# 74LVC2G86 Dual 2-input EXCLUSIVE-OR gate Rev. 13 — 3 July 2017

**Product data sheet** 

#### 1 **General description**

The 74LVC2G86 provides a dual 2-input EXCLUSIVE-OR gate.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in a mixed 3.3 V and 5 V environment.

This device is fully specified for partial power-down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

#### **Features and benefits** 2

- Wide supply voltage range from 1.65 V to 5.5 V
- 5 V tolerant inputs for interfacing with 5 V logic
- High noise immunity
- · Complies with JEDEC standard:
  - **–** JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2 000 V
  - MM JESD22-A115-A exceeds 200 V
- ±24 mA output drive (V<sub>CC</sub> = 3.0 V)
- CMOS low-power consumption
- Latch-up performance exceeds 250 mA
- · Direct interface with TTL levels
- Inputs accept voltages up to 5 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C



# 3 Ordering information

**Table 1. Ordering information** 

Type number	Package			
	Temperature range	Name	Description	Version
74LVC2G86DP	-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
74LVC2G86DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74LVC2G86GT	-40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm	SOT833-1
74LVC2G86GF	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 x 1 x 0.5 mm	SOT1089
74LVC2G86GM	-40 °C to +125 °C	XQFN8	plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 x 1.6 x 0.5 mm	SOT902-2
74LVC2G86GN	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.2 x 1.0 x 0.35 mm	SOT1116
74LVC2G86GS	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 x 1.0 x 0.35 mm	SOT1203
74LVC2G86GX	-40 °C to +125 °C	X2SON8	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; body 1.35 x 0.8 x 0.35 mm	SOT1233

# 4 Marking

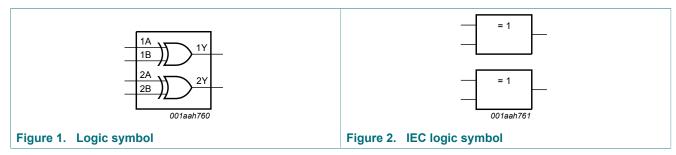
Table 2. Marking codes

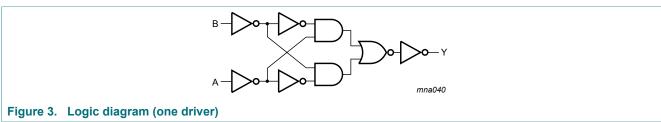
Type number	Marking code <sup>[1]</sup>
74LVC2G86DP	V86
74LVC2G86DC	V86
74LVC2G86GT	V86
74LVC2G86GF	VH
74LVC2G86GM	V86
74LVC2G86GN	VH
74LVC2G86GS	VH
74LVC2G86GX	VH

