

# 74AHC1G14; 74AHCT1G14

## Inverting Schmitt trigger

Rev. 05 — 29 June 2007

Product data sheet

## 1. General description

74AHC1G14 and 74AHCT1G14 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 AHC device has CMOS input switching levels and supply voltage range 2 V to 5.5 V.

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

## 2. Features

- Symmetrical output impedance
- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114E: exceeds 2000 V
  - ◆ MM JESD22-A115-A: exceeds 200 V
  - ◆ CDM JESD22-C101C: exceeds 1000 V
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options
- Specified from -40 °C to +125 °C

## 3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

## 4. Ordering information

Table 1. Ordering information

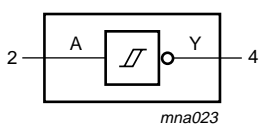
Type number	Package			
	Temperature range	Name	Description	Version
74AHC1G14GW 74AHCT1G14GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74AHC1G14GV 74AHCT1G14GV	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753

## 5. Marking

**Table 2. Marking codes**

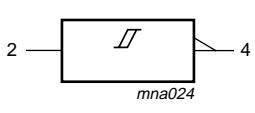
Type number	Marking code
74AHC1G14GW	AF
74AHCT1G14GW	CF
74AHC1G14GV	A14
74AHCT1G14GV	C14

## 6. Functional diagram



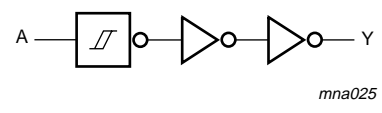
mna023

**Fig 1. Logic symbol**



mna024

**Fig 2. IEC logic symbol**



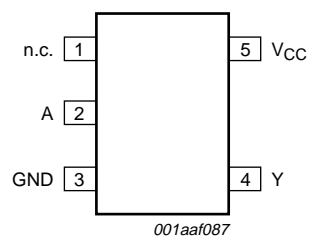
mna025

**Fig 3. Logic diagram**

## 7. Pinning information

### 7.1 Pinning

**74AHC1G14**  
**74AHCT1G14**



001aaf087

**Fig 4. Pin configuration**

### 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).*

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+7.0	V
$V_I$	input voltage		-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$	-20	-	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	[1] -	±20	mA
$I_O$	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	±25	mA
$I_{CC}$	supply current		-	75	mA
$I_{GND}$	ground current		-75	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$	[2] -	250	mW

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

[2] For both TSSOP5 and SC-74A packages: above 87.5 °C the value of  $P_{tot}$  derates linearly with 4.0 mW/K.

## 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

Symbol	Parameter	Conditions	74AHC1G14			74AHCT1G14			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{CC}$	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	0	-	5.5	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).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>For type 74AHC1G14</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.36	-	0.44	-	0.55	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	-	1.0	-	2.0	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	1.0	-	10	-	40	μA
C <sub>I</sub>	input capacitance		-	1.5	10	-	10	-	10	pF
<b>For type 74AHCT1G14</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -50 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -8.0 mA	3.94	-	-	3.8	-	3.70	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 50 μA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 8.0 mA	-	-	0.36	-	0.44	-	0.55	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	-	1.0	-	2.0	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	1.0	-	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = 3.4 V; other inputs at V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C <sub>I</sub>	input capacitance		-	1.5	10	-	10	-	10	pF

