Triple inverting Schmitt trigger with 5 V tolerant inputRev. 12 — 9 April 2013Product of

Product data sheet

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

The 74LVC3G14 provides three inverting buffers with Schmitt trigger input. It is capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

The inputs can be driven from either 3.3 V or 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 the inputs makes the circuit tolerant of slower input rise and fall time. 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
- 5 V tolerant input/output for interfacing with 5 V logic
- High noise immunity
- 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
- Unlimited rise and fall times
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C.

#### Applications 3.

- Wave and pulse shaper for highly noisy environment
- Astable multivibrator
- Monostable multivibrator.



Triple inverting Schmitt trigger with 5 V tolerant input

## 4. Ordering information

Table 1. Orde	ring information			
Type number	Package			
	Temperature range	Name	Description	Version
74LVC3G14DP	–40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74LVC3G14DC	–40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74LVC3G14GT	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 $\times$ 1.95 $\times$ 0.5 mm	SOT833-1
74LVC3G14GF	–40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.35 \times 1 \times 0.5$ mm	SOT1089
74LVC3G14GD	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body $3 \times 2 \times 0.5$ mm	SOT996-2
74LVC3G14GM	–40 °C to +125 °C	XQFN8	plastic, extremely thin quad flat package; no leads; 8 terminals; body $1.6 \times 1.6 \times 0.5$ mm	SOT902-2
74LVC3G14GN	–40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.2 \times 1.0 \times 0.35$ mm	SOT1116
74LVC3G14GS	–40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.35 \times 1.0 \times 0.35$ mm	SOT1203

### 5. Marking

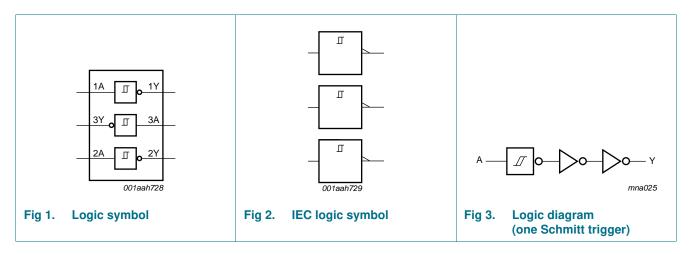
#### Table 2.Marking codes

Type number	Marking code <sup>[1]</sup>
74LVC3G14DP	V14
74LVC3G14DC	V14
74LVC3G14GT	V14
74LVC3G14GF	VK
74LVC3G14GD	V14
74LVC3G14GM	V14
74LVC3G14GN	VK
74LVC3G14GS	VK

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

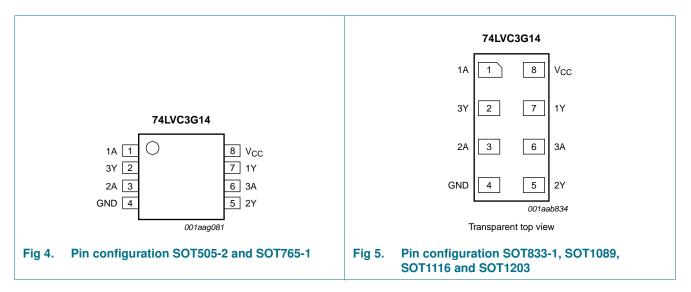
Triple inverting Schmitt trigger with 5 V tolerant input

### 6. Functional diagram

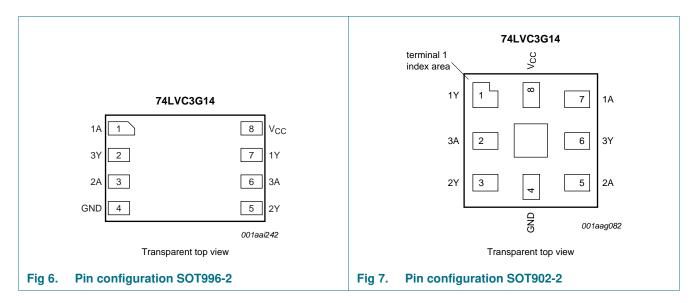


### 7. Pinning information

### 7.1 Pinning



Triple inverting Schmitt trigger with 5 V tolerant input



### 7.2 Pin description

Symbol	Pin	Pin		
	SOT505-2, SOT765-1, SOT833-1, SOT1089, SOT996-2, SOT1116 and SOT1203	SOT902-2		
1A, 2A, 3A	1, 3, 6	7, 5, 2	data input	
1Y, 2Y, 3Y	7, 5, 2	1, 3, 6	data output	
GND	4	4	ground (0 V)	
V <sub>CC</sub>	8	8	supply voltage	

