

74HC1GU04-Q100

Single unbuffered inverter

Rev. 4 — 5 December 2023

Product data sheet

1. General description

The 74HC1GU04-Q100 is a single unbuffered inverter. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 2.0 to 6.0 V
- High noise immunity
- Symmetrical output impedance
- CMOS low power dissipation
- Balanced propagation delays
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC1GU04GW-Q100	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HC1GU04GV-Q100	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753

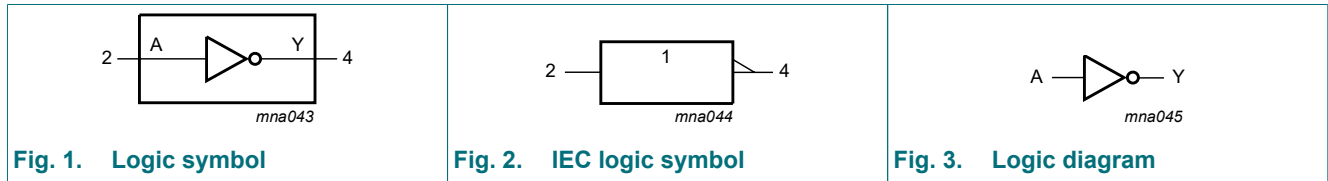
4. Marking

Table 2. Marking codes

Type number	Marking ^[1]
74HC1GU04GW-Q100	HD
74HC1GU04GV-Q100	HU4

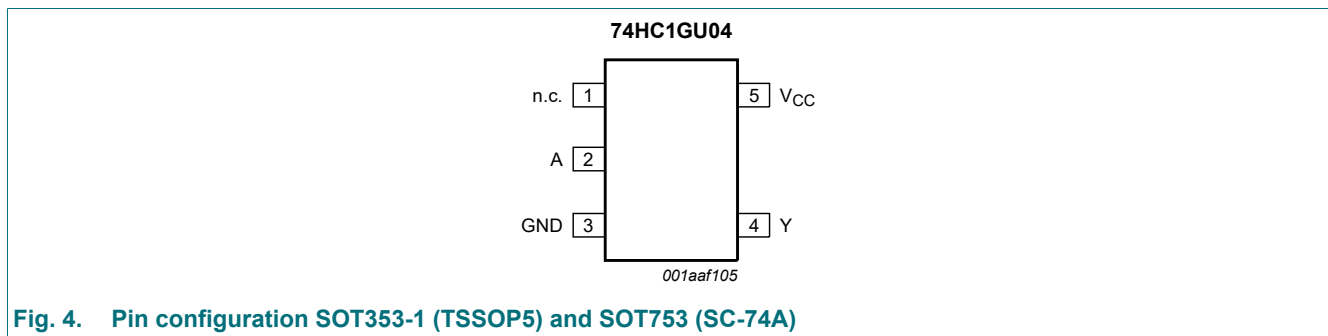
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional 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 _{CC}	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). 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]	-	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	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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = -20 μA; V _{CC} = 2.0 V	1.8	2.0	-	1.8	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.0	4.5	-	4.0	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.5	6.0	-	5.5	-	V
		I _O = -2.0 mA; V _{CC} = 4.5 V	4.13	4.32	-	3.7	-	V
		I _O = -2.6 mA; V _{CC} = 6.0 V	5.63	5.81	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.2	-	0.2	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.5	-	0.5	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.5	-	0.5	V
		I _O = 2.0 mA; V _{CC} = 4.5 V	-	0.15	0.33	-	0.4	V
		I _O = 2.6 mA; V _{CC} = 6.0 V	-	0.16	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	1.0	-	1.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	10	-	20	μA
C _I	input capacitance		-	5	-	-	-	pF

11. Dynamic characteristics

Table 8. Dynamic characteristics

GND = 0 V; t_r = t_f = 6.0 ns; For test circuit see Fig. 6. All typical values are measured at T_{amb} = 25 °C.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
t _{pd}	propagation delay	A to Y; see Fig. 5 [1]						
		V _{CC} = 2.0 V; C _L = 50 pF	-	10	90	-	105	ns
		V _{CC} = 4.5 V; C _L = 50 pF	-	7	18	-	21	ns
		V _{CC} = 6.0 V; C _L = 50 pF	-	6	15	-	18	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	5	-	-	-	ns
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} [2]	-	14	-	-	-	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 (μW).

