

# 74HC1G86-Q100; 74HCT1G86-Q100

2-input EXCLUSIVE-OR gate

Rev. 3 — 27 January 2022

Product data sheet

## 1. General description

The 74HC1G86-Q100; 74HCT1G86-Q100 is a single 2-input EXCLUSIVE-OR gate. 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 V to 6.0 V
- Input levels:
  - For 74HC1G86-Q100: CMOS level
  - For 74HCT1G86-Q100: TTL level
- CMOS low power dissipation
- High noise immunity
- Symmetrical output impedance
- 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:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

## 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC1G86GW-Q100	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HCT1G86GW-Q100				
74HC1G86GV-Q100	-40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753
74HCT1G86GV-Q100				

## 4. Marking

Table 2. Marking codes

Type number	Marking <sup>[1]</sup>
74HC1G86GW-Q100	HH
74HCT1G86GW-Q100	TH
74HC1G86GV-Q100	H86
74HCT1G86GV-Q100	T86

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

## 5. Functional diagram

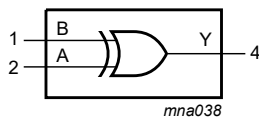


Fig. 1. Logic symbol

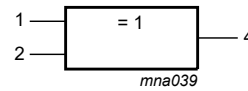


Fig. 2. IEC logic symbol

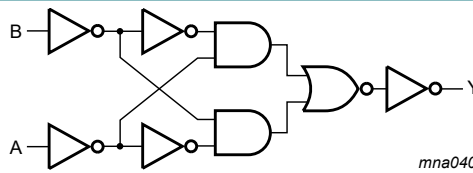


Fig. 3. Logic diagram

## 6. Pinning information

### 6.1. Pinning

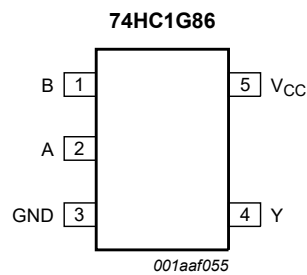


Fig. 4. Pin configuration for SOT353-1 (TSSOP5) and SOT753 (SC-74A)

## 6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
B	1	data input
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

Inputs		Output
A	B	Y
L	L	L
L	H	H
H	L	H
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 <sub>CC</sub>	supply voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V	-	±20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V	-	±20	mA
I <sub>O</sub>	output current	-0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V	[1]	±12.5	mA
I <sub>CC</sub>	supply current		-	25	mA
I <sub>GND</sub>	ground current		-25	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -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<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C.

For SOT753 (SC-74A) package: P<sub>tot</sub> 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	74HC1G86-Q100			74HCT1G86-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	-	139	-	-	139	ns/V
		V <sub>CC</sub> = 6.0 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<sub>amb</sub> = 25 °C.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
<b>74HC1G86-Q100</b>								
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	V
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	1.9	2.0	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	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	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	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		-	1.5	-	-	-	pF

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
<b>74HCT1G86-Q100</b>								
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	V
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> = 4.5 V	4.4	4.5	-	4.4	-	V
		I <sub>O</sub> = -2.0 mA; V <sub>CC</sub> = 4.5 V	4.13	4.32	-	3.7	-	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> = 4.5 V	-	0	0.1	-	0.1	V
		I <sub>O</sub> = 2.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	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> = 5.5 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> = 5.5 V	-	-	10	-	20	µA
ΔI <sub>CC</sub>	additional supply current	per input; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A	-	-	500	-	850	µA
C <sub>I</sub>	input capacitance		-	1.5	-	-	-	pF

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

GND = 0 V; t<sub>r</sub> = t<sub>f</sub> ≤ 6.0 ns; All typical values are measured at T<sub>amb</sub> = 25 °C. For test circuit see Fig. 6

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
<b>74HC1G86-Q100</b>								
t <sub>pd</sub>	propagation delay	A and B to Y; see Fig. 5 [1]						
		V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF	-	22	115	-	135	ns
		V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF	-	11	23	-	27	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	9	-	-	-	ns
		V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF	-	9	20	-	23	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> [2]	-	23	-	-	-	pF
<b>74HCT1G86-Q100</b>								
t <sub>pd</sub>	propagation delay	A and B to Y; see Fig. 5 [1]						
		V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF	-	13	23	-	27	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	10	-	-	-	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [2]	-	23	-	-	-	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