## 11.1 Transfer characteristics

**Table 8. Transfer characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). See [Figure 7](#) and [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>For type 74AHC1G14</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 3.0 V	-	-	2.2	-	2.2	-	2.2	V
		V <sub>CC</sub> = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V <sub>CC</sub> = 5.5 V	-	-	3.85	-	3.85	-	3.85	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 3.0 V	0.9	-	-	0.9	-	0.9	-	V
		V <sub>CC</sub> = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V <sub>CC</sub> = 5.5 V	1.65	-	-	1.65	-	1.65	-	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 3.0 V	0.3	-	1.2	0.3	1.2	0.25	1.2	V
		V <sub>CC</sub> = 4.5 V	0.4	-	1.4	0.4	1.4	0.35	1.4	V
		V <sub>CC</sub> = 5.5 V	0.5	-	1.6	0.5	1.6	0.45	1.6	V
<b>For type 74AHCT1G14</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 4.5 V	-	-	2.0	-	2.0	-	2.0	V
		V <sub>CC</sub> = 5.5 V	-	-	2.0	-	2.0	-	2.0	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 4.5 V	0.5	-	-	0.5	-	0.5	-	V
		V <sub>CC</sub> = 5.5 V	0.6	-	-	0.6	-	0.6	-	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 4.5 V	0.4	-	1.4	0.4	1.4	0.35	1.4	V
		V <sub>CC</sub> = 5.5 V	0.4	-	1.6	0.4	1.6	0.35	1.6	V

## 12. Dynamic characteristics

**Table 9. Dynamic characteristics**

$GND = 0 V$ ;  $t_r = t_f \leq 3.0 ns$ . For waveform see [Figure 5](#). For test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>For type 74AHC1G14</b>										
$t_{pd}$	propagation delay	A to Y;	[1]							
		$V_{CC} = 3.0 V$ to $3.6 V$	[2]							
		$C_L = 15 pF$	-	4.2	12.8	1.0	15.0	1.0	16.5	ns
		$C_L = 50 pF$	-	6.0	16.3	1.0	18.5	1.0	20.5	ns
		$V_{CC} = 4.5 V$ to $5.5 V$	[3]							
		$C_L = 15 pF$	-	3.2	8.6	1.0	10.0	1.0	11.0	ns
		$C_L = 50 pF$	-	4.6	10.6	1.0	12.0	1.0	13.5	ns
$C_{PD}$	power dissipation capacitance	per buffer; $C_L = 50 pF$ ; $f = 1 MHz$ ; $V_I = GND$ to $V_{CC}$	[4]	-	12	-	-	-	-	pF
<b>For type 74AHCT1G14</b>										
$t_{pd}$	propagation delay	A to Y;	[1]							
		$V_{CC} = 4.5 V$ to $5.5 V$	[3]							
		$C_L = 15 pF$	-	4.1	7.0	1.0	8.0	1.0	9.0	ns
		$C_L = 50 pF$	-	5.9	8.5	1.0	10.0	1.0	11.0	ns
$C_{PD}$	power dissipation capacitance	per buffer; $V_I = GND$ to $V_{CC}$	[4]	-	13	-	-	-	-	pF

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

[2] Typical values are measured at  $V_{CC} = 3.3 V$ .

[3] Typical values are measured at  $V_{CC} = 5.0 V$ .

