

# 74HC1G14; 74HCT1G14

Inverting Schmitt trigger

Rev. 6 — 27 December 2012

Product data sheet

## 1. General description

74HC1G14 and 74HCT1G14 are high-speed Si-gate CMOS devices. They provide an inverting buffer function with Schmitt trigger action. These devices are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

The HC device has CMOS input switching levels and supply voltage range 2 V to 6 V.

The HCT device has TTL input switching levels and supply voltage range 4.5 V to 5.5 V.

The standard output currents are half of those of the 74HC14 and 74HCT14.

## 2. Features and benefits

- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

## 4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC1G14GW 74HCT1G14GW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HC1G14GV 74HCT1G14GV	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SC-74A	plastic surface-mounted package; 5 leads	SOT753

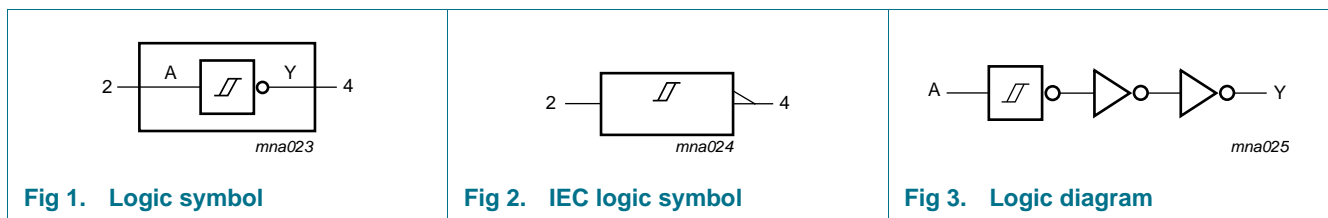
## 5. Marking

Table 2. Marking codes

Type number	Marking code <sup>[1]</sup>
74HC1G14GW	HF
74HCT1G14GW	TF
74HC1G14GV	H14
74HCT1G14GV	T14

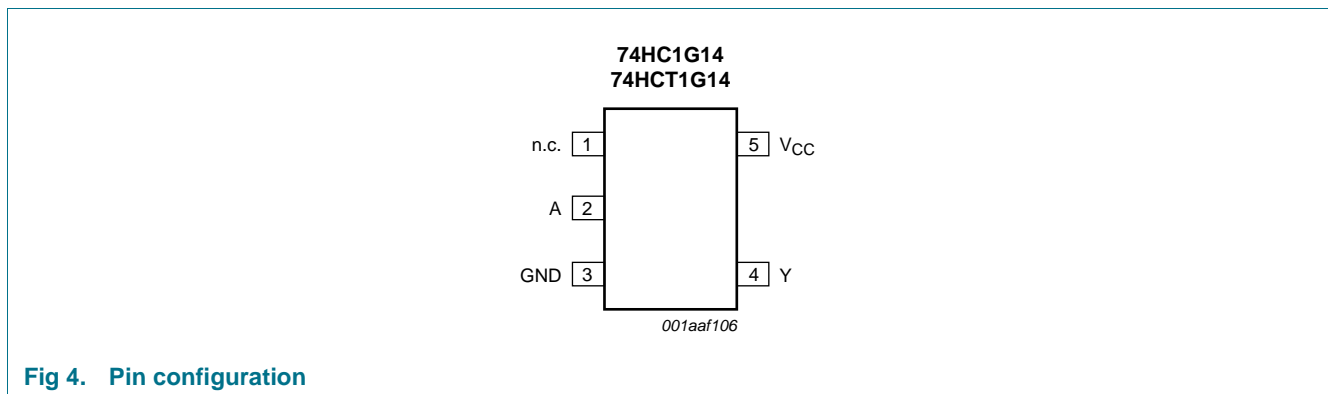
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 6. Functional diagram



## 7. Pinning information

### 7.1 Pinning



### 7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
n.c.	1	not connected
A	2	data input
GND	3	ground (0 V)
Y	4	data output
V <sub>CC</sub>	5	supply voltage

## 8. Functional description

**Table 4. Function table**

H = HIGH voltage level; L = LOW voltage level

Input	Output
A	Y
L	H
H	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). [\[1\]](#)

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_O$	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	$\pm 12.5$	mA
$I_{CC}$	supply current		-	25	mA
$I_{GND}$	ground current		-25	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$	<a href="#">[2]</a> -	200	mW

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

[2] Above 55 °C, the value of  $P_{tot}$  derates linearly with 2.5 mW/K.

