# 74LVC1G86

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

**Product data sheet** 

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

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 <sup>[1]</sup>
74LVC1G86GW	VH
74LVC1G86GV	V86
74LVC1G86GM	VH
74LVC1G86GF	VH
74LVC1G86GN	VH
74LVC1G86GS	VH
74LVC1G86GX	VH

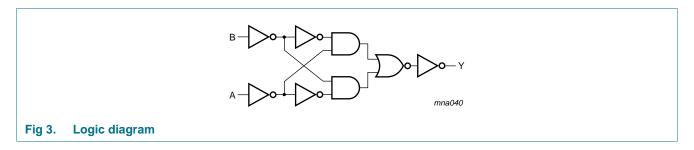
<sup>[1]</sup> The pin 1 indicator is located on the lower left corner of the device, below the marking code.

# 5. Functional diagram



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### 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	
A	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
Vo	output voltage	Active mode	[ <u>1][2]</u> –0.5	$V_{CC} + 0.5$	V
		Power-down mode	[ <u>1][2]</u> –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	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$	[3] -	250	mW
T <sub>stg</sub>	storage temperature		-65	+150	°C

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

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<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 °C the value of P<sub>tot</sub> derates linearly with 4.0 mW/K. For XSON6 and X2SON5 packages: above 118 °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
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	-	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 5.5 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	<b>-40</b> °	-40 °C to +85 °C			+125 °C	Unit
			Min	Typ[1]	Max	Min	Max	
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65V <sub>CC</sub>	-	-	0.65V <sub>CC</sub>	-	V
input volta	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	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	V
$V_{IL}$		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	$0.35V_{CC}$	-	$0.35V_{CC}$	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	-	-	8.0	-	8.0	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	V
$V_{OH}$	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$						
	output voltage	$I_O = -100 \mu A;$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	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	-	V
		$I_{O} = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.9	-	-	1.7	-	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	1.9	-	V
		$I_{O} = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	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	$I_O = 100 \mu A;$ $V_{CC} = 1.65 \text{ V to 5.5 V}$	-	-	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	V
		$I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	-	0.80	V
		$I_O = 32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	-	0.55	-	0.80	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 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	–40 °C to +85 °C			-40 °C to +125 °C		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	μА
$\Delta I_{CC}$	additional supply current	per pin; $V_{CC} = 2.3 \text{ V to } 5.5 \text{ V};$ $V_I = V_{CC} - 0.6 \text{ V}; I_O = 0 \text{ A}$	-	5	500	-	5000	μА
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 °C to +85 °C			-40 °C to +125 °C		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
10 1	power dissipation	$V_I = GND \text{ to } V_{CC}$	[3]						
	capacitance	$V_{CC} = 3.3 \text{ V}$		-	25	-	-	-	рF

<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

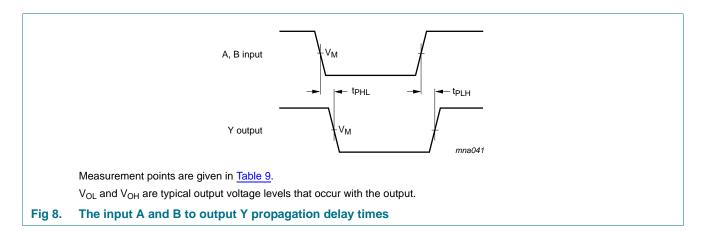
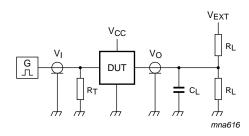


Table 9. Measurement points

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>

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Test data is given in Table 10.

