

# 74AHC1G09-Q100

## 2-input AND gate with open-drain output

Rev. 2 — 16 August 2012

Product data sheet

### 1. General description

The 74AHC1G09-Q100 is a high-speed Si-gate CMOS device.

The 74AHC1G09-Q100 provides the 2-input AND function with open-drain output.

The output of the 74AHC1G09-Q100 is an open drain and can be connected to other open-drain outputs to implement active-LOW, wired-OR or active-HIGH wired-AND functions. For digital operation, this device must have a pull-up resistor to establish a logic HIGH level.

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  $-40\text{ °C}$  to  $+85\text{ °C}$  and from  $-40\text{ °C}$  to  $+125\text{ °C}$
- High noise immunity
- Low power dissipation
- SOT353-1 and SOT753 package options
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\ \Omega$ )

### 3. Ordering information

Table 1. Ordering information

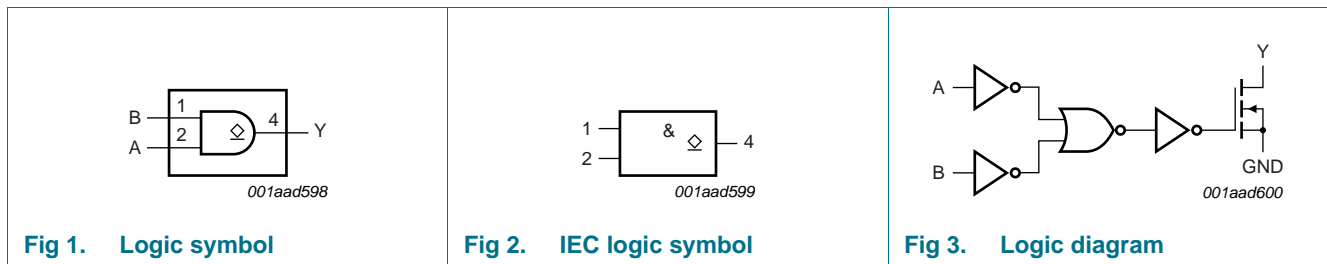
Type number	Package			
	Temperature range	Name	Description	Version
74AHC1G09GW-Q100	$-40\text{ °C}$ to $+125\text{ °C}$	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74AHC1G09GV-Q100	$-40\text{ °C}$ to $+125\text{ °C}$	SC-74A	plastic surface-mounted package; 5 leads	SOT753

## 4. Marking

Table 2. Marking

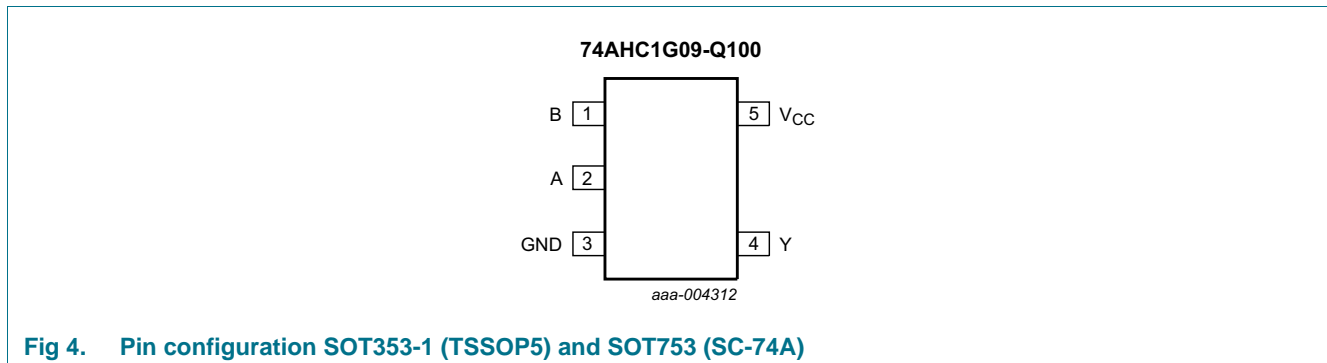
Type number	Marking code
74AHC1G09GW-Q100	A9
74AHC1G09GV-Q100	A09

## 5. Functional diagram



## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
B	1	data input B
A	2	data input A
GND	3	ground (0 V)
Y	4	data output Y
V <sub>CC</sub>	5	supply voltage