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

11.1. Waveform and test circuit

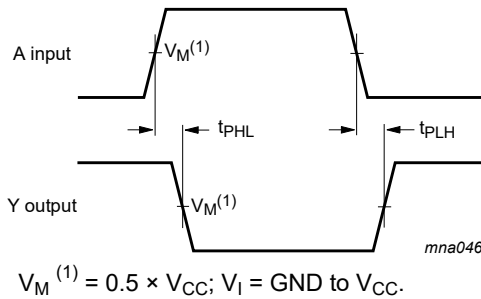


Fig. 5. Input to output propagation delays

$V_M^{(1)} = 0.5 \times V_{CC}$; $V_I = \text{GND to } V_{CC}$.

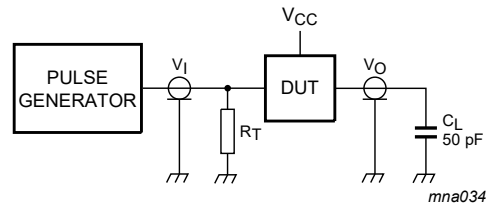


Fig. 6. Test circuit for measuring switching times

Test data is given in [Table 8](#).

DUT = Device Under Test

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.

11.2. Additional characteristics

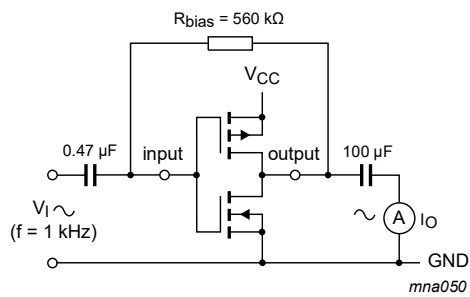


Fig. 7. Test set-up for measuring forward transconductance

$g_{fs} = \Delta I_O / \Delta V_I$ at V_O is constant.