Definitions for test circuit:

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

C<sub>L</sub> = 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

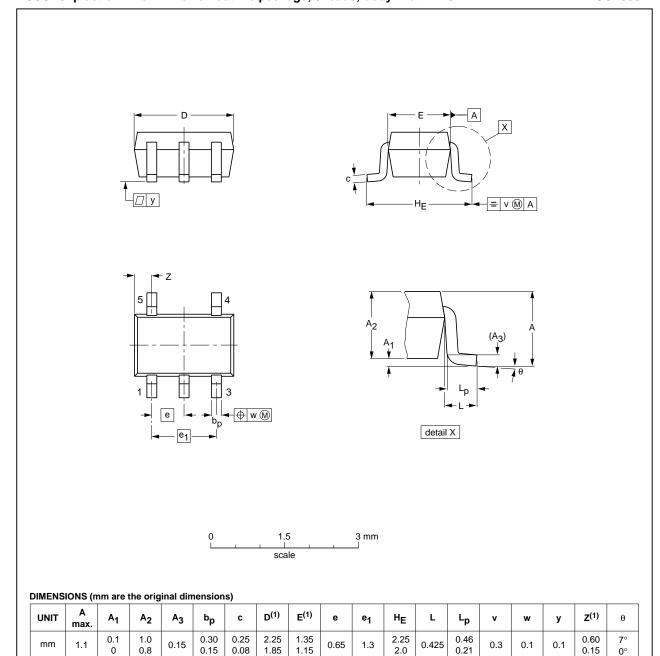
Table 10. Test data

Supply voltage	Input		Load	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	$V_{CC}$	$\leq$ 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



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
SOT353-1		MO-203	SC-88A		<del>-00-09-01</del> 03-02-19

Fig 10. Package outline SOT353-1 (TSSOP5)

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### Plastic surface-mounted package; 5 leads

**SOT753** 

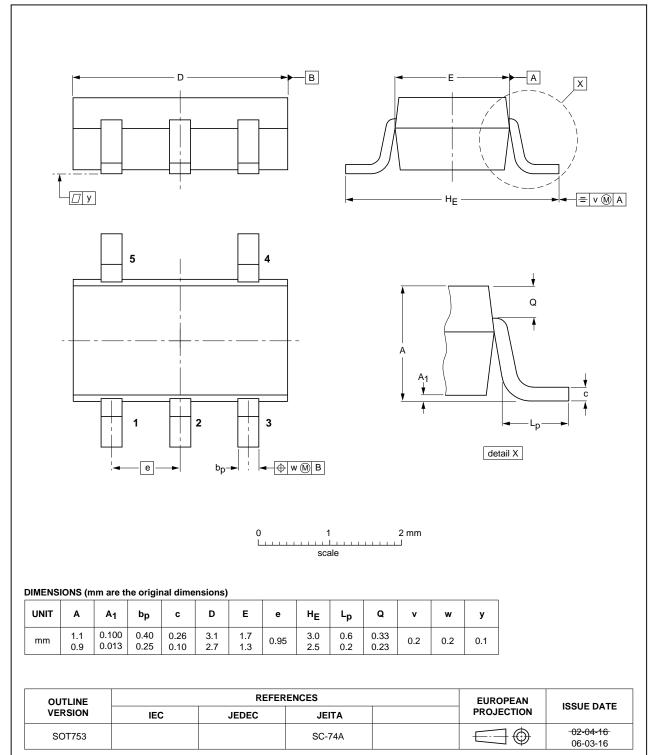


Fig 11. Package outline SOT753 (SC-74A)

