Single Schmitt trigger inverter Rev. 6 — 4 May 2021

nexperia

### 1. General description

The 74LVC1G14-Q100 is a single inverter with Schmitt-trigger inputs. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments. This device is fully specified for partial power down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

### 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 1.65 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- I<sub>OFF</sub> circuitry provides partial Power-down mode operation
- ±24 mA output drive (V<sub>CC</sub> = 3.0 V)
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- Unlimited rise and fall times
- Complies with JEDEC standard:
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8C (2.7 V to 3.6 V)
  - JESD36 (4.5 V to 5.5 V)
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pf, R = 0 Ω)
- Multiple package options

### 3. Applications

- Wave and pulse shaper
- Astable multivibrator
- Monostable multivibrator

### 4. Ordering information

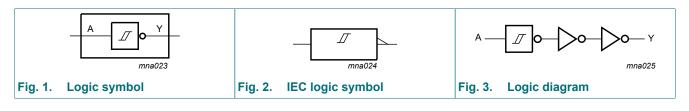
Type number	Package						
	Temperature range	Name	Description	Version			
74LVC1G14GW-Q100	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1			
74LVC1G14GV-Q100	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753			
74LVC1G14GM-Q100	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886			
74LVC1G14GX4-Q100	-40 °C to +125 °C	X2SON4	plastic thermal enhanced extremely thin small outline package; no leads; 4 terminals; body 0.6 × 0.6 × 0.32 mm	SOT1269-2			

### 5. Marking

Table 2. Marking				
Type number	Marking code[1]			
74LVC1G14GW-Q100	VF			
74LVC1G14GV-Q100	V14			
74LVC1G14GM-Q100	VF			
74LVC1G14GX4-Q100	VF			

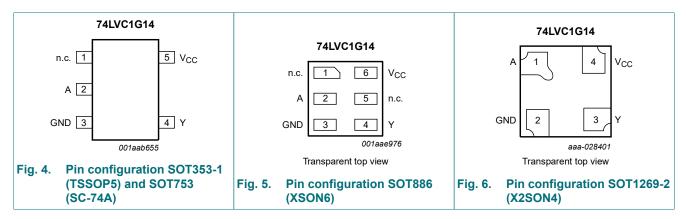
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

### 6. Functional diagram



### 7. Pinning information

### 7.1. Pinning



#### 74LVC1G14\_Q100

### 7.2. Pin description

Table 3. Pin de	Table 3. Pin description						
Symbol	Pin	Pin					
	TSSOP5 and SC-74A	XSON6	X2SON4				
n.c.	1	1, 5	-	not connected			
A	2	2	1	data input			
GND	3	3	2	ground (0 V)			
Y	4	4	3	data output			
V <sub>CC</sub>	5	6	4	supply voltage			

### 8. Functional description

#### Table 4. Function table

H = HIGH voltage level; L = LOW voltage level

Input	Output
A	Y
L	Н
Н	L

### 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
V <sub>CC</sub>	supply voltage			-0.5	+6.5	V
VI	input voltage		[1]	-0.5	+6.5	V
Vo	output voltage	Active mode	[1]	-0.5	V <sub>CC</sub> + 0.5	V
		Power-down mode; $V_{CC} = 0 V$	[1]	-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>1</sub> < 0 V		-50	-	mA
I <sub>OK</sub>	output clamping current	$V_{\rm O}$ > $V_{\rm CC}$ or $V_{\rm O}$ < 0 V		-	±50	mA
I <sub>O</sub>	output current	$V_{O} = 0 V \text{ to } V_{CC}$		-	±50	mA
I <sub>CC</sub>	supply current			-	+100	mA
I <sub>GND</sub>	ground current			-100	-	mA
T <sub>stg</sub>	storage temperature			-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C				
		TSSOP5, SC-74A and XSON6 package	[2]	-	250	mW
		X2SON4 package	[3]	-	150	mW

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

[2] 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<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C. [3] For SOT1269-2 (X2SON4) package: P<sub>tot</sub> derates linearly with 1.7 mW/K above 57 °C.

