NCX2222

Low voltage comparator; open-drain output

Rev. 1 — 20 December 2012 Product data sheet

1. General description

The NCX2222 provides a dual, low voltage, low-power comparator with open-drain outputs.

The NCX2222 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 it 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 1C. Exceeds 1500 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
NCX2222DP	−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
NCX2222GU	−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]
NCX2222GT	−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
NCX2222GF	−40 °C to +85 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1 × 0.5 mm	SOT1089
NCX2222GM	−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]
NCX2222DP	gb
NCX2222GU	gb
NCX2222GT	gb
NCX2222GF	gb
NCX2222GM	gb

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

6. Functional diagram

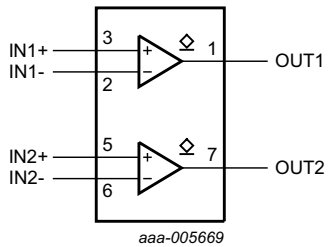
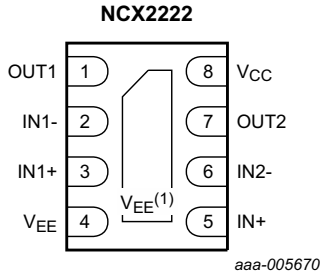


Fig 1. Logic symbol

7. Pinning information

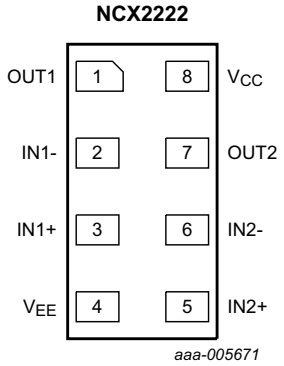
7.1 Pinning



Transparent top view

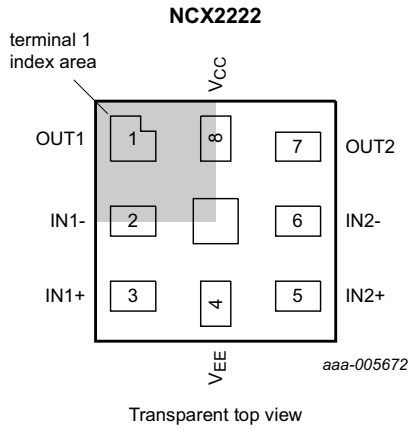
(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land must remain floating or be connected to V_{EE}.

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

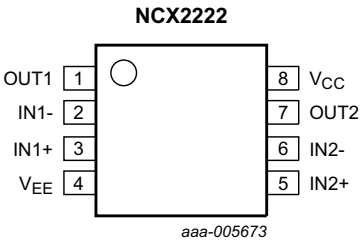


Fig 5. Pin configuration SOT505-2

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
V_O	output voltage			V_{EE} – 0.5	7.0	V
$t_{sc(o)}$	output short-circuit 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] Do not exceed the maximum total power dissipation.

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
V_O	output voltage		V_{EE}	-	5.5	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_{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
I_{OZ}	OFF-state output current	IN– = V_{EE}; IN+ = V_{CC}; V_O = 5.5 V		-	3	-	-	-	nA
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

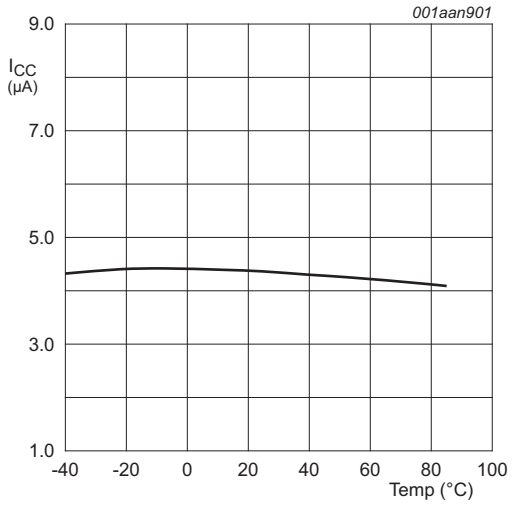
Voltages are referenced to V_{EE} (V_{EE} = 0 V);V_{CC} = 1.6 V to 5.5 V; V_{CM} = 0.5V_{CC} unless otherwise specified.