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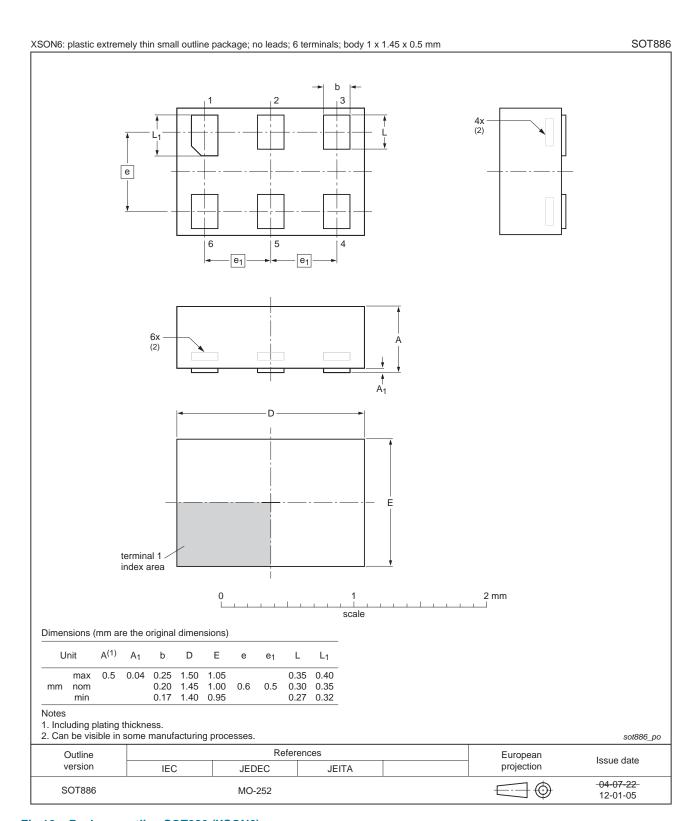


Fig 12. Package outline SOT886 (XSON6)

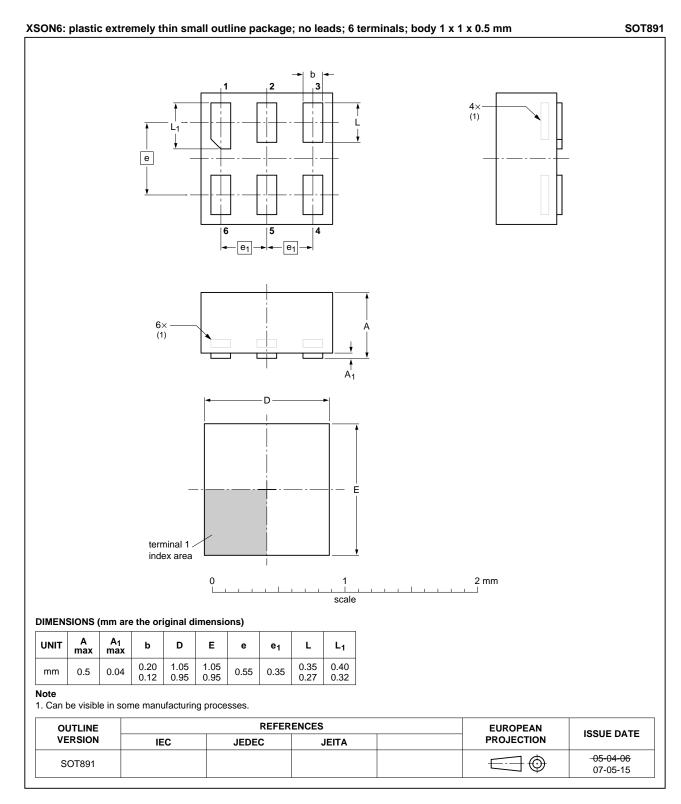


Fig 13. Package outline SOT891 (XSON6)