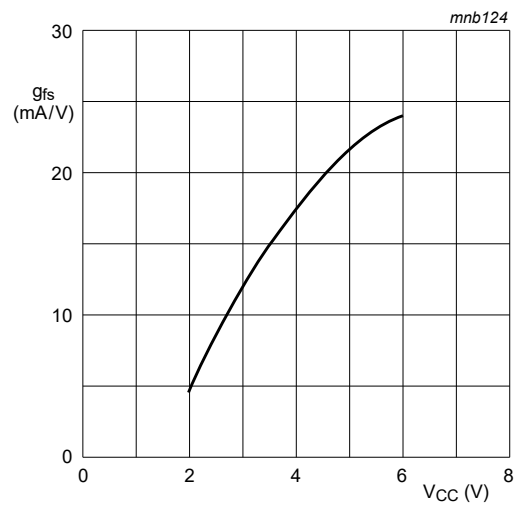
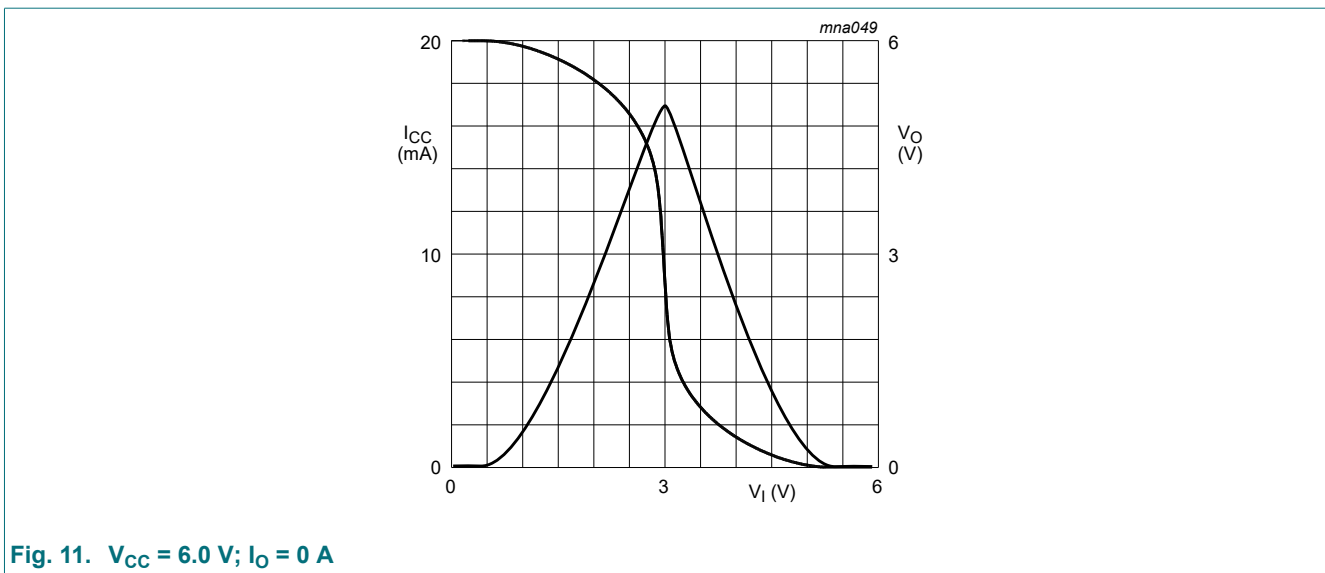
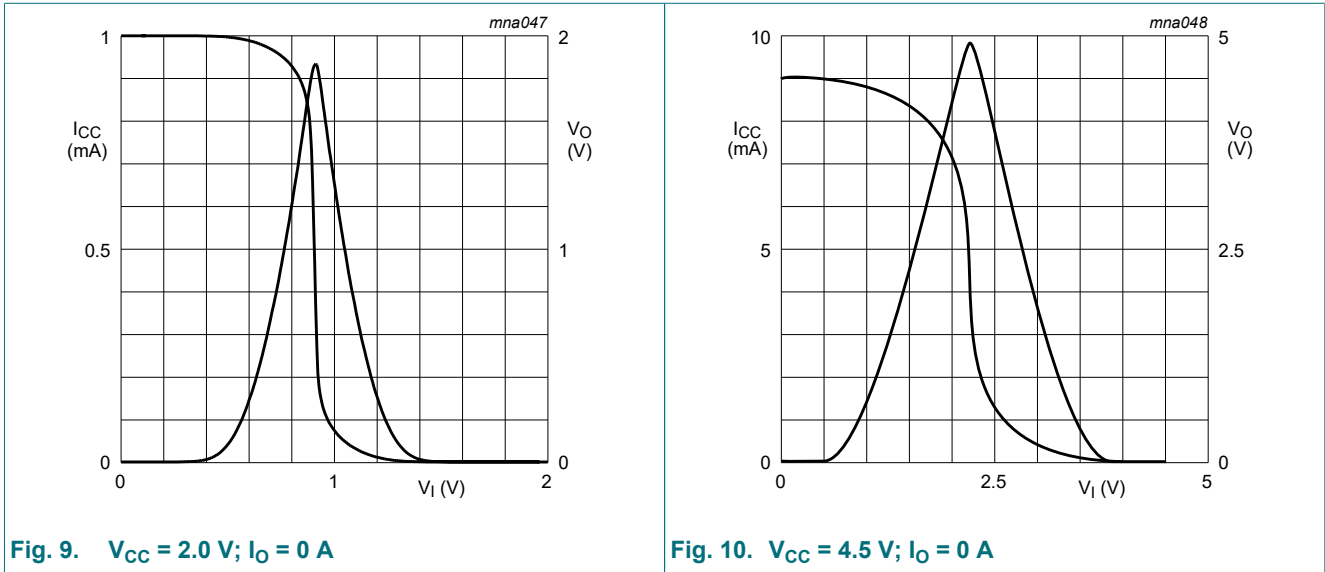


Fig. 8. Typical forward transconductance as a function of supply voltage

$T_{amb} = 25 \text{ }^\circ\text{C}$

11.3. Typical transfer characteristics

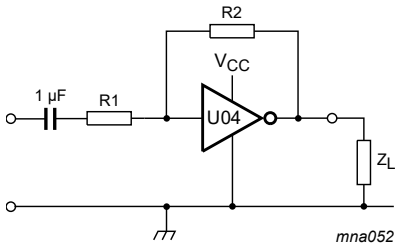


12. Application information

Some applications are:

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

Remark: All values given are typical unless otherwise specified.

