

# 74AHC1GU04

## Inverter

Rev. 6 — 12 January 2022

Product data sheet

## 1. General description

The 74AHC1GU04 is a single unbuffered inverter. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

## 2. Features

- Wide supply voltage range from 2.0 to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Symmetrical output impedance
- ESD protection:
  - HBM JESD22-A114E: exceeds 2000 V
  - MM JESD22-A115-A: exceeds 200 V
  - CDM JESD22-C101C: exceeds 1000 V
- Specified from -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC1GU04GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74AHC1GU04GV	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753

## 4. Marking

Table 2. Marking codes

Type number	Marking
74AHC1GU04GW	AD
74AHC1GU04GV	AU4

## 5. Functional diagram

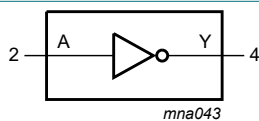


Fig. 1. Logic symbol

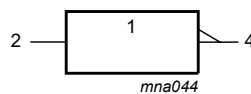


Fig. 2. IEC logic symbol

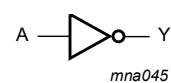
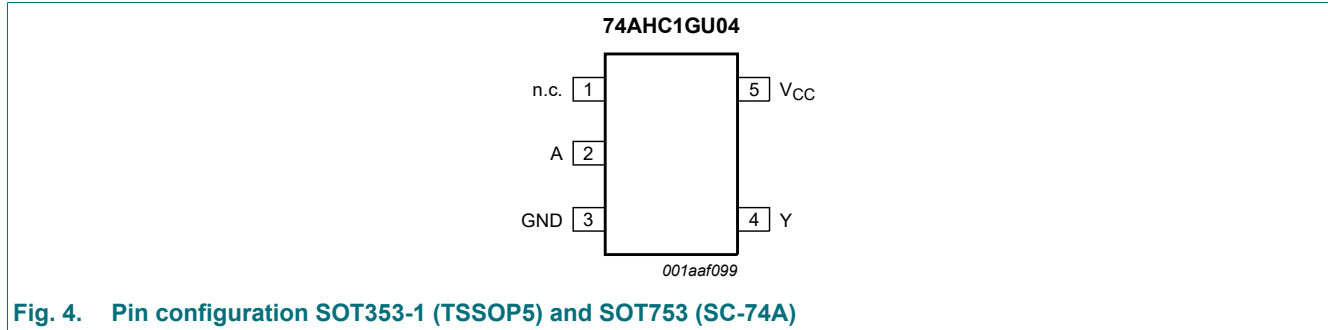


Fig. 3. Logic diagram

## 6. Pinning information

### 6.1. Pinning



### 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
A	Y
L	H
H	L

## 8. 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
$I_{IK}$	input clamping current	$V_I < -0.5$ V	-20	-	mA
$V_I$	input voltage		[1] -0.5	+7.0	V
$I_{OK}$	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	-	$\pm 20$	mA
$I_O$	output current	$-0.5$ V $< V_O < V_{CC} + 0.5$ V	-	$\pm 25$	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	$T_{amb} = -40$ °C to +125 °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 SOT353-1 (TSSOP5) package:  $P_{tot}$  derates linearly with 3.3 mW/K above 74 °C.

For SOT753 (SC-74A) package:  $P_{tot}$  derates linearly with 3.8 mW/K above 85 °C.

## 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	5.5	V
$V_I$	input voltage		0	-	5.5	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	$V_{CC} = 3.3$ V $\pm 0.3$ V	-	-	100	ns/V
		$V_{CC} = 5.0$ V $\pm 0.5$ V	-	-	20	ns/V

## 10. 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	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0$ V	1.7	-	-	1.7	-	1.7	-	V
		$V_{CC} = 3.0$ V	2.4	-	-	2.4	-	2.4	-	V
		$V_{CC} = 5.5$ V	4.4	-	-	4.4	-	4.4	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0$ V	-	-	0.3	-	0.3	-	0.3	V
		$V_{CC} = 3.0$ V	-	-	0.6	-	0.6	-	0.6	V
		$V_{CC} = 5.5$ V	-	-	1.1	-	1.1	-	1.1	V

