Triple inverting Schmitt trigger Rev. 5 — 9 December 2013

Product data sheet

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

The 74HC3G14; 74HCT3G14 is a triple inverter with Schmitt-trigger inputs. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>. Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

#### **Features and benefits** 2.

- Wide supply voltage range from 2.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC3G14: CMOS level
  - For 74HCT3G14: TTL level
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Unlimited input rise and fall times
- Multiple package options
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

#### Applications 3.

- Wave and pulse shaper for highly noisy environments
- Astable multivibrators
- Monostable multivibrators



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### 4. Ordering information

Type number	Package								
	Temperature range	Name	Description	Version					
74HC3G14DP	–40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads;	SOT505-2					
74HCT3G14DP			body width 3 mm; lead length 0.5 mm						
74HC3G14DC	–40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads;	SOT765-1					
74HCT3G14DC			body width 2.3 mm						
74HC3G14GD	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads;	SOT996-2					
74HCT3G14GD			8 terminals; body $3 \times 2 \times 0.5$ mm						

### 5. Marking

Table 2. Marking	
Type number	Marking code <sup>[1]</sup>
74HC3G14DP	H14
74HCT3G14DP	T14
74HC3G14DC	H14
74HCT3G14DC	T14
74HC3G14GD	H14
74HCT3G14GD	T14

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

## 6. Functional diagram



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### 7. Pinning information

### 7.1 Pinning



#### 7.2 Pin description

Table 3. Pin de	scription	
Symbol	Pin	Description
1A, 2A, 3A	1, 3, 6	data input
GND	4	ground (0 V)
1Y, 2Y, 3Y	7, 5, 2	data output
V <sub>CC</sub>	8	supply voltage

## 8. Functional description

#### Table 4.Function table<sup>[1]</sup>

Input	Output
nA	nY
L	Н
Н	L

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

### 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	+7.0	V
I <sub>IK</sub>	input clamping current	$V_{\rm I} < -0.5$ V or $V_{\rm I} > V_{\rm CC}$ + 0.5 V	<u>[1]</u> _	±20	mA
I <sub>OK</sub>	output clamping current	$V_{\rm O}$ < –0.5 V or $V_{\rm O}$ > $V_{\rm CC}$ + 0.5 V	<u>[1]</u> _	±20	mA
lo	output current	$V_{\rm O}$ = –0.5 V to V_{\rm CC} + 0.5 V	<u>[1]</u> -	±25	mA
I <sub>CC</sub>	supply current		<u>[1]</u> _	+50	mA
I <sub>GND</sub>	ground current		<u>[1]</u> –50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation		[2] _	300	mW

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

[2] 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 package: above 118 °C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

## 10. Recommended operating conditions

#### Table 6. Recommended operating conditions

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

Symbol	DI Parameter Conditions		74HC3G14			74HCT3G14			Unit
			Min	Тур	Max	Min	Тур	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V <sub>CC</sub>	0	-	$V_{CC}$	V
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	$V_{CC}$	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C

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### 11. Static characteristics

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

Voltages are referenced to GND (ground = 0 V). All typical values are measured at  $T_{amb}$  = 25 °C.