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_t	transition time	HIGH to LOW; V_{CC} = 5.5 V; C_L = 50 pF	[2]	-	10	-	ns

[1] t_{pd} is the same as t_{PLZ} and t_{PZL}; t_{PLZ} is the actual time that the output is disabled.

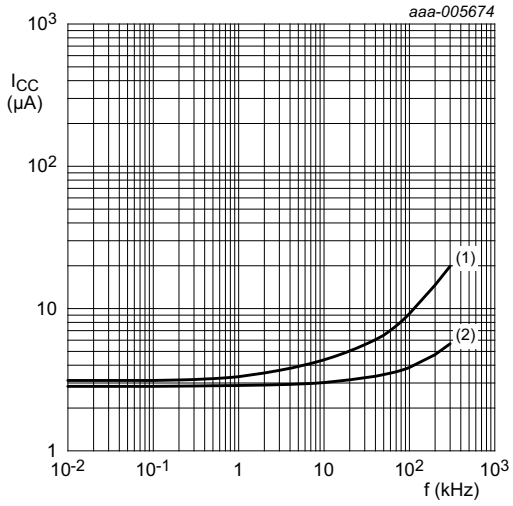
[2] Input signal: 1 kHz, square wave signal with 10 ns edge rate.

12. Graphs



V_{CC} = 5.0 V.

Fig 6. Supply current versus temperature (per comparator)

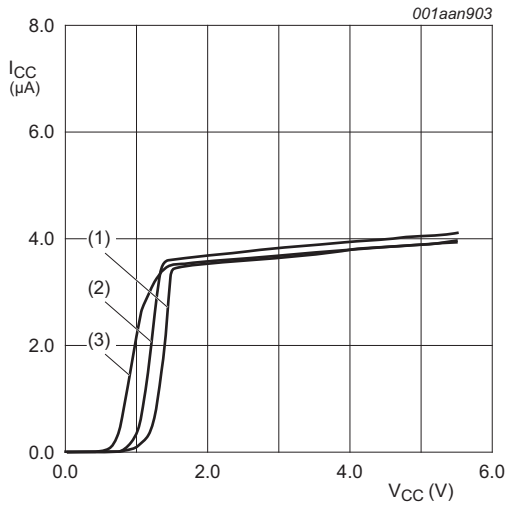


T_{amb} = 25 °C; C_L = 15 pF.

(1) V_{CC} = 5.0 V.

(2) V_{CC} = 2.7 V.

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

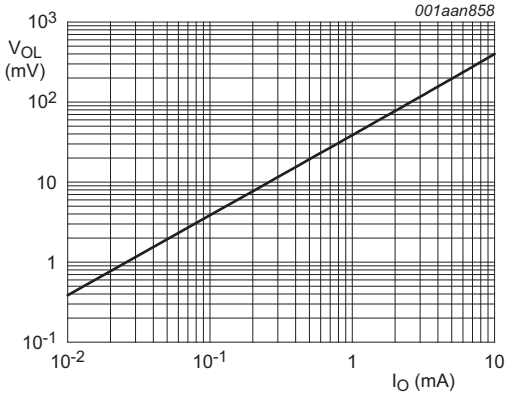


(1) T_{amb} = −40 °C.

(2) T_{amb} = 25 °C.

(3) T_{amb} = 85 °C.

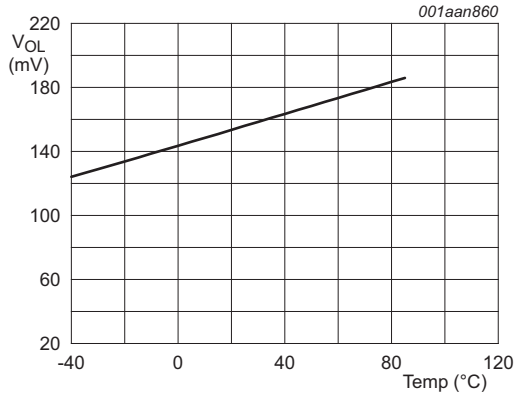
Fig 8. Supply current versus supply voltage (per comparator)



T_{amb} = 25 °C.

V_{CC} = 5.0 V.

