# **74LVC1GU04**

# Unbuffered inverter

Rev. 15 — 12 January 2022

**Product data sheet** 

## 1. General description

The 74LVC1GU04 is a single unbuffered inverter. Inputs can be driven from either 3.3 V or 5.5 V devices. This feature allows the use of this device in a mixed 3.3 V and 5 V environment.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

### 2. Features and benefits

- · Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.65 V to 5.5 V
- · High noise immunity
- ±24 mA output drive (V<sub>CC</sub> = 3.0 V)
- · CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard no. 8-1A
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 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
74LVC1GU04GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74LVC1GU04GV	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753
74LVC1GU04GM	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
74LVC1GU04GN	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115
74LVC1GU04GS	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202
74LVC1GU04GX	-40 °C to +125 °C	X2SON5	plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 × 0.8 × 0.32 mm	SOT1226-3



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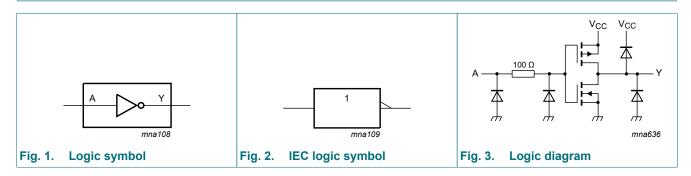
# 4. Marking

#### Table 2. Marking codes

Type number	Marking[1]
74LVC1GU04GW	VD
74LVC1GU04GV	VU4
74LVC1GU04GM	VD
74LVC1GU04GN	VD
74LVC1GU04GS	VD
74LVC1GU04GX	VD

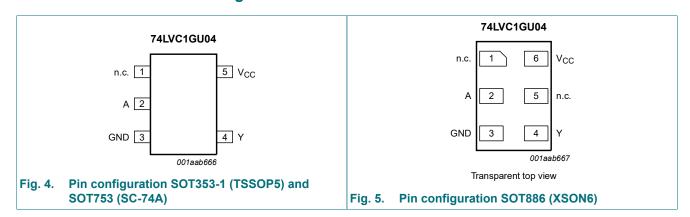
<sup>[1]</sup> The pin 1 indicator is located on the lower left corner of the device, below the marking code.

### 5. Functional diagram



# 6. Pinning information

### 6.1. Pinning



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### 6.2. Pin description

Table 3. Pin description

Symbol	Pin	Pin		
	TSSOP5, SC-74A and X2SON5	TSSOP5, SC-74A and X2SON5 XSON6		
n.c.	1	1	not connected	
A	2	2	data input	
GND	3	3	ground (0 V)	
Υ	4	4	data output	
n.c.	-	5	not connected	
V <sub>CC</sub>	5	6	supply voltage	

# 7. Functional description

### **Table 4. Function table**

 $H = HIGH \ voltage \ level; \ L = LOW \ voltage \ level.$ 

Input (A)	Output (Y)
L	Н
Н	L

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### 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 <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
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA
Vo	output voltage	Active mode [1][2]	-0.5	V <sub>CC</sub> + 0.5	V
Io	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	+100	mA
I <sub>GND</sub>	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

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- [2] When  $V_{CC}$  = 0 V (Power-down mode), the output voltage can be 5.5 V in normal operation
- [3] For SOT353-1 (TSSOP5) package: P<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C.
  - For SOT753 (SC-74A) package: P<sub>tot</sub> derates linearly with 3.8 mW/K above 85 °C.
  - For SOT886 (XSON6) package:  $P_{tot}$  derates linearly with 3.3 mW/K above 74  $^{\circ}\text{C}.$
  - For SOT1115 (XSON6) package: Ptot derates linearly with 3.2 mW/K above 71 °C.
  - For SOT1202 (XSON6) package: Ptot derates linearly with 3.3 mW/K above 74 °C.
  - For SOT1226-3 (X2SON5) package: Ptot derates linearly with 3.0 mW/K above 67 °C.

