

NCA9306DPH Datasheet



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DiGi Electronics Part Number NCA9306DPH-DG

Manufacturer Nexperia USA Inc.

Manufacturer Product Number NCA9306DPH

Description IC TRANSLTR BIDIRECTIONAL 8TSSOP

Detailed Description Voltage Level Translator Bidirectional 1 Circuit 2 Ch

annel 100MHz 8-TSSOP



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Purchase and inquiry

Manufacturer Product Number:	Manufacturer:
NCA9306DPH	Nexperia USA Inc.
Series:	Product Status:
	Active
Translator Type:	Channel Type:
Voltage Level	Bidirectional
Number of Circuits:	Channels per Circuit:
1	2
Voltage - VCCA:	Voltage - VCCB:
0 V ~ 5 V	0 V ~ 5 V
Input Signal:	Output Signal:
	-
- Output Type:	- Data Rate:
Output Type: Open Drain, Push-Pull	- Data Rate: 100MHz
Open Drain, Push-Pull	100MHz
Open Drain, Push-Pull Operating Temperature:	100MHz
Open Drain, Push-Pull Operating Temperature: -40°C ~ 125°C (TA)	100MHz Features:
Open Drain, Push-Pull Operating Temperature: -40°C ~ 125°C (TA) Mounting Type:	100MHz Features: - Package / Case:

Environmental & Export classification

8542.39.0001

RoHS Status:	Moisture Sensitivity Level (MSL):
ROHS3 Compliant	1 (Unlimited)
REACH Status:	ECCN:
REACH Unaffected	EAR99
HTSUS:	

NCA9306

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

Rev. 3.1 — 5 August 2024

Product data sheet

1. General description

The NCA9306 is a 2 channel bidirectional I²C and SMBus multi-voltage level translator with an enable (EN) pin input. It allows voltage translation between 0.95 V and 5 V without the use of a direction pin. It supports up to 100 MHz up translation and >100 MHz down translation at \leq 30 pF capacitive load. There is no need for a direction pin which minimizes the system effort. The NCA9306 supports 5 V tolerant I/O pins to support mixed mode signal operation. The ability to set up different voltage translation levels on each channel makes the device very flexible and suitable for a lot of different applications.

The low ON-state resistance R_{ON} of the switch allows connections to be made with minimal propagation delay. When EN is HIGH, the translator switch is on, and the SCLA and SDAA I/O are connected to the SCLB and SDAB I/O respectively, allowing bidirectional data flow between ports. When EN is LOW, the translator switch is off, and a high-impedance state exists between ports. As with the standard I²C bus-system, pull-up resistors are required to provide the logic HIGH levels on the translators bus. The NCA9306 has a standard open-drain configuration of the I²C-bus. The size of these pull-up resistors depend on the system. Each side of the translator must have a pull-up resistors. NCA9306 is designed to work with Standard-mode, Fast-mode and Fast-mode plus I²C bus devices in addition to the SMBus devices.

When the SDAA or SDAB pin is LOW, the clamp is in the ON-state and a low resistance connections exists between the SDAA and SDAB ports. Assuming the higher voltage is on the SDAB port when the SDAB port is HIGH, the voltage on the SDAA port is limited to the voltage set by refA. When the SDAA port is HIGH, the SDAB port is pulled to the refB supply voltage by the pull-up resistors. The SCLA or SCLB pins also follows the same behavior as described for SDAA or SDAB pins.

2. Features and benefits

- 2-channel bidirectional voltage translator for SDA and SCL lines in mixed mode I²C bus applications
- Open-drain I²C-bus I/O ports (SCLA, SDAA, SCLB and SDAB)
- Provides bidirectional voltage translation with no direction pin
- High-impedance SCLA, SDAA, SCLB and SDAB for EN = LOW
- Up translation
 - < 100 MHz; C_L = 30 pF
 - < 40 MHz; C_L = 50 pF
- Down translation
 - > 100 MHz; C_L = 30 pF
 - < 40 MHz; C_L = 50 pF
- Hot insertion
- Bidirectional voltage level translation between:
 - 0.95 V and 1.8 V, 2.5 V, 3.3 V and 5.0 V
 - 1.2 V and 1.8 V, 2.5 V, 3.3 V and 5.0 V
 - 1.8 V and 2.5 V. 3.3 V and 5.0 V
 - 2.5 V and 3.3 V and 5.0 V
 - 3.3 V and 5.0 V
- Low standby current
- 5 V tolerant I²C-bus I/O pins to support mixed mode signal operation



