

# 74AHC1G09

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

Rev. 01 — 26 September 2005

Product data sheet

### 1. General description

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

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

The output of the 74AHC1G09 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.

### 2. Features

- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114-C exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Low power dissipation
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

### 3. Quick reference data

**Table 1: Quick reference data**

$GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f \leq 3.0\text{ ns}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PZL}$ , $t_{PLZ}$	propagation delay A and B to Y	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ; $C_L = 15\text{ pF}$	-	3.2	5.5	ns
$C_i$	input capacitance		-	1.5	10	pF
$C_{PD}$	power dissipation capacitance	$C_L = 50\text{ pF}$ ; $f_i = 1\text{ MHz}$ ; $V_i = GND\text{ to }V_{CC}$	[1] -	5	-	pF

[1]  $C_{PD}$  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 Volts;

$N$  = 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.

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## 4. Ordering information

Table 2: Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74AHC1G09GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1

## 5. Marking

Table 3: Marking

Type number	Marking code
74AHC1G09GW	A9

## 6. Functional diagram

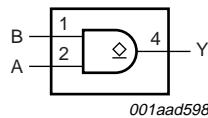


Fig 1. Logic symbol

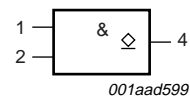


Fig 2. IEC logic symbol

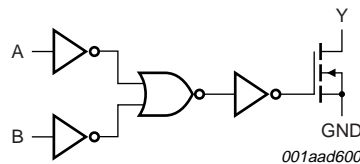


Fig 3. Logic diagram

## 7. Pinning information

### 7.1 Pinning

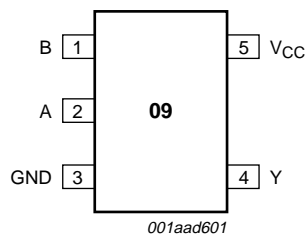


Fig 4. Pin configuration SOT353-1 (TSSOP5)

## 7.2 Pin description

Table 4: 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

## 8. Functional description

### 8.1 Function table

Table 5: Function table [1]

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.

## 9. Limiting values

Table 6: 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
V <sub>I</sub>	input voltage		[1] -0.5	+7.0	V
V <sub>O</sub>	output voltage	active mode	[1] -0.5	+7.0	V
		high-impedance mode	[1] -0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V	[1] -	-20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V	[1] -	±20	mA
I <sub>O</sub>	output current	V <sub>O</sub> > -0.5 V	-	25	mA
I <sub>CC</sub>	quiescent supply current		-	±75	mA
I <sub>GND</sub>	GND current		-	±75	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 TSSOP5 packages: above 87.5 °C the value of P<sub>tot</sub> derates linearly with 4.0 mW/K.

## 10. Recommended operating conditions

**Table 7: 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
$t_r, t_f$	input rise and fall times	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	100	ns/V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V

## 11. Static characteristics

**Table 8: Static characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25\text{ °C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 3.0\text{ V}$	2.1	-	-	V
		$V_{CC} = 5.5\text{ V}$	3.85	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.9	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.65	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	-	0	0.1	V
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 3.0\text{ V}$	-	0	0.1	V
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	-	0	0.1	V
		$I_O = 4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.36	V
	$I_O = 8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	-	-	0.36	V	
$I_{LI}$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$	-	-	$\pm 0.1$	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}; V_O = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$	-	-	$\pm 0.25$	$\mu\text{A}$
$I_{CC}$	quiescent supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}; V_{CC} = 5.5\text{ V}$	-	-	1.0	$\mu\text{A}$
$C_i$	input capacitance		-	1.5	10	pF
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 3.0\text{ V}$	2.1	-	-	V
		$V_{CC} = 5.5\text{ V}$	3.85	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.9	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.65	V

**Table 8: Static characteristics ...continued**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.44	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.44	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±1.0	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	-	-	±2.5	μA
I <sub>CC</sub>	quiescent 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	μA
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 3.0 V	2.1	-	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 3.0 V	-	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	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	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±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	-	-	±10	μA
I <sub>CC</sub>	quiescent 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	-	-	20	μA