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

**Dual 2-input EXCLUSIVE-OR gate** 

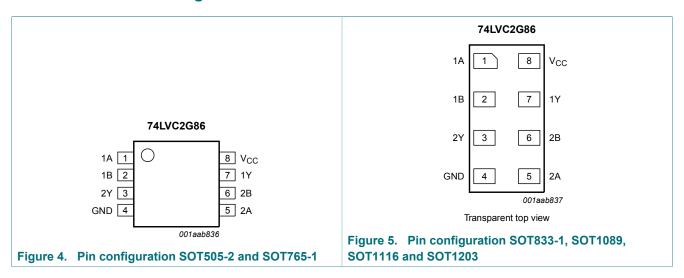
# 5 Functional diagram



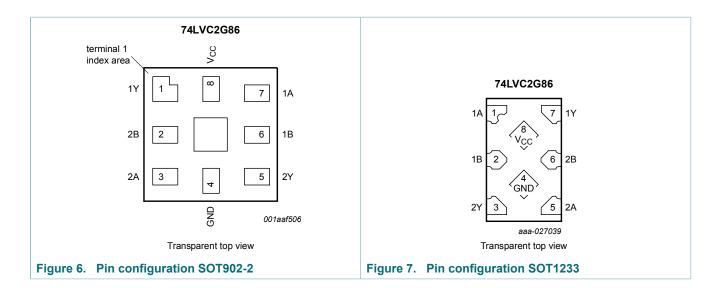


# 6 Pinnig information

# 6.1 Pinning



# **Dual 2-input EXCLUSIVE-OR gate**



# 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description	
	SOT505-2, SOT765-1, SOT833-1, SOT1089, SOT1116, SOT1203 and SOT1233	SOT902-2	
1A, 2A	1, 5	7, 3	data input
1B, 2B	2, 6	6, 2	data input
GND	4	4	ground (0 V)
1Y, 2Y	7, 3	1, 5	data output
V <sub>CC</sub>	8	8	supply voltage

# 7 Functional description

#### Table 4. Function table

H = HIGH voltage level; L = LOW voltage level

Input		Output
nA	nB	nY
L	L	L
L	Н	Н
Н	L	Н
Н	Н	L

# **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
V <sub>CC</sub>	supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
VI	input voltage	[1]	-0.5	+6.5	V
l <sub>OK</sub>	output clamping current	$V_O > V_{CC}$ or $V_O < 0 V$	-	±50	mA
V <sub>O</sub>	output voltage	Active mode [1] [2]	-0.5	V <sub>CC</sub> + 0.5	V
		Power-down mode [1] [2]	-0.5	+6.5	V
Io	output current	$V_{O} = 0$ to $V_{CC}$	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$ [3]	-	300	mW
T <sub>stg</sub>	storage temperature		-65	+150	°C

The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

# **Recommended operating conditions**

**Table 6. Operating conditions** 

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	5.5	V
VI	input voltage		0	5.5	V
V <sub>O</sub>	output voltage	Active mode	0	V <sub>CC</sub>	V
		V <sub>CC</sub> = 0 V; Power-down mode	0	5.5	V
T <sub>amb</sub>	ambient temperature		-40	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	-	20	ns/V
		$V_{CC}$ = 2.7 V to 5.5 V	-	10	ns/V

When  $V_{CC}$  = 0 V (Power-down mode), the output voltage can be 5.5 V in normal operation. For TSSOP8 packages: above 55 °C the value of  $P_{tot}$  derates linearly with 2.5 mW/K. For VSSOP8 packages: above 110  $^{\circ}$ C the value of P<sub>tot</sub> derates linearly with 8.0 mW/K. For XSON8 and XQFN8 packages: above 118 °C the value of Ptot derates linearly with 7.8 mW/K. For X2SON8 package: above 118 °C the value of Ptot derates linearly with 7.7 mW/K.

# 10 Static characteristics

# Table 7. Static characteristics

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

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
T <sub>amb</sub> = -4	0 °C to +85 °C			'		
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 x V <sub>CC</sub>	_	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	V
	LOW-level input voltage  LOW-level output voltage  HIGH-level output voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	0.7 x V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 x V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	V
V <sub>IL</sub> LOV		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.3 x V <sub>CC</sub>	V
V <sub>OL</sub>	LOW-level output voltage	$V_{I} = V_{IH}$ or $V_{IL}$				
		$I_O$ = 100 $\mu$ A; $V_{CC}$ = 1.65 V to 5.5 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	0.07	0.45	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	0.12	0.3	V
		$I_{O}$ = 12 mA; $V_{CC}$ = 2.7 V	-	0.17	0.4	V
		$I_{O}$ = 24 mA; $V_{CC}$ = 3.0 V	-	0.33	0.55	V
		$I_{O}$ = 32 mA; $V_{CC}$ = 4.5 V	-	0.39	0.55	V
V <sub>OH</sub>	HIGH-level output voltage	$V_{I} = V_{IH}$ or $V_{IL}$				
		$I_{O}$ = -100 $\mu$ A; $V_{CC}$ = 1.65 V to 5.5 V	V <sub>CC</sub> - 0.1	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	1.54	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.9	2.15	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	2.50	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.3	2.62	-	V
		$I_{O}$ = -32 mA; $V_{CC}$ = 4.5 V	3.8	4.11	-	V
I <sub>I</sub>	input leakage current	$V_I$ = 5.5 V or GND; $V_{CC}$ = 0 V to 5.5 V	-	±0.1	±1	μΑ
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V	-	±0.1	±2	μΑ
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V; I <sub>O</sub> = 0 A	-	0.1	4	μΑ
ΔI <sub>CC</sub>	additional supply current	per pin; $V_I = V_{CC} - 0.6 \text{ V};$ $V_{CC} = 2.3 \text{ V to } 5.5 \text{ V}; I_O = 0 \text{ A};$	-	5	500	μΑ
Cı	input capacitance		-	2.5	-	pF