Symbol	Parameter	Conditions		25 °C		–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC3G	14									
V <sub>OH</sub>	HIGH-level	$V_I = V_{T+} \text{ or } V_{T-}$								
	output voltage	$I_0 = -20 \ \mu\text{A}; \ V_{CC} = 2.0 \ \text{V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20 \ \mu\text{A}; \ V_{CC} = 4.5 \ \text{V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_0 = -20 \ \mu A; \ V_{CC} = 6.0 \ V$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_{O}$ = -4.0 mA; $V_{CC}$ = 4.5 V	4.18	4.32	-	4.13	-	3.7	-	V
		$I_{O}$ = -5.2 mA; $V_{CC}$ = 6.0 V	5.68	5.81	-	5.63	-	5.2	-	V
V <sub>OL</sub>	LOW-level	$V_I = V_{T+} \text{ or } V_{T-}$								
	output voltage	$I_0 = 20 \ \mu A; \ V_{CC} = 2.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 20 \ \mu A; \ V_{CC} = 4.5 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 20 \ \mu A; \ V_{CC} = 6.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_{O}$ = 4.0 mA; $V_{CC}$ = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
	$I_0 = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V	
lı	input leakage current	$V_{\text{I}}$ = $V_{\text{CC}}$ or GND; $V_{\text{CC}}$ = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>CC</sub>	supply current	per input pin; $V_{CC} = 6.0 V$ ; $V_I = V_{CC}$ or GND; $I_O = 0 A$ ;	-	-	1.0	-	10	-	20	μA
CI	input capacitance		-	2.0	-	-	-	-	-	pF
74HCT3	G14									
V <sub>он</sub>	HIGH-level	$V_I = V_{T+}$ or $V_{T-}$								
	output voltage	$I_0 = -20 \ \mu A; V_{CC} = 4.5 \ V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	4.18	4.32	-	4.13	-	3.7	-	V
V <sub>OL</sub>	LOW-level	$V_{I} = V_{IH} \text{ or } V_{IL}$								
	output voltage	$I_0 = 20 \ \mu A; \ V_{CC} = 4.5 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
l	input leakage current	$V_{I} = V_{CC}$ or GND; $V_{CC} = 5.5$ V	-	-	±0.1	-	±1.0	-	±1.0	μΑ
I <sub>CC</sub>	supply current	per input pin; $V_{CC} = 5.5 V$ ; $V_I = V_{CC}$ or GND; $I_O = 0 A$ ;	-	-	1.0	-	10	-	20	μA
Δl <sub>CC</sub>	additional supply current	per input; $V_{CC} = 4.5 V \text{ to } 5.5 V;$ $V_I = V_{CC} - 2.1 V; I_O = 0 A$	-	-	300	-	375	-	410	μΑ
Cı	input capacitance		-	2.0	-	-	-	-	-	pF

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Symbol	Parameter	Conditions		25 °C		-40	0 °C to +1	25 °C	Unit
			Min	Тур	Max	Min	Max (85 °C)	Max (125 °C)	
74HC3G	14								
V <sub>T+</sub>	positive-going	see Figure 6, Figure 7							
	threshold voltage	$V_{CC} = 2.0 V$	1.00	1.18	1.50	1.00	1.50	1.50	V
		$V_{CC} = 4.5 V$	2.30	2.60	3.15	2.30	3.15	3.15	V
		$V_{CC} = 6.0 V$	3.00	3.46	4.20	3.00	4.20	4.20	V
V <sub>T-</sub>	negative-going	see Figure 6, Figure 7							
threshold voltage	$V_{CC} = 2.0 V$	0.30	0.60	0.90	0.30	0.90	0.90	V	
		$V_{CC} = 4.5 V$	1.13	1.47	2.00	1.13	2.00	2.00	V
		$V_{CC} = 6.0 V$	1.50	2.06	2.60	1.50	2.60	2.60	V
V <sub>H</sub> hy	hysteresis voltage	(V <sub>T+</sub> – V <sub>T−</sub> ); see <u>Figure 6,</u> <u>Figure 7</u> and <u>Figure 9</u>							
		$V_{CC} = 2.0 V$	0.30	0.60	1.00	0.30	1.00	1.00	V
		$V_{CC} = 4.5 V$	0.60	1.13	1.40	0.60	1.40	1.40	V
		$V_{CC} = 6.0 V$	0.80	1.40	1.70	0.80	1.70	1.70	V
74HCT3	G14								
V <sub>T+</sub>	positive-going	see Figure 6, Figure 7							
	threshold voltage	$V_{CC} = 4.5 V$	1.20	1.58	1.90	1.20	1.90	1.90	V
		$V_{CC} = 5.5 V$	1.40	1.78	2.10	1.40	2.10	2.10	V
V <sub>T-</sub>	negative-going	see Figure 6, Figure 7							
	threshold voltage	$V_{CC} = 4.5 V$	0.50	0.87	1.20	0.50	1.20	1.20	V
		$V_{CC} = 5.5 V$	0.60	1.11	1.40	0.60	1.40	1.40	V
V <sub>H</sub>	hysteresis voltage	(V <sub>T+</sub> – V <sub>T−</sub> ); see <u>Figure 6,</u> <u>Figure 7</u> and <u>Figure 8</u>							
		$V_{CC} = 4.5 V$	0.40	0.71	-	0.40	-	-	V
		$V_{CC} = 5.5 V$	0.40	0.67	-	0.40	-	-	V

#### Table 8.Transfer characteristics

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

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### **11.1 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 <u>Figure 11</u>.

