## 74LVC1G86

# 2-input EXCLUSIVE-OR gate Rev. 10 — 2 July 2012

**Product data sheet** 

#### **General description** 1.

The 74LVC1G86 provides the 2-input EXCLUSIVE-OR function.

Inputs can be driven from either 3.3 V or 5 V devices. These features allow the use of these devices 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
- 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 2000 V
  - MM JESD22-A115-A exceeds 200 V
- $\pm$  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
74LVC1G86GW	–40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74LVC1G86GV	–40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753
74LVC1G86GM	–40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 $\times$ 1.45 $\times$ 0.5 mm	SOT886
74LVC1G86GF	–40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 $\times$ 1 $\times$ 0.5 mm	SOT891
74LVC1G86GN	–40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body $0.9 \times 1.0 \times 0.35$ mm	SOT1115
74LVC1G86GS	–40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 $\times$ 1.0 $\times$ 0.35 mm	SOT1202
74LVC1G86GX	–40 °C to +125 °C	X2SON5	X2SON5: plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body $0.8 \times 0.8 \times 0.35$ mm	SOT1226

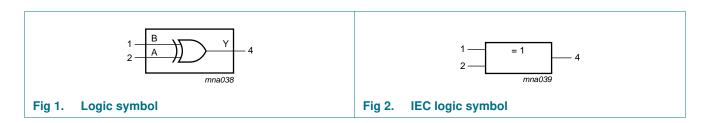
### 4. Marking

Table 2. Marking codes

Type number	Marking[1]
74LVC1G86GW	VH
74LVC1G86GV	V86
74LVC1G86GM	VH
74LVC1G86GF	VH
74LVC1G86GN	VH
74LVC1G86GS	VH
74LVC1G86GX	VH

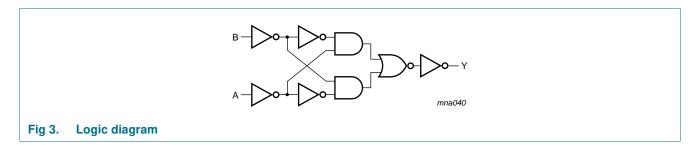
<sup>[1]</sup> The pin 1 indicator is located on the lower left corner of the device, below the marking code.

### 5. Functional diagram



NXP Semiconductors 74LVC1G86

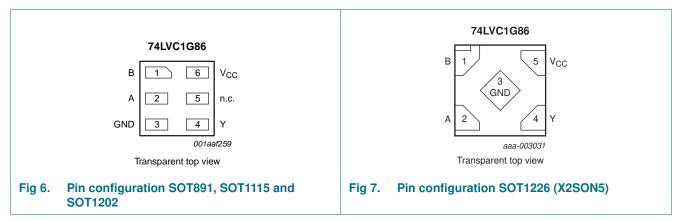
#### 2-input EXCLUSIVE-OR gate



### 6. Pinning information

### 6.1 Pinning





#### 6.2 Pin description

Table 3. Pin description

Symbol	Pin		Description
	TSSOP5 and X2SON5	XSON6	
В	1	1	data input
Α	2	2	data input
GND	3	3	ground (0 V)
Υ	4	4	data output
n.c.	-	5	not connected
$V_{CC}$	5	6	supply voltage

### 7. Functional description

Table 4. Function table[1]

Input		Output
Α	В	Υ
L	L	L
L	Н	Н
Н	L	Н
Н	Н	L

<sup>[1]</sup> H = HIGH voltage level; L = LOW voltage level.

### 8. 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
$V_{CC}$	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		<u>[1]</u> –0.5	+6.5	V
I <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	$V_{CC} + 0.5$	V
		Power-down mode	[1][2] -0.5	+6.5	V
Io	output current	$V_O = 0 V \text{ to } V_{CC}$	-	±50	mA
I <sub>CC</sub>	supply current		-	+100	mA
$I_{GND}$	ground current		-100	-	mA
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$	<u>[3]</u> _	250	mW
$T_{stg}$	storage temperature		<b>–65</b>	+150	°C

<sup>[1]</sup> The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

74LVC1G86

<sup>[2]</sup> When  $V_{CC} = 0 \ V$  (Power-down mode), the output voltage can be 5.5 V in normal operation.