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
T <sub>amb</sub> = -4	0 °C to +125 °C					
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 x V <sub>CC</sub>	-	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7 x V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 x V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.3 x V <sub>CC</sub>	V
V <sub>OL</sub>	LOW-level output voltage	$V_{I} = V_{IH}$ or $V_{IL}$				
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.70	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.45	V
		$I_{O}$ = 12 mA; $V_{CC}$ = 2.7 V	-	-	0.60	V
		$I_{O}$ = 24 mA; $V_{CC}$ = 3.0 V	-	-	0.80	V
		$I_{O}$ = 32 mA; $V_{CC}$ = 4.5 V	-	-	0.80	V
V <sub>OH</sub>	HIGH-level output voltage	$V_{I} = V_{IH}$ or $V_{IL}$				
		$I_{O}$ = -100 $\mu$ A; $V_{CC}$ = 1.65 V to 5.5 V	V <sub>CC</sub> - 0.1	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	0.95	-	-	V
		$I_{O}$ = -8 mA; $V_{CC}$ = 2.3 V	1.7	-	-	V
		$I_{O}$ = -12 mA; $V_{CC}$ = 2.7 V	1.9	-	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.0	-	-	V
		$I_{O}$ = -32 mA; $V_{CC}$ = 4.5 V	3.4	-	-	V
l <sub>l</sub>	input leakage current	$V_I$ = 5.5 V or GND; $V_{CC}$ = 0 V to 5.5 V	-	-	±1	μA
I <sub>OFF</sub>	power-off leakage current	$V_I$ or $V_O$ = 5.5 V; $V_{CC}$ = 0 V	-	-	±2	μΑ
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V; I <sub>O</sub> = 0 A	-	-	4	μΑ
Δl <sub>CC</sub>	additional supply current	per pin; $V_I = V_{CC} - 0.6 \text{ V};$ $V_{CC} = 2.3 \text{ V to } 5.5 \text{ V}; I_O = 0 \text{ A};$	-	-	500	μΑ

<sup>[1]</sup> All typical values are measured at  $V_{CC}$  = 3.3 V and  $T_{amb}$  = 25 °C.

# 11 Dynamic characteristics

**Table 8. Dynamic characteristics** 

Voltages are referenced to GND (ground 0 V); for test circuit see Figure 9.

Symbol	Parameter	Conditions		-40	°C to +85	°C	-40 °C to	Unit	
				Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Figure 8	[2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V		1.4	3.8	9.9	1.4	12.4	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V		0.8	2.5	5.7	0.8	7.2	ns
		V <sub>CC</sub> = 2.7 V		0.8	3.0	5.7	0.8	7.2	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V		0.8	2.3	4.7	0.8	5.9	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V		0.6	1.9	3.6	0.6	4.5	ns
C <sub>PD</sub>	power dissipation capacitance	per gate; $V_I$ = GND to $V_{CC}$ ; $V_{CC}$ = 3.3 V	[3]	-	15.8	-	-	-	pF

- Typical values are measured at  $T_{amb}$  = 25 °C and  $V_{CC}$  = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.
- $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$   $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).