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	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> = -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

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

GND = 0 V; t<sub>r</sub> = t<sub>f</sub> = ≤ 3.0 ns. For test circuit see Fig. 6.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	propagation delay	A to Y; see Fig. 5 [1]								
		V <sub>CC</sub> = 3.0 V to 3.6 V [2]								
		C <sub>L</sub> = 15 pF	-	3.4	7.1	1.0	8.5	1.0	10.0	ns
		C <sub>L</sub> = 50 pF	-	4.9	10.6	1.0	12.0	1.0	13.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V [3]								
		C <sub>L</sub> = 15 pF	-	2.6	5.5	1.0	6.0	1.0	7.0	ns
		C <sub>L</sub> = 50 pF	-	3.6	7.0	1.0	8.0	1.0	9.0	ns
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> [4]	-	14	-	-	-	-	-	pF

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

[2] Typical values are measured at V<sub>CC</sub> = 3.3 V.

[3] Typical values are measured at V<sub>CC</sub> = 5.0 V.

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

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

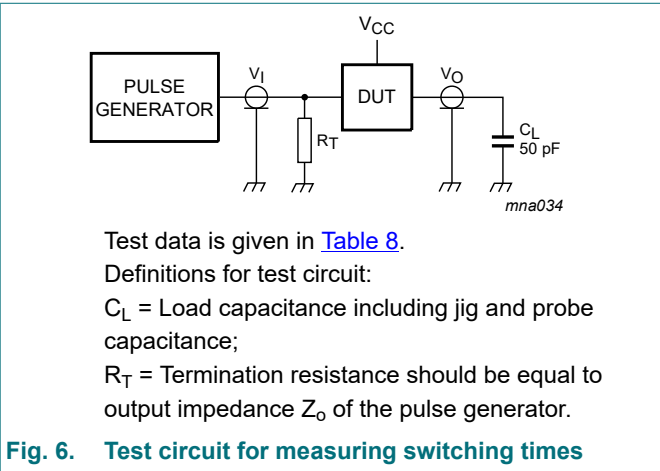
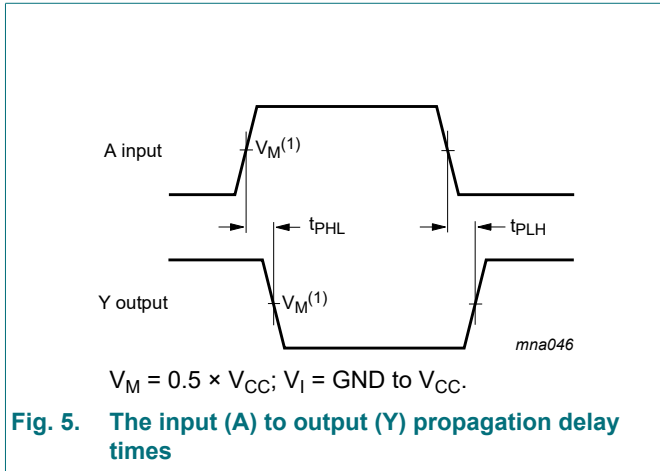
f<sub>i</sub> = input frequency in MHz;