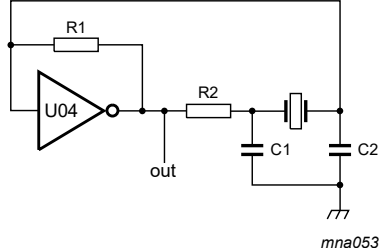


Maximum $V_{o(p-p)} = V_{CC} - 1.5 \text{ V}$ centered at $0.5 \times V_{CC}$.

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

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. 12. 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. 13. Crystal oscillator configuration

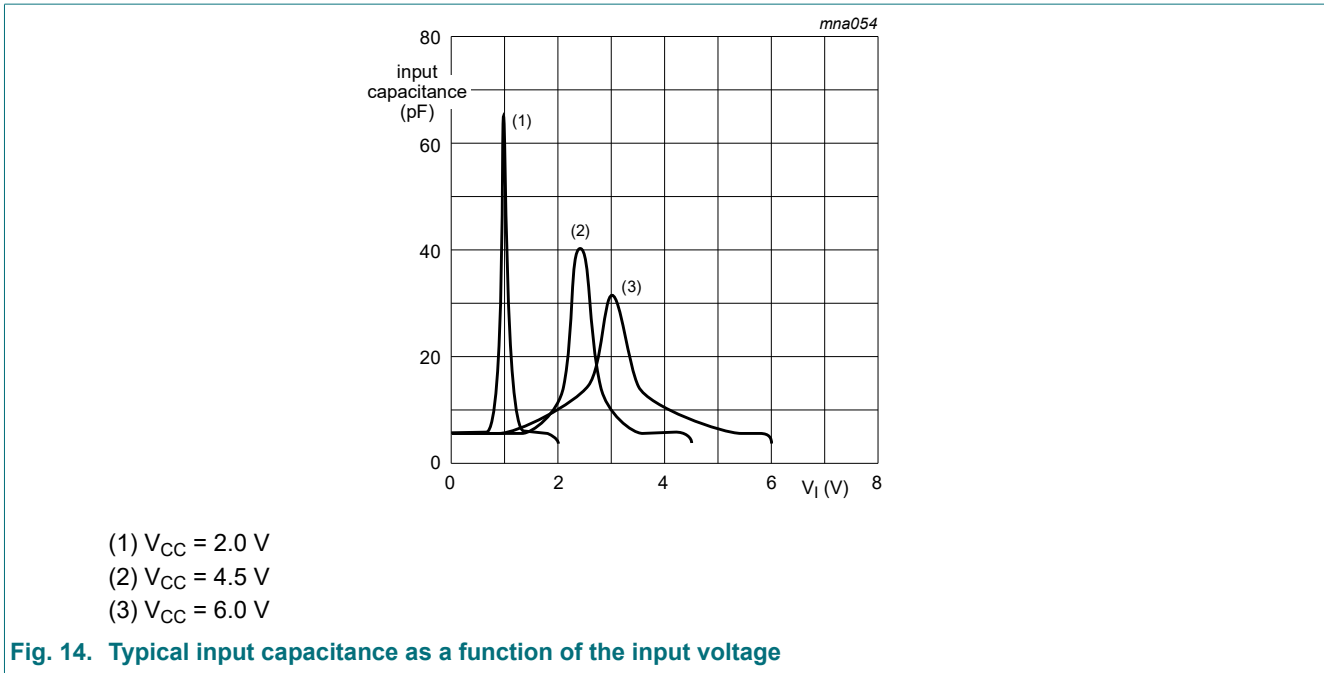
Table 9. External components for resonator (f < 1 MHz)

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	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_{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