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

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

13. Waveforms

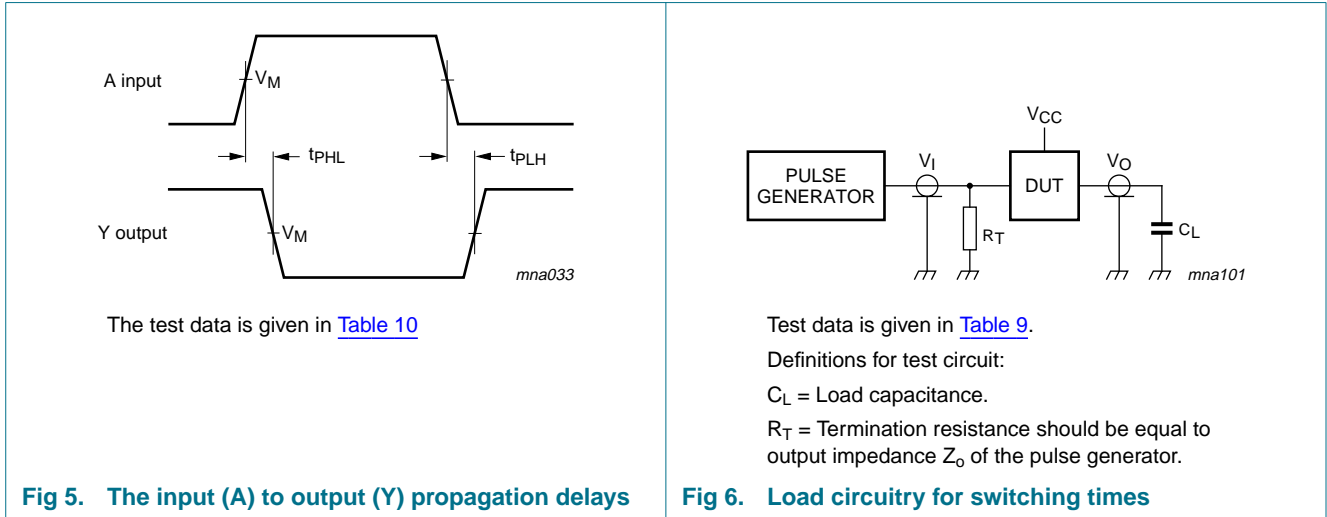


Fig 5. The input (A) to output (Y) propagation delays

Fig 6. Load circuitry for switching times

Table 10. Test data

Type number	Input		Output
	$V_I$	$V_M$	$V_M$
74AHC1G14	GND to $V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT1G14	GND to 3.0 V	1.5 V	$0.5 \times V_{CC}$

13.1 Transfer characteristic waveforms

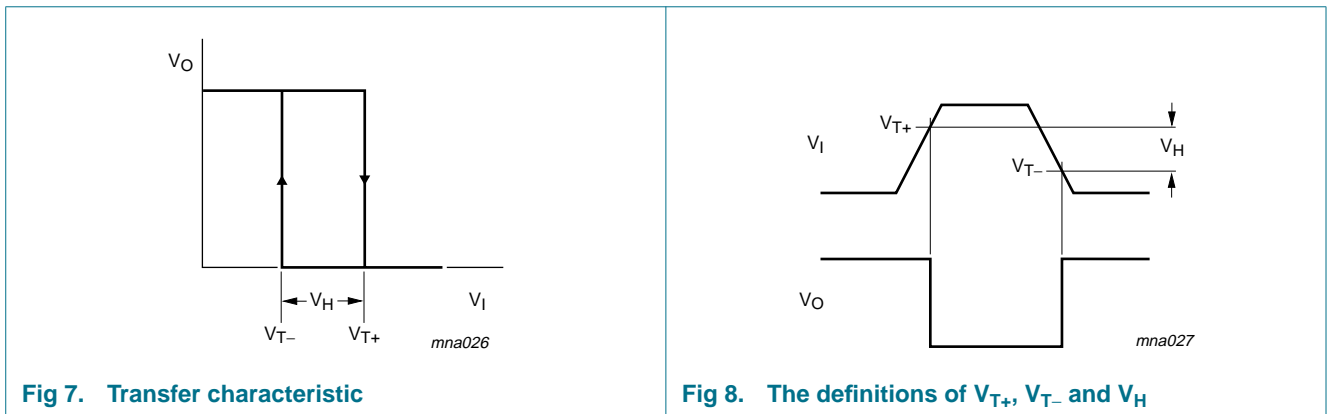
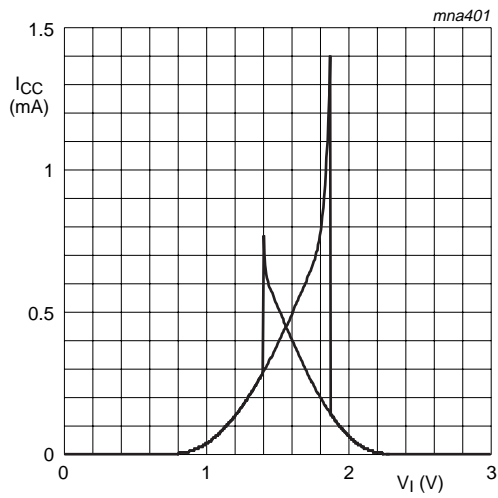
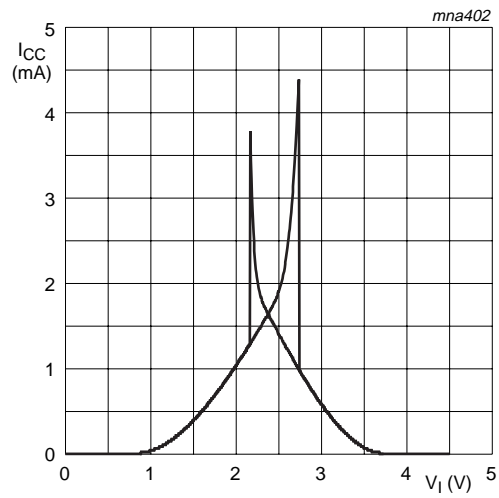