Low R_{ON} provides less signal distortion

- · Latch-up performance exceeds 100 mA per JESD78 class II level A
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +125 °C

3. Applications

· GPIO, MDIO, PMBus, SMBus, SDIO, UART, I2C, and other interfaces in Telecom infrastructure

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

- Industrial
- Personal computing
- · Router and Industrial Automation

4. Ordering information

Table 1. Ordering information

Type number	Package					
	Temperature range	Name	Description	Version		
NCA9306DP	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2		
NCA9306DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1		
NCA9306GS	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1.0 × 0.35 mm	SOT1203		
NCA9306GX	-40 °C to +125 °C	X2SON8	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; body 1.35 × 0.8 × 0.32 mm	SOT1233-2		

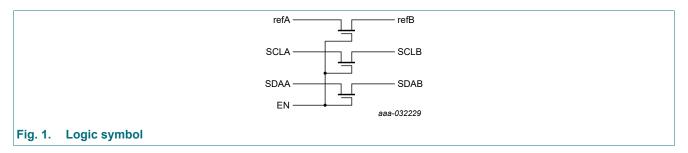
5. Marking

Table 2. Marking

Type number	Marking code[1]
NCA9306DP	h9
NCA9306DC	h9
NCA9306GS	h9
NCA9306GX	h9

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

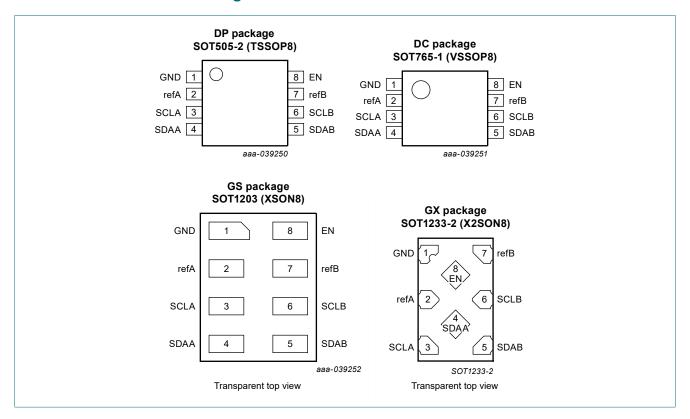
6. Functional diagram



2-bit bidirectional multi-voltage level translator; open-drain; push-pull

7. Pinning information

7.1. Pinning



7.2. Pin description

Table 3. Pin description

date 5.1 in description						
Symbol	Pin	Description				
GND	1	ground (0 V)				
refA	2	low-voltage side reference supply voltage for SCLA and SDAA				
SCLA, SCLB	3, 6	data input/output SCL				
SDAA, SDAB	4, 5	data input/output SDA				
refB	7	high-voltage side reference supply voltage for SCLB and SDAB				
EN	8	enable input (active HIGH)				

8. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Input	input/output	
EN	SCLn, SDAn channel	
Н	SCLA = SCLB; SDAA = SDAB	
L	Z	

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

9. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Max	Unit
VI	input voltage	pins refA, refB, SCLn, SDAn and EN	[1]	-0.5	+7.0	V
I _{I/O}	input/output current	pins refA, refB, SCLn, SDAn; continuous channel current		-	+128	mA
I _{IK}	input clamping current	V _I < 0 V		-50	-	mA
T _{stg}	storage temperature			-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C				
		For SOT505-2, SOT765-1, SOT1203	[2]	-	250	mW
		For SOT1233-2	[3]	-	300	mW

- [1] The minimum input voltage rating may be exceeded if the input current rating is observed.
- [2] For SOT505-2 (TSSOP8) package: P_{tot} derates linearly with 4.6 mW/K above 96 °C. For SOT765-1 (VSSOP8) package: P_{tot} derates linearly with 4.9 mW/K above 99 °C. For SOT1203 (XSON8) package: P_{tot} derates linearly with 3.6 mW/K above 81 °C.
- [3] For SOT1233-2 (X2SON8) package: P_{tot} derates linearly with 7.7 mW/K above 118 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
VI	input voltage	pins refA, refB, SCLn, SDAn and EN	0.0	5.0	V
I _{I/O}	input/output current	pins refA, refB, SCLn, SDAn; continuous channel current	-	+64	mA
T _{amb}	ambient temperature		-40	+125	°C

