

# 74HC1GU04

## Inverter

Rev. 05 — 10 July 2007

Product data sheet

### 1. General description

The 74HC1GU04 is a high-speed Si-gate CMOS device. It provides an inverting single stage function. The standard output currents are half those of the 74HCU04.

### 2. Features

- Symmetrical output impedance
- Wide operating voltage range from 2.0 V to 6.0 V
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options

### 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC1GU04GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HC1GU04GV	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753

### 4. Marking

Table 2. Marking codes

Type number	Marking
74HC1GU04GW	HD
74HC1GU04GV	HU4

### 5. Functional diagram

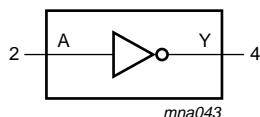


Fig 1. Logic symbol

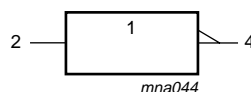


Fig 2. IEC logic symbol

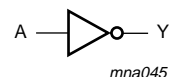


Fig 3. Logic diagram

## 6. Pinning information

### 6.1 Pinning

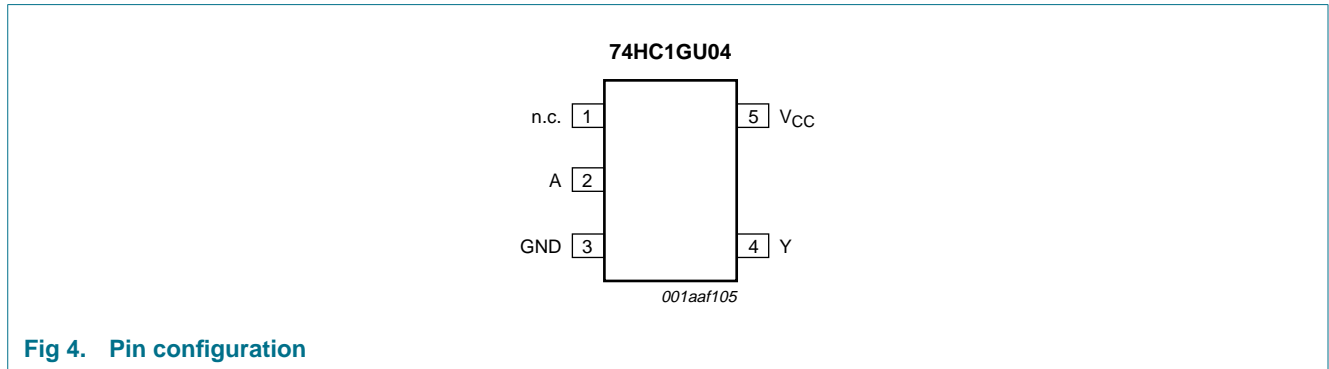


Fig 4. Pin configuration

### 6.2 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

## 7. Functional description

Table 4. Function table

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

Input	Output
<b>A</b>	<b>Y</b>
L	H
H	L

## 8. 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	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	[1] -	±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	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	[1] -	±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 $+125\text{ °C}$	[2] -	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.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		2.0	5.0	6.0	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	ns/V
		$V_{CC} = 4.5\text{ V}$	-	-	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	83	ns/V

## 10. 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	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.7	1.4	-	1.7	-	V
		$V_{CC} = 4.5\text{ V}$	3.6	2.6	-	3.6	-	V
		$V_{CC} = 6.0\text{ V}$	4.8	3.4	-	4.8	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	0.6	0.3	-	0.3	V
		$V_{CC} = 4.5\text{ V}$	-	1.9	0.9	-	0.9	V
		$V_{CC} = 6.0\text{ V}$	-	2.6	1.2	-	1.2	V

**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	
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> = -20 μA; V <sub>CC</sub> = 2.0 V	1.8	2.0	-	1.8	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.0	4.5	-	4.0	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.5	6.0	-	5.5	-	V
		I <sub>O</sub> = -2.0 mA; V <sub>CC</sub> = 4.5 V	4.13	4.32	-	3.7	-	V
		I <sub>O</sub> = -2.6 mA; V <sub>CC</sub> = 6.0 V	5.63	5.81	-	5.2	-	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> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.2	-	0.2	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.5	-	0.5	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.5	-	0.5	V
		I <sub>O</sub> = 2.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.33	-	0.4	V
		I <sub>O</sub> = 2.6 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	1.0	-	1.0	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> = 6.0 V	-	-	10	-	20	μA
C <sub>I</sub>	input capacitance		-	5	-	-	-	pF