 $P_D = C_{PD} x V_{CC}^2 x f_i x N + \sum (C_L x V_{CC}^2 x f_o)$  where:

 $f_i$  = input frequency in MHz;

 $f_0$  = output frequency in MHz;

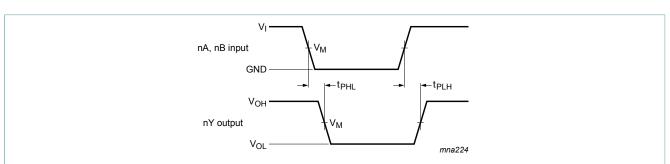
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

 $\sum (C_L \times V_{CC}^2 \times f_0) = \text{sum of outputs.}$ 

# 11.1 Waveforms and test circuit



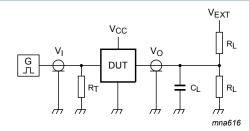
Measurement points are given in Table 9.

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

Figure 8. Propagation delay input (nA, nB) to output (nY)

Table 9. Measurement points

Supply voltage	Input	Output
V <sub>CC</sub>	V <sub>M</sub>	$V_{M}$
1.65 V to 1.95 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>
2.3 V to 2.7 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V
4.5 V to 5.5 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>



Test data is given in Table 10.

Definitions for test circuit:

R<sub>L</sub> = Load resistance.

 $C_L$  = Load capacitance including jig and probe capacitance.

 $R_T$  = Termination resistance should be equal to the output impedance  $Z_0$  of the pulse generator.

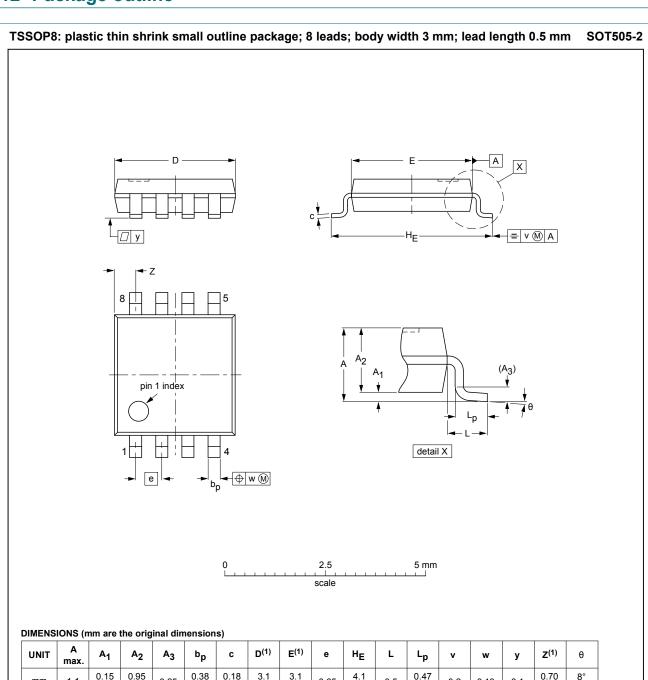
 $V_{EXT}$  = External voltage for measuring switching times.

Figure 9. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Input		Load	V <sub>EXT</sub>	
V <sub>CC</sub>	VI	t <sub>r</sub> , t <sub>f</sub>	CL	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>
1.65 V to 1.95 V	V <sub>CC</sub>	≤ 2.0 ns	30 pF	1 kΩ	open
2.3 V to 2.7 V	V <sub>CC</sub>	≤ 2.0 ns	30 pF	500 Ω	open
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
4.5 V to 5.5 V	V <sub>CC</sub>	≤ 2.5 ns	50 pF	500 Ω	open

# 12 Package outline



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	v	w	у	Z <sup>(1)</sup>	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