11. Static characteristics

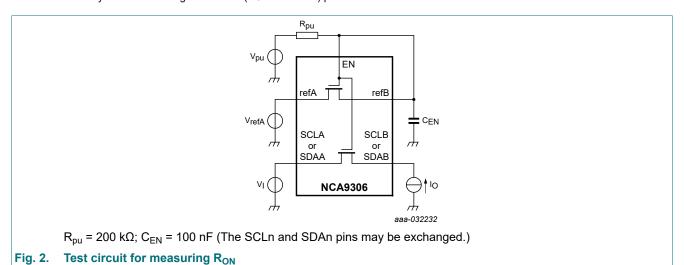
Table 7. Static characteristics

At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	T _{amb} = -40 °C to +12			Unit
			Min	Typ[1]	Max	
V _{IK}	input clamping voltage	V _{EN} = 0 V; I _I = -18 mA	-1.2	-	-	V
I ₁	leakage current	pins SCLn, SDAn, refA, refB and EN; V _I = GND to 5.0 V	-	1	5	μA
C _I	input capacitance	pins refA, refB and EN; V _I = 0 V or 3 V	-	6	-	pF
C _{io(off)}	OFF-state input/output capacitance	pins SCLn, SDAn; $V_O = 0 \text{ V or } 3 \text{ V}$; $V_{EN} = 0.0 \text{ V}$	-	3.0	6.0	pF
C _{io(on)}	ON-state input/output capacitance	pins SCLn, SDAn; $V_O = 0 \text{ V or } 3 \text{ V}; V_{EN} = 3.0 \text{ V}$	-	6.0	12.5	pF

Symbol	Parameter Conditions		T _{amb} =	-40 °C to +	+125 °C	Unit
			Min	Typ[1]	Max	
R _{ON}	ON resistance	see Fig. 2				
		$V_I = 0 \text{ V}; V_{pu} = 5.0 \text{ V}; I_O = 64 \text{ mA}$ [2]				
		V _{refA} = 3.3 V	-	3	7	Ω
		V _{refA} = 1.8 V	-	4	10	Ω
		$V_{I} = 0 \text{ V}; V_{refB} = V_{EN} = 5.0 \text{ V}; I_{O} = 32\text{mA}$				
		V _{refA} = 1.8 V	-	4	9	Ω
		V _{refA} = 2.5 V	-	3	8	Ω
		$V_{I} = 1.8 \text{ V}; V_{refB} = V_{EN} = 5.0 \text{ V}; I_{O} = 15 \text{ mA}$				
		V _{refA} = 3.3 V	-	4	13	Ω
		$V_{I} = 1.0 \text{ V}; V_{refB} = V_{EN} = 3.3 \text{ V}; I_{O} = 10 \text{ mA}$				
		V _{refA} = 1.8 V	-	7	24	Ω
		$V_{I} = 0 \text{ V}; V_{refB} = V_{EN} = 3.3 \text{ V}; I_{O} = 10 \text{ mA}$				
		V _{refA} = 1.0 V	-	5	18	Ω
		V _I = 0 V; V _{refB} = V _{EN} = 1.8 V; I _O = 10 mA				
		V _{refA} = 1.0 V	-	6	19	Ω

- [1]
- All typical values are measured at T_{amb} = 25 °C. Measured by the voltage drop between the SCLn and SDAn pins at the indicated current through the switch. ON resistance is determined by the lowest voltage of the two (SCLn or SDAn) pins.