## 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

Symbol	Parameter	Conditions	74HC1G14			74HCT1G14			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{CC}$	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
$V_I$	input voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	-40	+25	+125	°C

## 11. Static characteristics

**Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
<b>For type 74HC1G14</b>								
$V_{OH}$	HIGH-level output voltage	$V_I = V_{T+}$ or $V_{T-}$						
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	5.9	6.0	-	5.9	-	V
		$I_O = -2.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	4.13	4.32	-	3.7	-	V
		$I_O = -2.6\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$	5.63	5.81	-	5.2	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{T+}$ or $V_{T-}$						
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	-	0	0.1	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	-	0	0.1	-	0.1	V
		$I_O = 2.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	0.15	0.33	-	0.4	V
		$I_O = 2.6\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$	-	0.16	0.33	-	0.4	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	1.0	-	1.0	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$	-	-	10	-	20	$\mu\text{A}$
$C_I$	input capacitance		-	1.5	-	-	-	pF
$V_{T+}$	positive-going threshold voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 2.0\text{ V}$	0.7	1.09	1.5	0.7	1.5	V
		$V_{CC} = 4.5\text{ V}$	1.7	2.36	3.15	1.7	3.15	V
		$V_{CC} = 6.0\text{ V}$	2.1	3.12	4.2	2.1	4.2	V
$V_{T-}$	negative-going threshold voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 2.0\text{ V}$	0.3	0.60	0.9	0.3	0.9	V
		$V_{CC} = 4.5\text{ V}$	0.9	1.53	2.0	0.9	2.0	V
		$V_{CC} = 6.0\text{ V}$	1.2	2.08	2.6	1.2	2.6	V
$V_H$	hysteresis voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 2.0\text{ V}$	0.2	0.48	1.0	0.2	1.0	V
		$V_{CC} = 4.5\text{ V}$	0.4	0.83	1.4	0.4	1.4	V
		$V_{CC} = 6.0\text{ V}$	0.6	1.04	1.6	0.6	1.6	V
<b>For type 74HCT1G14</b>								
$V_{OH}$	HIGH-level output voltage	$V_I = V_{T+}$ or $V_{T-}$						
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	V
		$I_O = -2.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	4.13	4.32	-	3.7	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{T+}$ or $V_{T-}$						
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	V
		$I_O = 2.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	0.15	0.33	-	0.4	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$	-	-	1.0	-	1.0	$\mu\text{A}$

**Table 7.** Static characteristics ...continued

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 5.5\text{ V}$	-	-	10	-	20	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	per input; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ ; $V_I = V_{CC} - 2.1\text{ V}$ ; $I_O = 0\text{ A}$	-	-	500	-	850	$\mu\text{A}$
$C_I$	input capacitance		-	1.5	-	-	-	pF
$V_{T+}$	positive-going threshold voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 4.5\text{ V}$	1.2	1.55	1.9	1.2	1.9	V
		$V_{CC} = 5.5\text{ V}$	1.4	1.80	2.1	1.4	2.1	V
$V_{T-}$	negative-going threshold voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 4.5\text{ V}$	0.5	0.76	1.2	0.5	1.2	V
		$V_{CC} = 5.5\text{ V}$	0.6	0.90	1.4	0.6	1.4	V
$V_H$	hysteresis voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>						
		$V_{CC} = 4.5\text{ V}$	0.4	0.80	-	0.4	-	V
		$V_{CC} = 5.5\text{ V}$	0.4	0.90	-	0.4	-	V

## 12. Dynamic characteristics

**Table 8.** Dynamic characteristics

$GND = 0\text{ V}$ ;  $t_r = t_f \leq 6.0\text{ ns}$ ; All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ . For test circuit see [Figure 6](#)

