Dual inverting Schmitt trigger with 5 V tolerant inputRev. 13 — 24 January 2022Product data sheet

1. General description

The 74LVC2G14 is a dual 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.

2. Features and benefits

- Wide supply voltage range from 1.65 V to 5.5 V
- High noise immunity
- ±24 mA output drive (V_{CC} = 3.0 V)
- CMOS low power dissipation
- Direct interface with TTL levels
- Unlimited rise and fall times
- Overvoltage tolerant inputs to 5.5 V
- IOFF circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA
- 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:
 - 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. Applications

- Wave and pulse shaper
- Astable multivibrator
- Monostable multivibrator

4. Ordering information

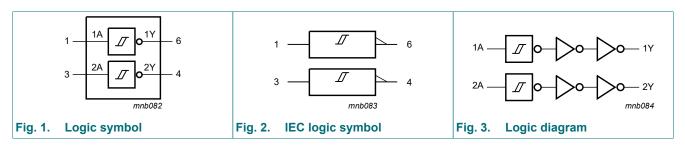
Type number	Package							
	Temperature range	Name	Description	Version				
74LVC2G14GW	-40 °C to +125 °C	TSSOP6	plastic thin shrink small outline package; 6 leads; body width 1.25 mm	SOT363-2				
74LVC2G14GV	-40 °C to +125 °C	SC-74; TSOP6	plastic surface-mounted package; 6 leads	SOT457				
74LVC2G14GM	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886				
74LVC2G14GN	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115				
74LVC2G14GS	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202				

5. Marking

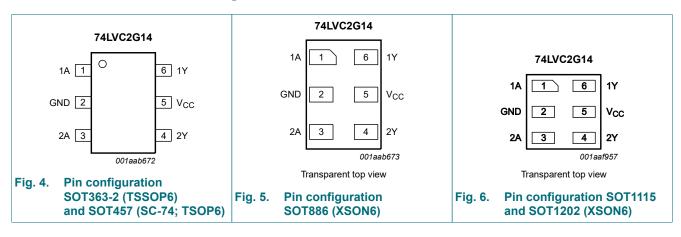
Table 2. Marking codes						
Type number	Marking code [1]					
74LVC2G14GW	VK					
74LVC2G14GV	V14					
74LVC2G14GM	VK					
74LVC2G14GN	VK					
74LVC2G14GS	VK					

[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

7.2. Pin description

Table 3. Pin description						
Symbol	Pin	Description				
1A	1	data input				
GND	2	ground (0 V)				
2A	3	data input				
2Y	4	data output				
V _{CC}	5	supply voltage				
1Y	6	data output				

8. Functional description

Table 4. Function table

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

Input	Output
nA	nY
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 _{CC}	supply voltage		-0.5	+6.5	V
I _{IK}	input clamping current	V _I < 0 V	-50	-	mA
VI	input voltage	[1]	-0.5	+6.5	V
I _{OK}	output clamping current	$V_{\rm O}$ > $V_{\rm CC}$ or $V_{\rm O}$ < 0 V	-	±50	mA
Vo	output voltage	Active mode [1]	-0.5	V _{CC} + 0.5	V
		Power-down mode; V _{CC} = 0 V [1]	-0.5	+6.5	V
I _O	output current	$V_{O} = 0 V \text{ to } V_{CC}$	-	±50	mA
I _{CC}	supply current		-	100	mA
I _{GND}	ground current		-100	-	mA
P _{tot}	total power dissipation	$T_{amb} = -40 \text{ °C to } +125 \text{ °C}$ [2]	-	250	mW
T _{stg}	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] For SOT363-2 (TSSOP6) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.
 For SOT457 (SC-74; TSOP6) package: P_{tot} derates linearly with 4.1 mW/K above 89 °C.
 For SOT886 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.
 For SOT1115 (XSON6) package: P_{tot} derates linearly with 3.2 mW/K above 71 °C.
 For SOT1202 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
V _{CC}	supply voltage		1.65	-	5.5	V
VI	input voltage		0	-	5.5	V
Vo	output voltage	Active mode	0	-	V _{CC}	V
		Power-down mode; $V_{CC} = 0 V$	0	-	5.5	V
T _{amb}	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	Min	Typ <mark>[1]</mark>	Max	Unit		
T _{amb} = -4	T _{amb} = -40 °C to +85 °C							
V _{OH}	HIGH-level output	$V_{I} = V_{T+}$ or V_{T-}						
	voltage	I_{O} = -100 µA; V_{CC} = 1.65 V to 5.5 V	V _{CC} - 0.1	-	-	V		
		I _O = -4 mA; V _{CC} = 1.65 V	1.2	-	-	V		
		I _O = -8 mA; V _{CC} = 2.3 V	1.9	-	-	V		
		I _O = -12 mA; V _{CC} = 2.7 V	2.2	-	-	V		
		I _O = -24 mA; V _{CC} = 3.0 V	2.3	-	-	V		
		I _O = -32 mA; V _{CC} = 4.5 V	3.8	-	-	V		

