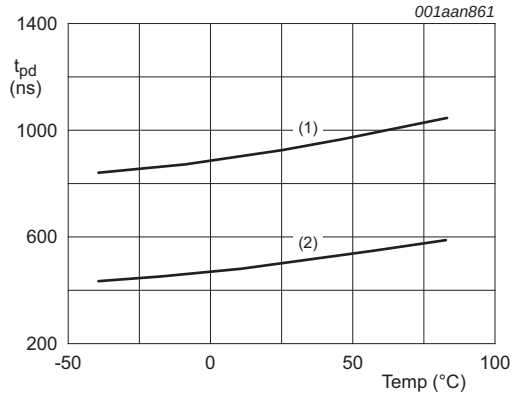
Fig 11. HIGH-level output voltage versus temperature



I_O = 4.0 mA.

V_{CC} = 5.0 V.

Fig 12. LOW-level output voltage versus temperature

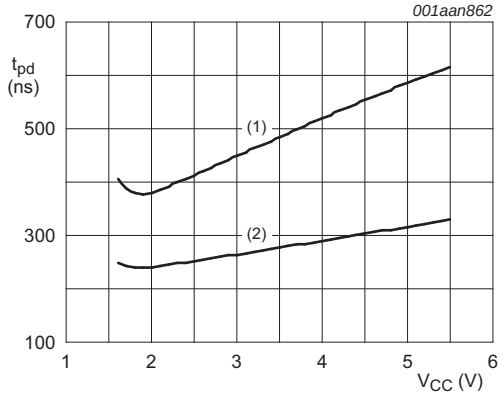


V_{CC} = 5.0 V; input overdrive = 50 mV.

(1) t_{PLH}.

(2) t_{PHL}.

Fig 13. Propagation delay versus temperature



T_{amb} = 25 °C; input overdrive = 100 mV.

(1) t_{PLH}.

(2) t_{PHL}.

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 µA per comparator of supply current while achieving a typical propagation delay of 0.8 µs 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

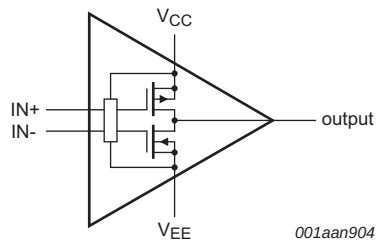
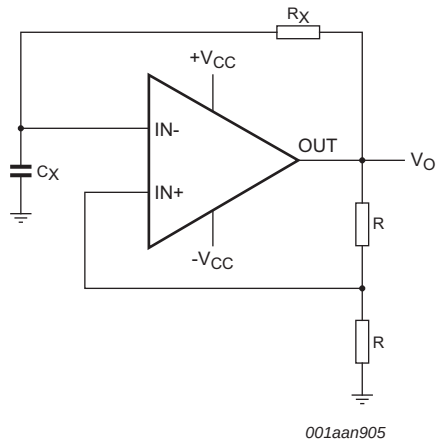


Fig 15. NCX2220 complementary output configuration (one comparator)

13.3 Schmitt trigger oscillator

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



The oscillation frequency can be calculated as follows:

$$f = \frac{1}{T} = \frac{1}{2.2 \cdot R_X \cdot C_X}$$

Fig 16. Schmitt trigger oscillator

13.4 Zero-crossing detector

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

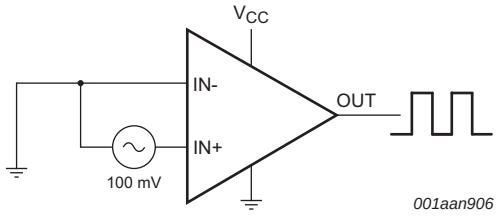
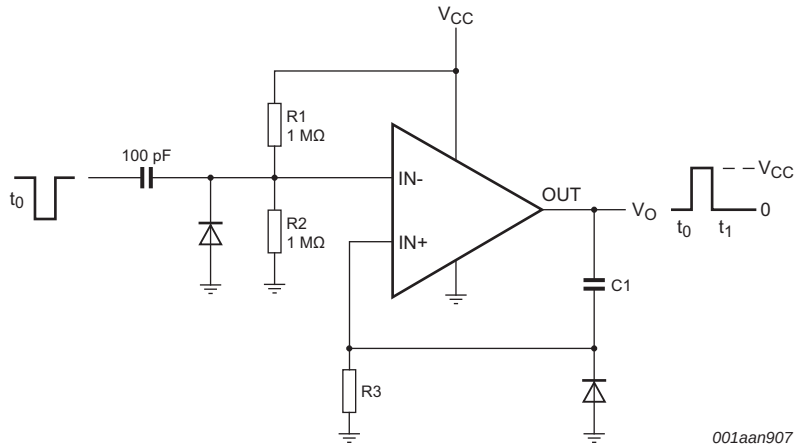


Fig 17. Zero-crossing detector

13.5 One-shot multivibrator

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

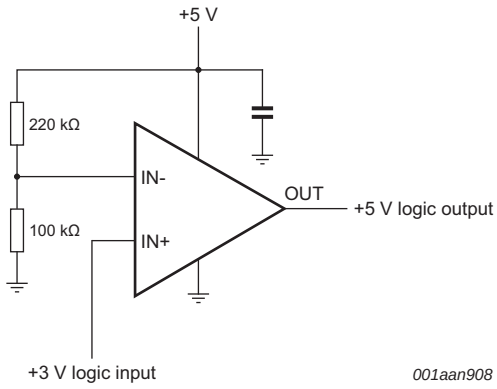


The resistor divider R1 and R2 can be used to set the magnitude of the input pulse. The pulse width is set by adjusting C1 and R3.

Fig 18. One-shot multivibrator

13.6 Logic level translator

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

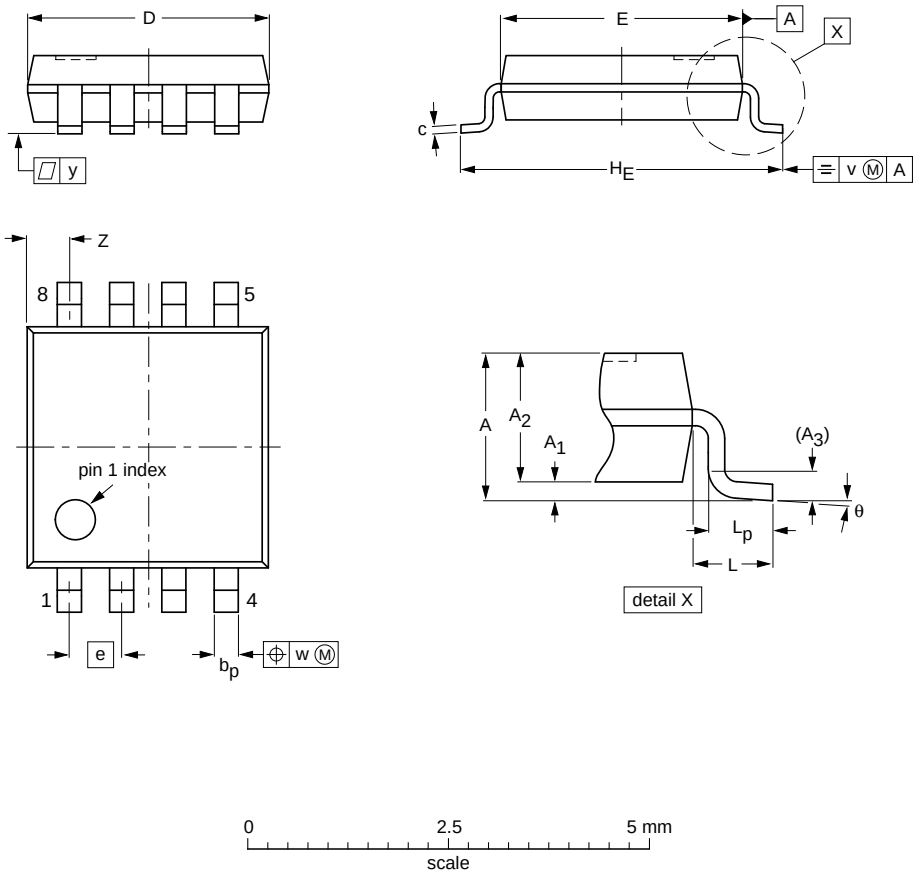


This circuit converts 3 V logic to 5 V logic.