## 9. Recommended operating conditions

#### Table 6. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	5.5	V
VI	input voltage		0	-	5.5	V
Vo	output voltage	Active mode	0	-	$V_{CC}$	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	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 5.5 V	0	-	10	ns/V

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# 10. Static characteristics

#### **Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	Min	Typ[1]	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 5.5 V	0.75 × V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.25 × V <sub>CC</sub>	V
V <sub>OH</sub>	HIGH-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	V <sub>CC</sub> - 0.1	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.9	-	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.3	-	-	V
	$I_{O}$ = -32 mA; $V_{CC}$ = 4.5 V	3.8	-	-	V	
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		$I_{O}$ = 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	-	-	0.45	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.3	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	V
l <sub>l</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	±1	μΑ
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 1.65 V to 5.5 V	-	0.1	4	μΑ
Cı	input capacitance	$V_{CC}$ = 3.3 V; $V_I$ = GND to $V_{CC}$	-	6	-	pF

Symbol	Parameter	Conditions	Min	Typ[1]	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 5.5 V	0.8 × V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.2 × V <sub>CC</sub>	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 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 <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.7	-	-	V
	I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	1.9	-	-	V	
	I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.0	-	-	V	
		I <sub>O</sub> = -32 mA; V <sub>CC</sub> = 4.5 V	3.4	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		$I_{O}$ = 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	-	-	0.7	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.45	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.80	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	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	±1	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	4	μΑ

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

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# 11. Dynamic characteristics

#### **Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 11.

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 to Y; see Fig. 8 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.3	1.7	5.0	0.3	6.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.3	1.3	4.0	0.3	5.5	ns
		V <sub>CC</sub> = 2.7 V	0.5	1.7	5.0	0.5	6.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	1.6	3.7	0.5	5.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	1.3	3.0	0.5	4.0	ns
C <sub>PD</sub>	power dissipation capacitance	$V_I = GND \text{ to } V_{CC};$ [3] $V_{CC} = 3.3 \text{ V}$	-	14.9	-	-	-	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  $\mu W$ ).

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

 $f_i$  = input frequency in MHz;

 $f_o$  = output frequency in MHz;

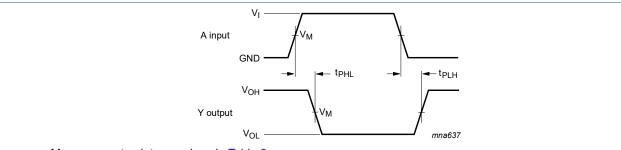
C<sub>L</sub> = output load capacitance in pF;

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. Waveform and test circuit



Measurement points are given in Table 9.

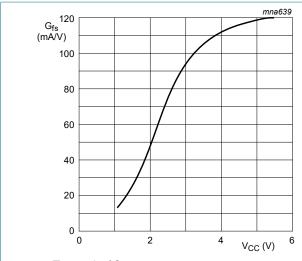
V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

The input A to output Y propagation delay times Fig. 8.

**Table 9. Measurement points** 

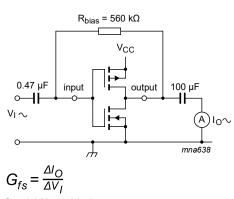
Supply voltage	Input	Output
V <sub>CC</sub>	$V_{M}$	V <sub>M</sub>
1.65 V to 1.95 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>
2.3 V to 2.7 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V
4.5 V to 5.5 V	0.5 x V <sub>CC</sub>	0.5 x V <sub>CC</sub>

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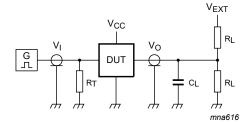
 $T_{amb}$  = 25 °C.

Fig. 9. Typical forward transconductance as a function | Fig. 10. Test set-up for measuring forward of supply voltage



f<sub>i</sub> = 1 kHz at V<sub>O</sub> is constant

transconductance



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  $Z_o$  of the pulse generator;

V<sub>EXT</sub> = External voltage for measuring switching times.