13. Package outline

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

SOT353-1

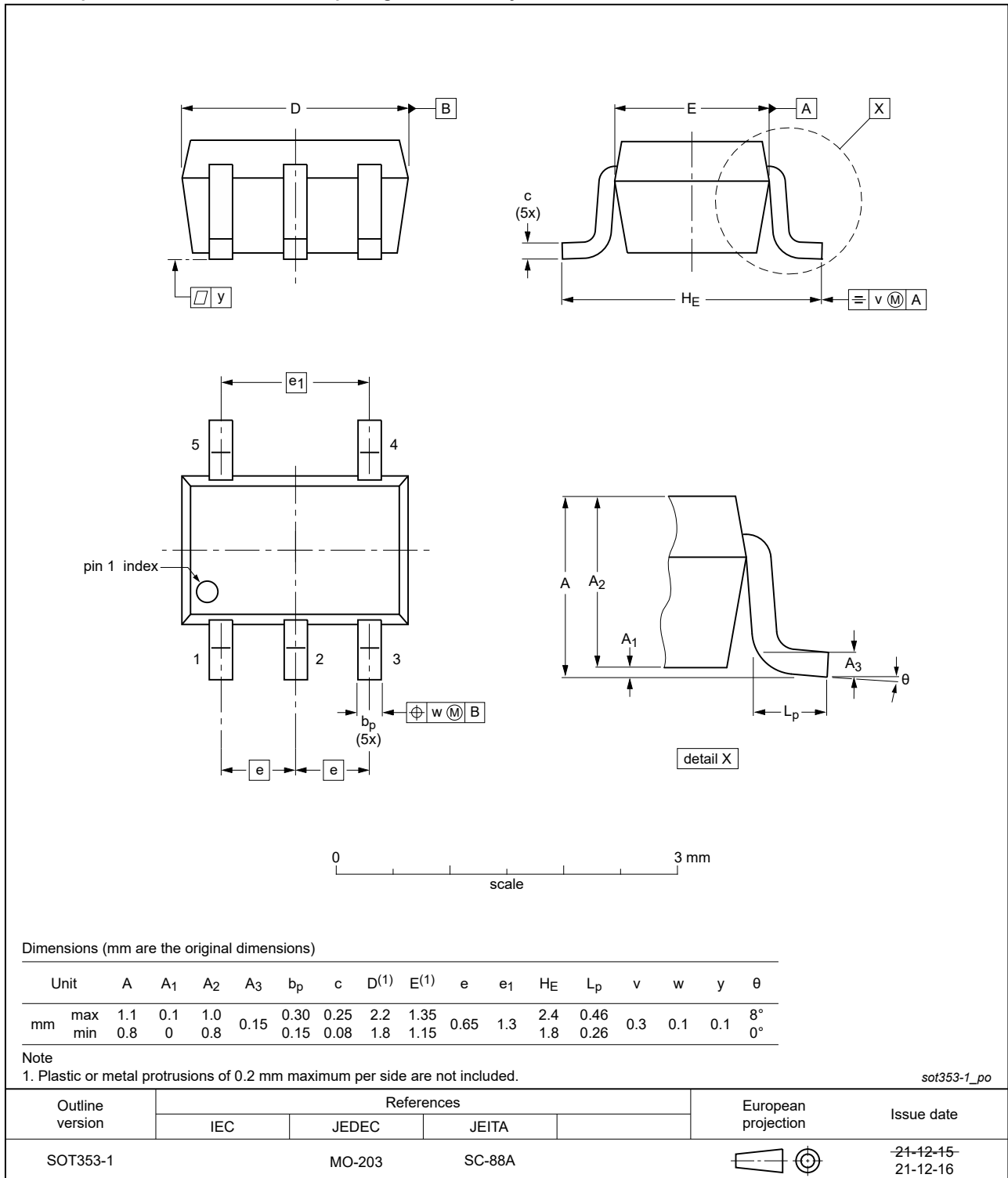


Fig. 15. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

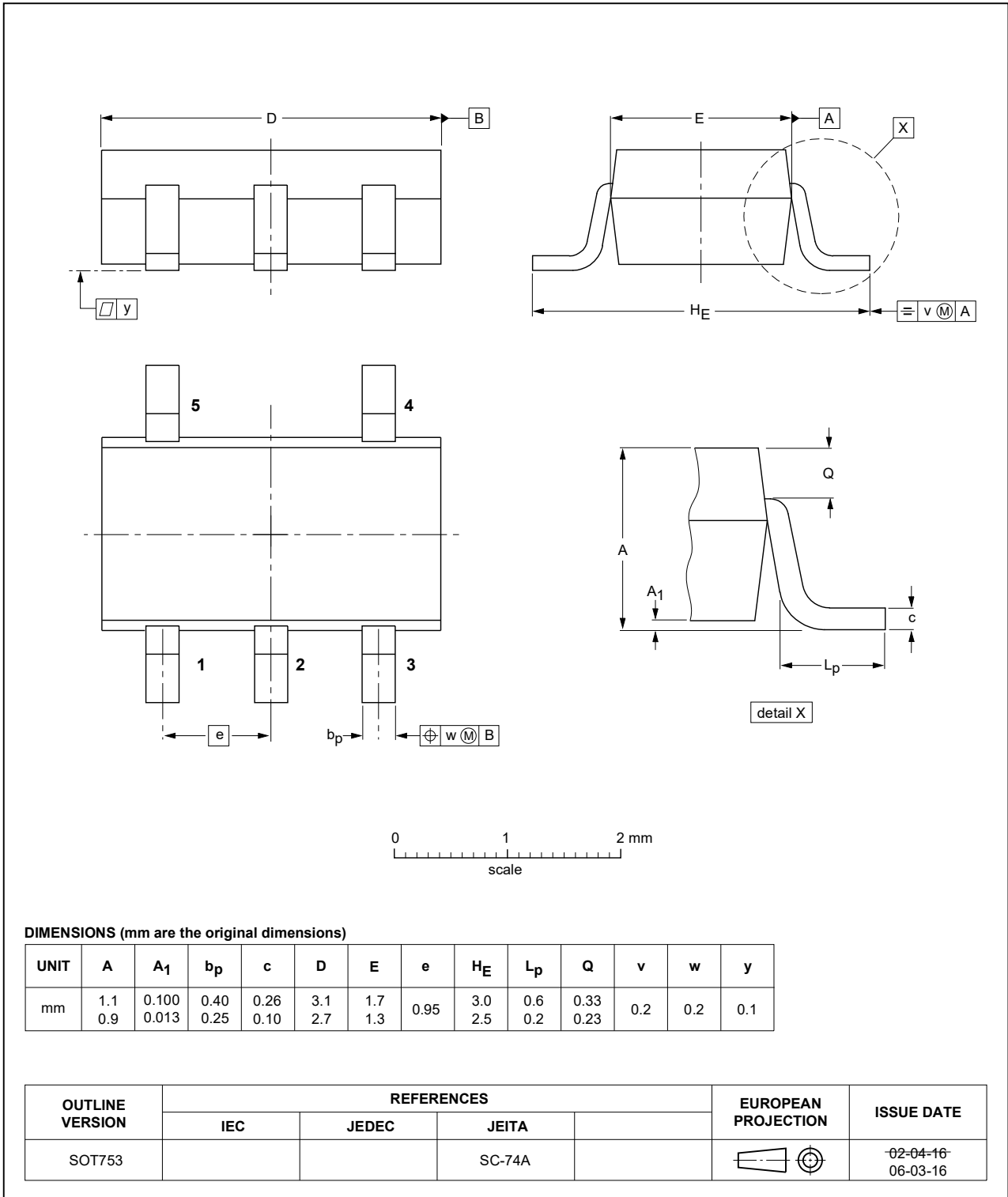


Fig. 16. Package outline SOT753 (SC-74A)

14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC1GU04_Q100 v.4	20231205	Product data sheet	-	74HC1GU04_Q100 v.3
Modifications:	<ul style="list-style-type: none"> Section 2: ESD specification updated according to the latest JEDEC standard. 			
74HC1GU04_Q100 v.3	20220204	Product data sheet	-	74HC1GU04_Q100 v.2
Modifications:	<ul style="list-style-type: none"> Section 2 updated. Section 8: Derating values for P_{tot} total power dissipation updated. Fig. 15: Package outline drawing SOT353-1 (TSSOP5) has been changed. 			
74HC1GU04_Q100 v.2	20180725	Product data sheet	-	74HC1GU04_Q100 v.1
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Fig. 8: forward transconductance graph added. 			
74HC1GU04_Q100 v.1	20120821	Product data sheet	-	-

16. 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.
Product [short] data sheet	Production	This document contains the product specification.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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