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

GND = 0 V;  $t_r = t_f = 6.0\text{ ns}$ ; For test circuit see [Figure 6](#). 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	
t <sub>pd</sub>	propagation delay	A to Y; see <a href="#">Figure 5</a> <a href="#">[1]</a>						
		V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF	-	10	90	-	105	ns
		V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF	-	7	18	-	21	ns
		V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF	-	6	15	-	18	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	5	-	-	-	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[2]</a>	-	14	-	-	-	pF

[1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[2] C<sub>PD</sub> is used to determine the dynamic power dissipation P<sub>D</sub> (μW).

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

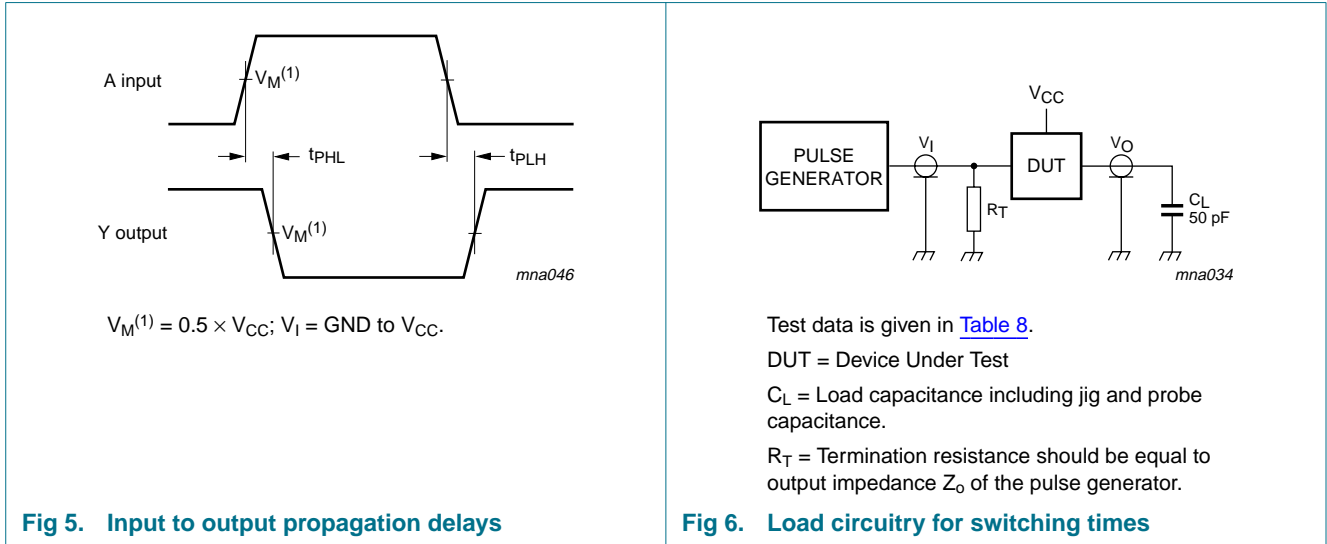
f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