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



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.00	0.95 0.75	0.25	0.38 0.22	0.18 0.08	3.1 2.9	3.1 2.9	0.65	4.1 3.9	0.5	0.47 0.33	0.2	0.13	0.1	0.70 0.35	8° 0°

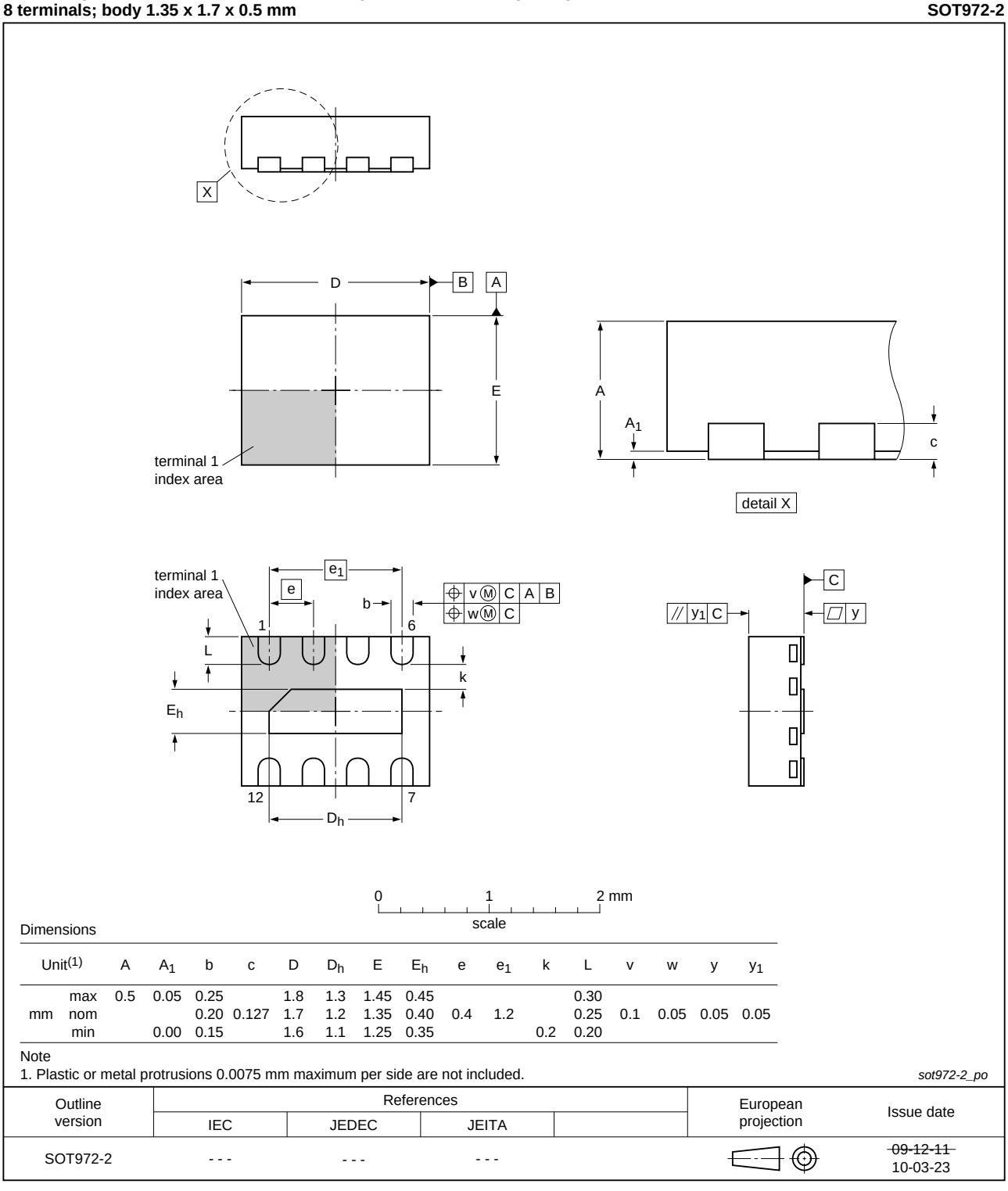
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT505-2		- - -				02-01-16