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

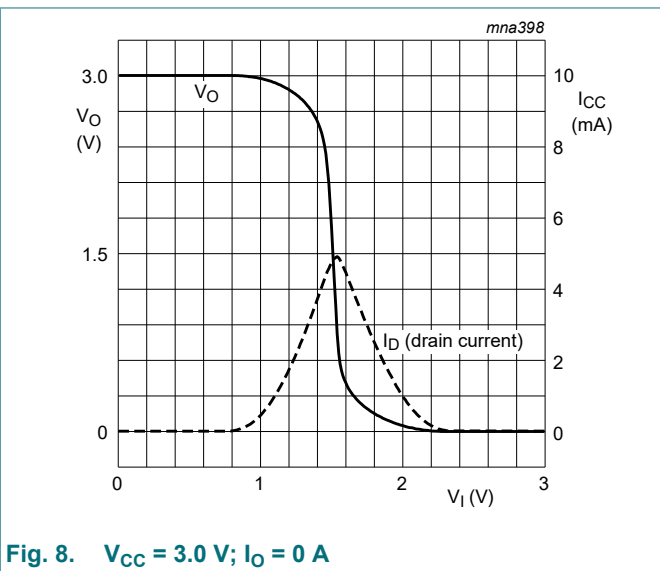
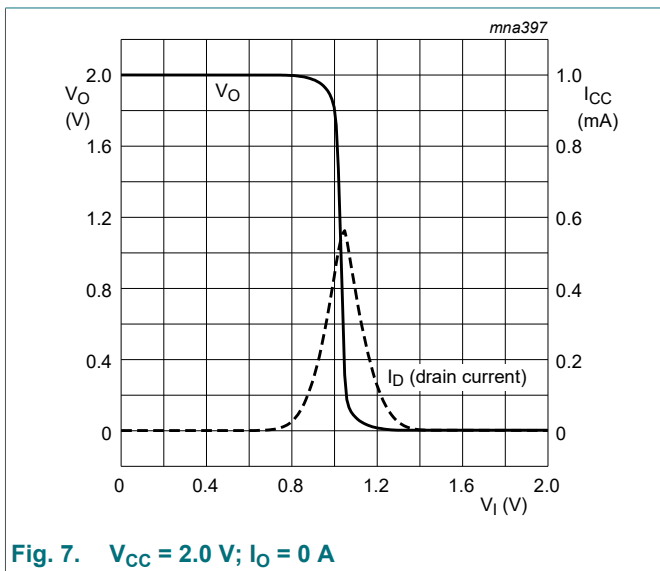
C<sub>L</sub> = output load capacitance in pF;