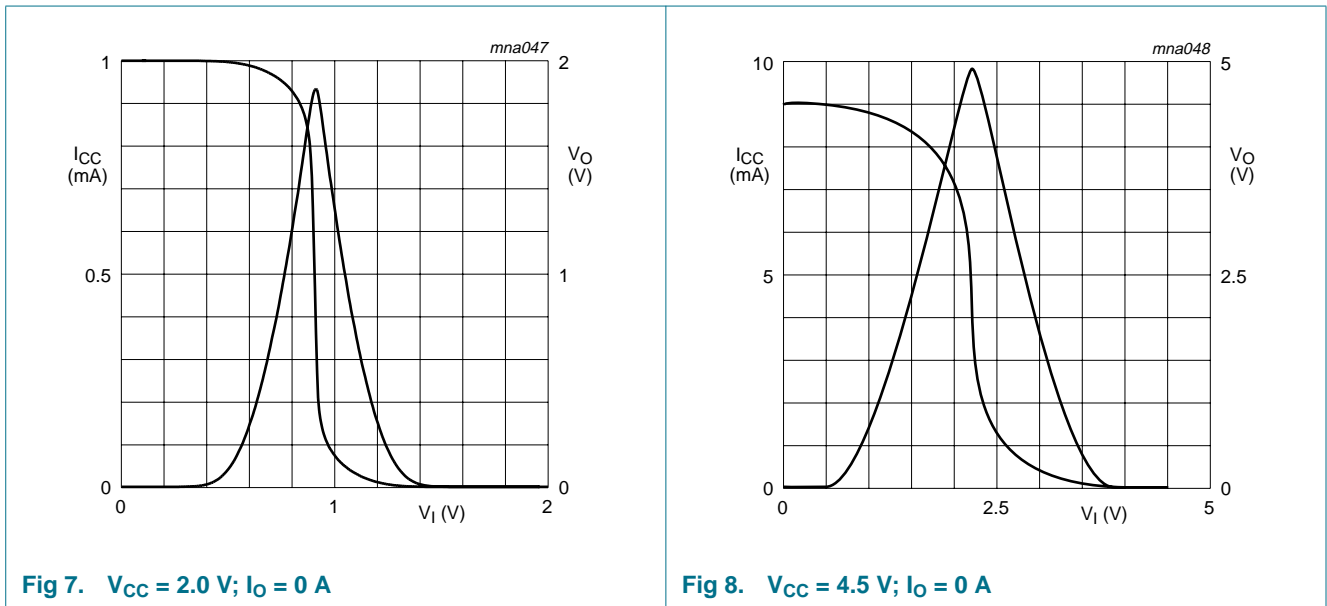
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in Volts.

12. Waveforms



13. Typical transfer characteristics



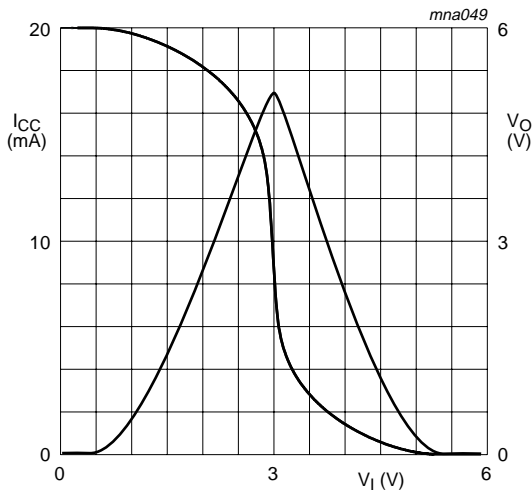


Fig 9.  $V_{CC} = 6.0\text{ V}$ ;  $I_O = 0\text{ A}$

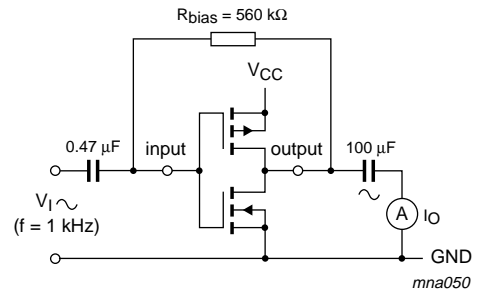


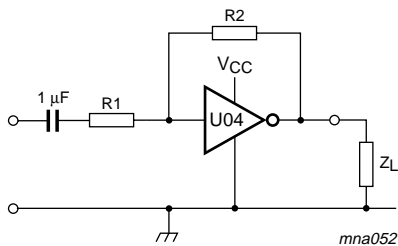
Fig 10. Test set-up for measuring forward transfer conductance  $g_{fs} = \Delta I_O / \Delta V_I$  at  $V_O$  is constant

## 14. Application information

Some applications are:

- Linear amplifier (see [Figure 11](#))
- In crystal oscillator design (see [Figure 12](#))

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



Maximum  $V_{o(p-p)} = V_{CC} - 1.5\text{ V}$  centered at  $0.5 \times V_{CC}$ .