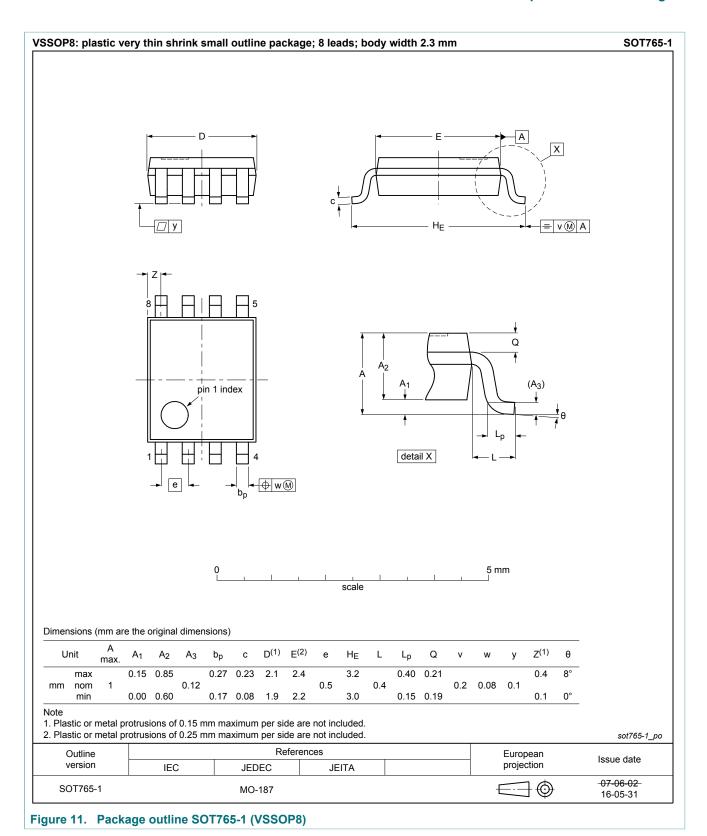
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

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

Figure 10. Package outline SOT505-2 (TSSOP8)