### 8. Functional description

Table 4.   Function table [1]	
Input nA	Output nY
L	Н
Н	L

[1] H = HIGH voltage level; L = LOW voltage level

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### 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
l <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	$V_{\rm O}$ > $V_{\rm CC}$ or $V_{\rm O}$ < 0 V	-	±50	mA
Vo	output voltage	Active mode	[1][2] -0.5	$V_{CC} + 0.5$	V
		Power-down mode	[1][2] -0.5	+6.5	V
lo	output current	$V_{O} = 0 V$ to $V_{CC}$	-	±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	$T_{amb} = -40 \ ^{\circ}C \ to \ +125 \ ^{\circ}C$	<u>[3]</u>	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 TSSOP8 package: above 55 °C the value of P<sub>tot</sub> derates linearly with 2.5 mW/K.
 For VSSOP8 package: above 110 °C the value of P<sub>tot</sub> derates linearly with 8 mW/K.
 For XSON8 and XQFN8 packages: above 118 °C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

### **10. Recommended operating conditions**

Operating conditions				
Parameter	Conditions	Min	Max	Unit
supply voltage		1.65	5.5	V
input voltage		0	5.5	V
output voltage	Active mode	0	V <sub>CC</sub>	V
	Power-down mode; $V_{CC} = 0 V$	0	5.5	V
ambient temperature		-40	+125	°C
	Parameter         supply voltage         input voltage         output voltage	Parameter     Conditions       supply voltage     input voltage       output voltage     Active mode       Power-down mode; V <sub>CC</sub> = 0 V	Parameter     Conditions     Min       supply voltage     1.65       input voltage     0       output voltage     Active mode     0       Power-down mode; V <sub>CC</sub> = 0 V     0	ParameterConditionsMinMaxsupply voltage1.655.5input voltage05.5output voltageActive mode0V <sub>CC</sub> Power-down mode; V <sub>CC</sub> = 0 V05.5

### Triple inverting Schmitt trigger with 5 V tolerant input

## 11. Static characteristics

### Table 7. Static characteristics

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

Symbol	Parameter	Conditions	Min	Typ 🛄	Max	Uni
T <sub>amb</sub> = ⊸	40 °C to +85 °C					
V <sub>OH</sub>	HIGH-level output voltage	$V_I = V_{T+} \text{ or } V_{T-}$				
		$I_O$ = $-100~\mu\text{A};V_{CC}$ = 1.65 V to 5.5 V	$V_{CC}-0.1$	-	-	V
		$I_{O} = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	1.2	-	-	V
		$I_{O} = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.9	-	-	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	V
		$I_{O} = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.3	-	-	V
		$I_{O} = -32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.8	-	-	V
V <sub>OL</sub>	LOW-level output voltage	$V_I = V_{T+}$ or $V_{T-}$				
		$I_{O}$ = 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
		$I_{O} = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	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
I	input leakage current	$V_{I} = 5.5$ V or GND; $V_{CC} = 0$ V to 5.5 V	-	±0.1	±5	μA
OFF	power-off leakage current	$V_1 \text{ or } V_0 = 5.5 \text{ V}; V_{CC} = 0 \text{ V}$	-	±0.1	±10	μA
СС	supply current	$V_{I} = 5.5 V \text{ or GND}; I_{O} = 0 A;$ $V_{CC} = 1.65 V \text{ to } 5.5 V$	-	0.1	10	μA
VI <sub>CC</sub>	additional supply current	$V_{I} = V_{CC} - 0.6 \text{ V}; I_{O} = 0 \text{ A};$ $V_{CC} = 2.3 \text{ V} \text{ to } 5.5 \text{ V}$	-	5	500	μA
Ci	input capacitance	$V_{CC}$ = 3.3 V; $V_{I}$ = GND to $V_{CC}$	-	3.5	-	pF
Γ <sub>amb</sub> = →	40 °C to +125 °C					
/ <sub>ОН</sub>	HIGH-level output voltage	$V_{I} = V_{T+}$ or $V_{T-}$				
		$I_{O} = -100 \ \mu A$ ; $V_{CC} = 1.65 \ V$ to 5.5 V	$V_{CC} - 0.1$	-	-	V
		$I_{O} = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	0.95	-	-	V
		$I_{O} = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.7	-	-	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	1.9	-	-	V
		$I_{\rm O} = -24$ mA; $V_{\rm CC} = 3.0$ V	2.0	-	-	V
		$I_{O} = -32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.4	-	-	V
/ <sub>OL</sub>	LOW-level output voltage	$V_{I} = V_{T+} \text{ or } V_{T-}$				
0L		$I_{O} = 100 \ \mu\text{A}; V_{CC} = 1.65 \ \text{V} \text{ to } 5.5 \ \text{V}$	-	-	0.1	V
		$I_0 = 4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	-	-	0.7	V
		$I_{O} = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.45	V
		$I_{O} = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.6	V
		$I_0 = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	_	_	0.8	V
		$I_0 = 32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	_	_	0.8	V
		$V_1 = 5.5 \text{ V or GND}; V_{CC} = 0 \text{ V to } 5.5 \text{ V}$			0.0	v