$$G_v = - \frac{G_{ol}}{1 + \frac{R1}{R2}(1 + G_{ol})}$$

$G_{ol}$  = open loop gain

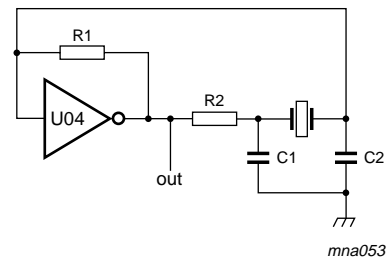
$G_v$  = voltage gain

$R1 \geq 3\text{ k}\Omega$ ,  $R2 \leq 1\text{ M}\Omega$

$Z_L > 10\text{ k}\Omega$ ;  $G_{ol} = 20$  (typ.)

Typical unity gain bandwidth product is 5 MHz.

Fig 11. Used as a linear amplifier



$C1 = 47\text{ pF}$  (typ.)

$C2 = 22\text{ pF}$  (typ.)

$R1 = 1\text{ M}\Omega$  to  $10\text{ M}\Omega$  (typ.)

$R2$  optimum value depends on the frequency and required stability against changes in  $V_{CC}$  or average minimum  $I_{CC}$  ( $I_{CC}$  is typically 2 mA at  $V_{CC} = 3\text{ V}$  and  $f = 1\text{ MHz}$ ).

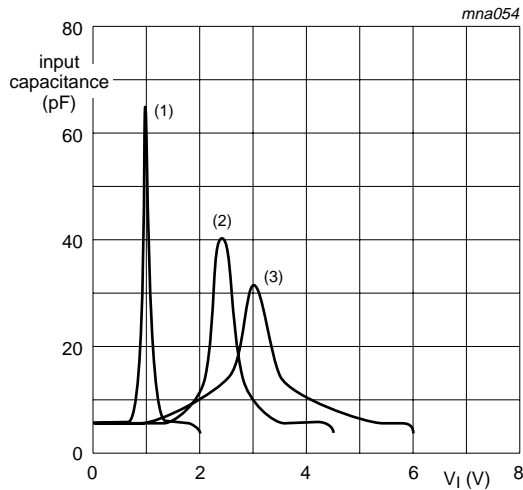
Fig 12. Crystal oscillator configuration

**Table 9. External components for resonator (f < 1 MHz)**  
 All values given are typical and must be used as an initial set-up

Frequency	R1	R2	C1	C2
10 kHz to 15.9 kHz	2.2 MΩ	220 kΩ	56 pF	20 pF
16 kHz to 24.9 kHz	2.2 MΩ	220 kΩ	56 pF	10 pF
25 kHz to 54.9 kHz	2.2 MΩ	100 kΩ	56 pF	10 pF
55 kHz to 129.9 kHz	2.2 MΩ	100 kΩ	47 pF	5 pF
130 kHz to 199.9 kHz	2.2 MΩ	47 kΩ	47 pF	5 pF
200 kHz to 349.9 kHz	2.2 MΩ	47 kΩ	47 pF	5 pF
350 kHz to 600 kHz	2.2 MΩ	47 kΩ	47 pF	5 pF

**Table 10. Optimum value for R2**

Frequency	R2	Optimum for
3 kHz	2.0 kΩ	minimum required I <sub>CC</sub>
	8.0 kΩ	minimum influence due to change in V <sub>CC</sub>
6 kHz	1.0 kΩ	minimum required I <sub>CC</sub>
	4.7 kΩ	minimum influence by V <sub>CC</sub>
10 kHz	0.5 kΩ	minimum required I <sub>CC</sub>
	2.0 kΩ	minimum influence by V <sub>CC</sub>
14 kHz	0.5 kΩ	minimum required I <sub>CC</sub>
	1.0 kΩ	minimum influence by V <sub>CC</sub>
>14 kHz	-	replace R2 by C3 with a typical value of 35 pF



- (1) V<sub>CC</sub> = 2.0 V.
- (2) V<sub>CC</sub> = 4.5 V.
- (3) V<sub>CC</sub> = 6.0 V.