Fig. 11. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Input		Load		V <sub>EXT</sub>
V <sub>CC</sub>	Vı	$t_r = t_f$	CL	$R_L$	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

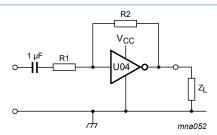
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# 12. Application information

Some applications are:

- Linear amplifier (see Fig. 12)
- In crystal oscillator design (see Fig. 13)

Remark: All values given are typical unless otherwise specified.



 $V_{o(p-p)} = V_{CC} - 1.5 \text{ V centered at } 0.5 V_{CC}.$ 

$$A_{u} = -\frac{G_{OL}}{1 + \frac{R1}{R2}(1 + G_{OL})}$$

 $G_{OL}$  = loop gain.

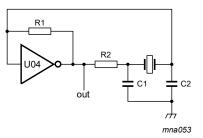
 $A_u$  = voltage amplification.

 $R1 \ge 3 \text{ k}\Omega, R2 \le 1 \text{ M}\Omega$ 

 $Z_L > 10 \text{ k}\Omega; A_{OL} = 20 \text{ (typ.)}$ 

Typical unity gain bandwidth product is 5 MHz.

Fig. 12. Used as a linear amplifier



C1 = 47 pF (typ.)

C2 = 22 pF (typ.)

R1 = 1 M $\Omega$  to 10 M $\Omega$  (typ.)

R2 optimum value depends on the frequency and required stability against changes in  $V_{CC}$  or average minimum  $I_{CC}$  ( $I_{CC}$  is typically 2 mA at  $V_{CC}$  = 3.3 V and f = 10 MHz).

Fig. 13. Crystal oscillator configuration

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# 13. Package outline

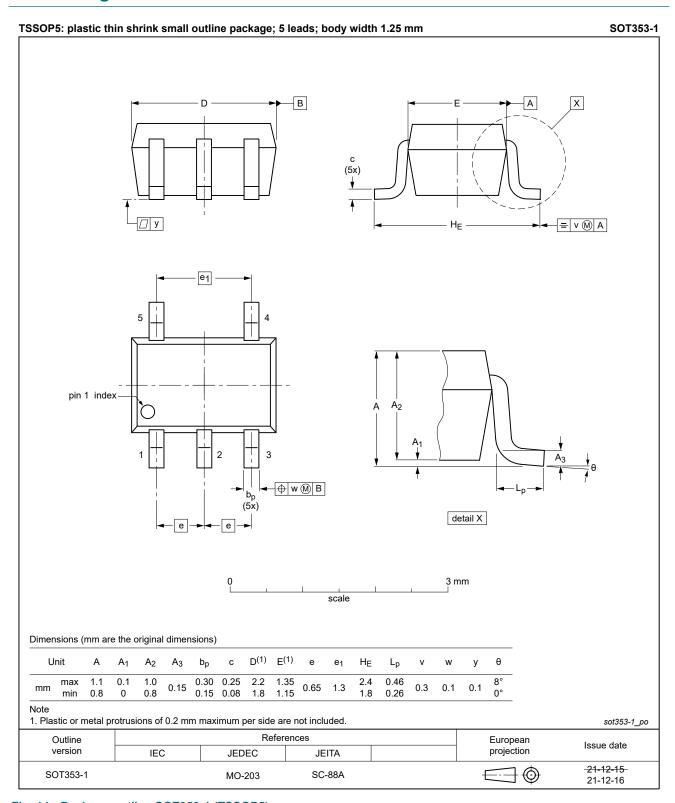


Fig. 14. Package outline SOT353-1 (TSSOP5)