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Symbol	Parameter	Conditions	Min	Typ <mark>[1]</mark>	Мах	Unit
V _{OL}	LOW-level output	$V_{I} = V_{T+}$ or V_{T-}				
	voltage	I_{O} = 100 µA; V_{CC} = 1.65 V to 5.5 V	-	-	0.1	V
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.45	V
		$I_{O} = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.3	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.4	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.55	V
		I _O = 32 mA; V _{CC} = 4.5 V	-	-	0.55	V
I _I	input leakage current	V_{I} = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	±0.1	±1	μA
I _{OFF}	power-off leakage current	$V_{1} \text{ or } V_{O} = 5.5 \text{ V}; V_{CC} = 0 \text{ V}$	-	±0.1	±2	μA
I _{CC}	supply current	V_{I} = 5.5 V or GND; V_{CC} = 1.65 V to 5.5 V; I_{O} = 0 A	-	0.1	4	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.6 \text{ V}; I_{O} = 0 \text{ A}; V_{CC} = 2.3 \text{ V to } 5.5 \text{ V}$	-	5	500	μA
CI	input capacitance	V_{CC} = 3.3 V; V_{I} = GND to V_{CC}	-	3.5	-	pF
T _{amb} = -	40 °C to +125 °C					
V _{OH}	HIGH-level output voltage	$V_{I} = V_{T+} \text{ or } V_{T-}$				
		I_{O} = -100 µA; V_{CC} = 1.65 V to 5.5 V	V _{CC} - 0.1	-	-	V
		I _O = -4 mA; V _{CC} = 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 _O = -24 mA; V _{CC} = 3.0 V	2.0	-	-	V
		$I_{\rm O}$ = -32 mA; $V_{\rm CC}$ = 4.5 V	3.4	-	-	V
V _{OL}	LOW-level output	$V_{I} = V_{T+}$ or V_{T-}				
	voltage	I_{O} = 100 µA; V_{CC} = 1.65 V to 5.5 V	-	-	0.1	V
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.7	V
		I _O = 8 mA; V _{CC} = 2.3 V	-	-	0.45	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.6	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.8	V
		I _O = 32 mA; V _{CC} = 4.5 V	-	-	0.8	V
l _l	input leakage current	V_1 = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	-	±1	μA
I _{OFF}	power-off leakage current	$V_{1} \text{ or } V_{O} = 5.5 \text{ V}; V_{CC} = 0 \text{ V}$	-	-	±2	μA
I _{CC}	supply current	V_{I} = 5.5 V or GND; V_{CC} = 1.65 V to 5.5 V; I_{O} = 0 A	-	-	4	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.6 \text{ V}; I_{O} = 0 \text{ A}; V_{CC} = 2.3 \text{ V to } 5.5 \text{ V}$	-	-	500	μA

[1] All typical values are measured at maximum V_{CC} and T_{amb} = 25 °C.