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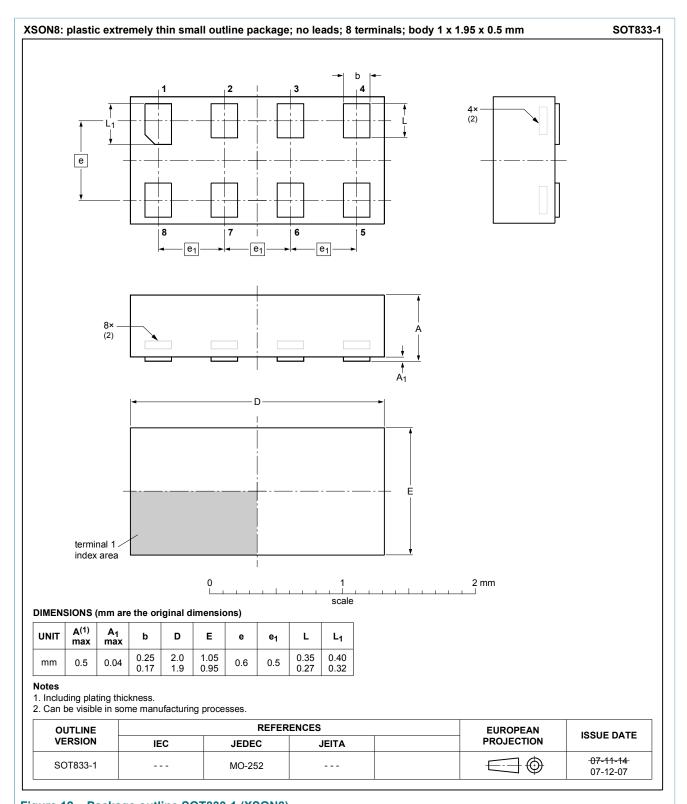
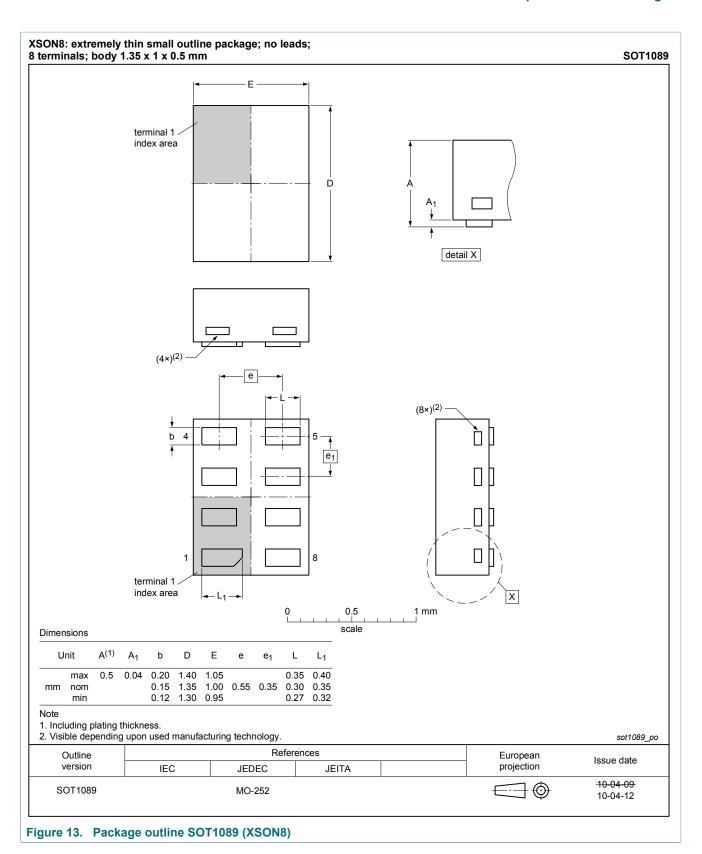
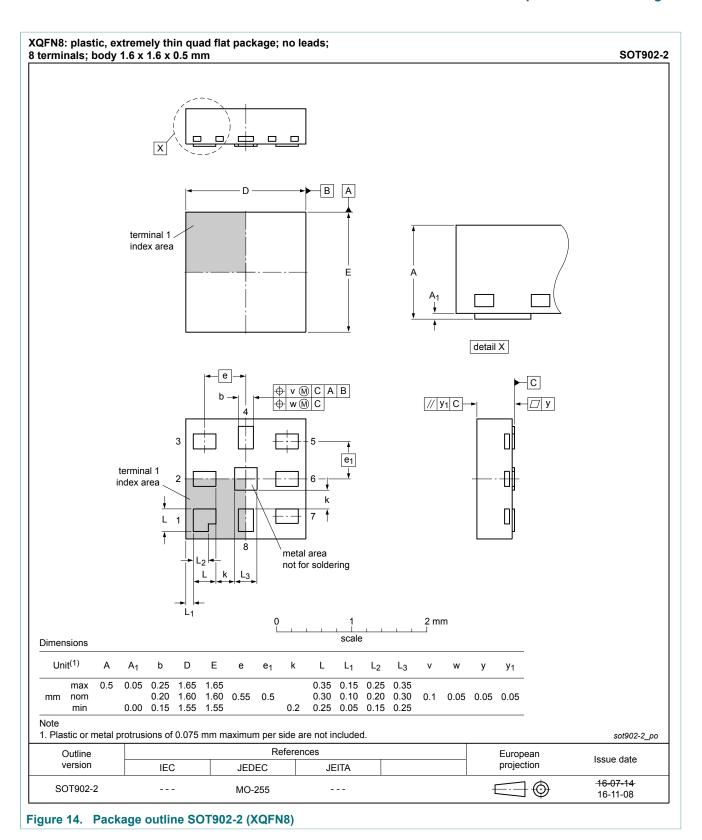


Figure 12. Package outline SOT833-1 (XSON8)