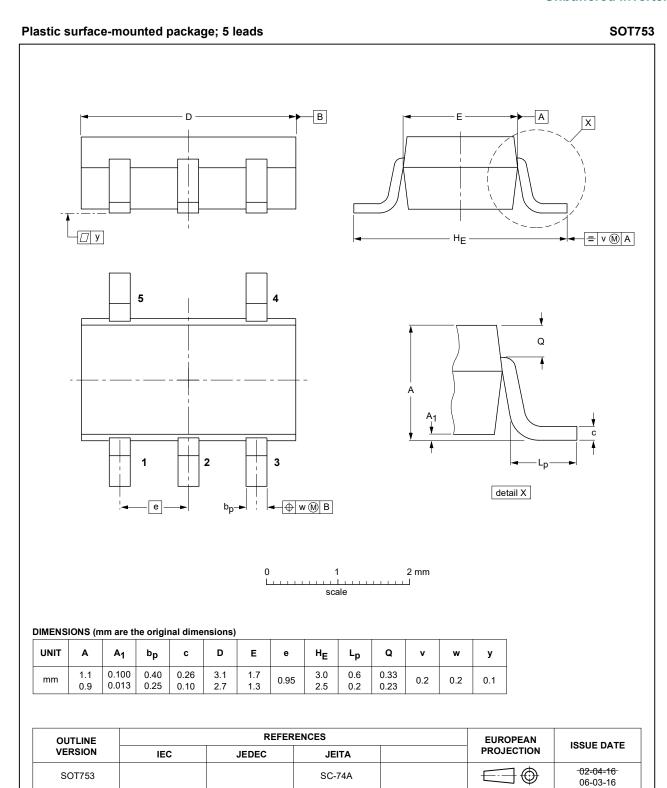


Fig. 15. Package outline SOT753 (SC-74A)

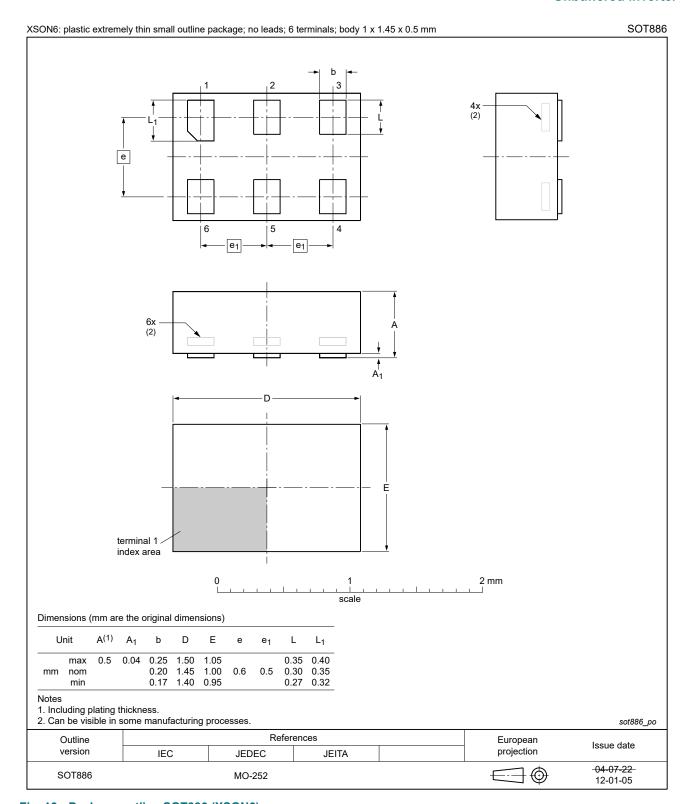


Fig. 16. Package outline SOT886 (XSON6)