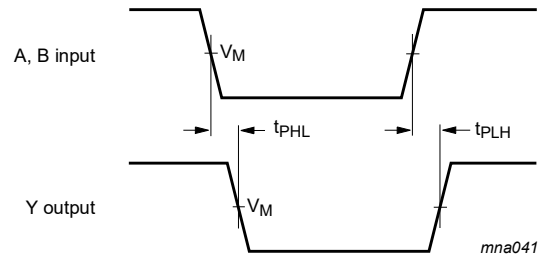
f<sub>o</sub> = output frequency in MHz

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

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

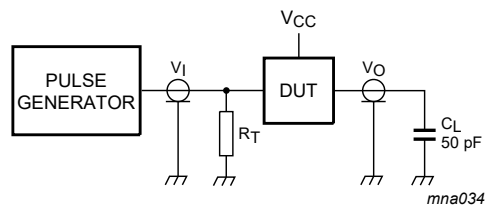
∑(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs

### 11.1. Waveforms and test circuit



For 74HC1G86-Q100:  $V_M = 0.5 \times V_{CC}$ ;  $V_I = \text{GND to } V_{CC}$ .  
 For 74HCT1G86-Q100:  $V_M = 1.3 \text{ V}$ ;  $V_I = \text{GND to } 3.0 \text{ V}$ .

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



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. Test circuit for measuring switching times**