Fig 7. Transfer characteristic

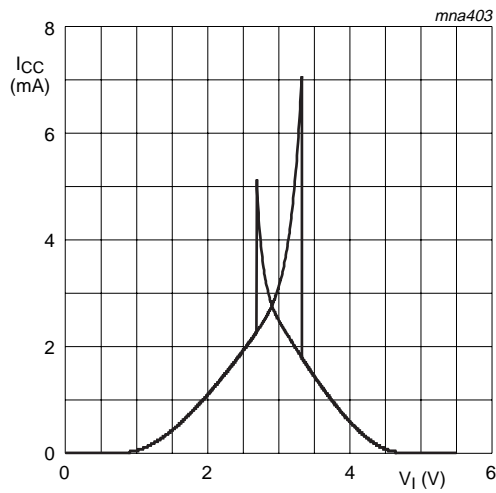
Fig 8. The definitions of  $V_{T+}$ ,  $V_{T-}$  and  $V_H$



**Fig 9. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 3.0\text{ V}$**



**Fig 10. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 4.5\text{ V}$**



**Fig 11. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 5.5\text{ V}$**



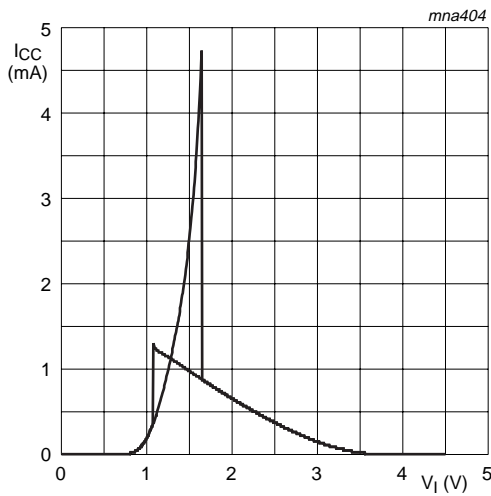


Fig 12. Typical 74AHCT1G14 transfer characteristics;  $V_{CC} = 4.5\text{ V}$

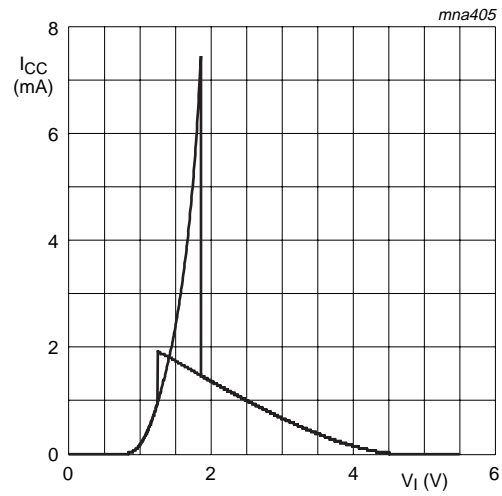


Fig 13. Typical 74AHCT1G14 transfer characteristics;  $V_{CC} = 5.5\text{ V}$

## 14. Application information

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

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

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

$f_i$  = input frequency (MHz);