### Triple inverting Schmitt trigger with 5 V tolerant input

At recom	At recommended operating conditions; voltages are referenced to $GND$ (ground = 0 V).								
Symbol	Parameter	Conditions	Min	Typ 🛄	Max	Unit			
I <sub>OFF</sub>	power-off leakage current	$V_{I} \text{ or } V_{O} = 5.5 \text{ V};  V_{CC} = 0 \text{ V}$	-	-	±20	μA			
I <sub>CC</sub>	supply current	$V_{I} = 5.5 \text{ V or GND}; I_{O} = 0 \text{ A};$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	-	40	μA			
$\Delta I_{CC}$	additional supply current		-	-	5000	μA			

#### Table 7. Static characteristics ... continued

[1] All typical values are measured at maximum V\_{CC} and T\_{amb} = 25 °C.

#### **Transfer characteristics** Table 8.

Voltages are referenced to GND (ground = 0 V; for test circuit see Figure 9

Symbol	Parameter	Conditions	-40	–40 °C to +85 °C			–40 °C to +125 °C	
			Min	Typ <mark>[1]</mark>	Max	Min	Max	
$V_{T+}$	positive-going threshold voltage	see <u>Figure 10</u> and <u>Figure 11</u>						
		V <sub>CC</sub> = 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
		$V_{CC} = 3.0 V$	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 <sub>T</sub> - negative-going threshold voltage		see <u>Figure 10</u> and <u>Figure 11</u>						
		V <sub>CC</sub> = 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
		$V_{CC} = 3.0 V$	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 <sub>H</sub> [2]	hysteresis voltage	see Figure 10, Figure 11 and Figure 12						
		V <sub>CC</sub> = 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
		$V_{CC} = 3.0 V$	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 <sub>CC</sub> = 5.5 V	0.70	1.02	1.70	0.70	1.90	V

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

[2]  $V_H = V_{T+} - V_{T-}$ 

#### Triple inverting Schmitt trigger with 5 V tolerant input

### **12. Dynamic characteristics**

#### Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Figure 9.

Symbol	Parameter	Conditions		–40 °C to +85 °C		-40 °C to +85 °C -40 °C to +125 °C		o +125 °C	C Unit
				Min	Typ <mark>[1]</mark>	Мах	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nY; see Figure 8	[2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V		1.0	4.2	11.0	1.0	12.0	ns
		$V_{CC} = 2.3 \text{ V}$ to 2.7 V		0.5	3.0	6.5	0.5	7.2	ns
		V <sub>CC</sub> = 2.7 V		0.5	3.8	7.0	0.5	7.7	ns
		$V_{CC} = 3.0 \text{ V} \text{ to } 3.6 \text{ V}$		0.5	3.2	6.0	0.5	6.7	ns
		$V_{CC} = 4.5 V \text{ to } 5.5 V$		0.5	2.4	4.3	0.5	4.7	ns
C <sub>PD</sub>	power dissipation capacitance	$V_{I}$ = GND to $V_{CC};V_{CC}$ = 3.3 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.