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**



Dimensions

Unit(1)		A	A_1	b	c	D	D_h	E	E_h	e	e_1	k	L	v	w	y	y_1
	max	0.5	0.05	0.25		1.8	1.3	1.45	0.45				0.30				
mm	nom			0.20	0.127	1.7	1.2	1.35	0.40	0.4	1.2		0.25	0.1	0.05	0.05	0.05
	min		0.00	0.15		1.6	1.1	1.25	0.35			0.2	0.20				

Note

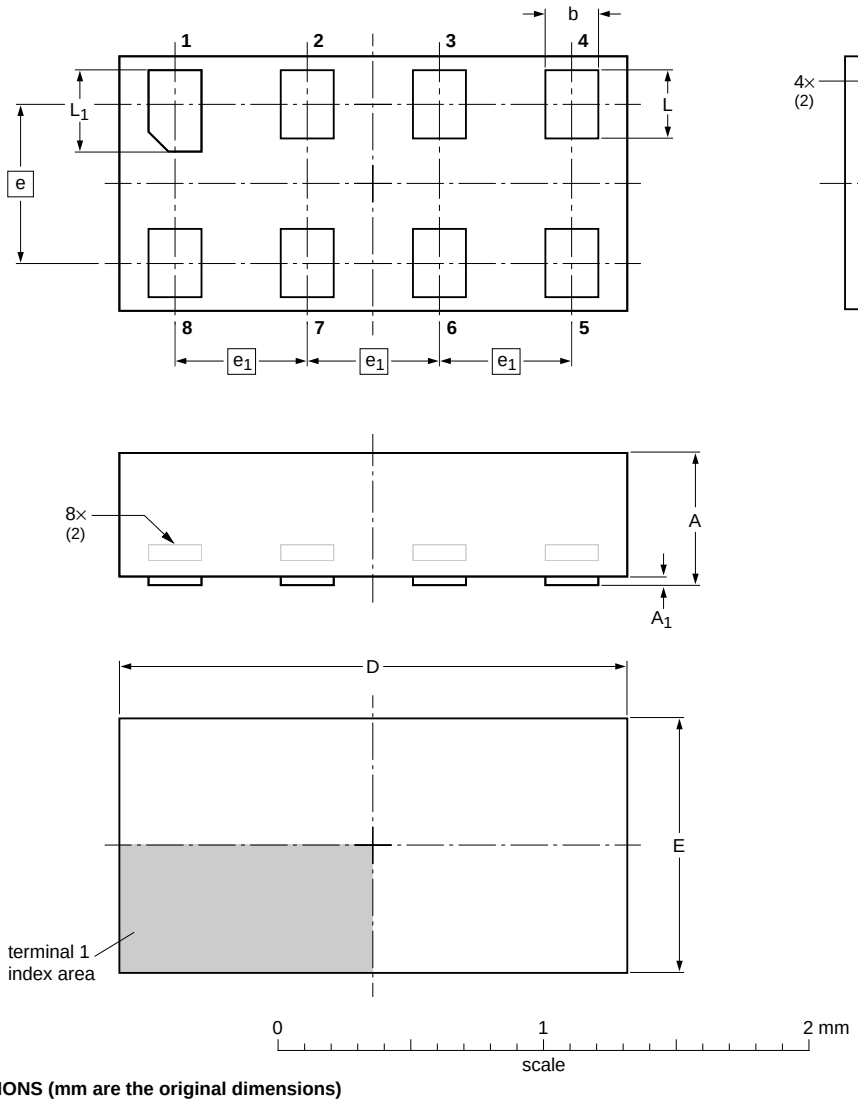
1. Plastic or metal protrusions 0.0075 mm maximum per side are not included.