<sup>[3]</sup> For TSSOP5 and SC-74A packages: above 87.5  $^{\circ}$ C the value of P<sub>tot</sub> derates linearly with 4.0 mW/K. For XSON6 and X2SON5 packages: above 118  $^{\circ}$ C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

### 9. Recommended operating conditions

Table 6. Recommended operating conditions

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

### 10. Static characteristics

Table 7. Static characteristics

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

Symbol	Parameter	Conditions	-40 °	°C to +8	5 °C	–40 °C to	Unit	
			Min	Typ[1]	Max	Min	Max	
V <sub>IH</sub>	HIGH-level	$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	0.65V <sub>CC</sub>	-	-	0.65V <sub>CC</sub>	-	V
	input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7V <sub>CC</sub>	-	-	0.7V <sub>CC</sub>	-	V
V <sub>IL</sub>	LOW-level input	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35V <sub>CC</sub>	-	0.35V <sub>CC</sub>	V
	voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	8.0	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	V
V <sub>OH</sub>	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$						
		$I_O = -100 \mu A;$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> – 0.1	-	V
		$I_{O} = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	1.2	-	-	0.95	-	٧
		$I_{O} = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.9	-	-	1.7	-	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	1.9	-	٧
		$I_{O} = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.3	-	-	2.0	-	V
		$I_{O} = -32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.8	-	-	3.4	-	V
V <sub>OL</sub>	LOW-level	$V_I = V_{IH}$ or $V_{IL}$						
	output voltage	$I_O = 100 \mu A;$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	-	0.10	-	0.10	V
		$I_O = 4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	-	-	0.45	-	0.70	V
		$I_{O} = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.30	-	0.45	V
		$I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.40	-	0.60	٧
		$I_{O} = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	-	0.80	٧
		$I_O = 32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	-	0.55	-	0.80	٧
I <sub>I</sub>	input leakage current	$V_1 = 5.5 \text{ V or GND};$ $V_{CC} = 0 \text{ V to } 5.5 \text{ V}$	-	±0.1	±5	-	±100	μΑ

Table 7. Static characteristics ... continued

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

Symbol	Parameter	Conditions	<b>–40</b>	°C to +85	°C	–40 °C to	Unit	
			Min	Typ[1]	Max	Min	Max	
I <sub>OFF</sub>	power-off leakage current	$V_{CC} = 0 \text{ V}; V_{I} \text{ or } V_{O} = 5.5 \text{ V}$	-	±0.1	±10	-	±200	μΑ
I <sub>CC</sub>	supply current	$V_{I} = 5.5 \text{ V or GND}; I_{O} = 0 \text{ A};$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	0.1	10	-	200	μΑ
$\Delta I_{CC}$	additional supply current	per pin; $V_{CC}$ = 2.3 V to 5.5 V; $V_I$ = $V_{CC}$ - 0.6 V; $I_O$ = 0 A	-	5	500	-	5000	μΑ
Cı	input capacitance	$V_{CC}$ = 3.3 V; $V_I$ = GND to $V_{CC}$	-	5	-	-	-	pF

<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 load circuit see Figure 9.

Symbol	Parameter	Conditions		-40	0 °C to +85	S °C	-40 °C to	Unit	
				Min	Typ[1]	Max	Min	Max	
t <sub>pd</sub>	propagation delay	A, B to Y; see Figure 8	[2]		1		'	'	
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$		1.0	3.7	9.9	1.0	13.0	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$		0.5	2.5	5.5	0.5	7.0	ns
		$V_{CC} = 2.7 \text{ V}$		0.5	2.8	5.8	0.5	7.5	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$		0.5	2.3	5.0	0.5	6.5	ns
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$		0.5	1.9	4.0	0.5	5.5	ns
$C_{PD}$	power dissipation	$V_I = GND$ to $V_{CC}$	[3]						
	capacitance	V <sub>CC</sub> = 3.3 V		-	25	-	-	-	pF

<sup>[1]</sup> All typical values are measured at nominal  $V_{CC}$ .