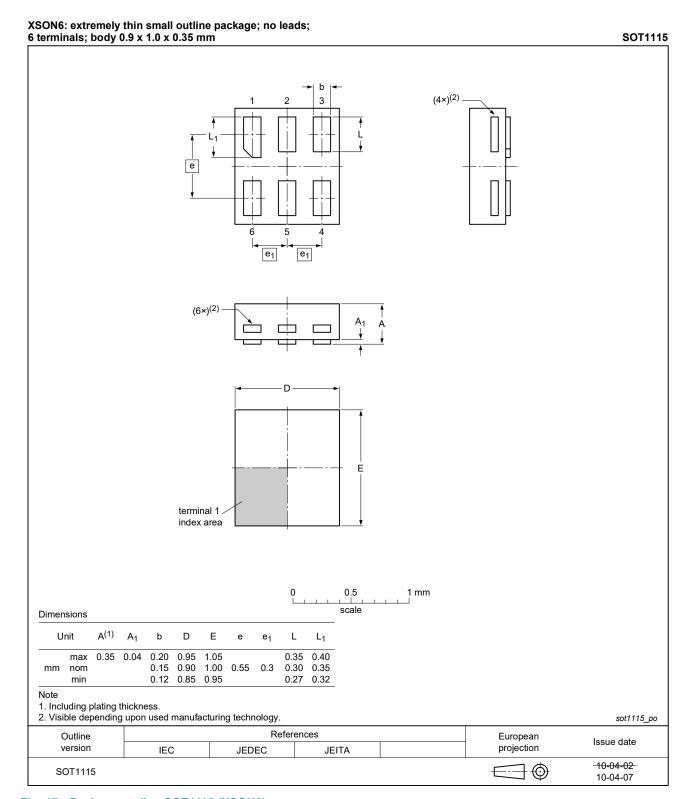


Fig. 17. Package outline SOT1115 (XSON6)

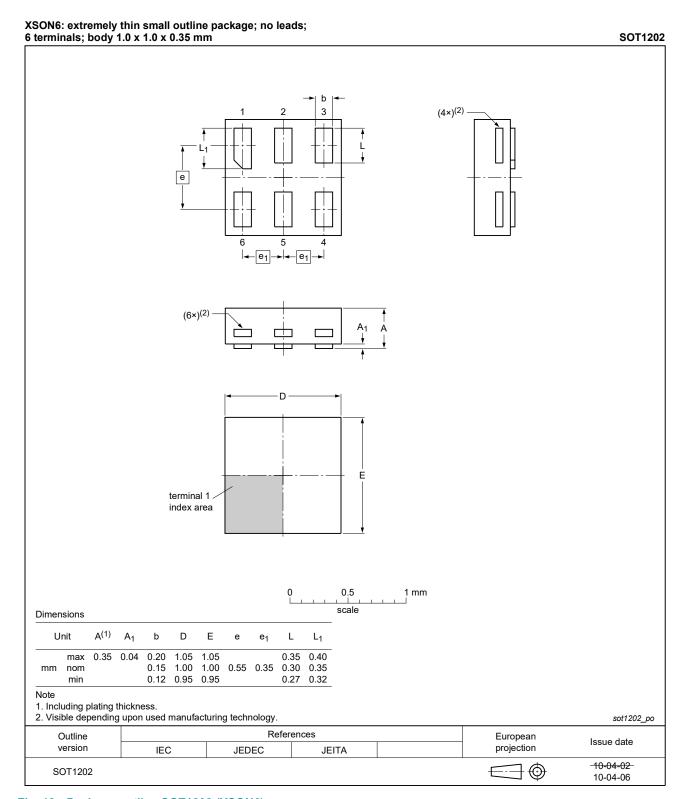


Fig. 18. Package outline SOT1202 (XSON6)