**Fig 13. Typical input capacitance as a function of the input voltage**

15. Package outline

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

SOT353-1

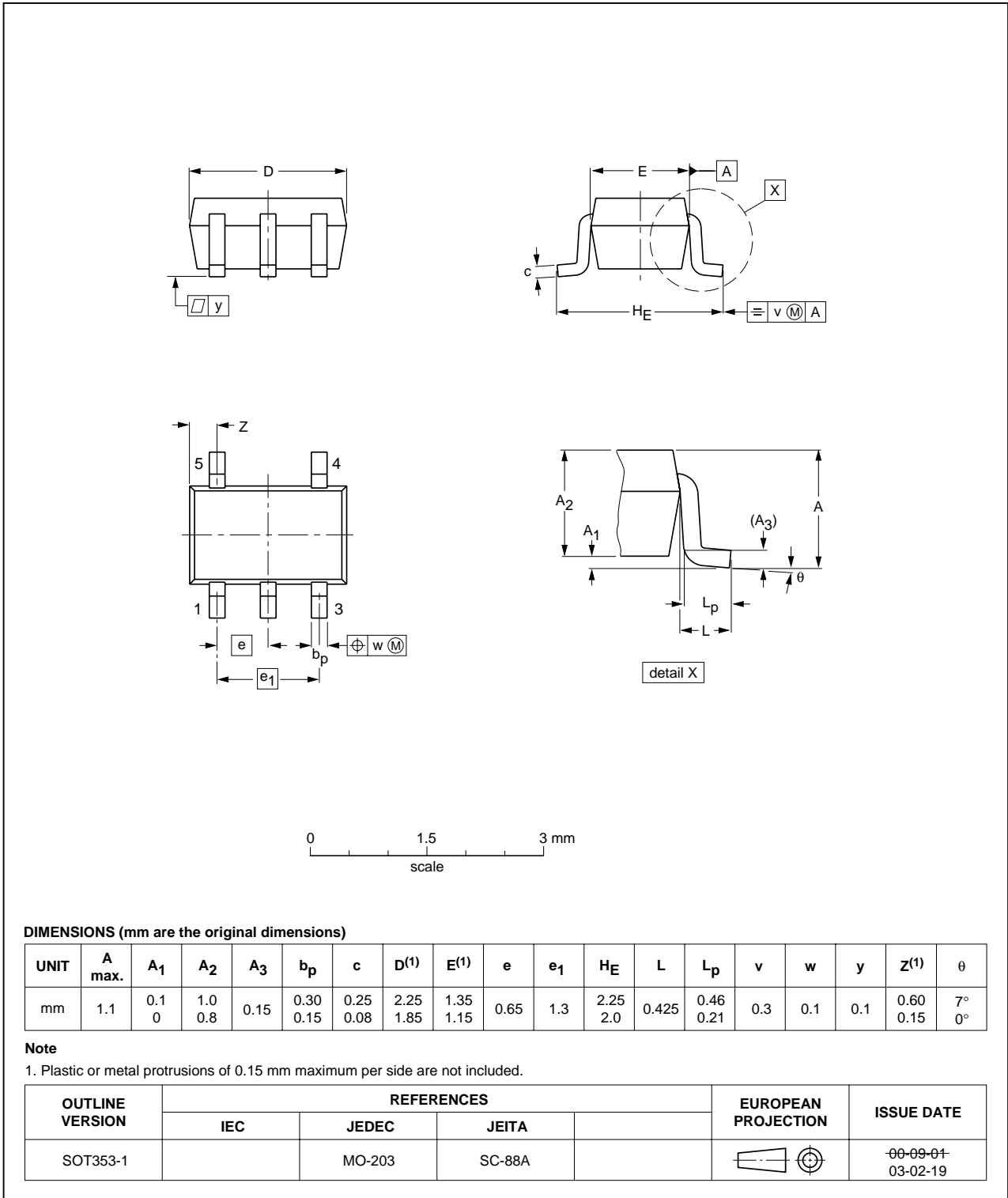


Fig 14. Package outline SOT353-1 (TSSOP5)