## 10. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Мах	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 <sub>CC</sub>	V
		Power-down mode; $V_{CC} = 0 V$	0	-	5.5	V
T <sub>amb</sub>	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	-40	-40 °C to +85 °C			-40 °C to +125 °C		
			Min Typ[1]		Max	Min	Max		
V <sub>OH</sub>	HIGH-level output	$V_{I} = V_{T+}$ or $V_{T-}$							
	voltage	I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	V	
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	1.54	-	0.95	-	V	
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.9	2.15	-	1.7	-	V	
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	2.50	-	1.9	-	V	
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.3	2.62	-	2.0	-	V	
		I <sub>O</sub> = -32 mA; V <sub>CC</sub> = 4.5 V	3.8	4.11	-	3.4	-	V	
V <sub>OL</sub>	LOW-level output	$V_{I} = V_{T+}$ or $V_{T-}$							
	voltage	I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.10	-	0.10	V	
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	0.07	0.45	-	0.70	V	
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	0.12	0.30	-	0.45	V	
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	0.17	0.40	-	0.60	V	
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	0.33	0.55	-	0.80	V	
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	0.39	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	±1	-	±1	μA	
I <sub>OFF</sub>	power-off leakage current	$V_{I} \text{ or } V_{O} = 5.5 \text{ V}; V_{CC} = 0 \text{ V}$	-	±0.1	±2	-	±2	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	-	0.1	4	-	4	μA	
ΔI <sub>CC</sub>	additional supply current	$V_{I} = V_{CC} - 0.6 V; I_{O} = 0 A;$ $V_{CC} = 2.3 V to 5.5 V$	-	5	500	-	500	μA	
CI	input capacitance	$V_{CC}$ = 3.3 V; $V_{I}$ = GND to $V_{CC}$	-	5.0	-	-	-	pF	

[1] All typical values are measured at maximum V<sub>CC</sub> and T<sub>amb</sub> = 25 °C.

### **11.1. Transfer characteristics**

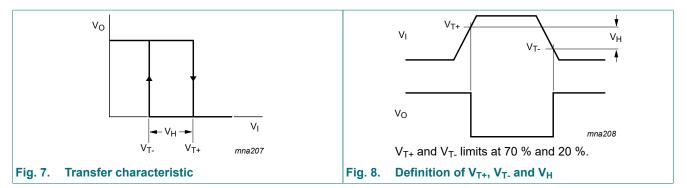
#### Table 8. Transfer characteristics

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

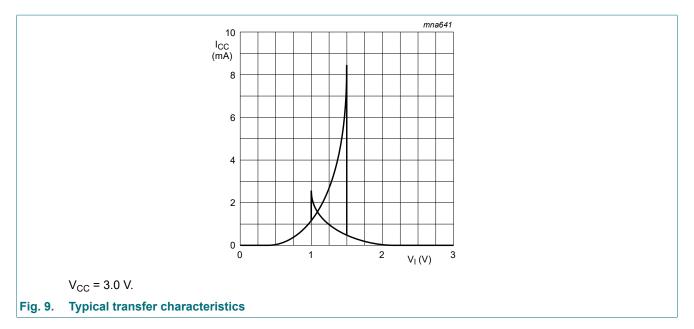
Symbol	Parameter	Conditions	-40	0 °C to +85	°C	-40 °C to	Unit	
			Min	Typ[1]	Мах	Min	Max	
V <sub>T+</sub>	positive-going	see Fig. 7 and Fig. 8						
	threshold voltage	V <sub>CC</sub> = 1.8 V	0.82	1.0	1.14	0.79	1.14	V
		V <sub>CC</sub> = 2.3 V	1.03	1.2	1.40	1.00	1.40	V
		V <sub>CC</sub> = 3.0 V	1.29	1.5	1.71	1.26	1.71	V
		V <sub>CC</sub> = 4.5 V	1.84	2.1	2.36	1.81	2.36	V
		V <sub>CC</sub> = 5.5 V	2.19	2.5	2.79	2.16	2.79	V
V <sub>T-</sub> negative-going		see Fig. 7 and Fig. 8						
	threshold voltage	V <sub>CC</sub> = 1.8 V	0.46	0.6	0.75	0.46	0.78	V
		V <sub>CC</sub> = 2.3 V	0.65	0.8	0.96	0.65	0.99	V
		V <sub>CC</sub> = 3.0 V	0.88	1.0	1.24	0.88	1.27	V
		V <sub>CC</sub> = 4.5 V	1.32	1.5	1.84	1.32	1.87	V
		V <sub>CC</sub> = 5.5 V	1.58	1.8	2.24	1.58	2.27	V
V <sub>H</sub>	hysteresis voltage	$(V_{T+} - V_{T-})$ ; see <u>Fig. 7</u> , <u>Fig. 8</u> and <u>Fig. 9</u>						
		V <sub>CC</sub> = 1.8 V	0.26	0.4	0.51	0.19	0.51	V
		V <sub>CC</sub> = 2.3 V	0.28	0.4	0.57	0.22	0.57	V
		V <sub>CC</sub> = 3.0 V	0.31	0.5	0.64	0.25	0.64	V
		V <sub>CC</sub> = 4.5 V	0.40	0.6	0.77	0.34	0.77	V
		V <sub>CC</sub> = 5.5 V	0.47	0.6	0.88	0.41	0.88	V

[1] Typical values are measured at  $T_{amb}$  = 25 °C.