12. Transfer characteristics

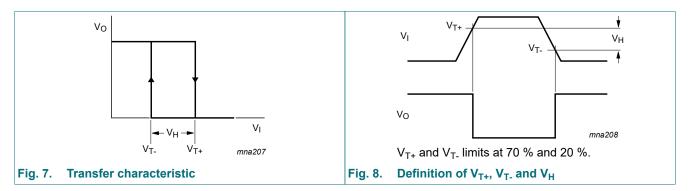
Table 8. Transfer characteristics

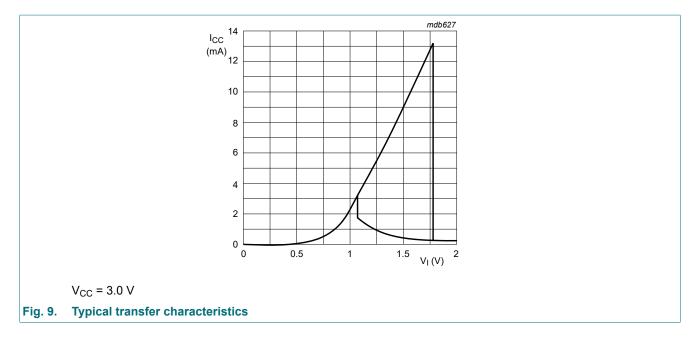
Voltages are referenced to GND (ground = 0 V; for test circuit see Fig. 11

Symbol	Parameter	Conditions	-40	-40 °C to +85 °C			-40 °C to +125 °C	
			Min	Typ[1]	Мах	Min	Мах	
V _{T+}	positive-going	see Fig. 7 and Fig. 8						
	threshold voltage	V _{CC} = 1.8 V	0.70	1.10	1.50	0.70	1.70	V
		V _{CC} = 2.3 V	1.00	1.40	1.80	1.00	2.00	V
		V _{CC} = 3.0 V; see <u>Fig. 9</u>	1.30	1.76	2.20	1.30	2.40	V
		V _{CC} = 4.5 V	1.90	2.47	3.10	1.90	3.30	V
		V _{CC} = 5.5 V	2.20	2.91	3.60	2.20	3.80	V
V _{T-}	negative-going	see Fig. 7 and Fig. 8						
	threshold voltage	V _{CC} = 1.8 V	0.25	0.61	0.90	0.25	1.10	V
		V _{CC} = 2.3 V	0.40	0.80	1.15	0.40	1.35	V
		V _{CC} = 3.0 V; see <u>Fig. 9</u>	0.60	1.04	1.50	0.60	1.70	V
		V _{CC} = 4.5 V	1.00	1.55	2.00	1.00	2.20	V
		V _{CC} = 5.5 V	1.20	1.86	2.30	1.20	2.50	V
V _H	hysteresis voltage	(V _{T+} - V _{T-}); see <u>Fig. 7</u> and <u>Fig. 8</u>						
		V _{CC} = 1.8 V	0.15	0.49	1.00	0.15	1.20	V
		V _{CC} = 2.3 V	0.25	0.60	1.10	0.25	1.30	V
		V _{CC} = 3.0 V; see <u>Fig. 9</u>	0.40	0.73	1.20	0.40	1.40	V
		V _{CC} = 4.5 V	0.60	0.92	1.50	0.60	1.70	V
		V _{CC} = 5.5 V	0.70	1.02	1.70	0.70	1.90	V