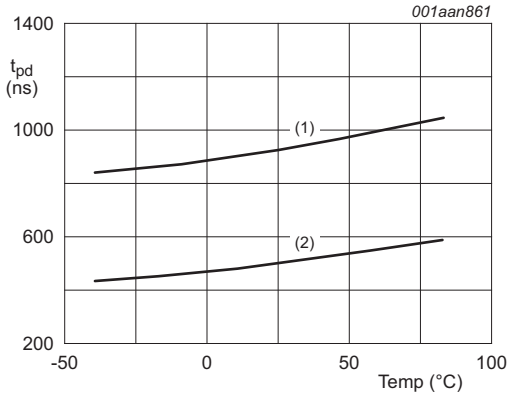
Fig 9. LOW-level output voltage versus output current



I_O = 4.0 mA.

V_{CC} = 5.0 V.

Fig 10. LOW-level output voltage versus temperature

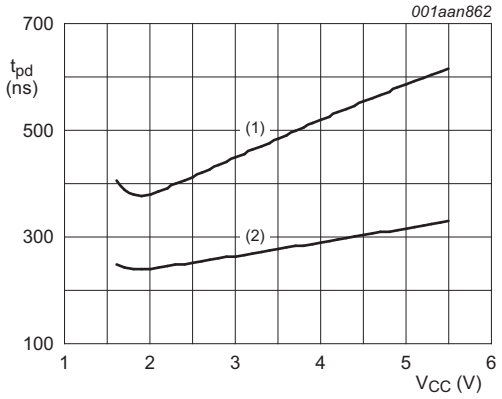


V_{CC} = 5.0 V; input overdrive = 50 mV.

(1) t_{PLZ}.

(2) t_{PZL}.

Fig 11. Propagation delay versus temperature



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

(1) t_{PLZ}.

(2) t_{PZL}.

Fig 12. Propagation delay versus supply voltage.

13. Application information

13.1 Operating description

The NCX2222 is a dual, low voltage, low-power comparator with open-drain output. This device is designed for use with a pull-up resistor to define the output switching levels. 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. Figure 11 and Figure 12 show propagation delay with various input overdrives. 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 which allows for greater noise immunity and clean output switching.

13.2 Output stage

The NCX2222 has an N-channel output stage that has the capability of sinking the output to V_{EE} with a load ranging up to 5.0 mA (see Figure 13).

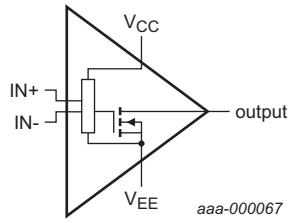


Fig 13. NCX2222 output configuration (one comparator)

13.3 Zero-crossing detector

Figure 14 shows the NCX2222 configured as a zero-crossing detector.

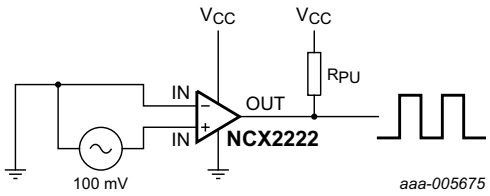
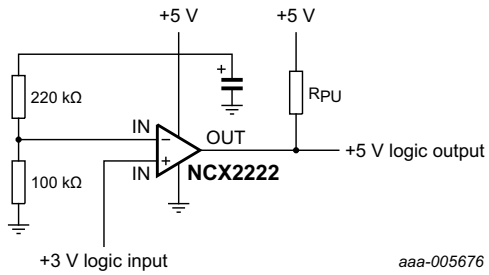


Fig 14. Zero-crossing detector

13.4 Logic level translator

Figure 15 shows the NCX2222 configured as a logic level translator.