### 11.2. Waveforms transfer characteristics



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### 12. Dynamic characteristics

#### **Table 9. Dynamic characteristics**

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

Symbol	Parameter	Parameter Conditions		-40 °C to +85 °C			-40 °C to +125 °C	
			Min	Typ[1]	Max	Min	Мах	
t <sub>pd</sub>	propagation delay	A to Y; see <u>Fig. 10</u> [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	4.1	11.0	1.0	14.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7	2.8	6.5	0.7	8.5	ns
		V <sub>CC</sub> = 2.7 V	0.7	3.2	6.5	0.7	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.7	3.0	5.5	0.7	7.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7	2.2	5.0	0.7	6.5	ns
C <sub>PD</sub>	power dissipation capacitance	$V_{CC} = 3.3 V; V_I = GND \text{ to } V_{CC}$ [3]	-	15.4	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ . [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

 $f_i$  = input frequency in MHz;

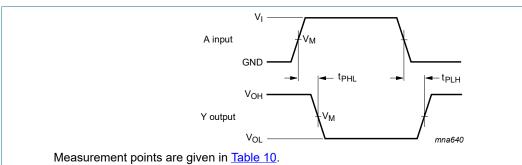
 $f_o$  = output frequency in MHz;

 $C_L$  = output load capacitance in pF;

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

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### 12.1. Waveform and test circuit

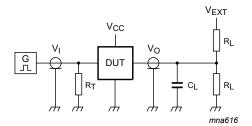


 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

#### Fig. 10. The data input (A) to output (Y) propagation delays

#### Table 10. 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	0.5 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 11.

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.

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

#### Fig. 11. Test circuit for measuring switching times

Supply voltage	ge Input		Load	Load		
V <sub>cc</sub>	VI	t <sub>r</sub> = t <sub>f</sub>	CL	RL	V <sub>EXT</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	

### **13. Application information**

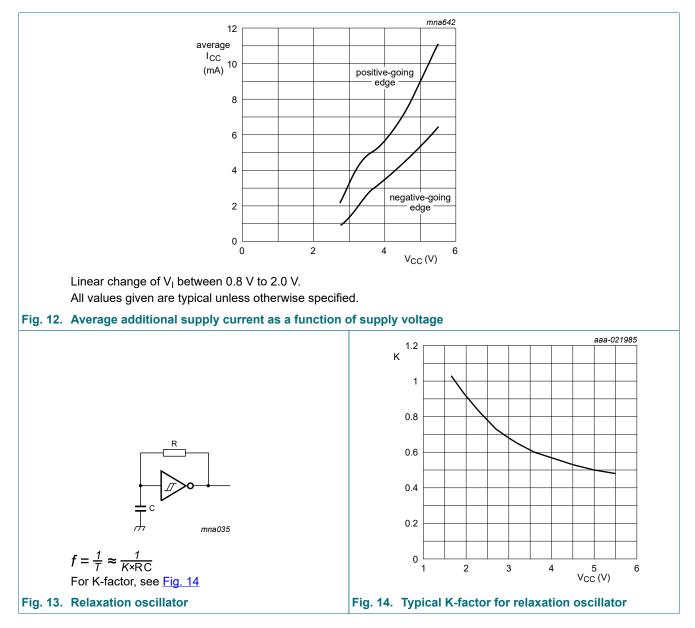
The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

 $P_{add} = f_i x (t_r x \Delta I_{CC(AV)} + t_f x \Delta I_{CC(AV)}) x V_{CC}$  where:

- P<sub>add</sub> = additional power dissipation (μW);
- f<sub>i</sub> = input frequency (MHz);
- t<sub>r</sub> = input rise time (ns); 10 % to 90 %;
- t<sub>f</sub> = input fall time (ns); 90 % to 10 %;
- ΔI<sub>CC(AV)</sub> = average additional supply current (µA).

