

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 °C to $+85\text{ °C}$ and from -40 °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

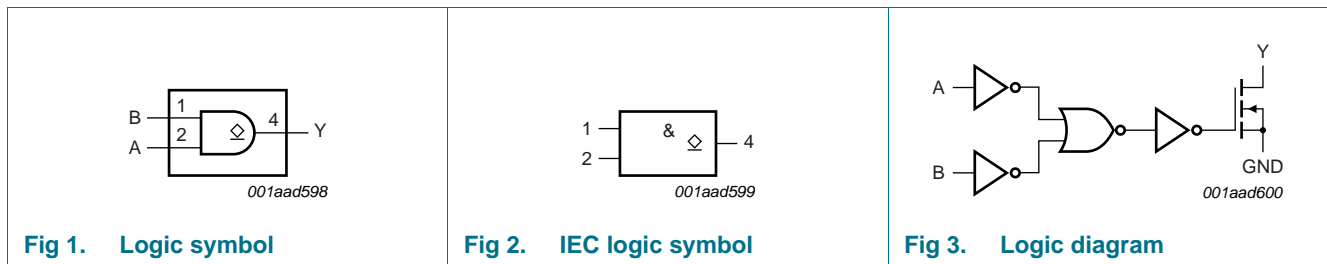
| Type number | Package | | | |
|------------------|-------------------------------------|--------|--|----------|
| | Temperature range | Name | Description | Version |
| 74AHC1G09GW-Q100 | -40 °C to $+125\text{ °C}$ | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm |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

4. Marking

Table 2. Marking

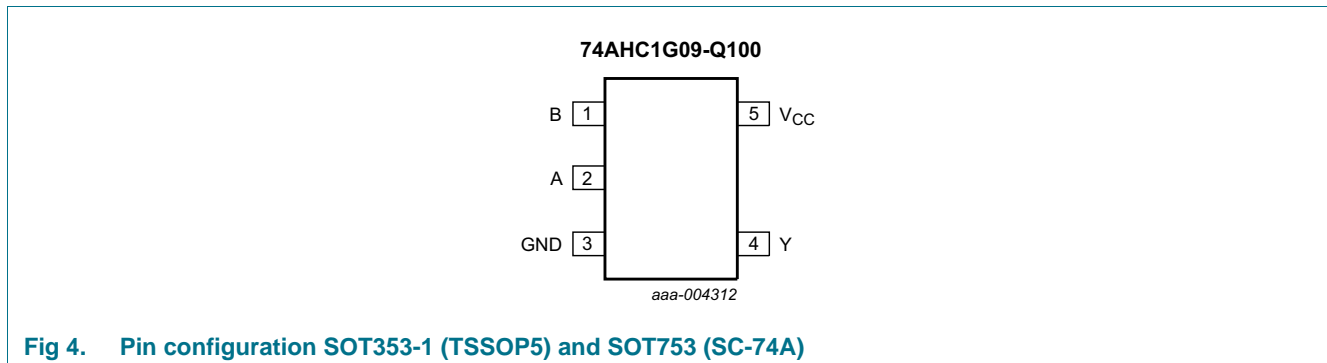
| Type number | Marking code |
|------------------|--------------|
| 74AHC1G09GW-Q100 | A9 |
| 74AHC1G09GV-Q100 | A09 |

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 _{CC} | 5 | supply voltage |

7. Functional description

Table 4. 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.

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 _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | - | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 3.0 V | 2.1 | - | - | 2.1 | - | 2.1 | - | V |
| | | V _{CC} = 5.5 V | 3.85 | - | - | 3.85 | - | 3.85 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | - | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 3.0 V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| | | V _{CC} = 5.5 V | - | - | 1.65 | - | 1.65 | - | 1.65 | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 50 μA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| | | I _O = 8.0 mA; V _{CC} = 4.5 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | - | ±0.1 | - | ±1.0 | - | ±2.0 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.25 | - | ±2.5 | - | ±10.0 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 1.0 | - | 10 | - | 20 | μA |
| C _I | input capacitance | | - | 1.5 | 10 | - | 10 | - | 10 | pF |

11. Dynamic characteristics

Table 8. Dynamic characteristics

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

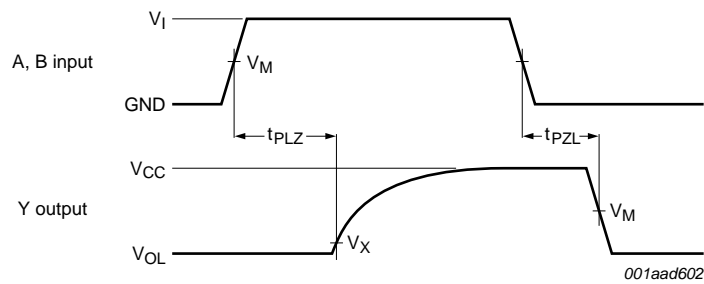
| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{pd} | propagation delay | A and B to Y; see Figure 5 | | | | | | | | |
| | | V _{CC} = 3.0 V to 3.6 V | | | | | | | | |
| | | C _L = 15 pF | - | 4.6 | 7.5 | 1.0 | 8.5 | 1.0 | 9.0 | ns |
| | | C _L = 50 pF | - | 6.5 | 11.0 | 1.5 | 12.0 | 1.5 | 12.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | C _L = 15 pF | - | 3.2 | 5.5 | 1.0 | 6.5 | 1.0 | 7.0 | ns |
| | | C _L = 50 pF | - | 4.6 | 7.5 | 1.5 | 8.0 | 1.5 | 8.5 | ns |
| C _{PD} | power dissipation capacitance | C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} | | 5 | - | - | - | - | - | pF |

[1] t_{pd} is the same as t_{pZL} and t_{pLZ}.