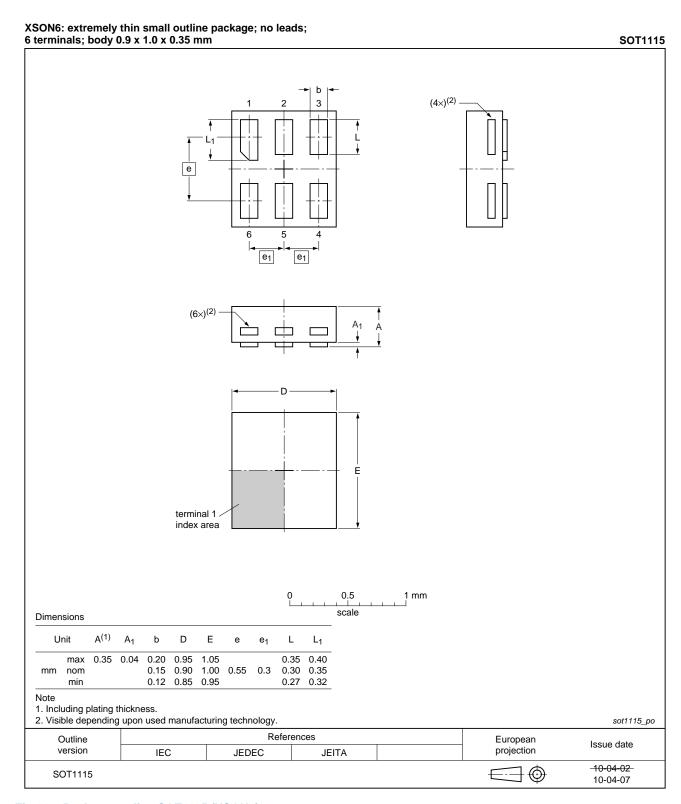


Fig 14. Package outline SOT1115 (XSON6)

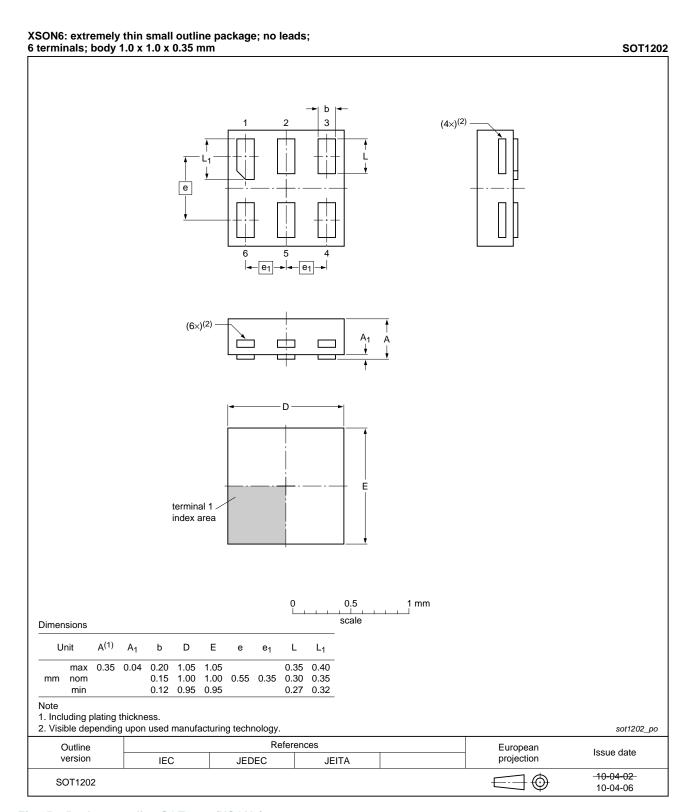


Fig 15. Package outline SOT1202 (XSON6)