2-bit bidirectional multi-voltage level translator; open-drain; push-pull

12. Dynamic characteristics

Table 8. Switching characteristics

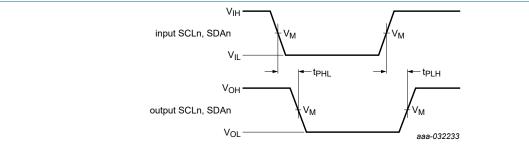
GND = 0 V; for waveform see Fig. 3; for test circuit see Fig. 4

Symbol	Parameter	Conditions	T _{amb}	T _{amb} = -40 °C to +125		Unit
			Min	Typ[1]	Max	
Translat	ing down		<u> </u>			
t _{PLH}	LOW to HIGH propagation	SCLA, SDAA to SCLB, SDAB or SCLB, SDAB to SCLA, SDAA;				
	delay	$V_{IH} = V_{pu} = V_{refA} + 1 V$				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.13	0.35	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	0.22	0.59	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	0.34	0.94	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.09	0.25	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.16	0.43	ns
		V _{refA} = 2.3 V; C _L = 50 pF	-	0.24	0.69	ns
t _{PHL}	HIGH to LOW propagation	SCLA, SDAA to SCLB, SDAB or SCLB, SDAB to SCLA, SDAA;				
	delay	$V_{IH} = V_{pu} = V_{refA} + 1 V$				
		$V_{refA} = 1.5 V; C_L = 15 pF$	-	0.21	0.99	ns
		$V_{refA} = 1.5 \text{ V}; C_L = 30 \text{ pF}$	-	0.36	1.78	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	0.51	2.42	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.12	0.45	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.19	0.77	ns
		$V_{refA} = 2.3 \text{ V}; C_L = 50 \text{ pF}$	-	0.30	1.17	ns
Translat	ing up					
	LOW to HIGH propagation	SCLA, SDAA to SCLB, SDAB or SCLB, SDAB to SCLA, SDAA;				
	delay	$V_{IH} = V_{refA}$; $V_{EXT} = V_{pu} = V_{refA} + 1 V$				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.06	0.11	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	0.14	0.32	ns
		$V_{refA} = 1.5 \text{ V}; C_L = 50 \text{ pF}$	-	0.26	0.58	ns
		$V_{refA} = 2.3 \text{ V}; C_L = 15 \text{ pF}$	-	0.06	0.13	ns
		$V_{refA} = 2.3 \text{ V}; C_L = 30 \text{ pF}$	-	0.13	0.28	ns
		$V_{refA} = 2.3 \text{ V}; C_L = 50 \text{ pF}$	-	0.20	0.50	ns
t _{PHL}	HIGH to LOW propagation	SCLA, SDAA to SCLB, SDAB or SCLB, SDAB to SCLA, SDAA;				
	delay	$V_{IH} = V_{refA}$; $V_{EXT} = V_{pu} = V_{refA} + 1 V$				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.34	1.54	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	0.60	2.60	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	0.90	3.82	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.17	0.71	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.29	1.09	ns
		$V_{refA} = 2.3 \text{ V}; C_L = 50 \text{ pF}$	-	0.45	1.67	ns

^[1] All typical values are measured at T_{amb} = 25 °C.

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

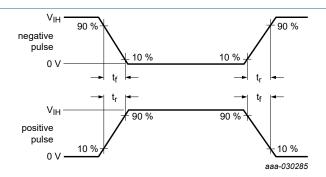
12.1. Waveforms and test circuit



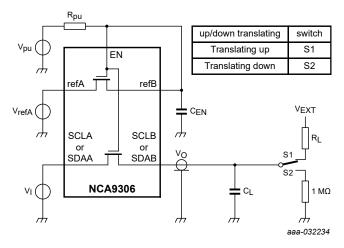
Measurement points are given in Table 9.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 3. The data input (SCLn, SDAn) to output (SCLn, SDAn) propagation delay times



a. V_I source waveform



b. Test circuit

Test data is given in Table 9.

The SCLn and SDAn pins may be exchanged.

All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz; Z_O = 50 Ω . Definitions test circuit:

C_L = Load capacitance including jig and probe capacitance; C_{EN} = Decoupling capacitance;

R_{pu} = Pull-up resistance;

R_L = Load resistance;

S1/S2 = Test selection switch.

Fig. 4. Test circuit for measuring switching times

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Nexperia NCA9306

Table 9. Test data

Input		Output	Load			
t _r , t _f	V _M	V _M	C _L C _{EN} [1] R _L [1] R _{pu}			R _{pu}
≤ 2 ns	0.5V _{refA}	0.5V _{refA}	15 pF, 30 pF, 50 pF	100 nF	300 Ω	200 kΩ

^[1] All typical values are measured at T_{amb} = 25 °C.