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz;

 $f_o = output frequency in MHz;$ 

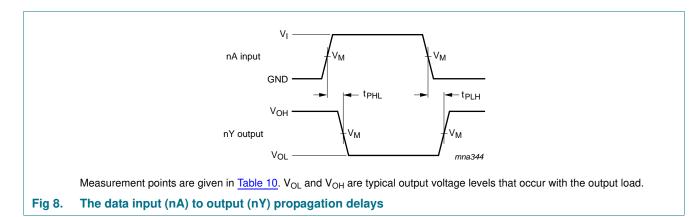
 $C_L$  = output load capacitance in pF;

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

N = number of inputs switching;

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

### 13. Waveforms

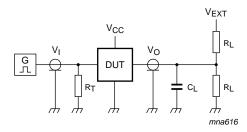


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### Triple inverting Schmitt trigger with 5 V tolerant input

Table 10. Measurement points		
V <sub>cc</sub>	Input V <sub>M</sub>	Output V <sub>M</sub>
1.65 V to 1.95 V	$0.5  imes V_{CC}$	$0.5  imes V_{CC}$
2.3 V to 2.7 V	$0.5  imes V_{CC}$	$0.5  imes V_{CC}$
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	$0.5  imes V_{CC}$	$0.5  imes V_{CC}$





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.

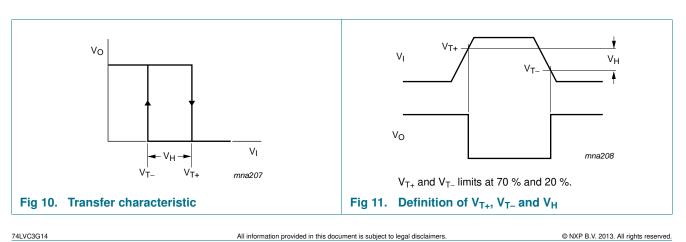
 $R_T$  = Termination resistance should be equal to the output impedance  $Z_0$  of the pulse generator.

- V<sub>EXT</sub> = External voltage for measuring switching times.
- Test circuit for measuring switching times Fig 9.

#### Table 11. Test data

Supply voltage	Input		Load		V <sub>EXT</sub>
V <sub>CC</sub>	VI	$t_r = t_f$	CL	RL	t <sub>PLH</sub> , t <sub>PHL</sub>
1.65 V to 1.95 V	V <sub>CC</sub>	$\leq$ 2.0 ns	30 pF	1 kΩ	open
2.3 V to 2.7 V	V <sub>CC</sub>	$\leq$ 2.0 ns	30 pF	500 Ω	open
2.7 V	2.7 V	$\leq$ 2.5 ns	50 pF	500 Ω	open
3.0 V to 3.6 V	2.7 V	$\leq$ 2.5 ns	50 pF	500 Ω	open
4.5 V to 5.5 V	V <sub>CC</sub>	$\leq$ 2.5 ns	50 pF	500 Ω	open

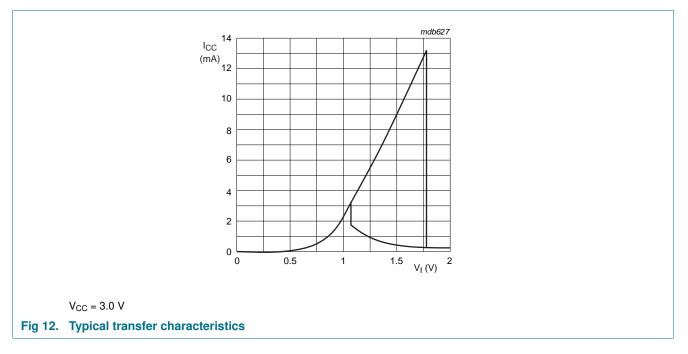
### 14. Waveforms transfer characteristics



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### Triple inverting Schmitt trigger with 5 V tolerant input



### **15. Application information**

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

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

 $P_{add}$  = additional power dissipation ( $\mu$ W);

 $f_i = input frequency (MHz);$ 

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

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

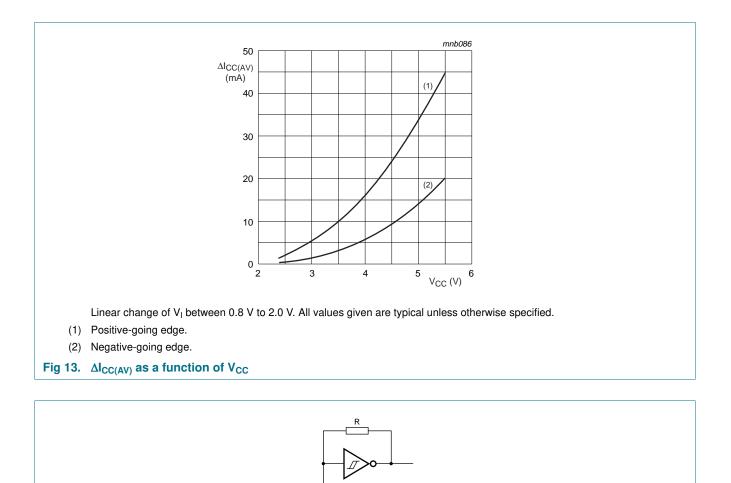
 $\Delta I_{CC(AV)}$  = average additional supply current (µA).