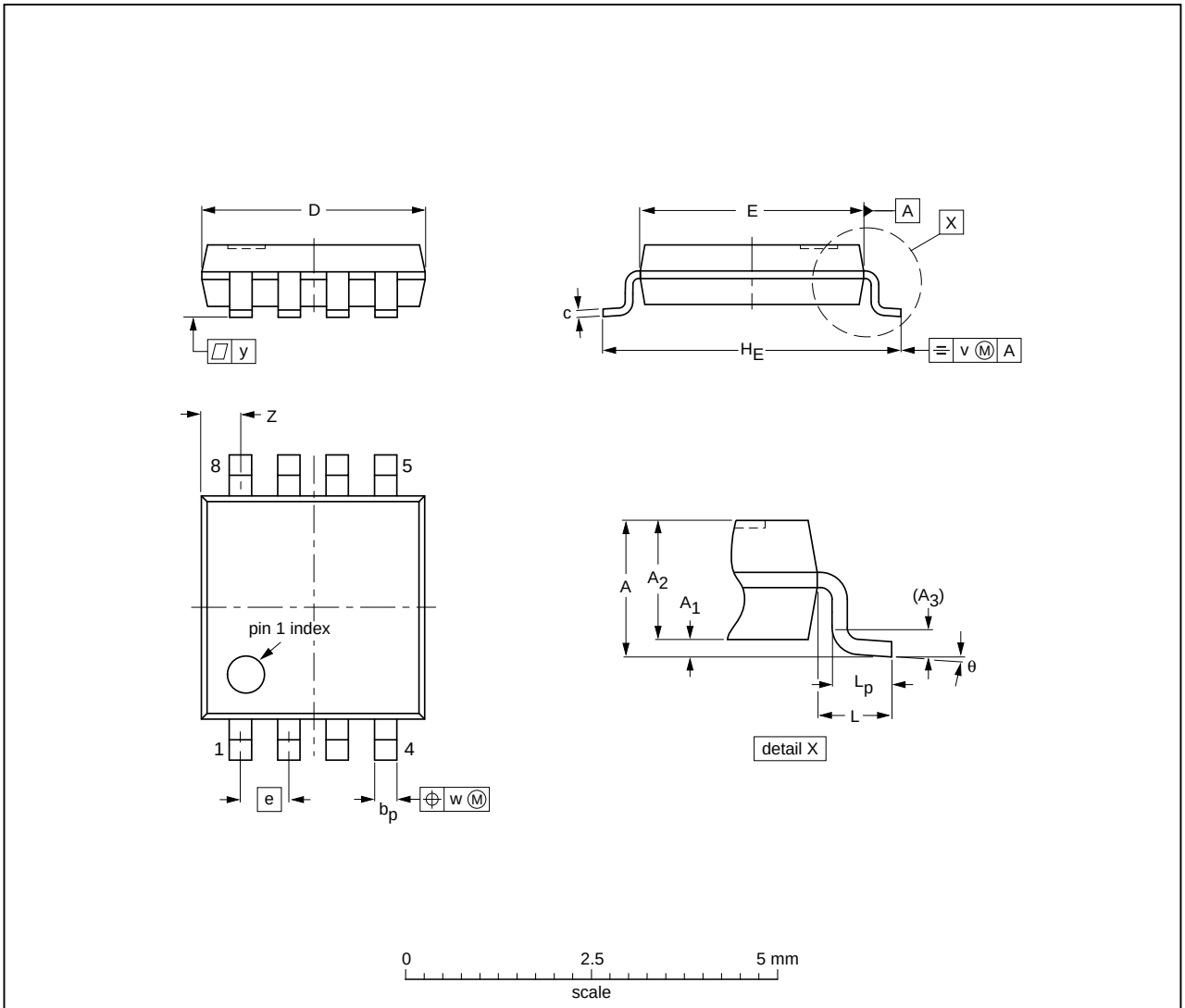


This circuit converts 3 V logic to 5 V logic.