[1] All typical values are measured at T_{amb} = 25 °C

12.1. Waveforms transfer characteristics





13. Dynamic characteristics

Table 9. 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]	Мах	Min	Max	
t _{pd}	propagation delay	nA to nY; see <u>Fig. 10</u> [2]						
		V _{CC} = 1.65 V to 1.95 V	1.0	5.6	11.0	1.0	12.0	ns
		V _{CC} = 2.3 V to 2.7 V	0.5	3.7	6.5	0.5	7.2	ns
		V _{CC} = 2.7 V	0.5	4.1	7.0	0.5	7.7	ns
		V _{CC} = 3.0 V to 3.6 V	0.5	3.9	6.0	0.5	6.7	ns
		V _{CC} = 4.5 V to 5.5 V	0.5	2.7	4.3	0.5	4.7	ns
C _{PD}	power dissipation capacitance	$V_1 = GND \text{ to } V_{CC}; V_{CC} = 3.3 \text{ V}$ [3]	-	18.1	-	-	-	pF

[1] 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.

[1] Typical values are inclusived at $r_{amb} = 25$ °C and $v_{CC} = 1.5$ v, 2.5 v. [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 μ 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;

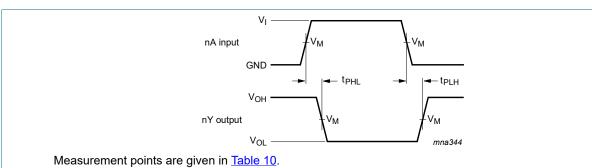
f_o = output frequency in MHz;

 C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching; $\Sigma(C_L \times V_{CC}^2 \times f_0)$ = sum of outputs.

13.1. Waveforms and test circuit

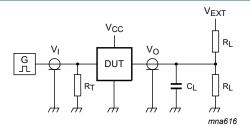


V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 10. The data input (nA) to output (nY) propagation delays

Table 10. Measurement points

Supply voltage	Input	Output	
V _{cc}	V _M	V _M	
1.65 V to 1.95 V	0.5 × V _{CC}	0.5 × V _{CC}	
2.3 V to 2.7 V	0.5 × V _{CC}	0.5 × V _{CC}	
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 × V _{CC}	$0.5 \times V_{CC}$	



Test data is given in Table 11.

Definitions for test circuit:

R_L = Load resistance.

C_L = 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

Table 11. Test data								
Supply voltage	Input	Input			V _{EXT}			
V _{cc}	Vi	t _r = t _f	CL	RL	t _{PLH} , t _{PHL}			
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 _{CC}	≤ 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			

14. Application information

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

 $\mathsf{P}_{\mathsf{add}} = \mathsf{f}_{\mathsf{i}} \times (\mathsf{t}_{\mathsf{r}} \times \Delta \mathsf{I}_{\mathsf{CC}(\mathsf{AV})} + \mathsf{t}_{\mathsf{f}} \times \Delta \mathsf{I}_{\mathsf{CC}(\mathsf{AV})}) \times \mathsf{V}_{\mathsf{CC}} \text{ where:}$

 P_{add} = additional power dissipation (μ W);

f_i = input frequency (MHz);

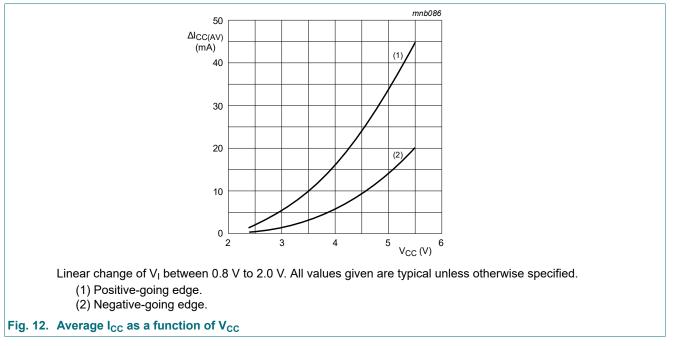
 t_r = input rise time (ns); 10 % to 90 %;

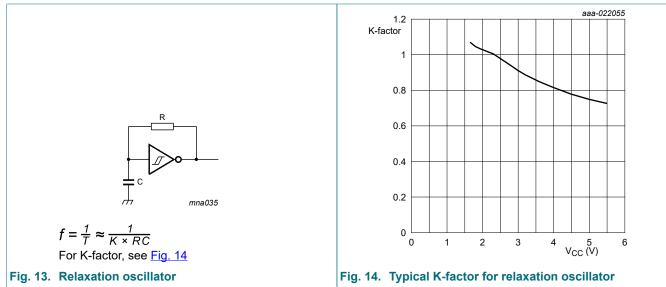
t_f = input fall time (ns); 90 % to 10 %;

 $\Delta I_{CC(AV)}$ = average additional supply current (µA).