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

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

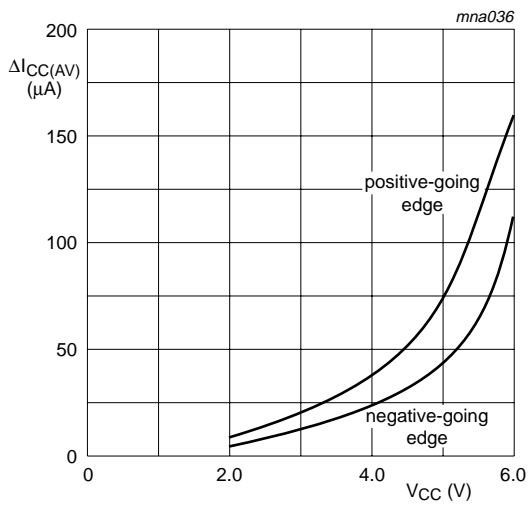
$\Delta I_{\text{CC(AV)}}$  = average additional supply current ( $\mu\text{A}$ ).

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

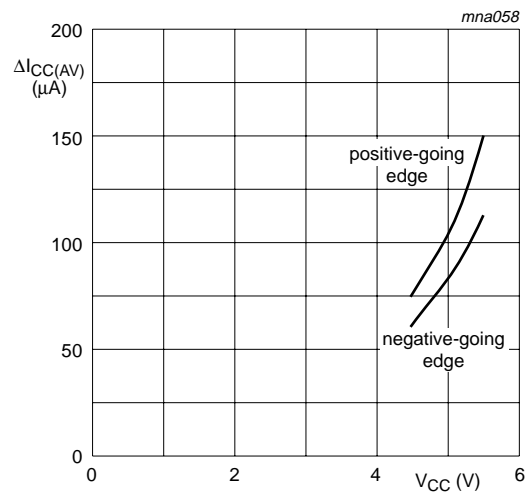
For 74AHC1G14 and 74AHCT1G14 used in relaxation oscillator circuit, see [Figure 16](#).

### Note to the application information:

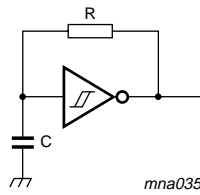
1. All values given are typical unless otherwise specified.



**Fig 14. Average additional  $I_{CC}$  for 74AHC1G14 Schmitt trigger devices; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$**



**Fig 15. Average additional  $I_{CC}$  for 74AHCT1G14 Schmitt trigger devices; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$**