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

13. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

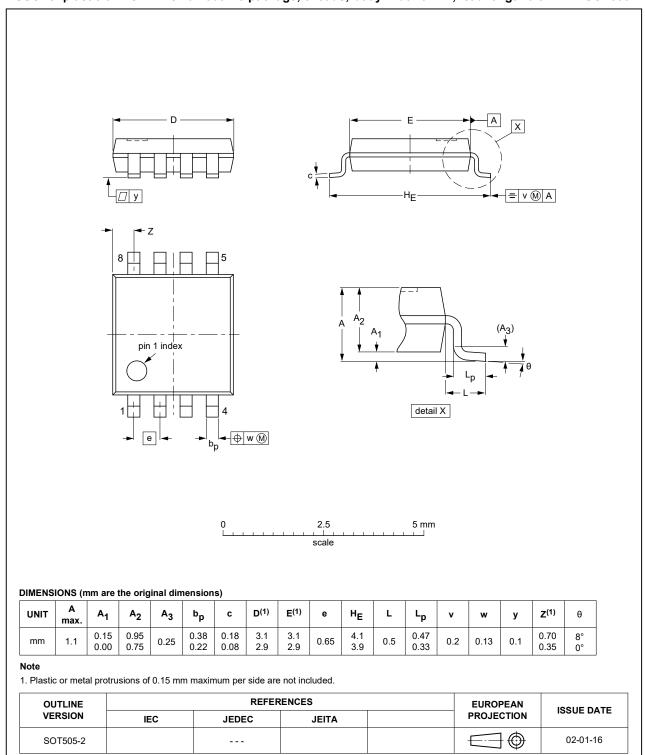


Fig. 5. Package outline SOT505-2 (TSSOP8)

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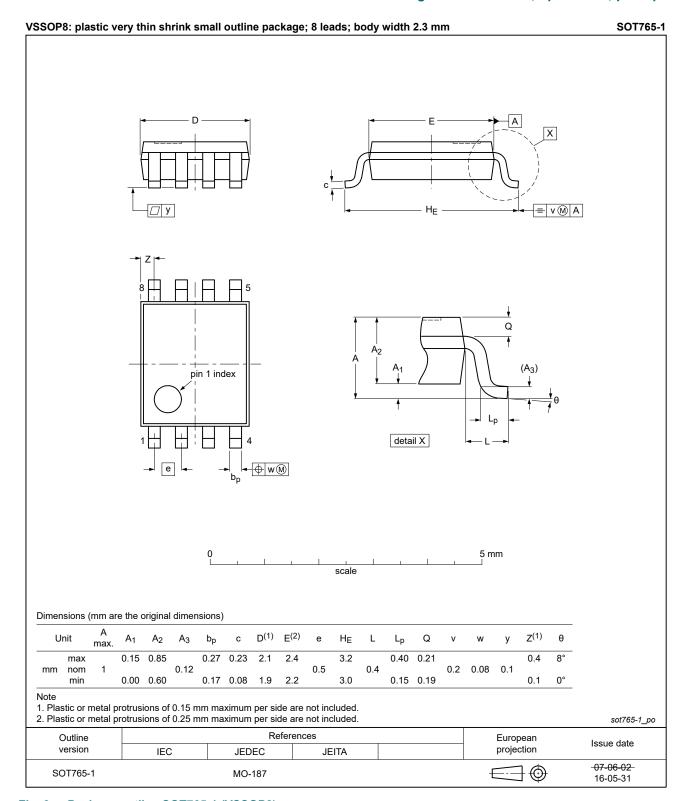


Fig. 6. Package outline SOT765-1 (VSSOP8)