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

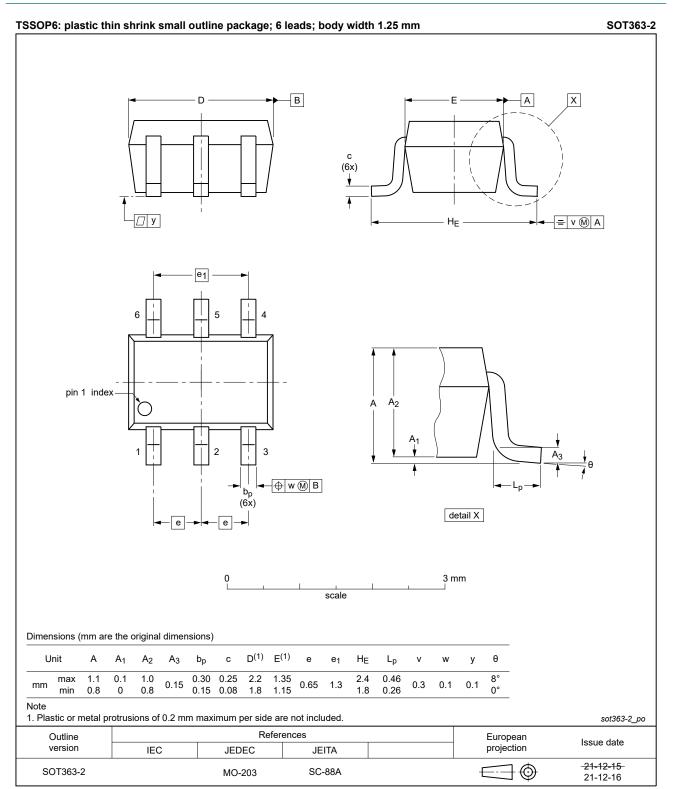
An example of a relaxation circuit using the 74LVC2G14 is shown in Fig. 13.





Dual inverting Schmitt trigger with 5 V tolerant input

15. Package outline





Dual inverting Schmitt trigger with 5 V tolerant input

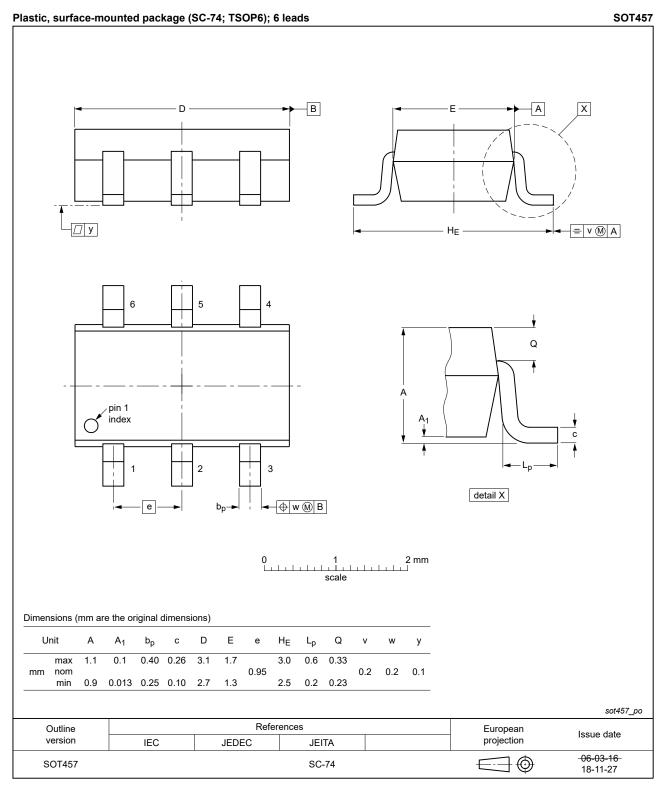


Fig. 16. Package outline SOT457 (SC-74; TSOP6)