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

 $f_i$  = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

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

 $V_{CC}$  = supply voltage in V;

N = number of inputs switching;

 $\Sigma(C_L\times V_{CC}{}^2\times f_o)$  = sum of the outputs.

<sup>[2]</sup>  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ 

<sup>[3]</sup>  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).

2-input EXCLUSIVE-OR gate

### 12. Waveforms

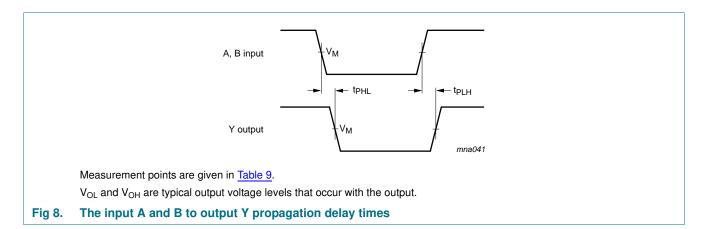
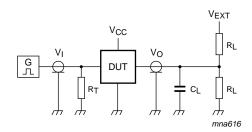


Table 9. Measurement points

Supply voltage	Input	Output
V <sub>CC</sub>	V <sub>M</sub>	V <sub>M</sub>
1.65 V to 1.95 V	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>
2.3 V to 2.7 V	0.5V <sub>CC</sub>	0.5V <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	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>

#### 2-input EXCLUSIVE-OR gate



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.

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

Fig 9. Test circuit for measuring switching times

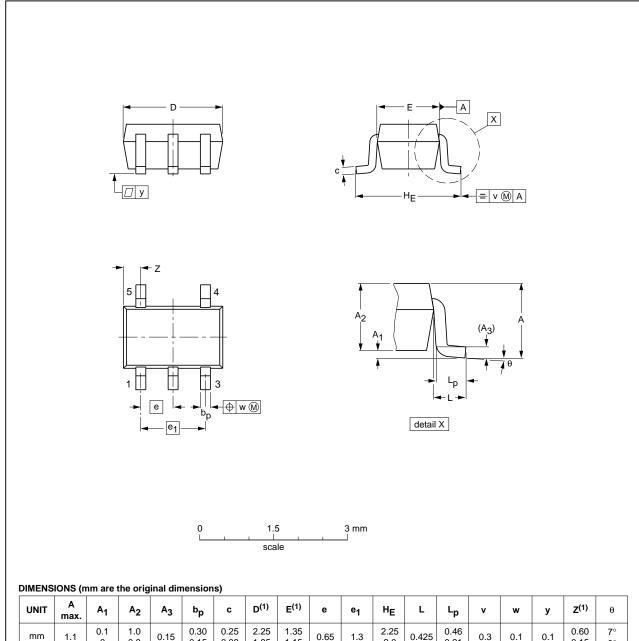
Table 10. Test data

Supply voltage	Input	Input		Load			
V <sub>CC</sub>	V <sub>I</sub>	$t_r = t_f$	CL	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>		
1.65 V to 1.95 V	$V_{CC}$	≤ 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	$V_{CC}$	≤ 2.5 ns	50 pF	500 Ω	open		

### 13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1



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	e <sub>1</sub>	HE	L	Lp	v	w	у	Z <sup>(1)</sup>	θ
mm	1.1	0.1 0	1.0 0.8	0.15	0.30 0.15	0.25 0.08	2.25 1.85	1.35 1.15	0.65	1.3	2.25 2.0	0.425	0.46 0.21	0.3	0.1	0.1	0.60 0.15	7° 0°

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

			REFERENCES			
IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
	MO-203	SC-88A			<del>-00-09-01</del> 03-02-19	
	120				W0.000 00.000	

Fig 10. Package outline SOT353-1 (TSSOP5)

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#### Plastic surface-mounted package; 5 leads