Plastic surface-mounted package; 5 leads

SOT753

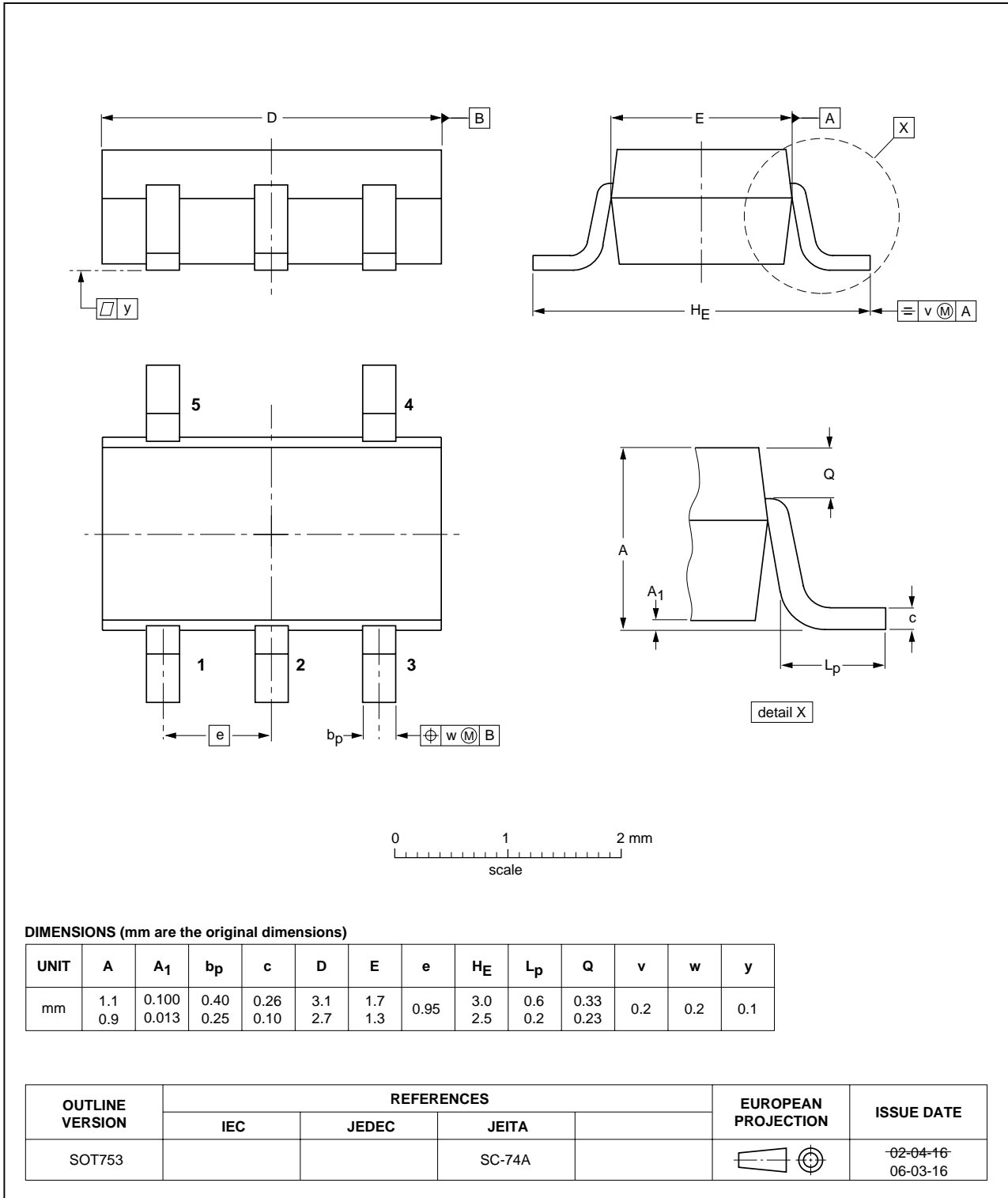


Fig 15. Package outline SOT753 (SC-74A)

## 16. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC1GU04_5	20070710	Product data sheet	-	74HC1GU04_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="#">Table 1</a> and <a href="#">Figure 14</a>.</li><li>• Quick Reference Data and Soldering sections removed.</li><li>• <a href="#">Section 2 "Features"</a> updated.</li></ul>		
74HC1GU04_4	20020527	Product specification	-	74HC1GU04_3
74HC1GU04_3	20020513	Product specification	-	74HC1GU04_2
74HC1GU04_2	20010427	Product specification	-	74HC1GU04_1
74HC1GU04_1	19981118	Product specification	-	-

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### 17.1 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".

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