Dual inverting Schmitt trigger with 5 V tolerant input

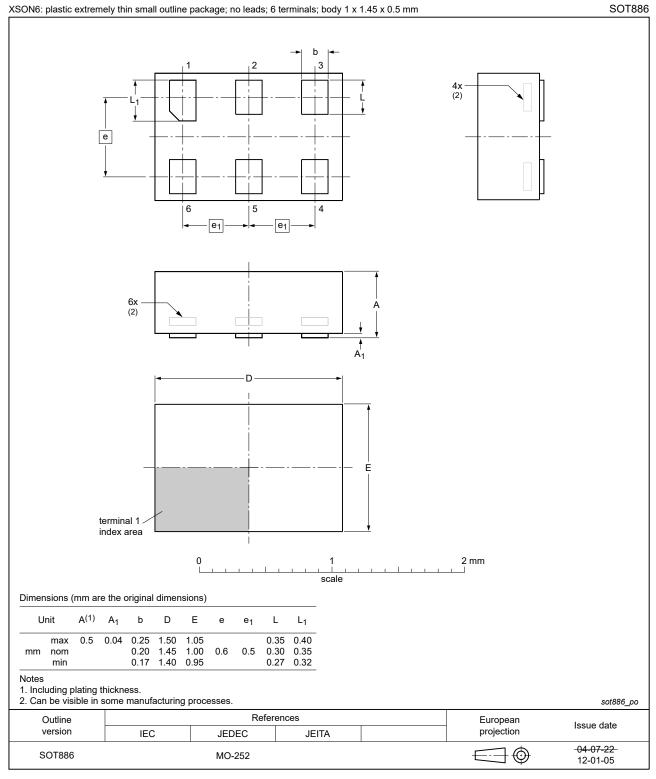
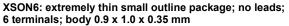
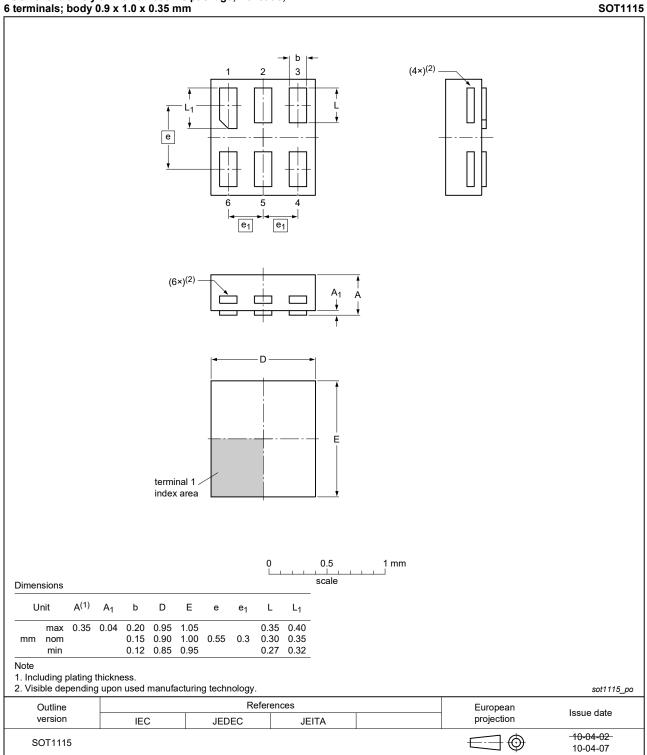