**SOT753** 

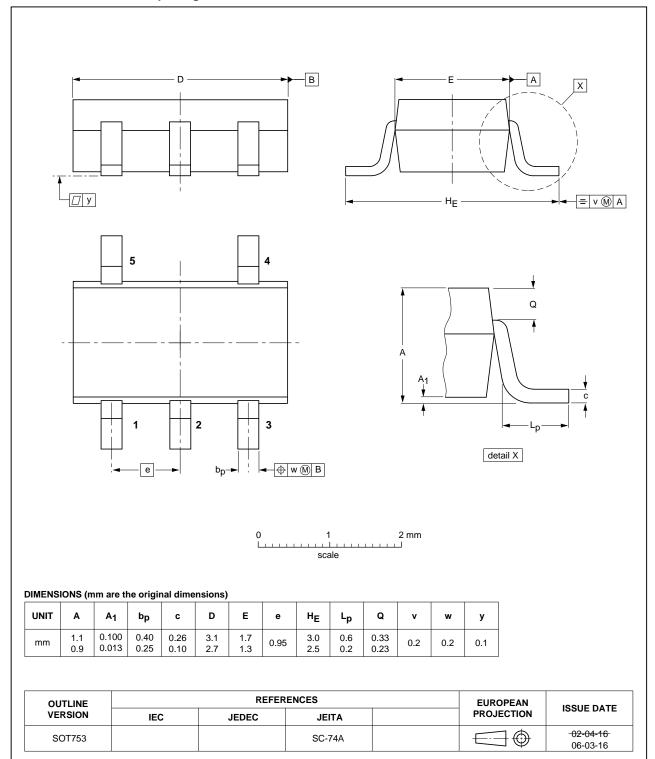


Fig 11. Package outline SOT753 (SC-74A)

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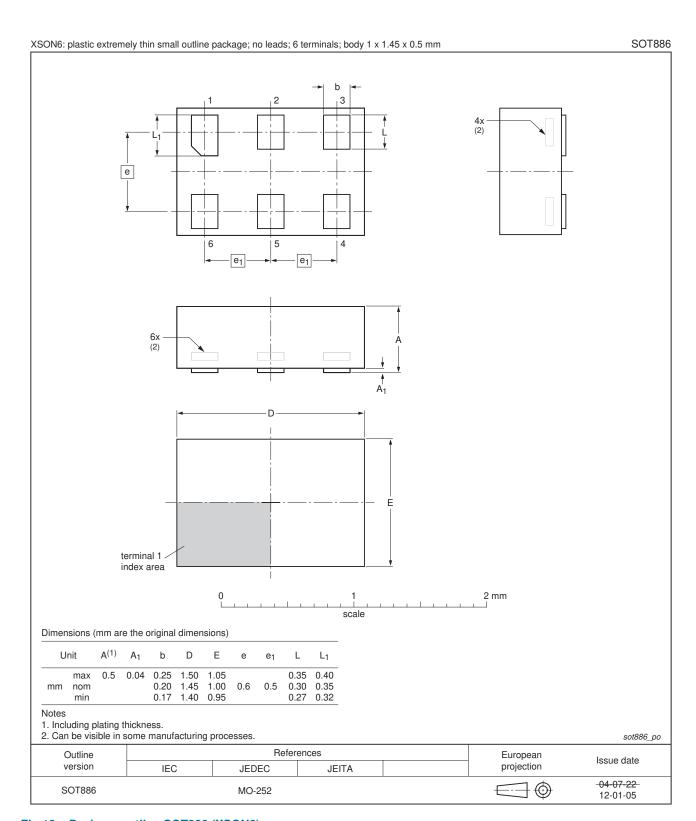


Fig 12. Package outline SOT886 (XSON6)