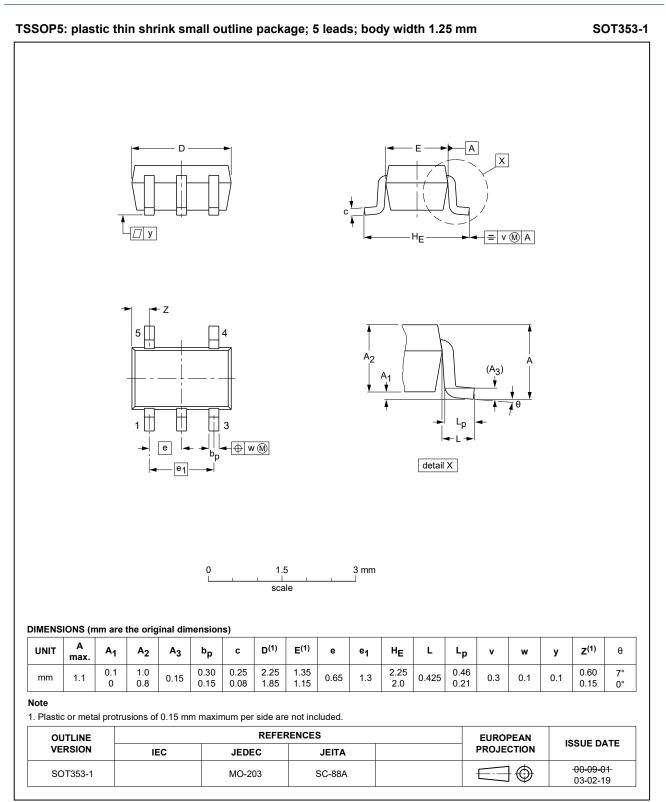
Average  $\Delta I_{CC(AV)}$  differs with positive or negative input transitions, as shown in Fig. 12.

An example of a relaxation circuit using the 74LVC1G14-Q100 is shown in Fig. 13.



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### 14. Package outline



#### Fig. 15. Package outline SOT353-1 (TSSOP5)

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**SOT753** 

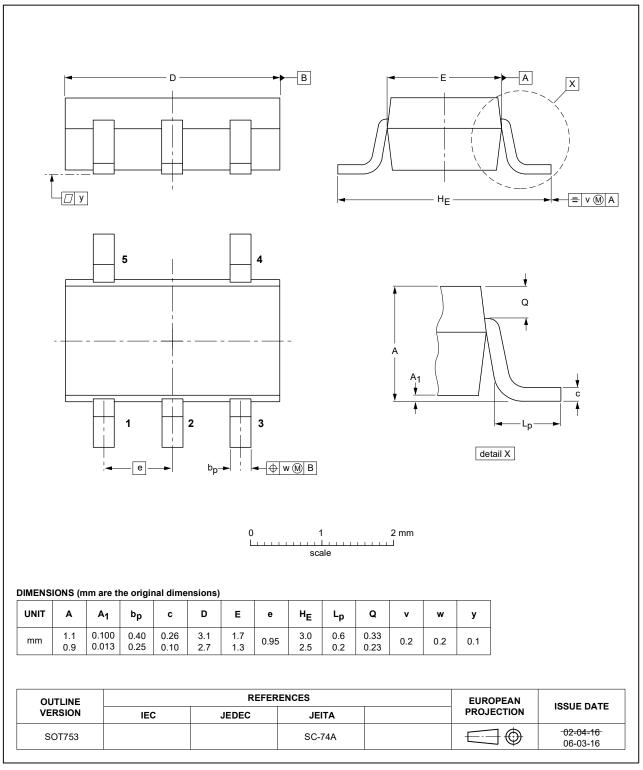


Fig. 16. Package outline SOT753 (SC-74A)