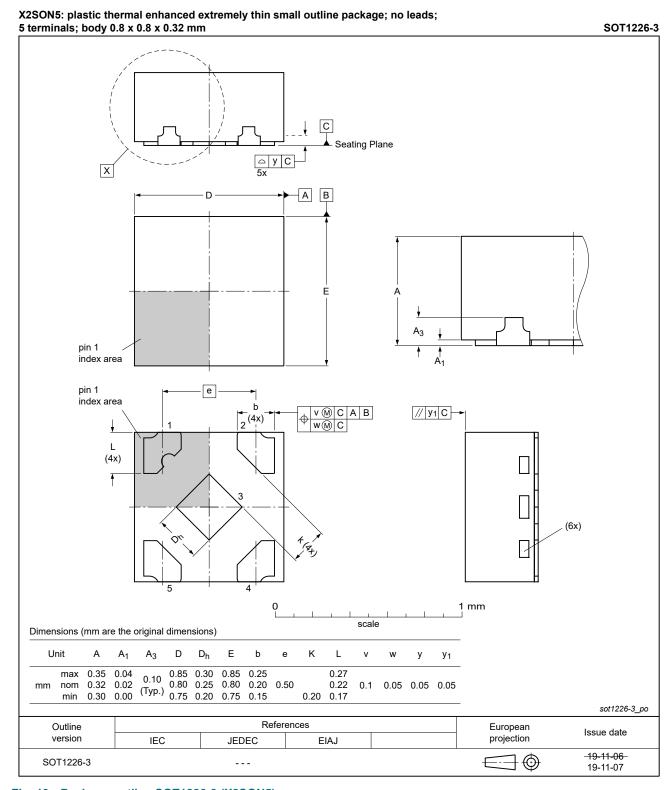


Fig. 19. Package outline SOT1226-3 (X2SON5)

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# 14. Abbreviations

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

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

# 15. Revision history

### **Table 12. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes		
74LVC1GU04 v.15	20220112	Product data sheet	-	74LVC1GU04 v.14		
Modifications:	Fig. 14: Package outline drawing SOT353-1 (TSSOP5) has changed.					
74LVC1GU04 v.14	20219027	Product data sheet	-	74LVC1GU04 v.13		
Modifications:	<ul> <li>SOT1226 (</li> <li>Section 1 a</li> <li>Table 5: De</li> <li>The format guidelines of</li> </ul>	<ul> <li>Type number 74LVC1GU04GF (SOT891/XSON6) removed.</li> <li>SOT1226 (X2SON5) package changed to SOT1226-3 (X2SON5) package.</li> <li>Section 1 and Section 2 updated.</li> <li>Table 5: Derating values for P<sub>tot</sub> total power dissipation updated.</li> <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> </ul>				
74LVC1GU04 v.13	20161212	Product data sheet	-	74LVC1GU04 v.12		
Modifications:	<u>Table 7</u> : The maximum limits for leakage current and supply current have changed.					
74LVC1GU04 v.12	20130409	Product data sheet	-	74LVC1GU04 v.11		
Modifications:	Descriptive title changed to Unbuffered inverter.					
74LVC1GU04 v.11	20120702	Product data sheet	-	74LVC1GU04 v.10		
Modifications:		<ul> <li>Added type number 74LVC1GU04GX (SOT1226)</li> <li>Package outline drawing of SOT886 (Fig. 16) modified.</li> </ul>				
74LVC1GU04 v.10	20111201	Product data sheet	-	74LVC1GU04 v.9		
Modifications:	Legal pages updated.					
74LVC1GU04 v.9	20101021	Product data sheet	-	74LVC1GU04 v.8		
74LVC1GU04 v.8	20070612	Product data sheet	-	74LVC1GU04 v.7		
74LVC1GU04 v.7	20061006	Product data sheet	-	74LVC1GU04 v.6		
74LVC1GU04 v.6	20040921	Product specification	-	74LVC1GU04 v.5		
74LVC1GU04 v.5	20040628	Product specification	-	74LVC1GU04 v.4		
74LVC1GU04 v.4	20030630	Product specification	-	74LVC1GU04 v.3		
74LVC1GU04 v.3	20030212	Product specification	-	74LVC1GU04 v.2		
74LVC1GU04 v.2	20010406	Product specification	-	74LVC1GU04 v.1		
74LVC1GU04 v.1	20001212	Product specification	-	-		

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### 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.

- Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- 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 <a href="https://www.nexperia.com">https://www.nexperia.com</a>.

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### **Unbuffered inverter**

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