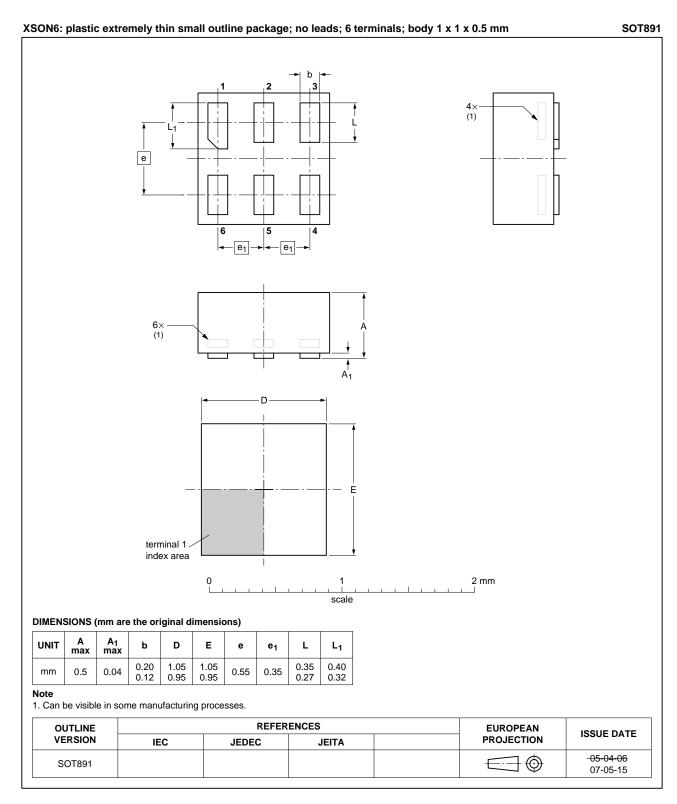


Fig 13. Package outline SOT891 (XSON6)

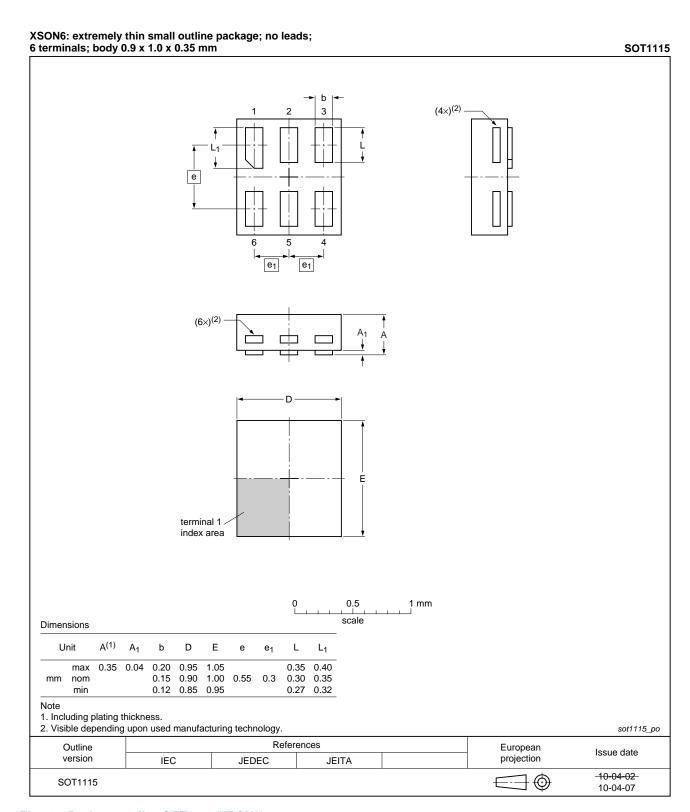


Fig 14. Package outline SOT1115 (XSON6)