sot972-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT972-2	- - -	- - -	- - -			~~09-12-11~~ 10-03-23

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**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max	A1 max	b	D	E	e	e1	L	L1
mm	0.5	0.04	0.25 0.17	2.0 1.9	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

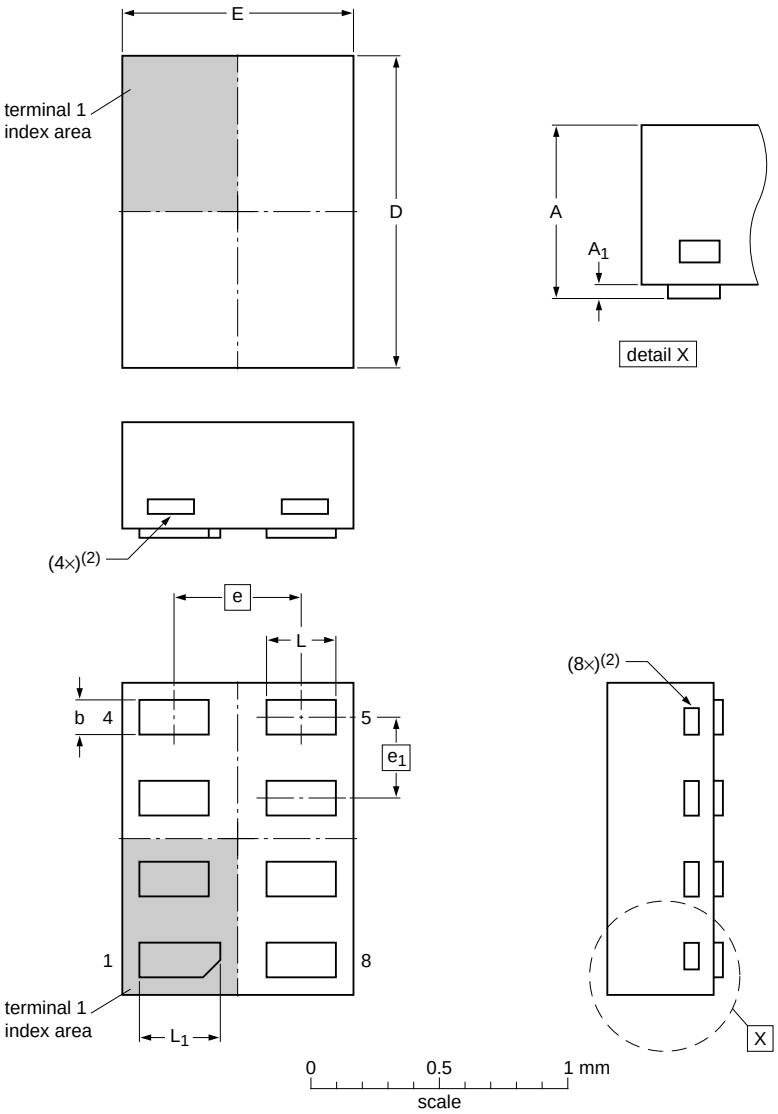
Notes

1. Including plating thickness.
2. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT833-1	- - -	MO-252	- - -			~~07-11-14~~ 07-12-07

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**



Dimensions

Unit		A(1)	A1	b	D	E	e	e1	L	L1
mm	max	0.5	0.04	0.20	1.40	1.05			0.35	0.40
	nom			0.15	1.35	1.00	0.55	0.35	0.30	0.35
	min			0.12	1.30	0.95			0.27	0.32