 $\Delta I_{CC(AV)}$  differs with positive or negative input transitions, as shown in Figure 13.

An example of a relaxation circuit using the 74LVC3G14 is shown in Figure 14.

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Triple inverting Schmitt trigger with 5 V tolerant input



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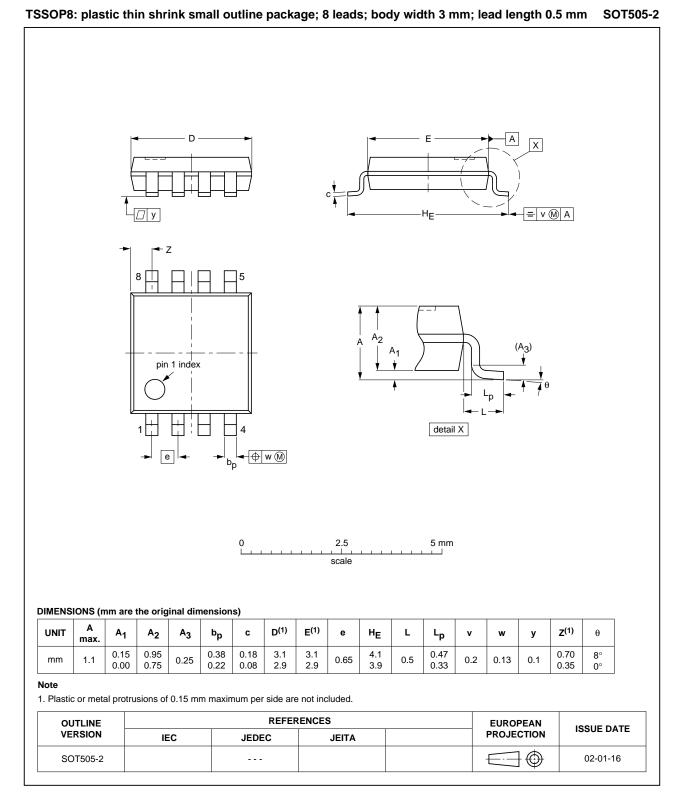
 $f = \frac{l}{T} \approx \frac{l}{0.8 \times RC}$ 



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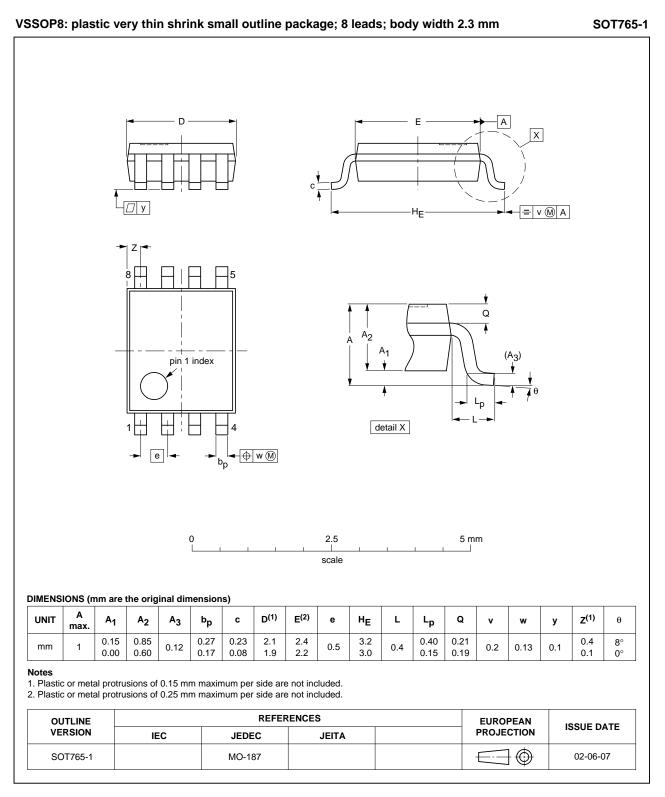
### 16. Package outline