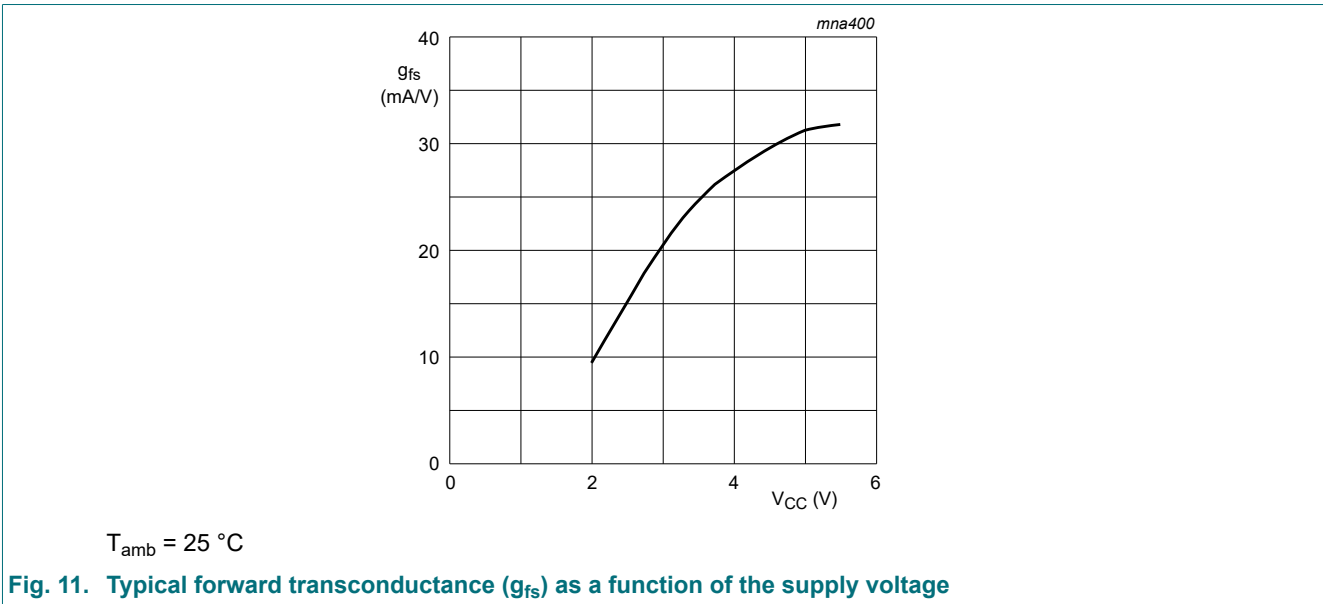
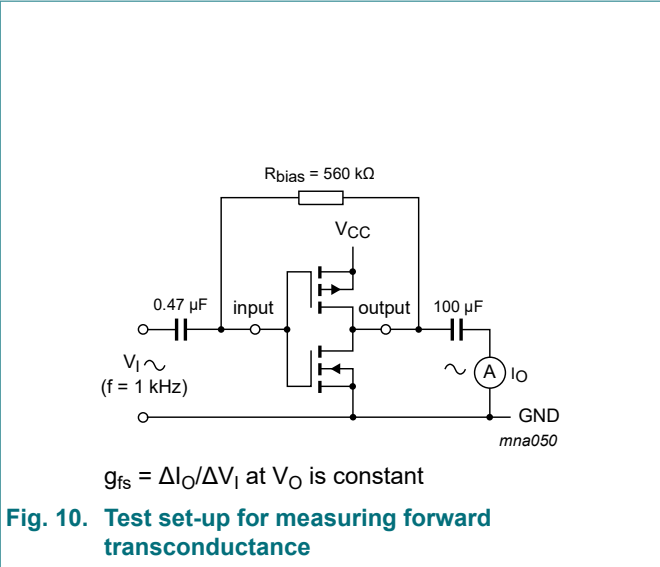
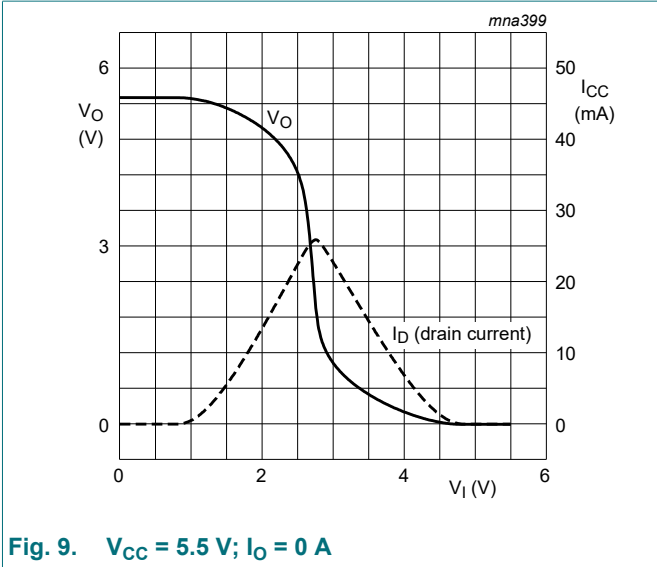
V<sub>CC</sub> = supply voltage in Volts.

11.1. Waveform and test circuit



12. Typical transfer characteristics



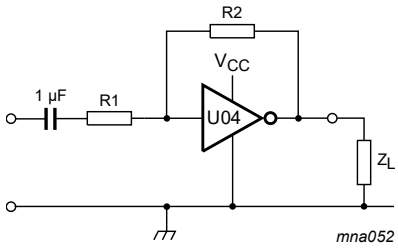


### 13. Application information

Some applications are:

- Linear amplifier (see Fig. 12)
- In crystal oscillator design (see Fig. 13)

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



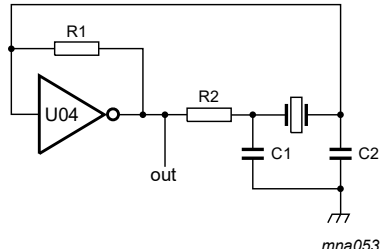
Maximum  $V_{o(p-p)} = V_{CC} - 1.5 \text{ V}$  centered at  $0.5 \times V_{CC}$ .

$$G_v = - \frac{G_{ol}}{1 + \frac{R_1}{R_2}(1 + G_{ol})}$$
 where:
 

- $G_{ol}$  = open loop gain;
- $G_v$  = voltage gain;
- $R_1 \geq 3 \text{ k}\Omega$ ;  $R_2 \leq 1 \text{ M}\Omega$ ;
- $Z_L > 10 \text{ k}\Omega$ ;  $G_{ol} = 20$  (typ.);

Typical unity gain bandwidth product is 5 MHz.