Fig 15. 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°

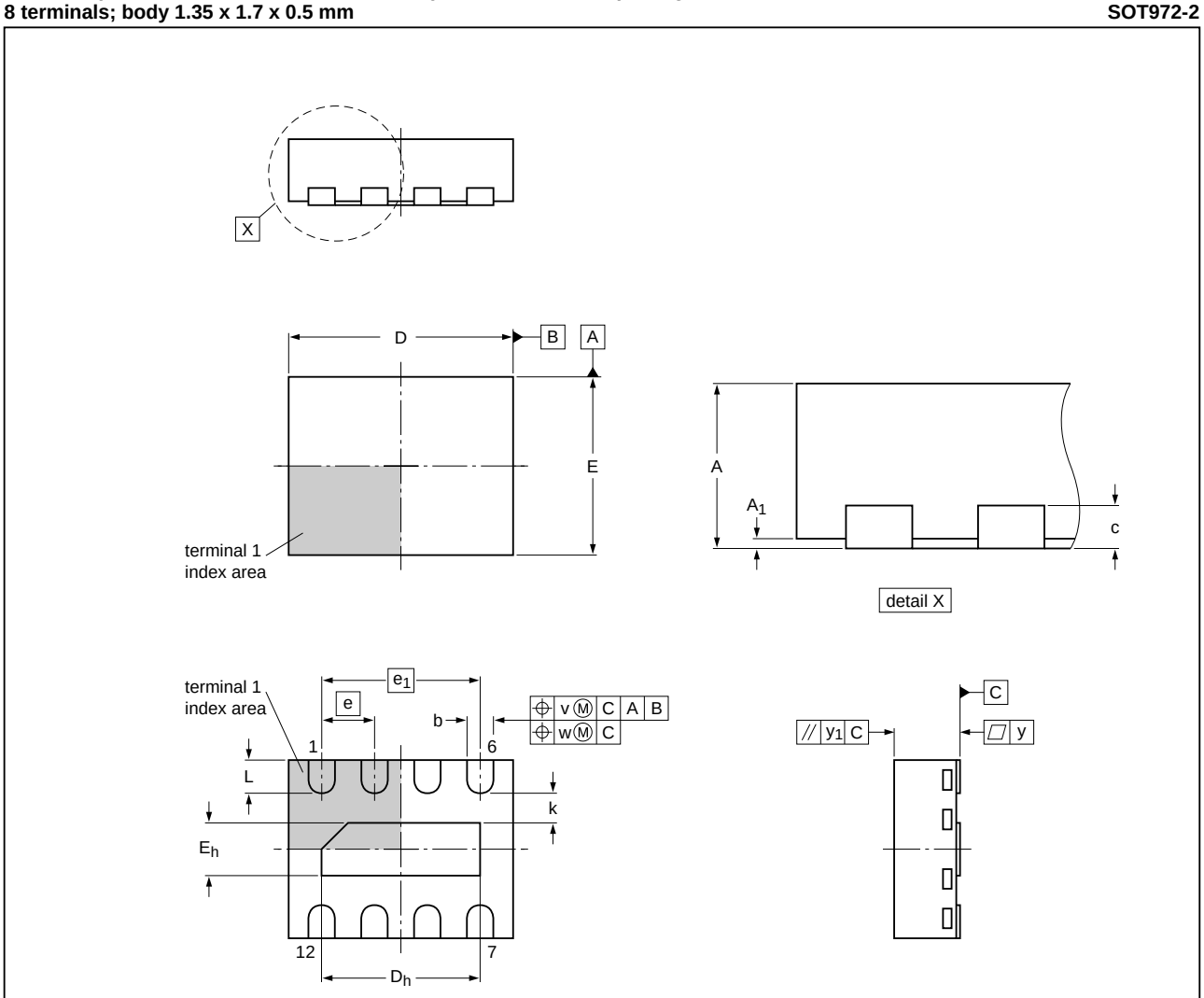
Note

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 16. 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
mm	max	0.5	0.05	0.25		1.8	1.3	1.45	0.45				0.30				
	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