#### Fig 15. Package outline SOT505-2 (TSSOP8)

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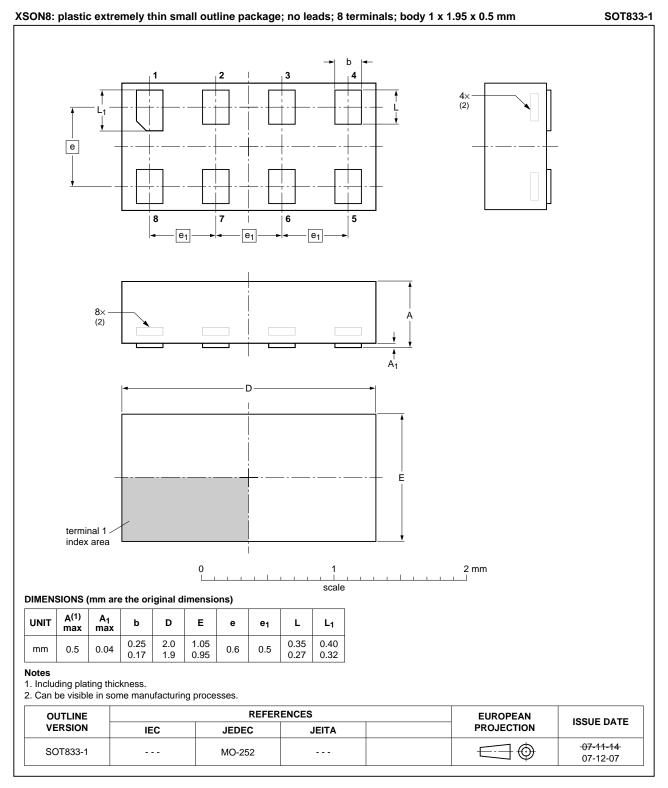
#### Triple inverting Schmitt trigger with 5 V tolerant input



#### Fig 16. Package outline SOT765-1 (VSSOP8)

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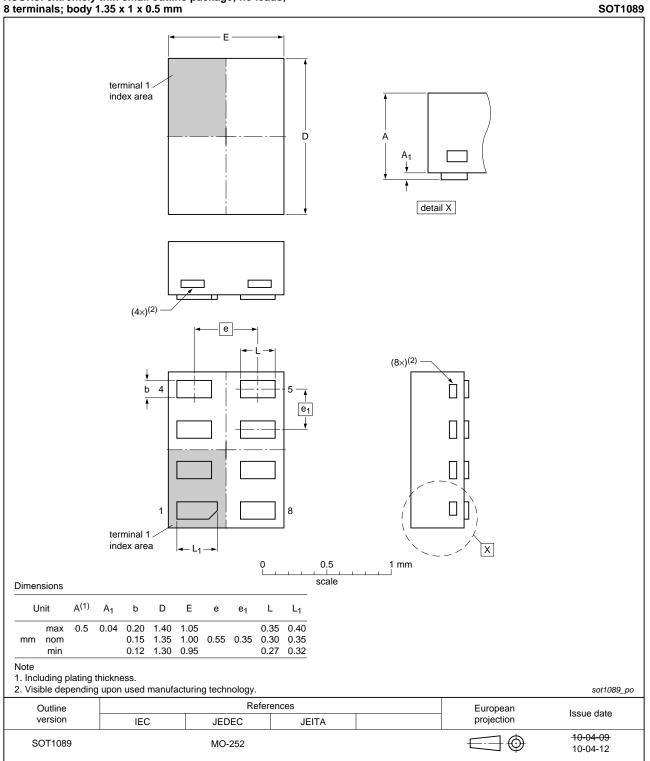
#### Triple inverting Schmitt trigger with 5 V tolerant input