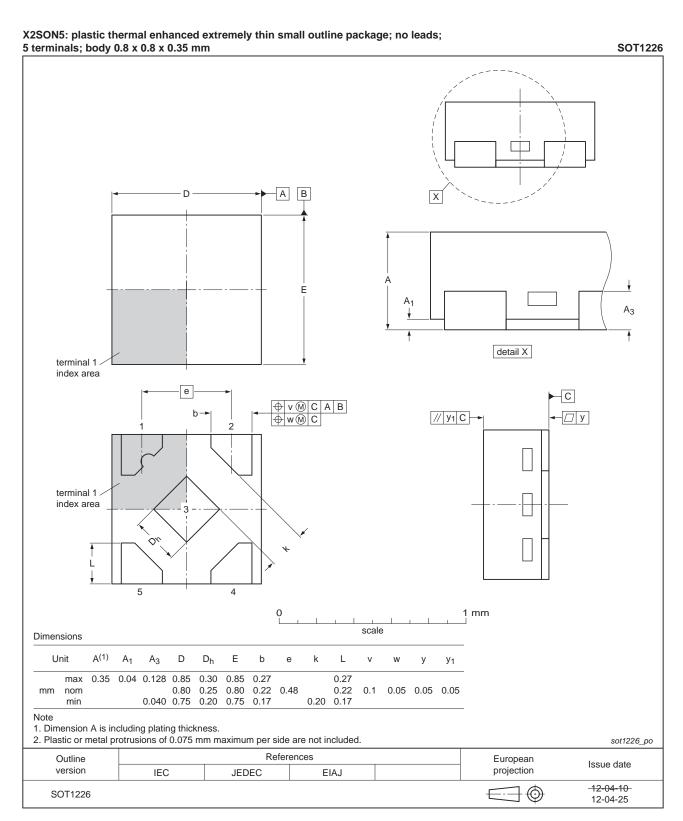


Fig 16. Package outline SOT1226 (X2SON5)

# 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

74LVC1G86 v.10       20120702       Product data sheet       -       74LVC1G86 v.9         Modifications:       ● Added type number 74LVC1G86GX (SOT1226)         74LVC1G86 v.9       20120305       Product data sheet       -       74LVC1G86 v.8         Modifications:       ● Package outline drawing of SOT886 (Figure 12) modified.         74LVC1G86 v.8       20111201       Product data sheet       -       74LVC1G86 v.7         Modifications:       ● Legal pages 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.2       20010406       Preliminary specification       -       74LVC1G86 v.1						
Modifications:         ● Added type number 74LVC1G86GX (SOT1226)           74LVC1G86 v.9         20120305         Product data sheet         -         74LVC1G86 v.8           Modifications:         ● Package outline drawing of SOT886 (Figure 12) modified.           74LVC1G86 v.8         20111201         Product data sheet         -         74LVC1G86 v.7           Modifications:         ● Legal pages 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.2         20010406         Preliminary specification         -         74LVC1G86 v.1	Document ID	Release date	Data sheet status	Change notice	Supersedes	
74LVC1G86 v.9       20120305       Product data sheet       -       74LVC1G86 v.8         Modifications:       ● Package outline drawing of SOT886 (Figure 12) modified.         74LVC1G86 v.8       20111201       Product data sheet       -       74LVC1G86 v.7         Modifications:       ● Legal pages 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.2       20010406       Preliminary specification       -       74LVC1G86 v.1	74LVC1G86 v.10	20120702	Product data sheet	-	74LVC1G86 v.9	
Modifications:         ● Package outline drawing of SOT886 (Figure 12) modified.           74LVC1G86 v.8         20111201         Product data sheet         -         74LVC1G86 v.7           Modifications:         ● Legal pages 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.2         20010406         Preliminary specification         -         74LVC1G86 v.1	Modifications:	<ul> <li>Added type r</li> </ul>	number 74LVC1G86GX (SOT1	226)		
74LVC1G86 v.8       20111201       Product data sheet       -       74LVC1G86 v.7         Modifications:       • Legal pages 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.2       20010406       Preliminary specification       -       74LVC1G86 v.1	74LVC1G86 v.9	20120305	Product data sheet	-	74LVC1G86 v.8	
Modifications:         • Legal pages 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	Modifications:	<ul> <li>Package outline drawing of SOT886 (<u>Figure 12</u>) modified.</li> </ul>				
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.8	20111201	Product data sheet	-	74LVC1G86 v.7	
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	Modifications:	<ul> <li>Legal pages</li> </ul>	updated.			
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.7	20100914	Product data sheet	-	74LVC1G86 v.6	
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Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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