## 7. Functional description

Table 4. Function table<sup>[1]</sup>

Input		Output
A	B	Y
L	L	L
L	H	L
H	L	L
H	H	Z

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

## 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
$V_I$	input voltage		[1] -0.5	+7.0	V
$V_O$	output voltage	active mode	[1] -0.5	+7.0	V
		high-impedance mode	[1] -0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5$ V	[1] -	-20	mA
$I_{OK}$	output clamping current	$V_O < -0.5$ V	[1] -	±20	mA
$I_O$	output current	$V_O > -0.5$ 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	$T_{amb} = -40$ °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 TSSOP5 and SC-74A packages: above 87.5 °C the value of  $P_{tot}$  derates linearly with 4.0 mW/K.

## 9. Recommended operating conditions

Table 6. Recommended operating operations

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	active mode	0	-	$V_{CC}$	V
		high-impedance mode	0	-	6.0	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0$ V to 3.6 V	-	-	100	ns/V
		$V_{CC} = 4.5$ V to 5.5 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 <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	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>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.25		±2.5		±10.0	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	-	20	μA
C <sub>I</sub>	input capacitance		-	1.5	10	-	10	-	10	pF

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

GND = 0 V; for test circuit see [Figure 6](#).

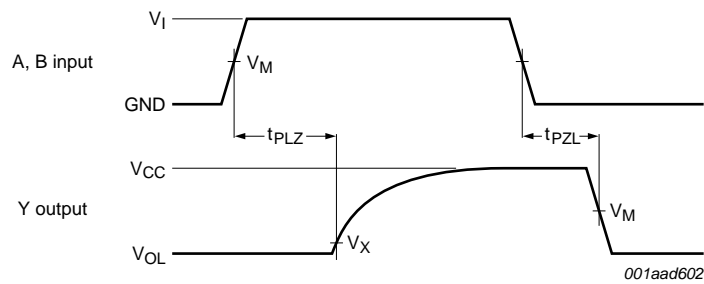
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	propagation delay	A and B to Y; see <a href="#">Figure 5</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V								
		C <sub>L</sub> = 15 pF	-	4.6	7.5	1.0	8.5	1.0	9.0	ns
		C <sub>L</sub> = 50 pF	-	6.5	11.0	1.5	12.0	1.5	12.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V								
		C <sub>L</sub> = 15 pF	-	3.2	5.5	1.0	6.5	1.0	7.0	ns
		C <sub>L</sub> = 50 pF	-	4.6	7.5	1.5	8.0	1.5	8.5	ns
C <sub>PD</sub>	power dissipation capacitance	C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub>		5	-	-	-	-	-	pF

[1] t<sub>pd</sub> is the same as t<sub>pZL</sub> and t<sub>pLZ</sub>.

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

- [3] Typical values are measured at  $V_{CC} = 5.0\text{ V}$ .
- [4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + (C_L \times V_{CC}^2 \times f_o)$  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 V;  
 $N$  = number of inputs switching;  
 $(C_L \times V_{CC}^2 \times f_o)$  = dissipation due to the output if the combination of the pull-up voltage and resistance results in  $V_{CC}$  at the output.

## 12. Waveforms

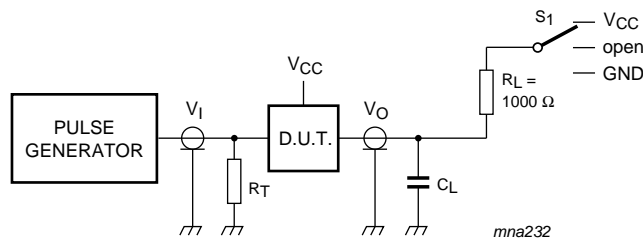


Measurement points are given in [Table 9](#).  
 $V_{OL}$  is the typical voltage output level that occurs with the output load.