## 12. Dynamic characteristics

**Table 9: Dynamic characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $t_r = t_f \leq 3.0$  ns; see [Figure 6](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25</math> °C</b>						
$t_{PZL}$ , $t_{PLZ}$	propagation delay A and B to Y	see <a href="#">Figure 5</a>				
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 15$ pF	[1] -	4.6	7.5	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 15$ pF	[1] -	3.2	5.5	ns
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 50$ pF	[1] -	6.5	11.0	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 50$ pF	[1] -	4.6	7.5	ns
$C_{PD}$	power dissipation capacitance	$C_L = 50$ pF; $f_i = 1$ MHz; $V_1 = GND$ to $V_{CC}$	[2] -	5	-	pF
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b>						
$t_{PZL}$ , $t_{PLZ}$	propagation delay A and B to Y	see <a href="#">Figure 5</a>				
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 15$ pF	1.0	-	8.5	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 15$ pF	1.0	-	6.5	ns
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 50$ pF	1.5	-	12.0	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 50$ pF	1.5	-	8.0	ns
<b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b>						
$t_{PZL}$ , $t_{PLZ}$	propagation delay A and B to Y	see <a href="#">Figure 5</a>				
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 15$ pF	1.0	-	9.0	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 15$ pF	1.0	-	7.0	ns
		$V_{CC} = 3.0$ V to $3.6$ V; $C_L = 50$ pF	1.5	-	12.5	ns
		$V_{CC} = 4.5$ V to $5.5$ V; $C_L = 50$ pF	1.5	-	8.5	ns

[1] All typical values are measured at nominal  $V_{CC}$ .

[2]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ 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 Volts;

$N$  = 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.

13. Waveforms

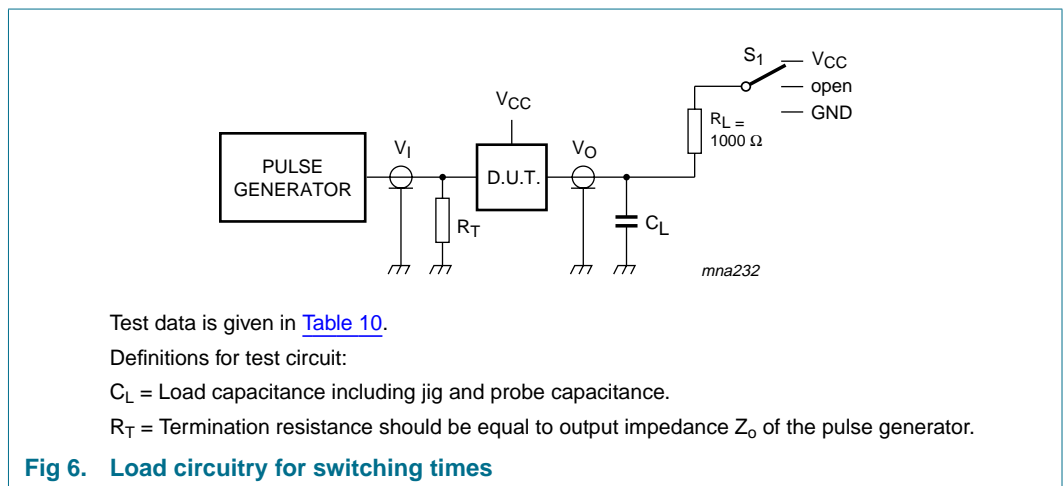
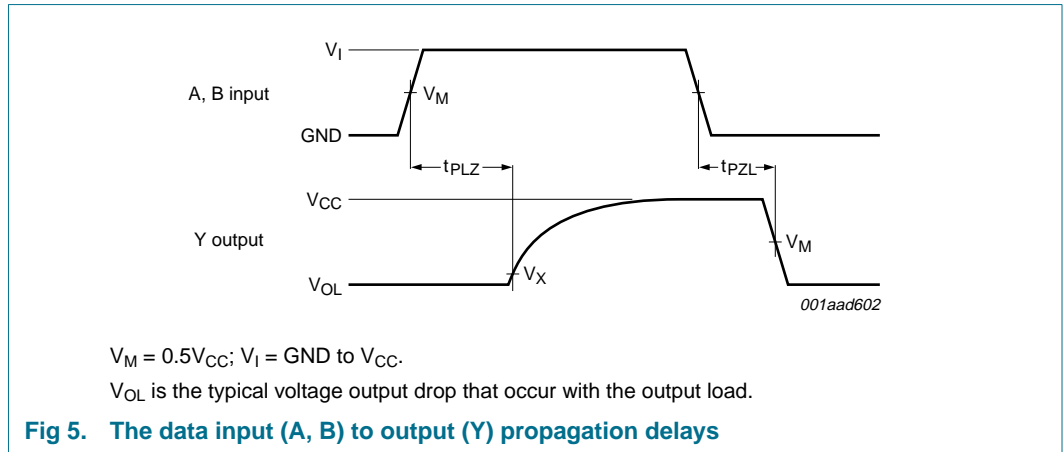