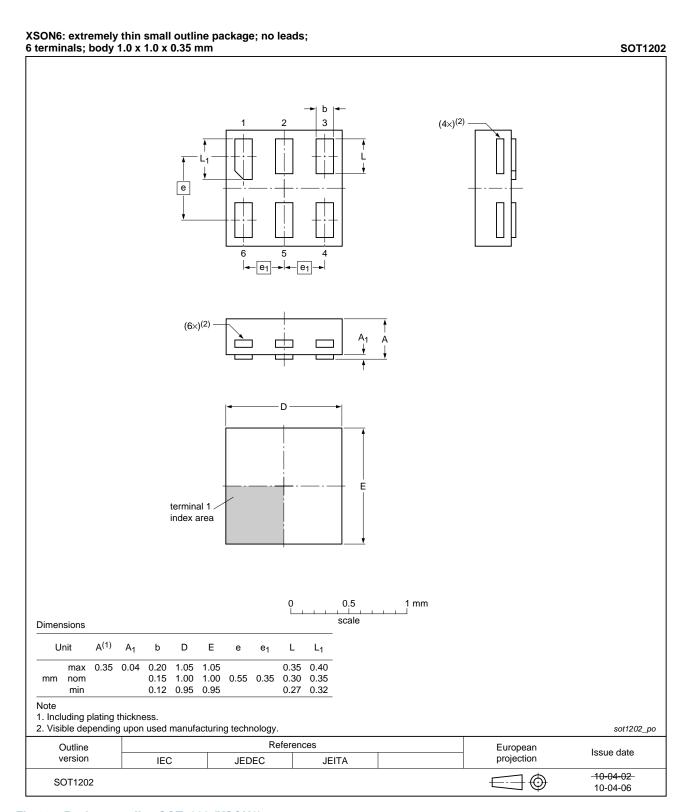


Fig 15. Package outline SOT1202 (XSON6)

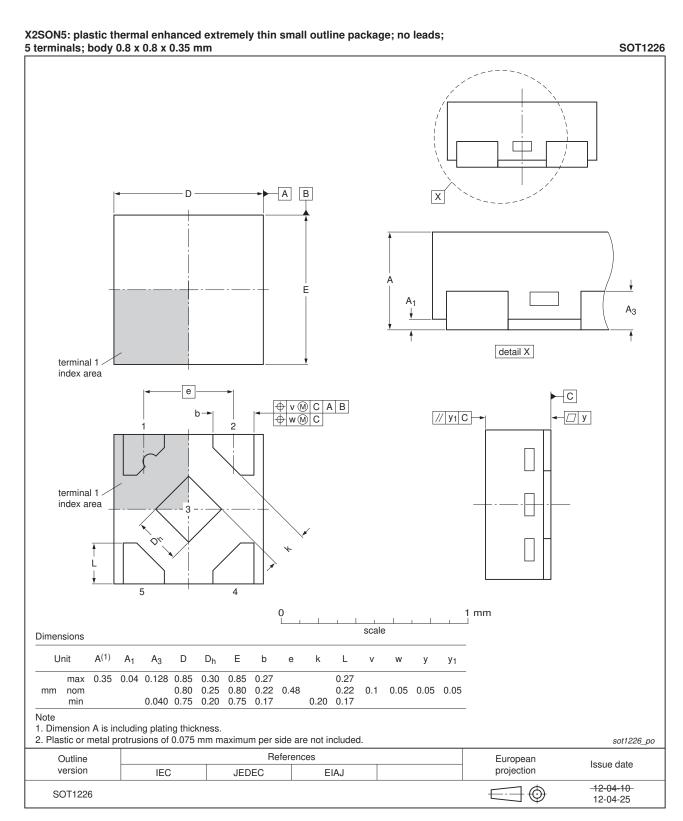


Fig 16. Package outline SOT1226 (X2SON5)

2-input EXCLUSIVE-OR gate

### 14. 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

### 15. Revision history

#### Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC1G86 v.10	20120702	Product data sheet	-	74LVC1G86 v.9
Modifications:	<ul> <li>Added type</li> </ul>	number 74LVC1G86GX (SO	T1226)	
74LVC1G86 v.9	20120305	Product data sheet	-	74LVC1G86 v.8
Modifications:	<ul> <li>Package ou</li> </ul>	ıtline drawing of SOT886 ( <u>Fig</u>	ure 12) modified.	
74LVC1G86 v.8	20111201	Product data sheet	-	74LVC1G86 v.7
Modifications:	<ul> <li>Legal pages</li> </ul>	s updated.		
74LVC1G86 v.7	20100914	Product data sheet	-	74LVC1G86 v.6
74LVC1G86 v.6	20070718	Product data sheet	-	74LVC1G86 v.5
74LVC1G86 v.5	20060913	Product data sheet	-	74LVC1G86 v.4
74LVC1G86 v.4	20040908	Product specification	-	74LVC1G86 v.3
74LVC1G86 v.3	20021115	Product specification	-	74LVC1G86 v.2
74LVC1G86 v.2	20010406	Preliminary specification	-	74LVC1G86 v.1
74LVC1G86 v.1	20001222	Preliminary specification	-	-

### 16. Legal information

#### 16.1 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.

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