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
<b>For type 74HC1G14</b>								
$t_{pd}$	propagation delay	A to Y; see <a href="#">Figure 5</a>						
		$V_{CC} = 2.0\text{ V}$ ; $C_L = 50\text{ pF}$	-	25	155	-	190	ns
		$V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$	-	12	31	-	38	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$	-	10	-	-	-	ns
		$V_{CC} = 6.0\text{ V}$ ; $C_L = 50\text{ pF}$	-	11	26	-	32	ns
$C_{PD}$	power dissipation capacitance	$V_I = GND$ to $V_{CC}$	-	20	-	-	-	pF
<b>For type 74HCT1G14</b>								
$t_{pd}$	propagation delay	A to Y; see <a href="#">Figure 5</a>						
		$V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$	-	17	43	-	51	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$	-	15	-	-	-	ns
$C_{PD}$	power dissipation capacitance	$V_I = GND$ to $V_{CC} - 1.5\text{ V}$	-	22	-	-	-	pF

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

[2]  $C_{PD}$  is used to determine the dynamic power dissipation  $P_D$  ( $\mu\text{W}$ ).

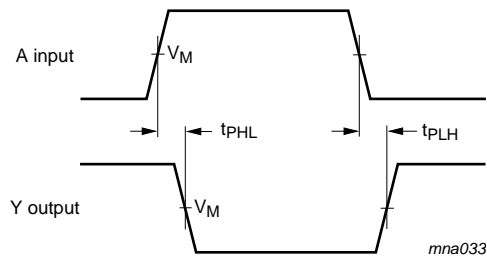
$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

$C_L$  = output load capacitance in pF;  $V_{CC}$  = supply voltage in Volts

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

## 13. Waveforms

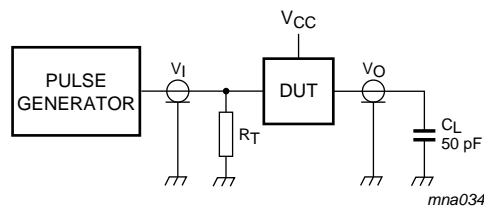


Measurement points are given in [Table 9](#).

**Fig 5. The input (A) to output (Y) propagation delays**

**Table 9. Measurement points**

Type number	Input		Output
	$V_I$	$V_M$	$V_M$
74HC1G14	GND to $V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74HCT1G14	GND to 3.0 V	1.5 V	$0.5 \times V_{CC}$



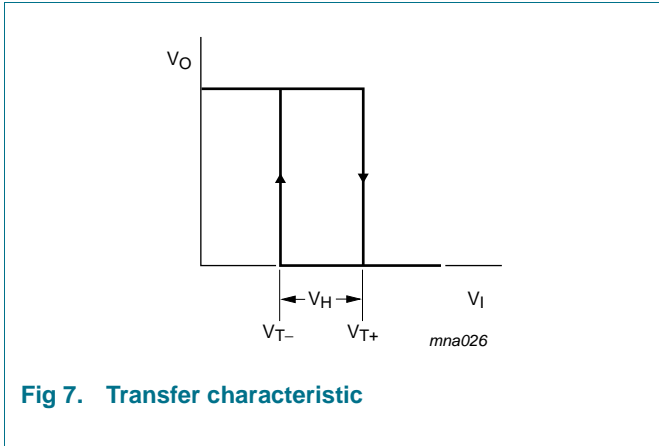
Test data is given in [Table 8](#). Definitions for test circuit:

$C_L$  = Load capacitance including jig and probe capacitance.

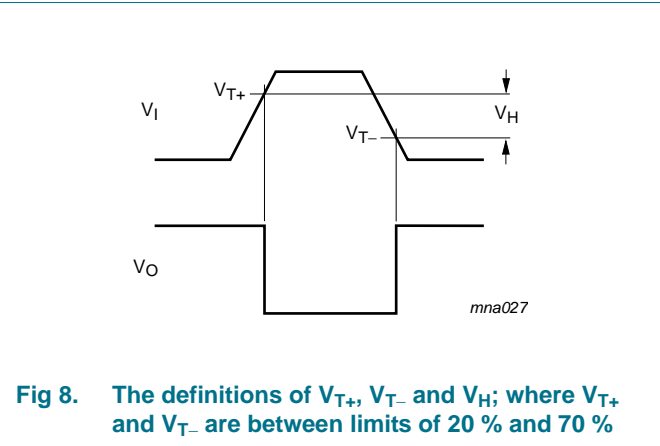
$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