#### Fig 17. Package outline SOT833-1 (XSON8)

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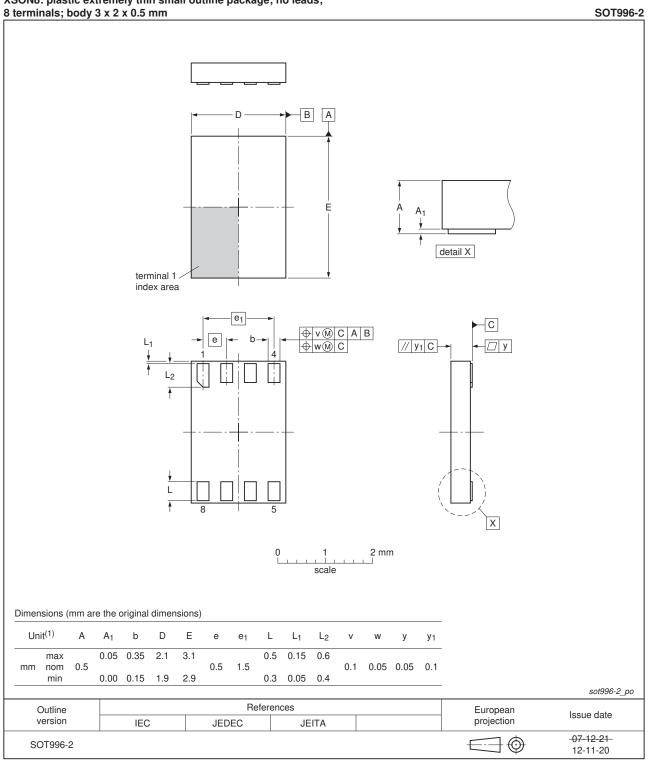


XSON8: extremely thin small outline package; no leads; 8 terminals; body 1.35 x 1 x 0.5 mm

Fig 18. Package outline SOT1089 (XSON8)

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Triple inverting Schmitt trigger with 5 V tolerant input

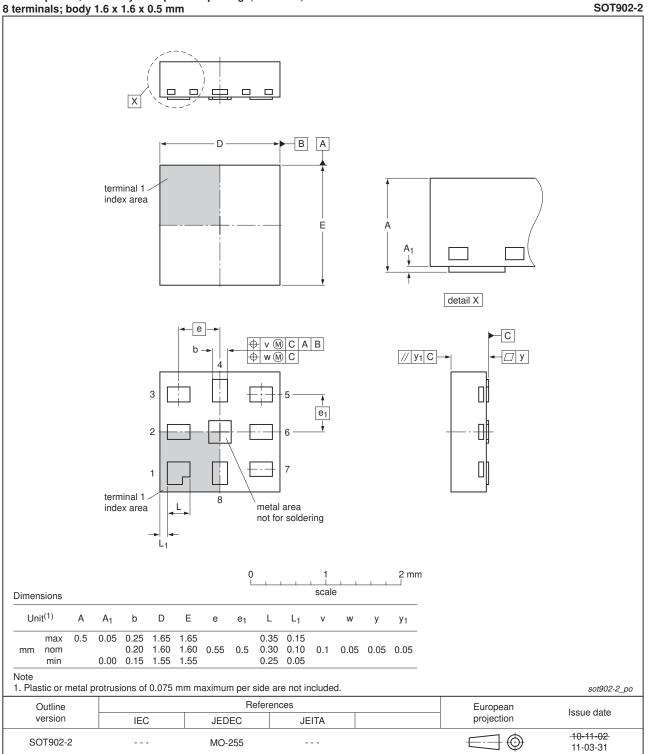


XSON8: plastic extremely thin small outline package; no leads;

Fig 19. Package outline SOT996-2 (XSON8)

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#### Triple inverting Schmitt trigger with 5 V tolerant input

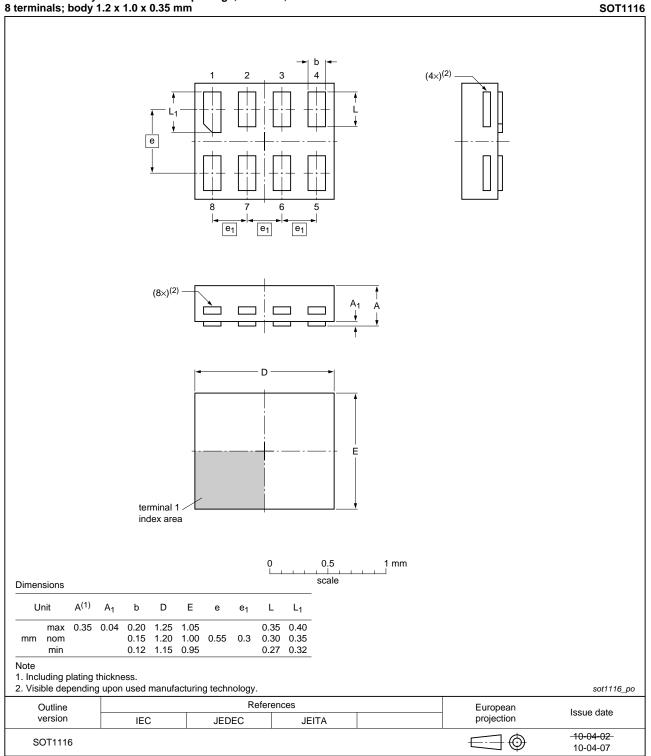


XQFN8: plastic, extremely thin quad flat package; no leads; 8 terminals: body 1.6 x 1.6 x 0.5 mm