## 12. Package outline

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

SOT353-1

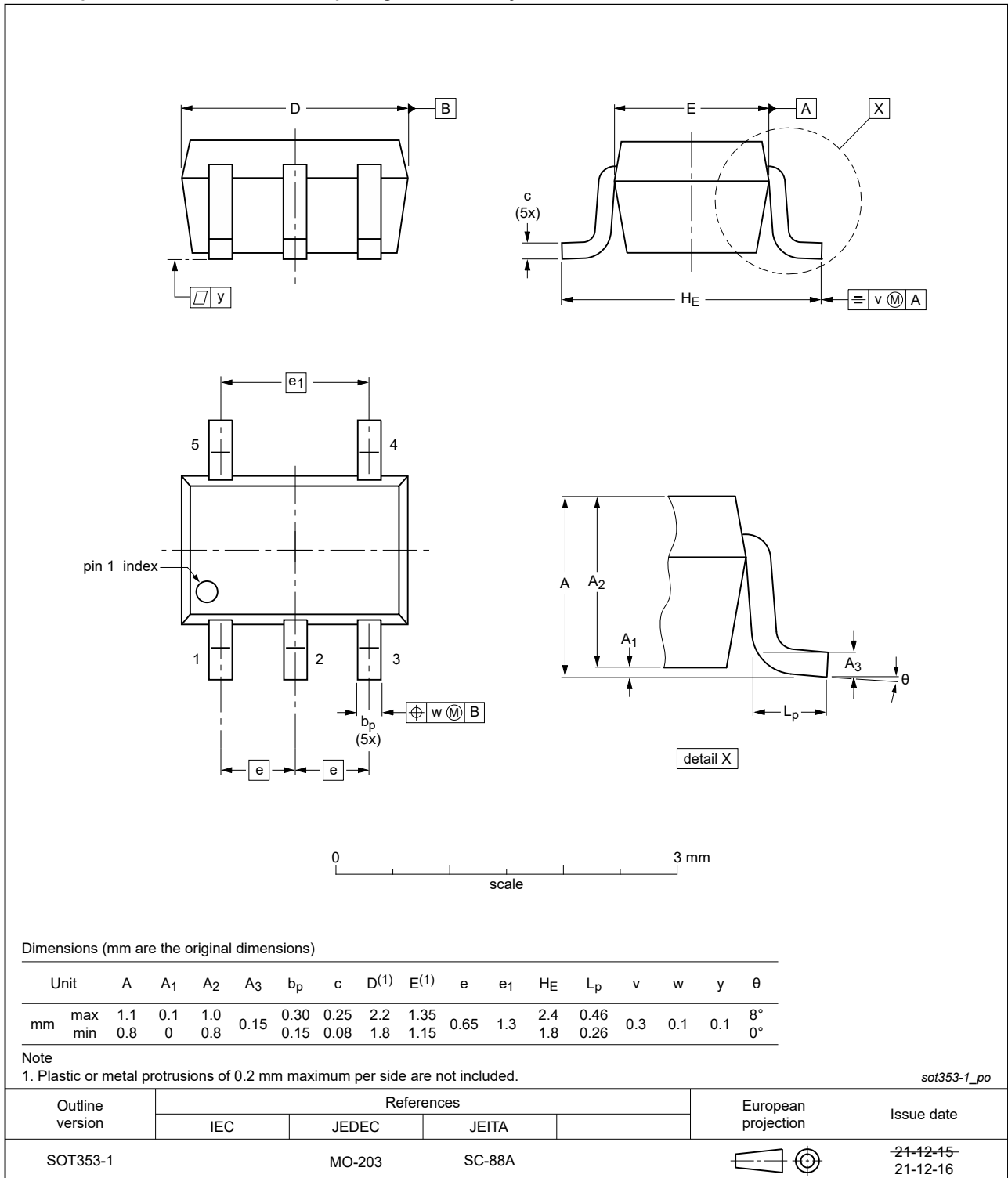


Fig. 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

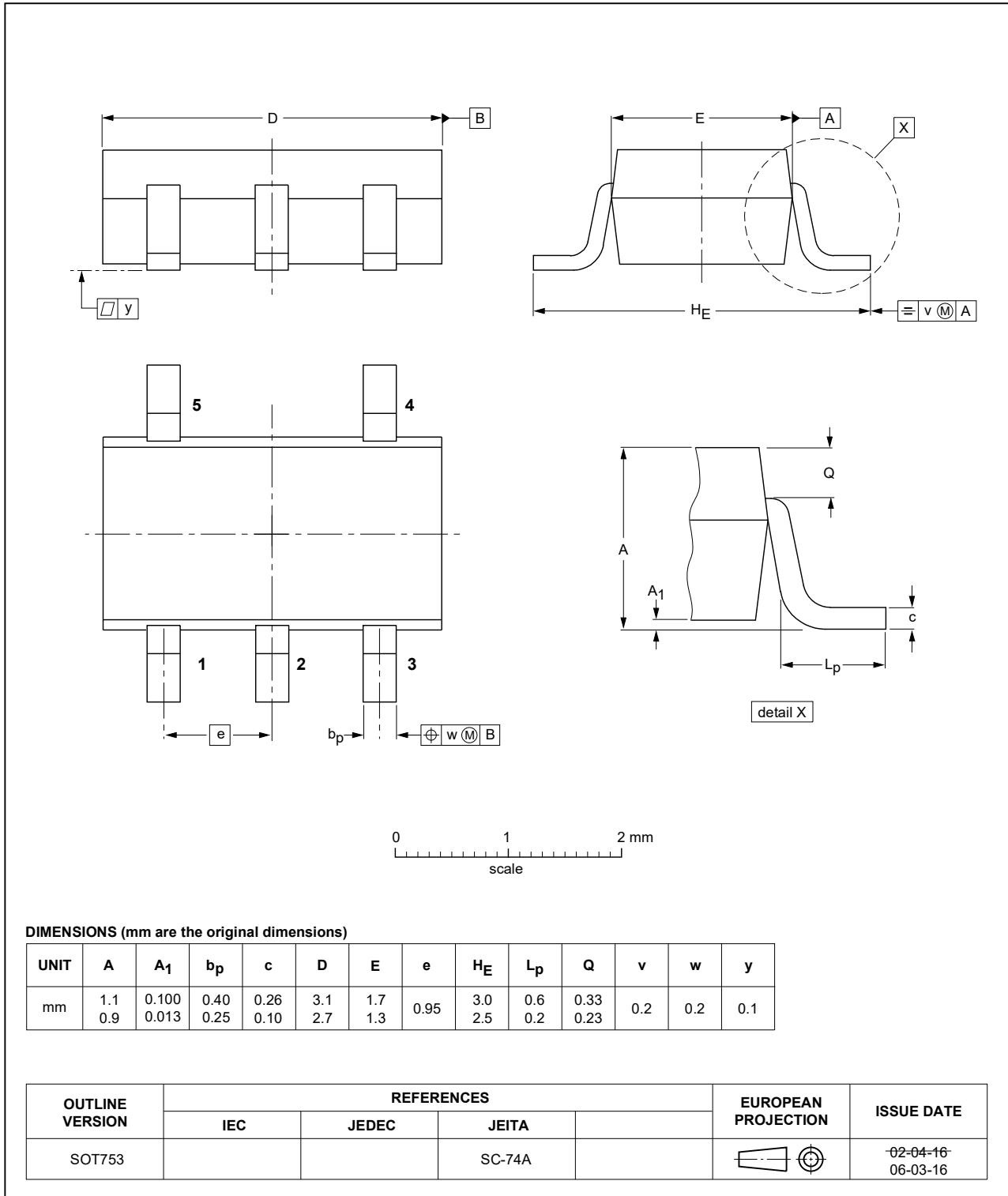


Fig. 8. Package outline SOT753 (SC-74A)



## 13. Abbreviations

Table 9. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT1G86_Q100 v.3	20220127	Product data sheet	-	74HC_HCT1G86_Q100 v.2
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="#">Table 5</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li><a href="#">Fig. 7</a>: Package outline drawing for SOT353-1 (TSSOP5) has changed.</li> </ul>			
74HC_HCT1G86_Q100 v.2	20131216	Product data sheet	-	74HC_HCT1G86_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <li>Features and benefits updated (errata).</li> </ul>			
74HC_HCT1G86_Q100 v.1	20130326	Product data sheet	-	-

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### 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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