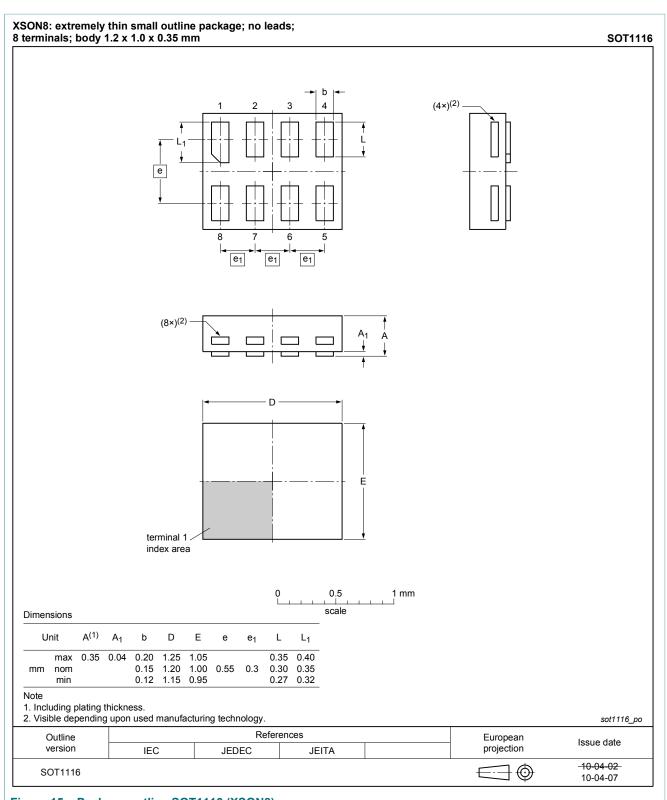
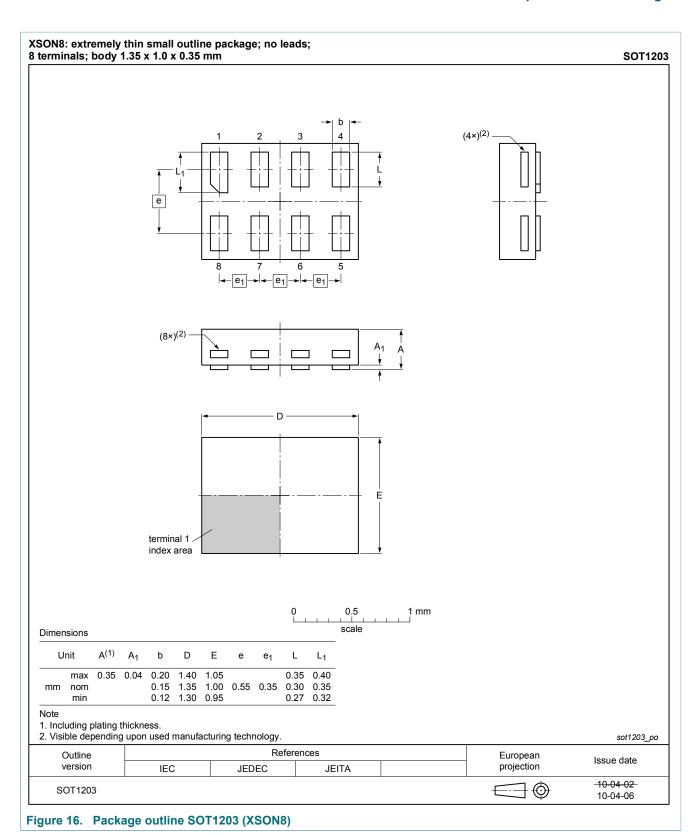
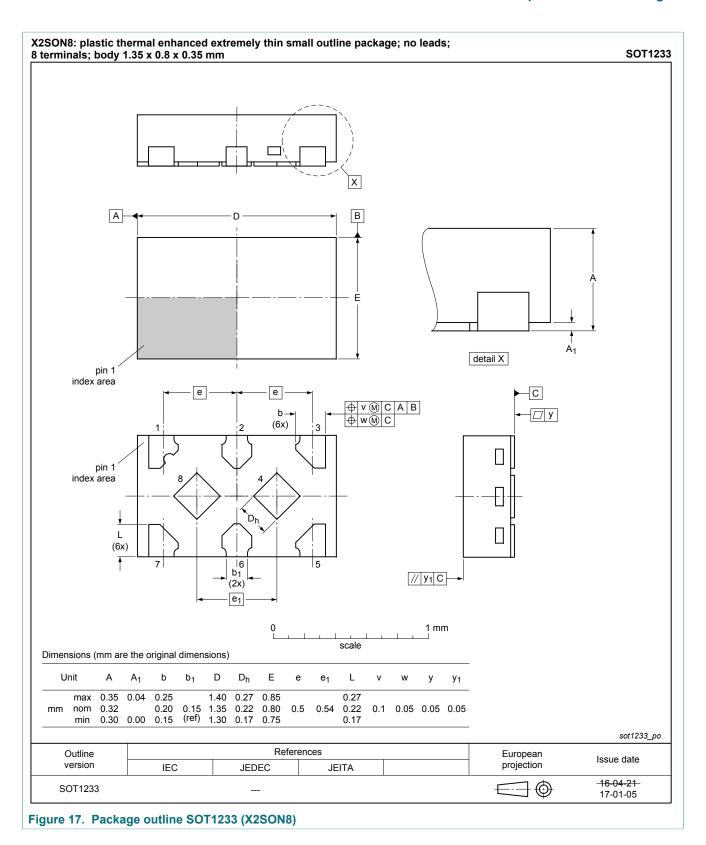