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

**Table 9. Measurement points**

Input	Output	
$V_M$	$V_M$	$V_X$
$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3\text{ V}$



Test data is given in [Table 10](#).  
 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**

Table 10. Test data

Input		Load		S <sub>1</sub>		
V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	R <sub>L</sub>	C <sub>L</sub>	t <sub>PHZ</sub> , t <sub>PZH</sub>	t <sub>PLZ</sub> , t <sub>PZL</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>
GND to V <sub>CC</sub>	≤ 3.0 ns	1000 Ω	15 pF	GND	V <sub>CC</sub>	open
GND to V <sub>CC</sub>	≤ 3.0 ns	1000 Ω	50 pF	GND	V <sub>CC</sub>	open

13. Package outline

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

SOT353-1

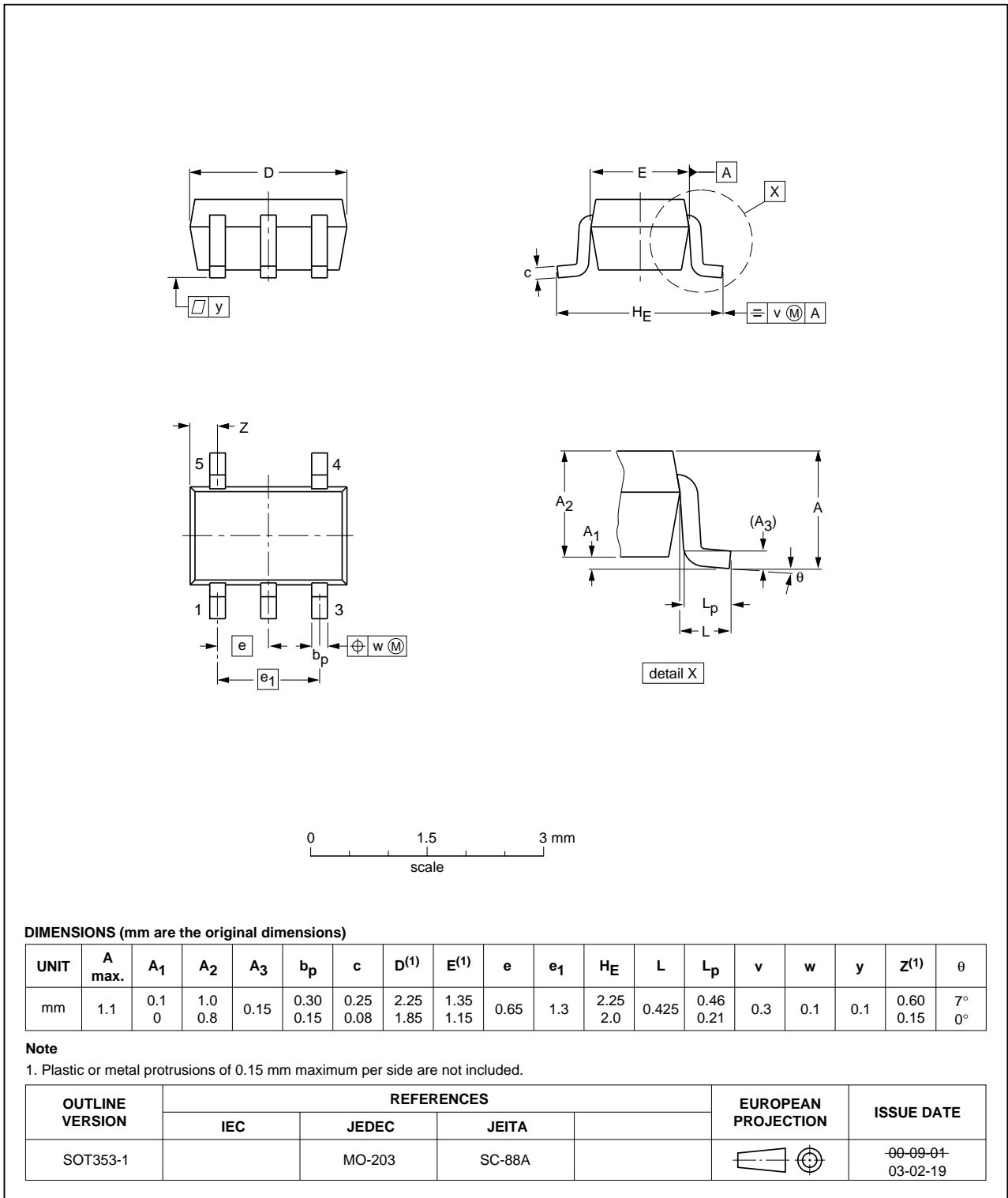


Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

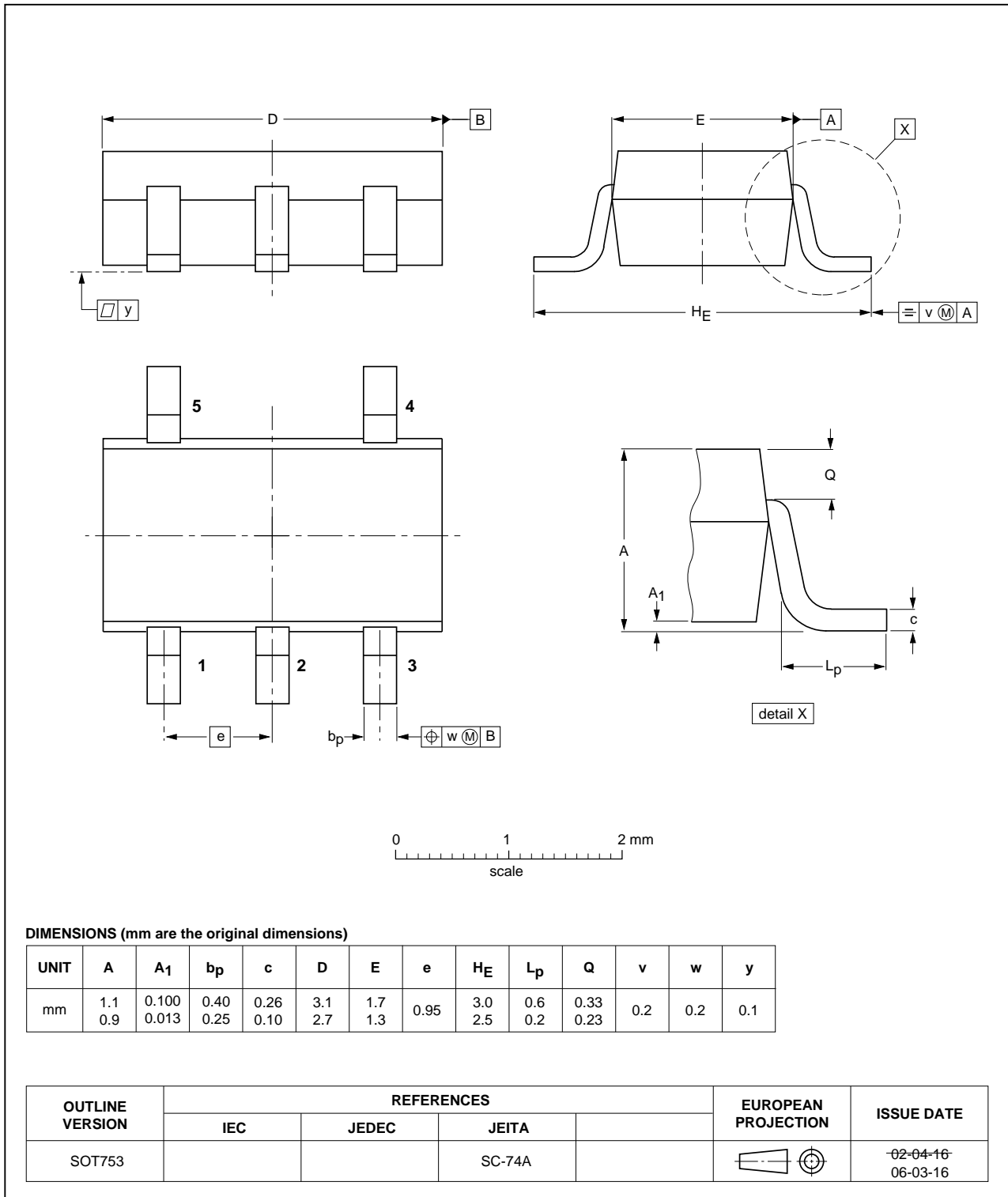


Fig 8. Package outline SOT753 (SC-74A)



## 14. Abbreviations

Table 11. Abbreviations

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

## 15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC1G09_Q100 v.2	20120816	Product data sheet	-	74AHC1G09_Q100 v.1
Modifications:	• Features list corrected (errata).			
74AHC1G09_Q100 v.1	20120807	Product data sheet	-	-

## 16. Legal information

### 16.1 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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