**Fig 6. Load circuitry for switching times**

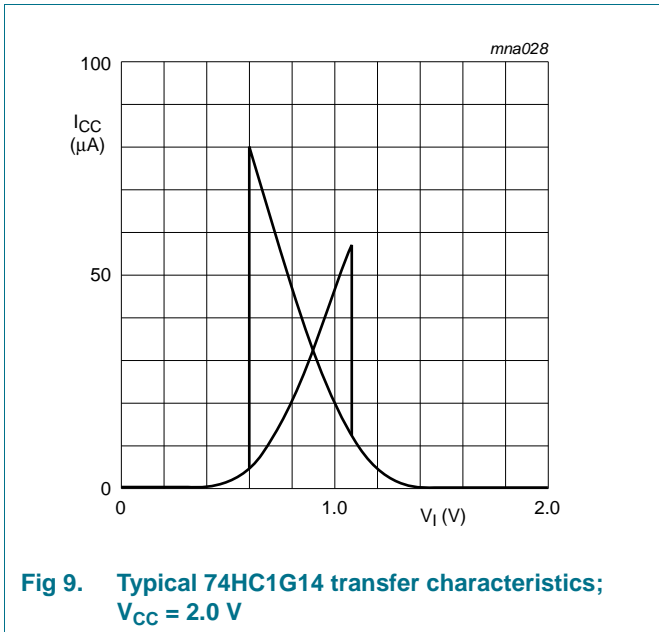
## 14. Transfer characteristics waveforms



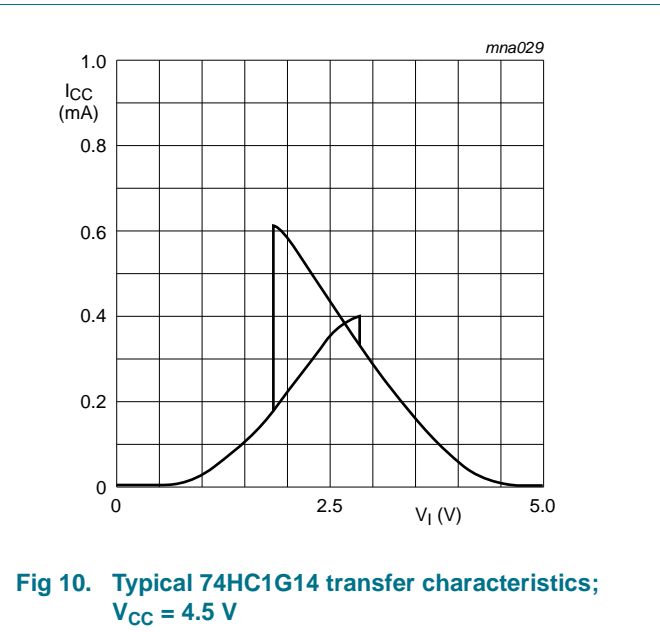
**Fig 7. Transfer characteristic**



**Fig 8. The definitions of  $V_{T+}$ ,  $V_{T-}$  and  $V_H$ ; where  $V_{T+}$  and  $V_{T-}$  are between limits of 20 % and 70 %**