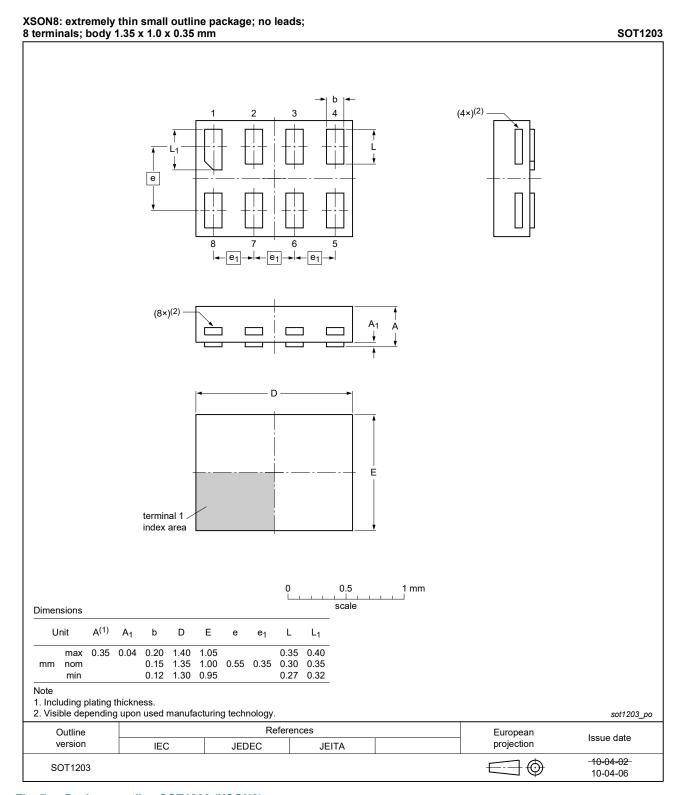


Fig. 7. Package outline SOT1203 (XSON8)

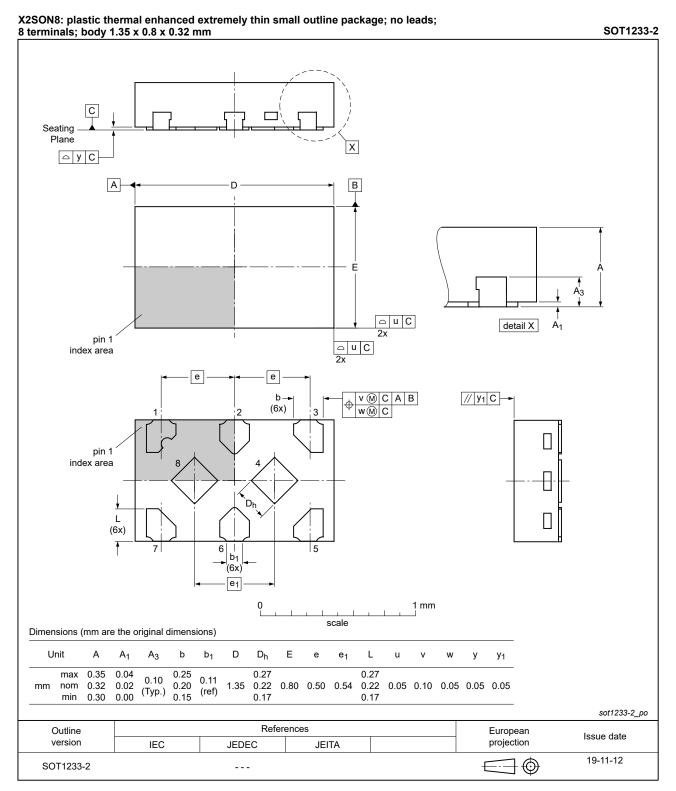


Fig. 8. Package outline SOT1233-2 (X2SON8)

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

14. Abbreviations

Table 10. Abbreviations

Acronym	Description			
ANSI	American National Standards Institute			
CDM	Charged Device Model			
ESD	ElectroStatic Discharge			
ESDA	ElectroStatic Discharge Association			
НВМ	Human Body Model			
I ² C	Inter-Integrated Circuit			
JEDEC	Joint Electron Device Engineering Council			
PMBus	Power Management Bus			
PRR	Pulse Rate Repetition			
SMBus	System Management Bus			

15. Revision history

Table 11. Revision history

Table 111 Notices							
Document ID	Release date	Data sheet status	Change notice	Supersedes			
NCA9306 v.3.1	20240805	Product data sheet	-	NCA9306 v.3			
NCA9306 v.3	20240314	Product data sheet	-	NCA9306 v.2			
Modifications:	Type number NCA9306GS added.						
NCA9306 v.2	20211126	Product data sheet	-	NCA9306 v.1			
Modifications:	<u>Table 3</u> : Typo corrected in the description of pin refB (errata).						
NCA9306 v.1	20200922	Product data sheet	-	-			

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

16. Legal information

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.

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2-bit bidirectional multi-voltage level translator; open-drain; push-pull

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