Table 10: Test data

Input		Load		$S_1$		
$V_I$	$t_r, t_f$	$R_L$	$C_L$	$t_{PHZ}, t_{PZH}$	$t_{PLZ}, t_{PZL}$	$t_{PLH}, t_{PHL}$
GND to $V_{CC}$	$\leq 3.0$ ns	1000 $\Omega$	15 pF	GND	$V_{CC}$	open
GND to $V_{CC}$	$\leq 3.0$ ns	1000 $\Omega$	50 pF	GND	$V_{CC}$	open

14. Package outline

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

SOT353-1

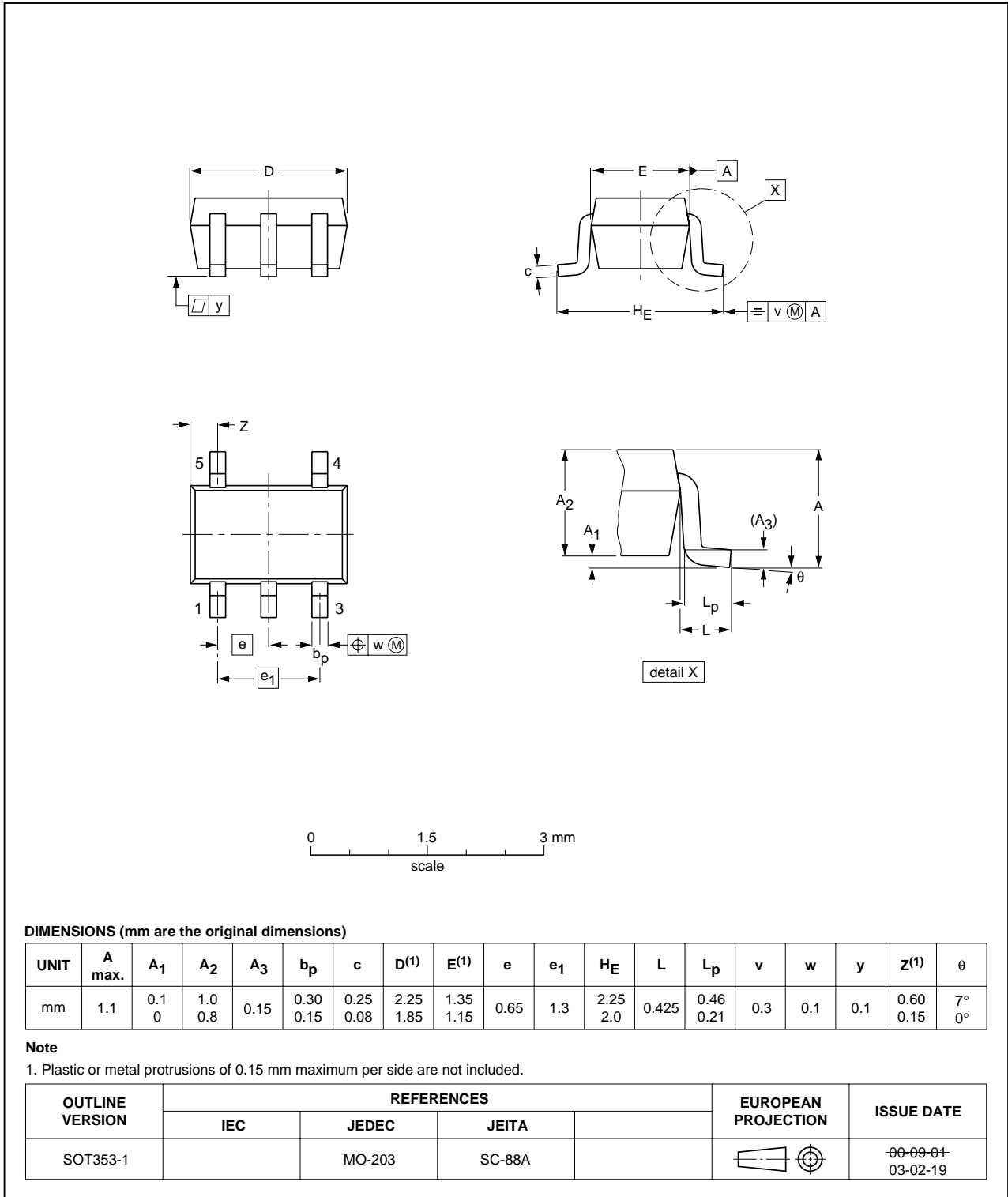


Fig 7. Package outline SOT353-1 (TSSOP5)



## 15. Abbreviations

Table 11: Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide semiconductor
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	Doc. number	Supersedes
74AHC1G09_1	20050926	Product data sheet	-	-	-

## 17. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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## 18. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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