Figure 15. Package outline SOT1116 (XSON8)





# 13 Abbreviations

#### **Table 11. Abbreviations**

Acronym	Description		
CMOS	Complementary Metal-Oxide Semiconductor		
DUT	Device Under Test		
ESD	ElectroStatic Discharge		
НВМ	Human Body Model		
MM	Machine Model		
TTL	Transistor-Transistor Logic		

# 14 Revision history

# Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes		
74LVC2G86 v.13	20170703	Product data sheet	-	74LVC2G86 v.12		
Modifications:	Nexperia.  • Legal texts hav  • Added type nur	<ul> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Added type number 74LVC2G86GX (SOT1233 / X2SON8).</li> <li>Type number 74LVC2G86GD removed.</li> </ul>				
74LVC2G86 v.12	20161215	Product data sheet	-	74LVC2G86 v.11		
Modifications:	• Table 7: The m	• Table 7: The maximum limits for leakage current and supply current have changed.				
74LVC2G86 v.11	20130408	Product data sheet	-	74LVC2G86 v.10		
Modifications:	For type number	For type number 74LVC2G86GD XSON8U has changed to XSON8.				
74LVC2G86 v.10	20120521	Product data sheet	-	74LVC2G86 v.9		
Modifications:	For type number	For type number 74LVC2G86GM the sot code has changed to SOT902-2.				
74LVC2G86 v.9	20111125	Product data sheet	-	74LVC2G86 v.8		
Modifications:	<ul> <li>Legal pages up</li> </ul>	Legal pages updated.				
74LVC2G86 v.8	20101019	Product data sheet	-	74LVC2G86 v.7		
74LVC2G86 v.7	20080613	Product data sheet	-	74LVC2G86 v.6		
74LVC2G86 v.6	20080222	Product data sheet	-	74LVC2G86 v.5		
74LVC2G86 v.5	20070907	Product data sheet	-	74LVC2G86 v.4		
74LVC2G86 v.4	20061013	Product data sheet	-	74LVC2G86 v.3		
74LVC2G86 v.3	20050207	Product data sheet	-	74LVC2G86 v.2		
74LVC2G86 v.2	20041018	Product specification	-	74LVC2G86 v.1		
74LVC2G86 v.1	20030825	Product specification	-	-		

# 15 Legal information

#### 15.1 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.

- Please consult the most recently issued document before initiating or completing a design.
- The term 'short data sheet' is explained in section "Definitions". [2] [3]
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