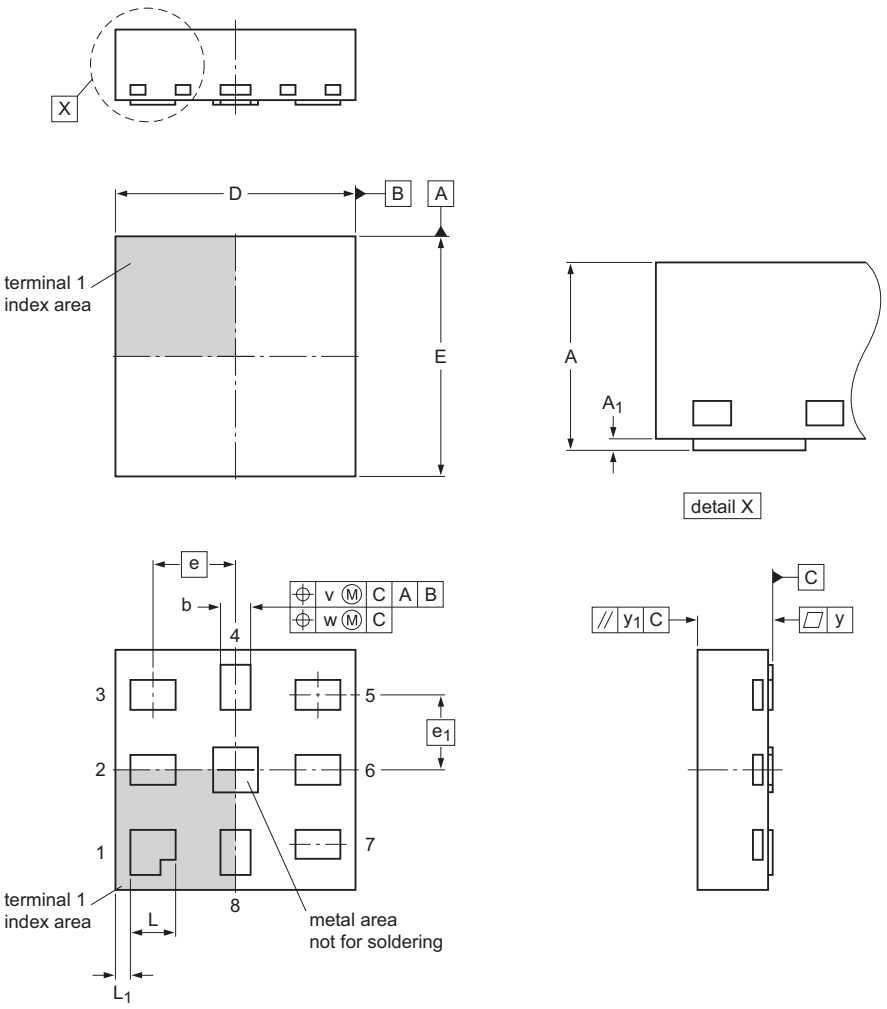
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1089_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1089		MO-252				~~10-04-09~~ 10-04-12

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**



Dimensions

Unit(1)		A	A_1	b	D	E	e	e_1	L	L_1	v	w	y	y_1
mm	max	0.5	0.05	0.25	1.65	1.65	0.55	0.5	0.35	0.15	0.1	0.05	0.05	0.05
	nom			0.20	1.60	1.60			0.30	0.10				
	min		0.00	0.15	1.55	1.55			0.25	0.05				

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot902-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT902-2	- - -	MO-255	- - -			~~10-11-02~~ 11-03-31

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:	• For type number NCX2220GM the SOT code has changed to SOT902-2. • NCX2220DP added.			
NCX2220 v.3	20111110	Product data sheet	-	NCX2220 v.2
Modifications:	• Legal pages updated.			
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[1][2]	Product status[3]	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.
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[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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19. Contents

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Date of release: 27 June 2012
Document identifier: NCX2220

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