#### Fig 20. Package outline SOT902-2 (XQFN8)

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#### Triple inverting Schmitt trigger with 5 V tolerant input

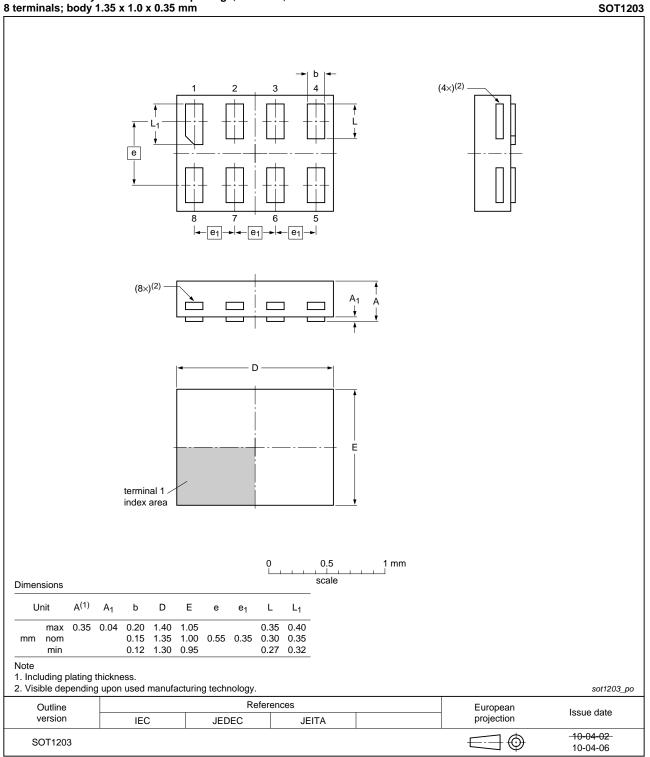


XSON8: extremely thin small outline package; no leads; 8 terminals; body 1.2 x 1.0 x 0.35 mm

Fig 21. Package outline SOT1116 (XSON8)

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Triple inverting Schmitt trigger with 5 V tolerant input



XSON8: extremely thin small outline package; no leads; 8 terminals; body 1.35 x 1.0 x 0.35 mm

Fig 22. Package outline SOT1203 (XSON8)

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Triple inverting Schmitt trigger with 5 V tolerant input

## **17. 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		
UTLP	Ultra-Thin Leadless Package		

## **18. Revision history**

### Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC3G14 v.12	20130409	Product data sheet	-	74LVC3G14 v.11
Modifications:	<ul> <li>For type nu</li> </ul>	mber 74LVC3G14GD XSO	N8U has changed to XS	SON8.
74LVC3G14 v.11	20120706	Product data sheet	-	74LVC3G14 v.10
Modifications:	<ul> <li>For type nu</li> </ul>	mber 74LVC3G14GM the S	SOT code has changed	to SOT902-2.
74LVC3G14 v.10	20111123	Product data sheet	-	74LVC3G14 v.9
Modifications:	<ul> <li>Legal pages</li> </ul>	s updated.		
74LVC3G14 v.9	20110922	Product data sheet	-	74LVC3G14 v.8
74LVC3G14 v.8	20100819	Product data sheet	-	74LVC3G14 v.7
74LVC3G14 v.7	20080612	Product data sheet	-	74LVC3G14 v.6
74LVC3G14 v.6	20080207	Product data sheet	-	74LVC3G14 v.5
74LVC3G14 v.5	20071005	Product data sheet	-	74LVC3G14 v.4
74LVC3G14 v.4	20070314	Product data sheet	-	74LVC3G14 v.3
74LVC3G14 v.3	20050131	Product data sheet	-	74LVC3G14 v.2
74LVC3G14 v.2	20041027	Product data sheet	-	74LVC3G14 v.1
74LVC3G14 v.1	20040510	Product data sheet	-	-
-				

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### **19. Legal information**

### **19.1 Data sheet status**

Document status[1][2]	Product status <sup>[3]</sup>	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.

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[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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