Symbol	Parameter	Conditions			25 °C		-4	0 °C to +1	25 °C	Unit
				Min	Тур	Max	Min	Max (85 °C)	Max (125 °C)	_
74HC3G1	4									
t <sub>pd</sub>	propagation delay	nA to nY; see Figure 10	<u>[1]</u>							
	$V_{CC} = 2.0 V$		-	53	125	-	155	190	ns	
	$V_{CC} = 4.5 V$		-	16	25	-	31	38	ns	
		$V_{CC} = 6.0 V$		-	13	21	-	26	32	ns
t <sub>t</sub> transition time	transition time	nY; see <u>Figure 10</u>	[2]							
		$V_{CC} = 2.0 V$		-	20	75	-	95	110	ns
		$V_{CC} = 4.5 V$		-	7	15	-	19	22	ns
		$V_{CC} = 6.0 V$		-	5	13	-	16	19	ns
C <sub>PD</sub>	power dissipation capacitance	$V_I = GND$ to $V_{CC}$	<u>[3]</u>	-	10	-	-	-	-	pF
74HCT36	614									
t <sub>pd</sub>	propagation delay	nA to nY; see <u>Figure 10</u>	<u>[1]</u>							
		$V_{CC} = 4.5 V$		-	21	32	-	40	48	ns
tt	transition time	nY; see <u>Figure 10</u>	[2]							
		$V_{CC} = 4.5 V$		-	6	15	-	19	22	ns
C <sub>PD</sub>	power dissipation capacitance	$V_{I}$ = GND to $V_{CC}$ – 1.5 V	<u>[3]</u>	-	10	-	-	-	-	pF

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

 $\label{eq:ttilde} [2] \quad t_t \text{ is the same as } t_{TLH} \text{ and } t_{THL}$ 

[3] C\_{PD} is used to determine the dynamic power dissipation (P\_D in  $\mu W).$ 

 $P_{D} = C_{PD} \times V_{CC}^{2} \times f_{i} \times N + \Sigma (C_{L} \times V_{CC}^{2} \times f_{o}) \text{ where:}$ 

 $f_i$  = 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;

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

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### 13. Waveforms



#### Table 10. Measurement points

Туре	Input	Output
	V <sub>M</sub>	V <sub>M</sub>
74HC3G14	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>
74HCT3G14	1.3 V	1.3 V

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#### Table 11. Test data

Туре	Input		Load	S1 position	
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	RL	t <sub>PHL</sub> , t <sub>PLH</sub>
74HC3G14	GND to V <sub>CC</sub>	≤ 6 ns	50 pF	1 kΩ	open
74HCT3G14	GND to 3.0 V	≤ 6 ns	50 pF	1 kΩ	open

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### 14. Application information

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

 $P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC}$  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 12 and Figure 13.

An example of a relaxation circuit using the 74HC3G14/74HCT3G14 is shown in Figure 14.



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### 15. Package outline



#### Fig 16. Package outline SOT505-2 (TSSOP8)

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Fig 17. Package outline SOT765-1 (VSSOP8)

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XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 3 x 2 x 0.5 mm

Fig 18. Package outline SOT996-2 (XSON8)

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## **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
-	

## **17. Revision history**

### Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT3G14 v.5	20131209	Product data sheet	-	74HC_HCT3G14 v.4
Modifications:	• Figure 15 a	dded (typical K-factor for rela	axation oscillator).	
74HC_HCT3G14 v.4	20131003	Product data sheet	-	74HC_HCT3G14 v.3
Modifications:	<ul> <li>For type nu</li> </ul>	mbers 74HC3G14GD and 74	4HCT3G14GD XSON8	U has changed to XSON8.
74HC_HCT3G14 v.3	20090508	Product data sheet	-	74HC_HCT3G14 v.2
74HC_HCT3G14 v.2	20031104	Product specification	-	74HC_HCT3G14 v.1
74HC HCT3G14 v.1	20020723	Product specification	-	-

### **18. Legal information**

#### 18.1 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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