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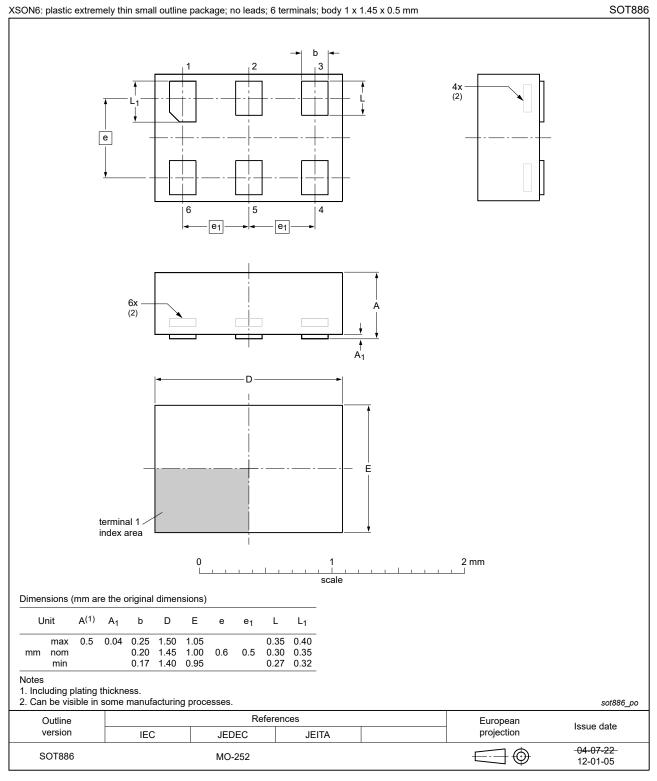
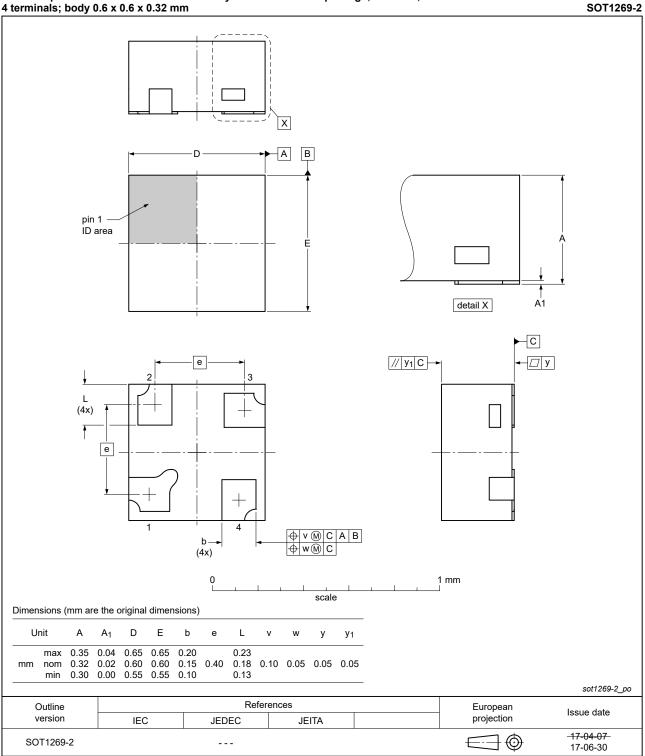


Fig. 17. Package outline SOT886 (XSON6)

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# X2SON4: plastic thermal enhanced extremely thin small outline package; no leads; 4 terminals; body 0.6 x 0.6 x 0.32 mm

Fig. 18. Package outline SOT1269-2 (X2SON4)

### 15. Abbreviations

Table 12. Abbreviati	Table 12. Abbreviations				
Acronym	Description				
CMOS	Complementary Metal Oxide Semiconductor				
DUT	Device Under Test				
ESD	ElectroStatic Discharge				
НВМ	Human Body Model				
MIL	Military				
MM	Machine Model				
TTL	Transistor-Transistor Logic				

### 16. Revision history

Table 13. Revision histor	У				
Document ID	Release date	Data sheet status	Change notice	Supersedes	
74LVC1G14_Q100 v.6	20210504	Product data sheet	-	74LVC1G14_Q100 v.5	
Modifications:	<u>Section 1</u> and <u>Section 2</u> updated.				
74LVC1G14_Q100 v.5	20210127	Product data sheet	-	74LVC1G14_Q100 v.4	
Modifications:	<ul> <li>Added type number 74LVC1G14GX4-Q100 (SOT1269-2).</li> <li><u>Table 5</u>: Derating values for P<sub>tot</sub> total power dissipation updated.</li> </ul>				
74LVC1G14_Q100 v.4	20190125	Product data sheet	-	74LVC1G14_Q100 v.3	
Modifications:	<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 74LVC1G14GM-Q100 (SOT886)</li> </ul>				
74LVC1G14_Q100 v.3	20161208	Product data sheet	-	74LVC1G14_Q100 v.2	
Modifications:	• <u>Table 7</u> : The maximum limits for leakage current and supply current have changed.				
74LVC1G14_Q100 v.2	20160315	Product data sheet	-	74LVC1G14_Q100 v.1	
Modifications:	• Fig. 14 added (typical K-factor for relaxation oscillator).				
74LVC1G14_Q100 v.1	20120709	Product data sheet	-	-	

## 17. 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".
- [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 <u>https://www.nexperia.com</u>.

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### Single Schmitt trigger inverter

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