Fig. 17. Package outline SOT886 (XSON6)

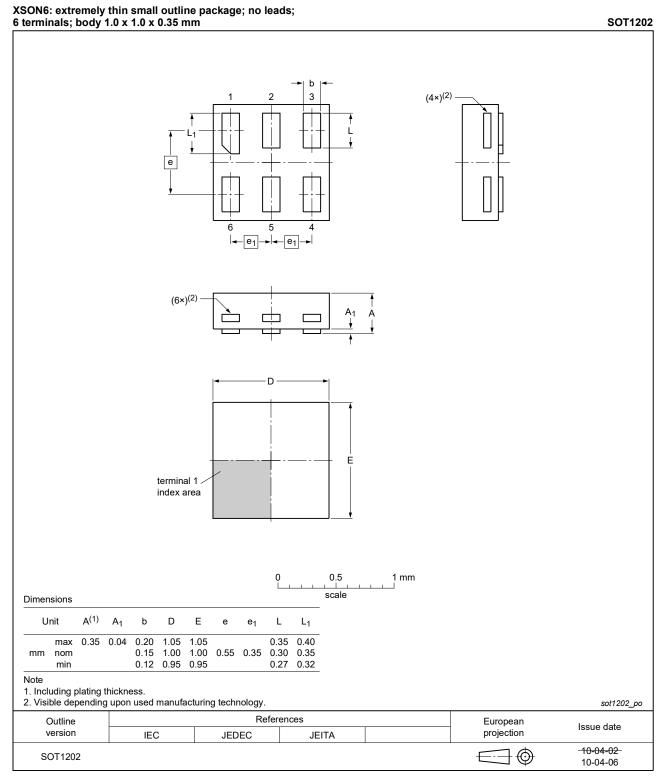
Dual inverting Schmitt trigger with 5 V tolerant input







Dual inverting Schmitt trigger with 5 V tolerant input





16. Abbreviations

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

17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
74LVC2G14 v.13	20220124	Product data sheet	-	74LVC2G14 v.12	
Modifications:	Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6).				
74LVC2G14 v.12	20210611	Product data sheet	-	74LVC2G14 v.11	
Modifications:	 Type number 74LVC2G14GF (SOT891 / XSON6) removed. <u>Section 1</u> updated. <u>Section 7.2</u>: pin 6 description corrected (Errata). <u>Section 9</u>: Derating values for P_{tot} total power dissipation updated. <u>Fig. 16</u>: Package outline drawing SOT457 (SC-74) updated. 				
74LVC2G14 v.11	20180810	Product data sheet	-	74LVC2G14 v.10	
Modifications:	 The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. 				
74LVC2G14 v.10	20161215	Product data sheet	-	74LVC2G14 v.9	
Modifications:	• <u>Table 7</u> : The maximum limits for leakage current and supply current have changed.				
74LVC2G14 v.9	20160315	Product data sheet	-	74LVC2G14 v.8	
Modifications:	• Fig. 14 added (typical K-factor for relaxation oscillator).				
74LVC2G14 v.8	20140910	Product data sheet	-	74LVC2G14 v.7	
Modifications:	Package outline drawing of SOT886 (Fig. 17) modified.				
74LVC2G14 v.7	20111130	Product data sheet	-	74LVC2G14 v.6	
74LVC2G14 v.6	20110923	Product data sheet	-	74LVC2G14 v.5	
74LVC2G14 v.5	20101029	Product data sheet	-	74LVC2G14 v.4	
74LVC2G14 v.4	20070904	Product data sheet	-	74LVC2G14 v.3	
74LVC2G14 v.3	20070220	Product data sheet	-	74LVC2G14 v.2	
74LVC2G14 v.2	20040908	Product specification	-	74LVC2G14 v.1	
74LVC2G14 v.1	20030731	Product specification	-	-	

18. 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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Dual inverting Schmitt trigger with 5 V tolerant input

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