For 74AHC1G14:  $f = \frac{1}{T} \approx \frac{1}{0.55 \times RC}$

For 74AHCT1G14:  $f = \frac{1}{T} \approx \frac{1}{0.60 \times RC}$

**Fig 16. Relaxation oscillator using the 74AHC1G14 and 74AHCT1G14**

15. Package outline

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

SOT353-1

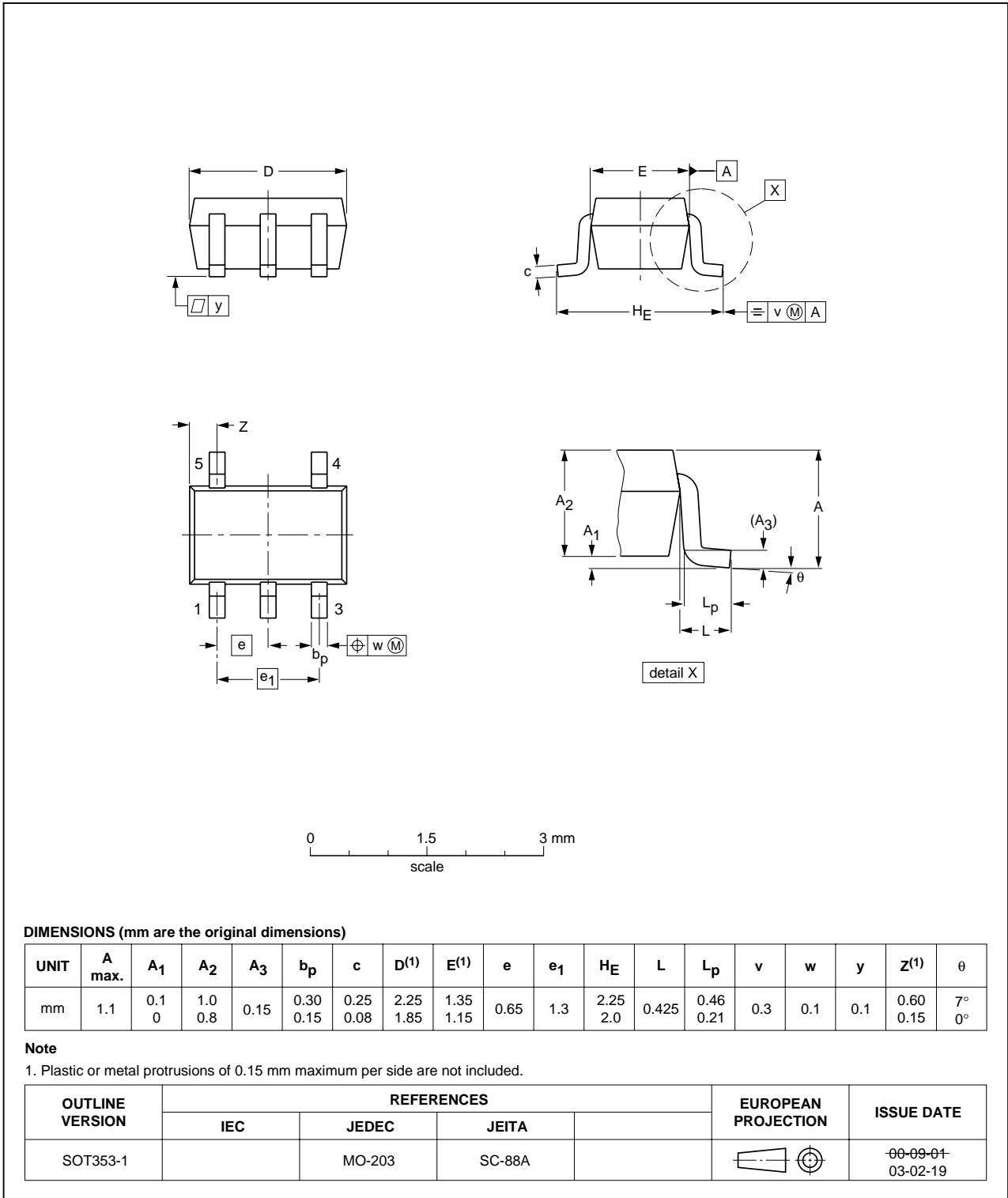


Fig 17. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

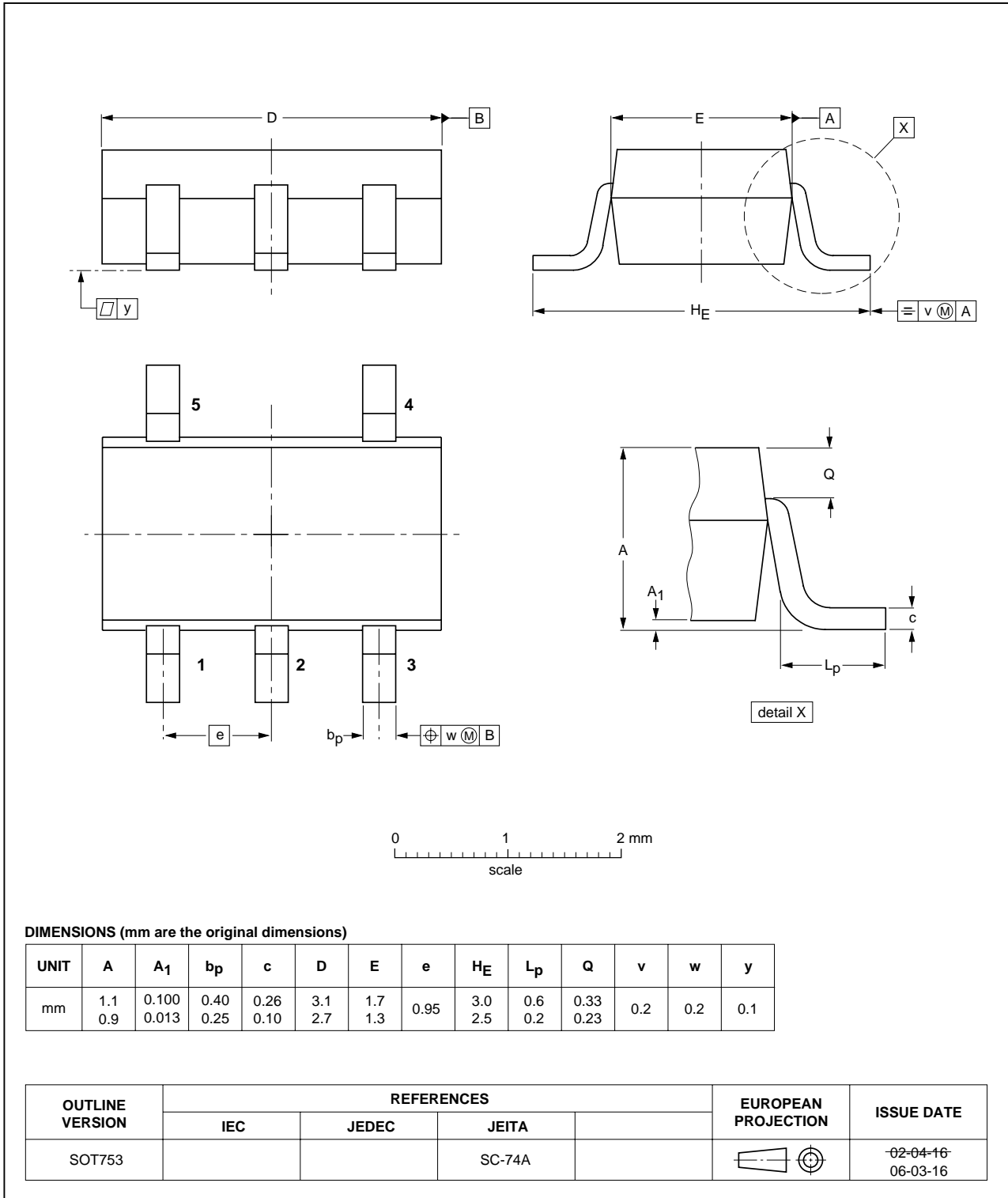


Fig 18. Package outline SOT753 (SC-74A)

## 16. Abbreviations

**Table 11. Abbreviations**

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 17. Revision history

**Table 12. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT1G14_5	20070629	Product data sheet	-	74AHC_AHCT1G14_4
Modifications:	<ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• Package SOT353 changed to SOT353-1 in <a href="#">Section 4</a> and <a href="#">Section 15</a>.</li> <li>• Quick reference data and Soldering sections removed.</li> </ul>			
74AHC_AHCT1G14_4	20020528	Product specification	-	74AHC_AHCT1G14_3
74AHC_AHCT1G14_3	20020218	Product specification	-	74AHC_AHCT1G14_2
74AHC_AHCT1G14_2	20010222	Product specification	-	74AHC_AHCT1G14_1
74AHC_AHCT1G14_1	19990805	Product specification	-	-

## 18. Legal information

### 18.1 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.nxp.com>.

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**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

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