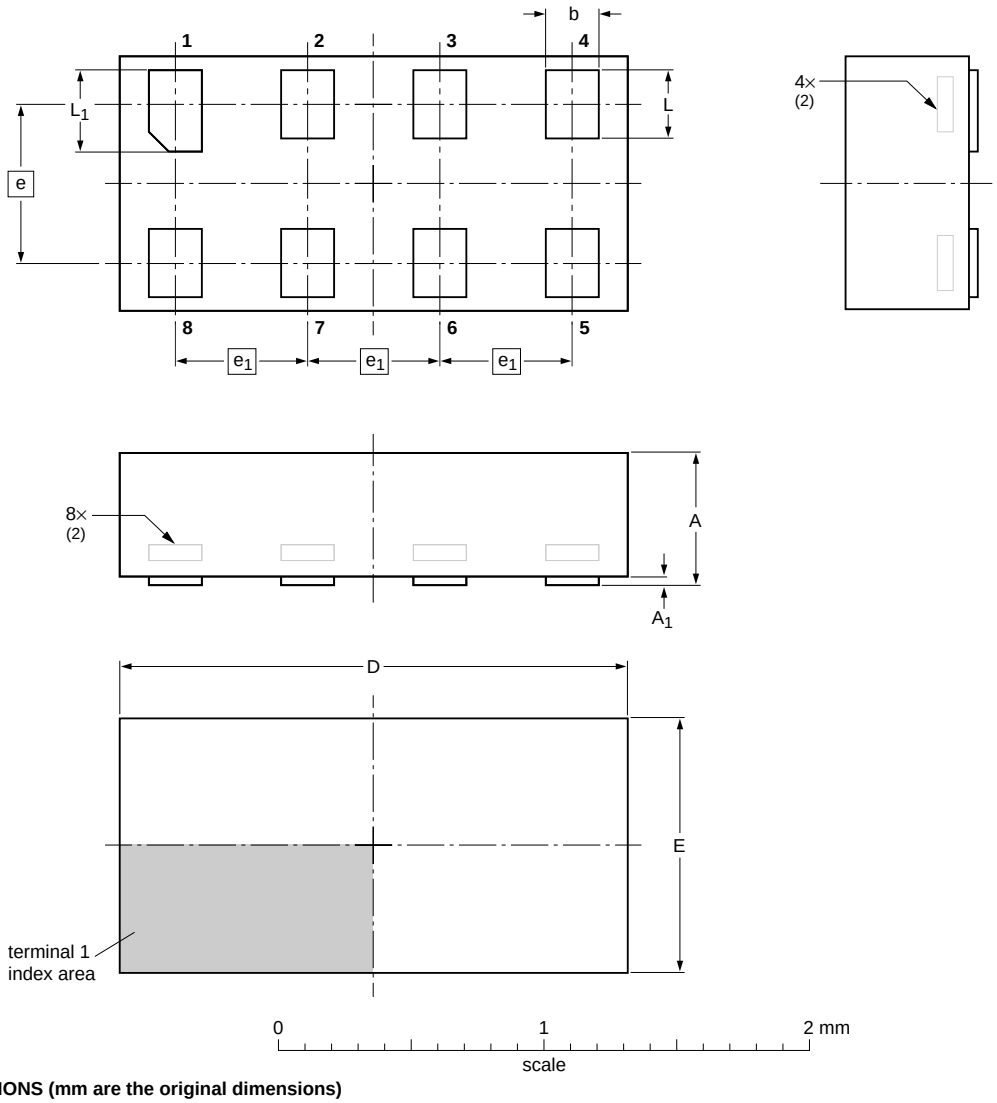
1. Plastic or metal protrusions 0.0075 mm maximum per side are not included.