**Fig. 12. Used as a linear amplifier**



$C_1 = 47 \text{ pF}$  (typ.);  
 $C_2 = 22 \text{ pF}$  (typ.);  
 $R_1 = 1 \text{ M}\Omega$  to  $10 \text{ M}\Omega$  (typ.);  
 $R_2$  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. 13. 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	22 MΩ	220 kΩ	56 pF	20 pF
16 kHz to 24.9 kHz	22 MΩ	220 kΩ	56 pF	10 pF
25 kHz to 54.9 kHz	22 MΩ	100 kΩ	56 pF	10 pF
55 kHz to 129.9 kHz	22 MΩ	100 kΩ	47 pF	5 pF
130 kHz to 199.9 kHz	22 MΩ	47 kΩ	47 pF	5 pF
200 kHz to 349.9 kHz	22 MΩ	47 kΩ	47 pF	5 pF
350 kHz to 600 kHz	22 MΩ	47 kΩ	47 pF	5 pF

**Table 10. Optimum value for R2**

Frequency	R2	Optimum for
3 kHz	2.0 kΩ	minimum required $I_{CC}$
	8.0 kΩ	minimum influence due to change in $V_{CC}$
6 kHz	1.0 kΩ	minimum required $I_{CC}$
	4.7 kΩ	minimum influence by $V_{CC}$
10 kHz	0.5 kΩ	minimum required $I_{CC}$
	2.0 kΩ	minimum influence by $V_{CC}$
14 kHz	0.5 kΩ	minimum required $I_{CC}$
	1.0 kΩ	minimum influence by $V_{CC}$
>14 kHz	-	replace R2 by C3 with a typical value of 35 pF