**Fig 9. Typical 74HC1G14 transfer characteristics;  $V_{CC} = 2.0\text{ V}$**



**Fig 10. Typical 74HC1G14 transfer characteristics;  $V_{CC} = 4.5\text{ V}$**

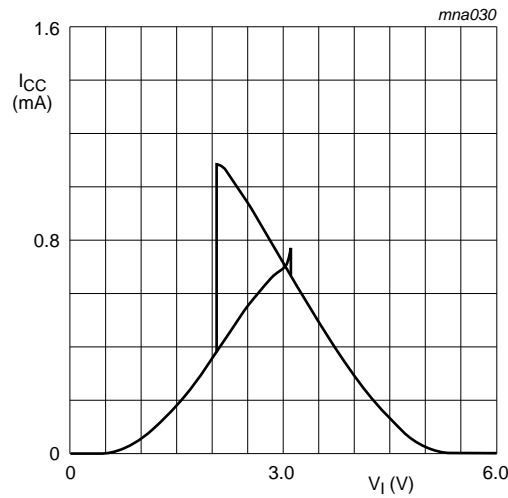


Fig 11. Typical 74HC1G14 transfer characteristics;  $V_{CC} = 6.0\text{ V}$

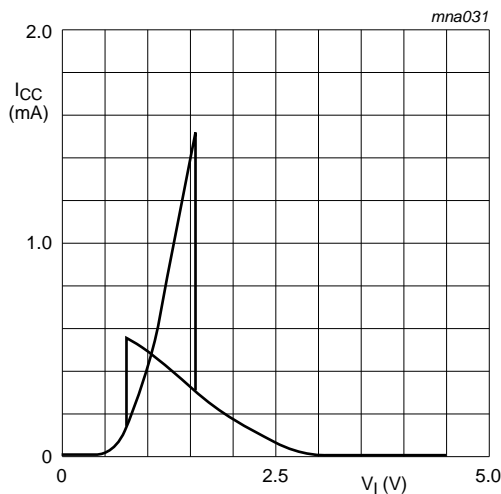


Fig 12. Typical 74HCT1G14 transfer characteristics;  $V_{CC} = 4.5\text{ V}$

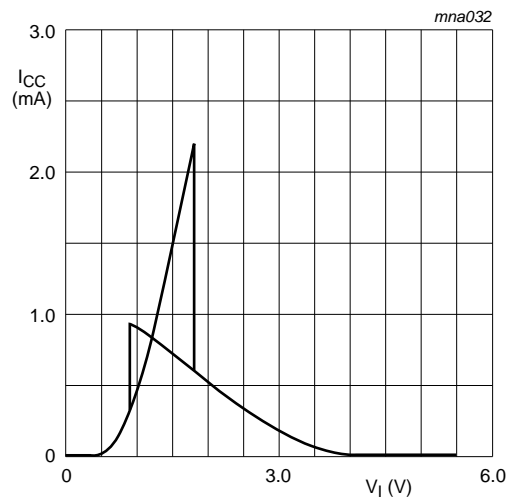


Fig 13. Typical 74HCT1G14 transfer characteristics;  $V_{CC} = 5.5\text{ V}$

## 15. Application information

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

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

Where:

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

$f_i$  = input frequency (MHz)

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



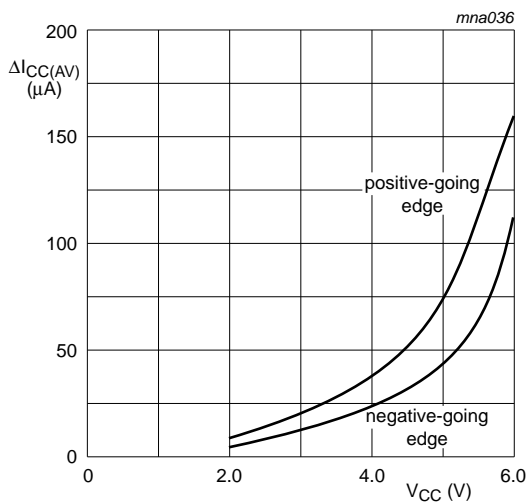
$t_f$  = fall time (ns); 90 % to 10 %

$\Delta I_{CC(AV)}$  = average additional supply current ( $\mu A$ )

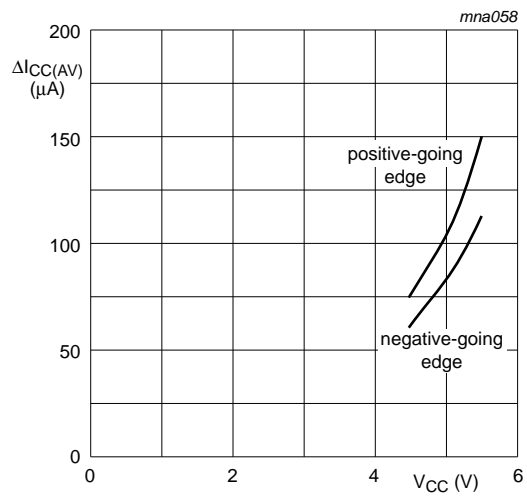
$\Delta I_{CC(AV)}$  differs with positive or negative input transitions, as shown in [Figure 14](#) and [Figure 15](#).