sot972-2_po

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

Fig 17. 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

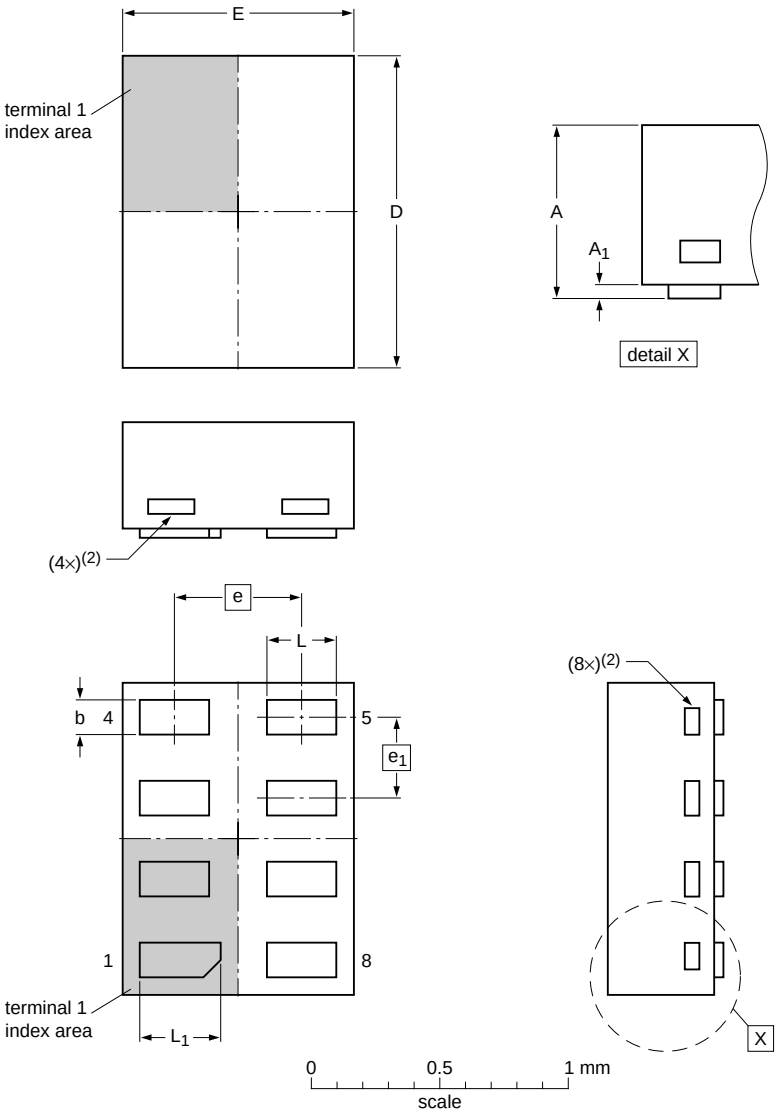
Notes

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 18. 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		$A^{(1)}$	A_1	b	D	E	e	e_1	L	L_1
	max	0.5	0.04	0.20	1.40	1.05			0.35	0.40
mm	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

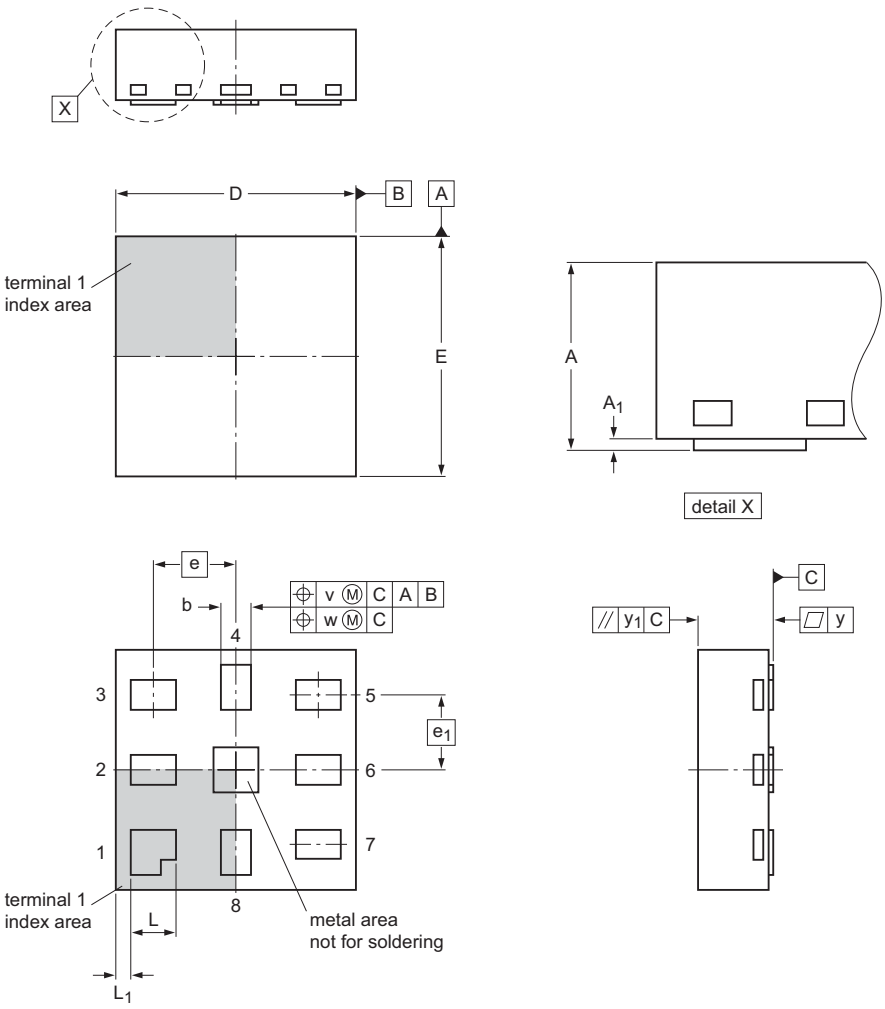
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1089_po

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

Fig 19. 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			0.35	0.15				
	nom			0.20	1.60	1.60	0.55	0.5	0.30	0.10	0.1	0.05	0.05	0.05
	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 20. 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
NCX2222 v.1	20121220	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.
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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

17.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

17.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

17.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

18. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

19. Contents

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 20 December 2012
Document identifier: NCX2222