### 14. 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

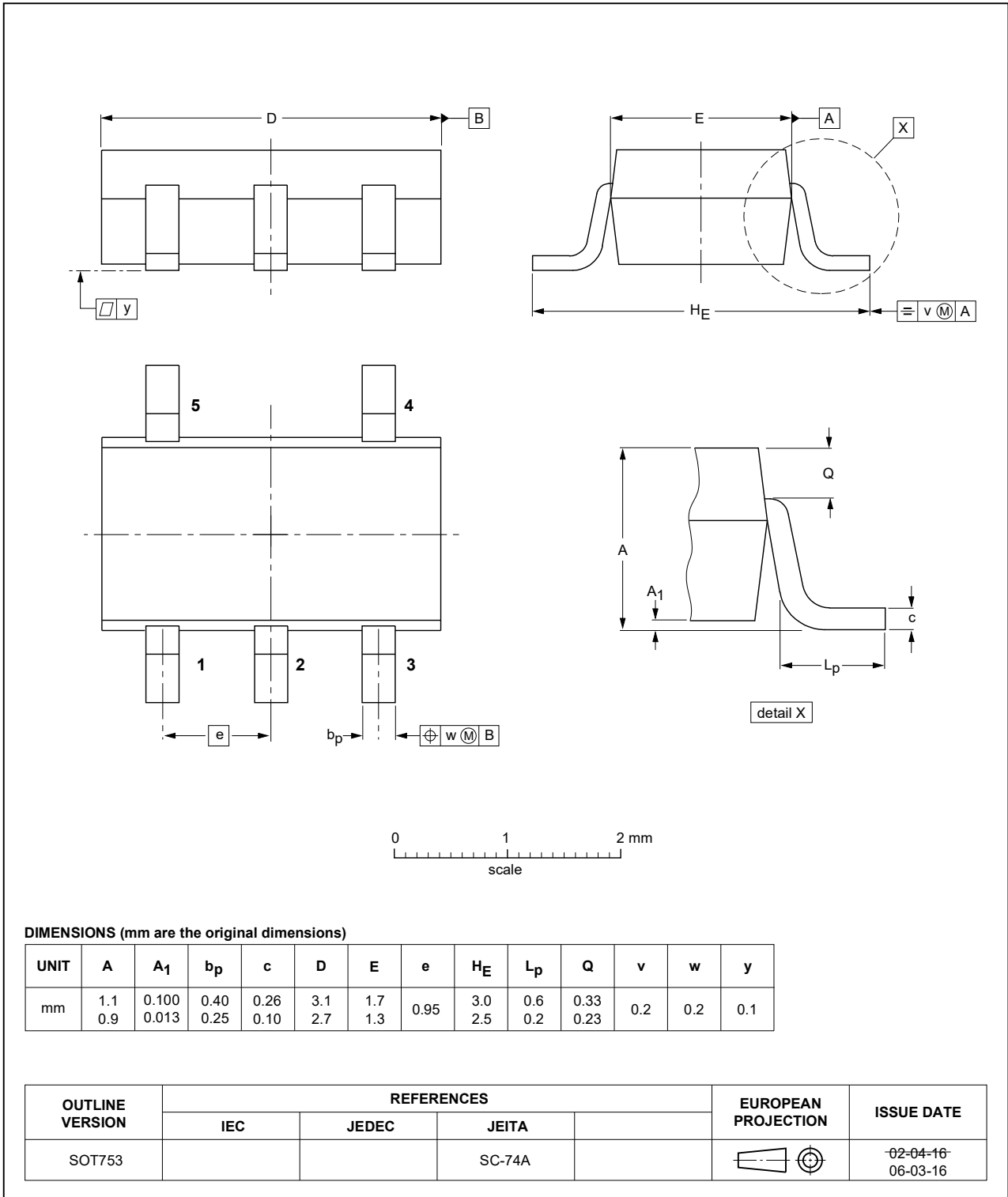


Fig. 15. Package outline SOT753 (SC-74A)

## 15. Abbreviations

Table 11. Abbreviations

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

## 16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC1GU04 v.6	20220112	Product data sheet	-	74AHC1GU04 v.5
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Section 1</a> and <a href="#">Section 2</a> updated.</li> <li><a href="#">Fig. 14</a>: Package outline drawing for SOT353-1 (TSSOP5) has changed.</li> <li><a href="#">Table 5</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74AHC1GU04 v.5	20070710	Product data sheet	-	74AHC1GU04 v.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 3</a> and <a href="#">Section 14</a>.</li> <li>Quick reference data and Soldering sections removed.</li> </ul>			
74AHC1GU04 v.4	20020528	Product specification	-	74AHC1GU04 v.3
74AHC1GU04 v.3	20020215	Product specification	-	74AHC1GU04 v.2
74AHC1GU04 v.2	20010427	Product specification	-	74AHC1GU04 v.1
74AHC1GU04 v.1	19990519	Product specification	-	-

## 17. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	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.
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- [1] Please consult the most recently issued document before initiating or completing a design.
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## Contents

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<b>1. General description</b> .....	<b>1</b>
<b>2. Features</b> .....	<b>1</b>
<b>3. Ordering information</b> .....	<b>1</b>
<b>4. Marking</b> .....	<b>1</b>
<b>5. Functional diagram</b> .....	<b>1</b>
<b>6. Pinning information</b> .....	<b>2</b>
6.1. Pinning.....	2
6.2. Pin description.....	2
<b>7. Functional description</b> .....	<b>2</b>
<b>8. Limiting values</b> .....	<b>3</b>
<b>9. Recommended operating conditions</b> .....	<b>3</b>
<b>10. Static characteristics</b> .....	<b>3</b>
<b>11. Dynamic characteristics</b> .....	<b>4</b>
11.1. Waveform and test circuit.....	5
<b>12. Typical transfer characteristics</b> .....	<b>5</b>
<b>13. Application information</b> .....	<b>7</b>
<b>14. Package outline</b> .....	<b>8</b>
<b>15. Abbreviations</b> .....	<b>10</b>
<b>16. Revision history</b> .....	<b>10</b>
<b>17. Legal information</b> .....	<b>11</b>

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