74HC1G14 and 74HCT1G14 used in relaxation oscillator circuit, see [Figure 16](#).

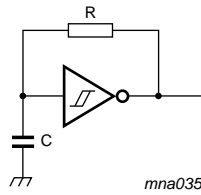
**Remark:** All values given are typical unless otherwise specified.



**Fig 14.**  $\Delta I_{CC(AV)}$  for 74HC1G14 devices; linear change of  $V_I$  between  $0.1 \times V_{CC}$  to  $0.9 \times V_{CC}$



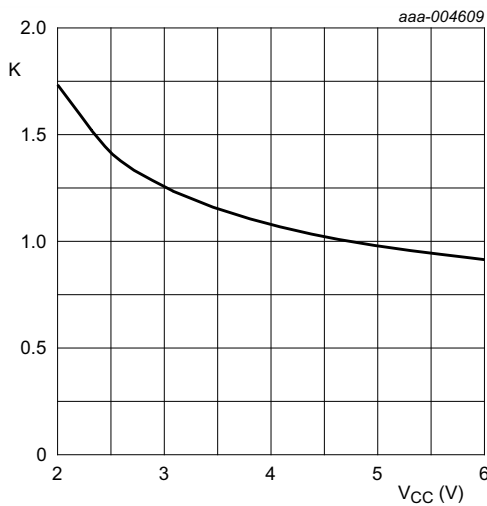
**Fig 15.**  $\Delta I_{CC(AV)}$  for 74HCT1G14 devices; linear change of  $V_I$  between  $0.1 \times V_{CC}$  to  $0.9 \times V_{CC}$



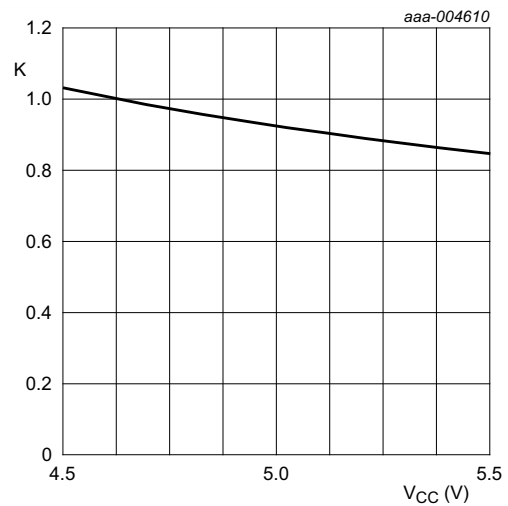
For 74HC1G14 and 74HCT1G14:  $f = \frac{1}{T} \approx \frac{1}{K \times RC}$

For K-factor, see [Figure 17](#)

**Fig 16. Relaxation oscillator using 74HC1G14 and 74HCT1G14**



K-factor for 74HC1G14



K-factor for 74HCT1G14

**Fig 17. Typical K-factor for relaxation oscillator**

16. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1

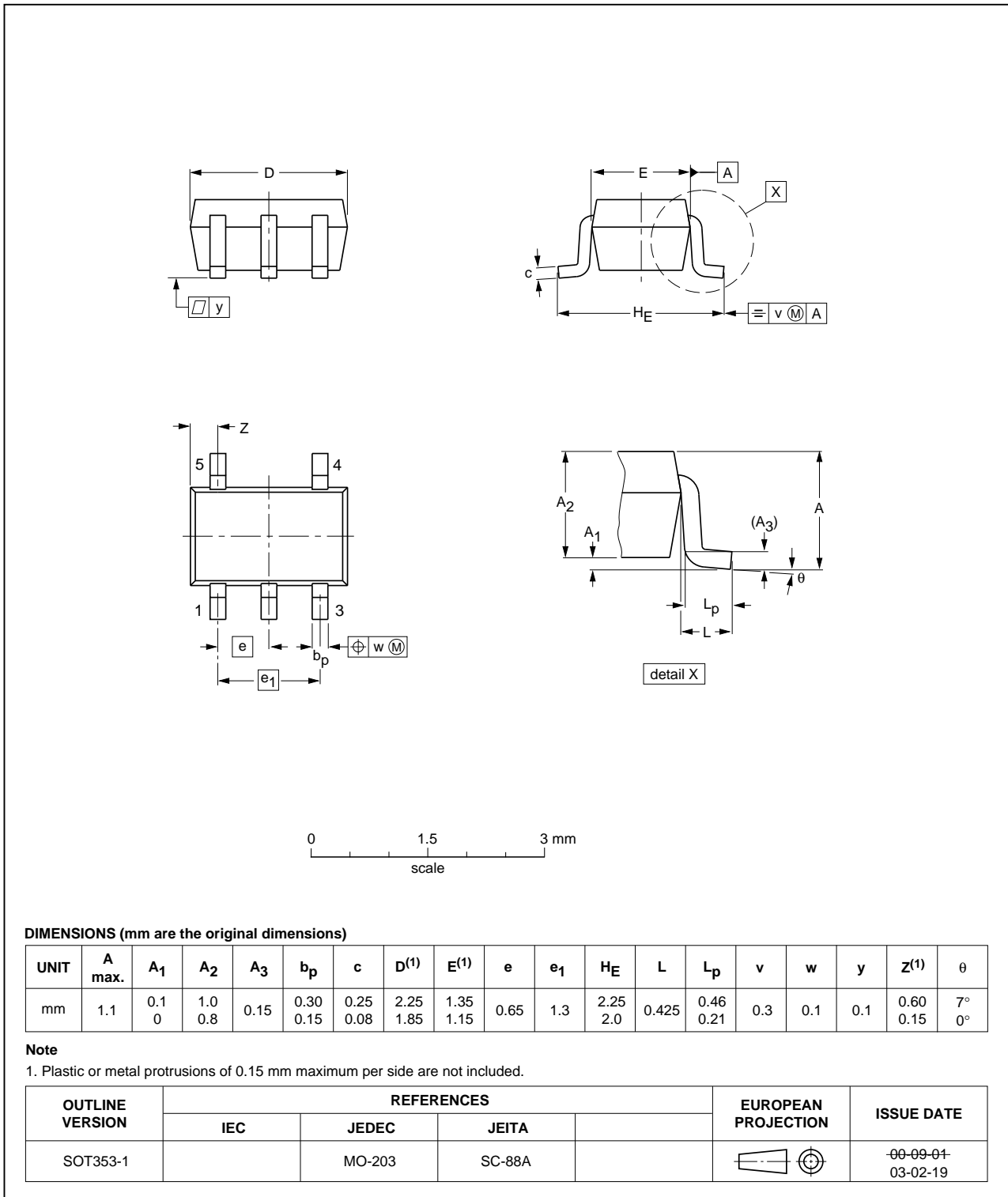


Fig 18. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

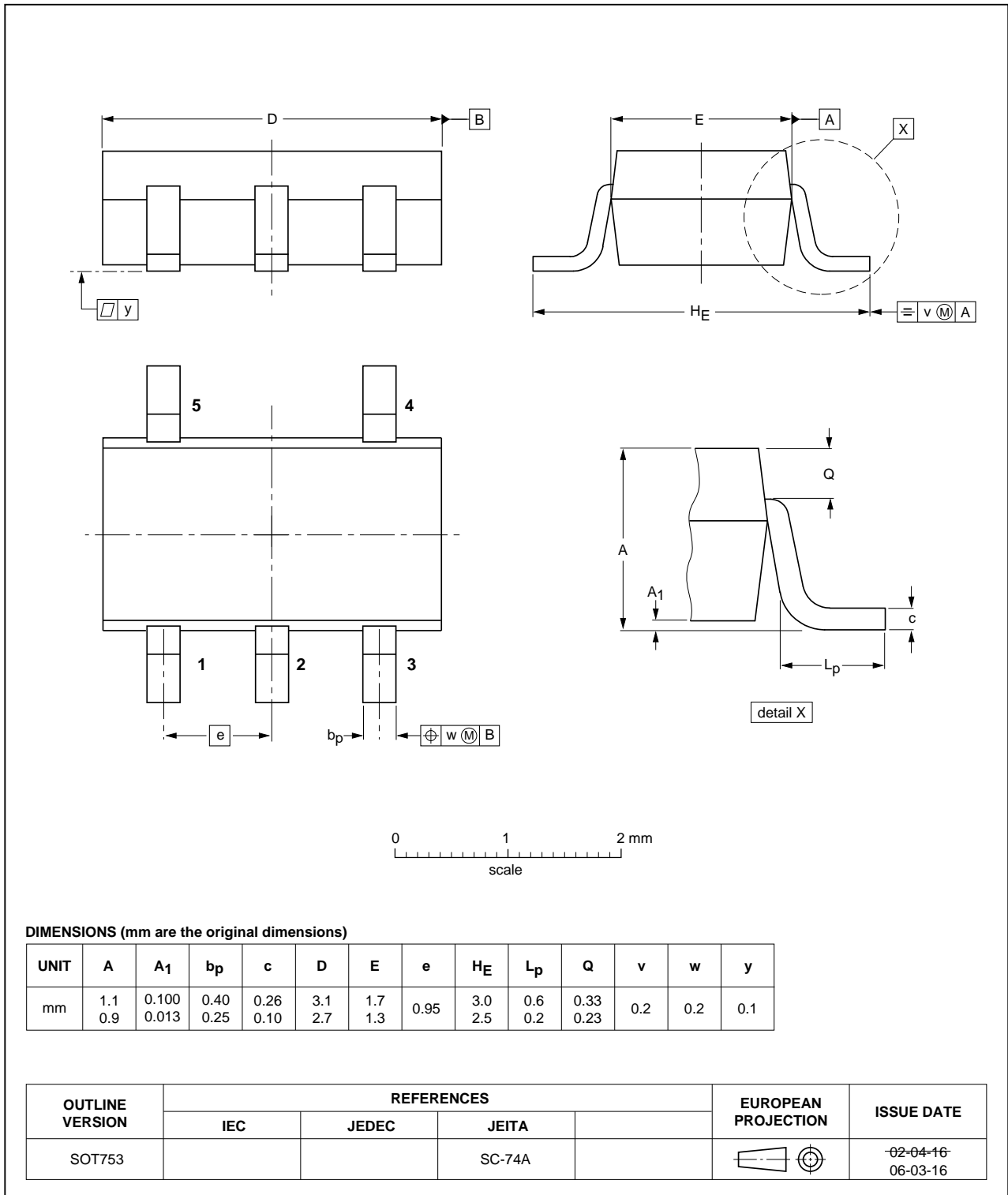


Fig 19. Package outline SOT753 (SC-74A)

## 17. Abbreviations

Table 10. Abbreviations

Acronym	Description
DUT	Device Under Test
TTL	Transistor-Transistor Logic

## 18. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT1G14 v.6	20121227	Product data sheet	-	74HC_HCT1G14 v.5
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Table 3</a>: Pin number Y output changed from 5 to 4 (errata).</li></ul>			
74HC_HCT1G14 v.5	20120924	Product data sheet	-	74HC_HCT1G14 v.4
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Figure 17</a> added (typical K-factor for relaxation oscillator).</li><li>• Legal page updated.</li></ul>			
74HC_HCT1G14 v.4	20070717	Product data sheet	-	74HC_HCT1G14 v.3
74HC_HCT1G14 v.3	20020515	Product specification	-	74HC_HCT1G14 v.2
74HC_HCT1G14 v.2	20010302	Product specification	-	74HC_HCT1G14 v.1
74HC_HCT1G14 v.1	19980805	Product specification	-	-

## 19. Legal information

### 19.1 Data sheet status

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

[1] 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 URL <http://www.nexperia.com>.

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