[2] Typical values are measured at V_{CC} = 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 μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + (C_L \times V_{CC}^2 \times f_o)$ 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

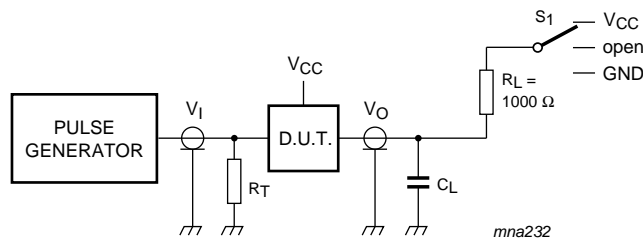


Measurement points are given in [Table 9](#).
 V_{OL} is the typical voltage output level that occurs with the output load.

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 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} | ≤ 3.0 ns | 1000 Ω | 15 pF | GND | V _{CC} | open |
| GND to V _{CC} | ≤ 3.0 ns | 1000 Ω | 50 pF | GND | V _{CC} | open |

13. Package outline

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

SOT353-1

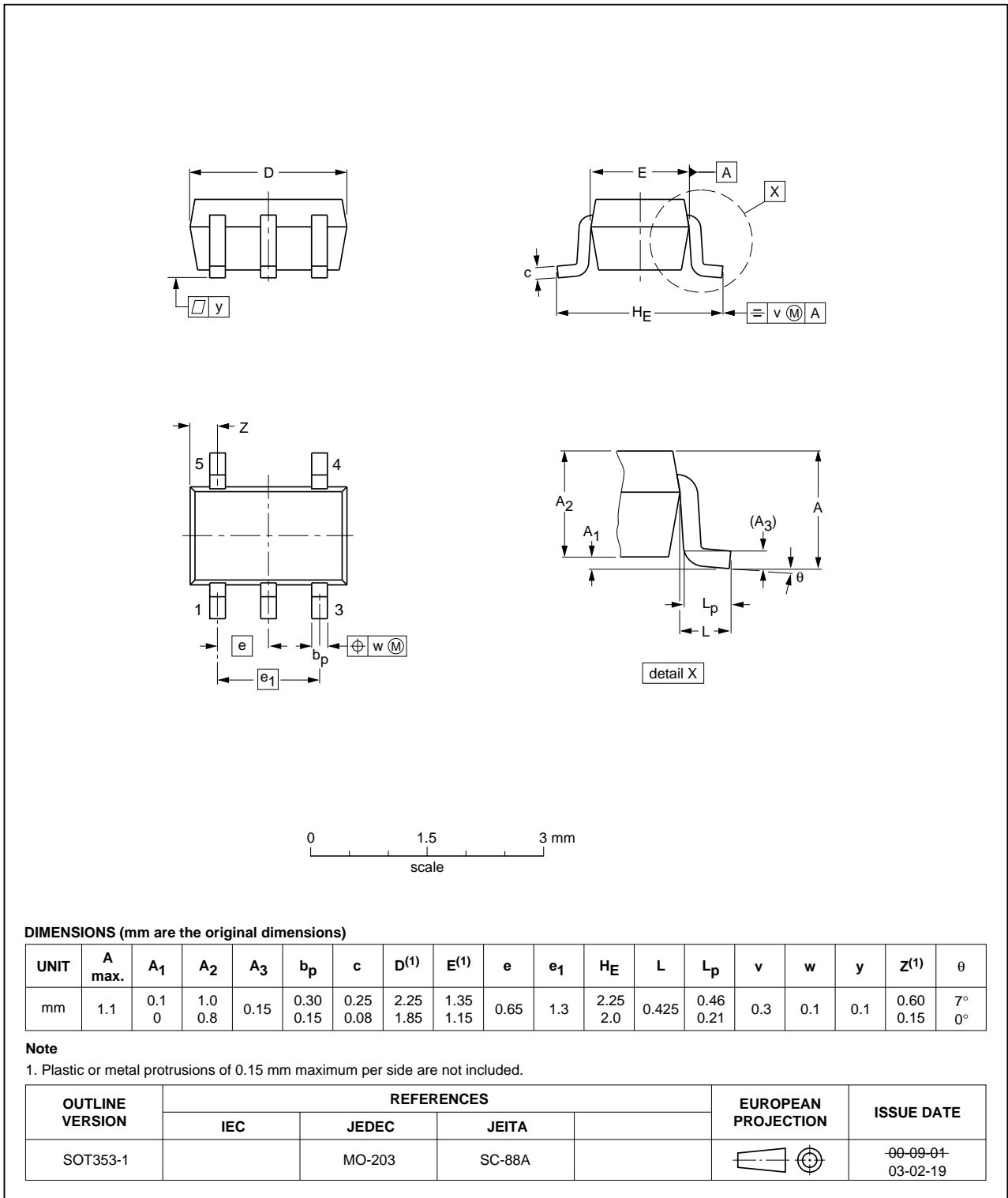


Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

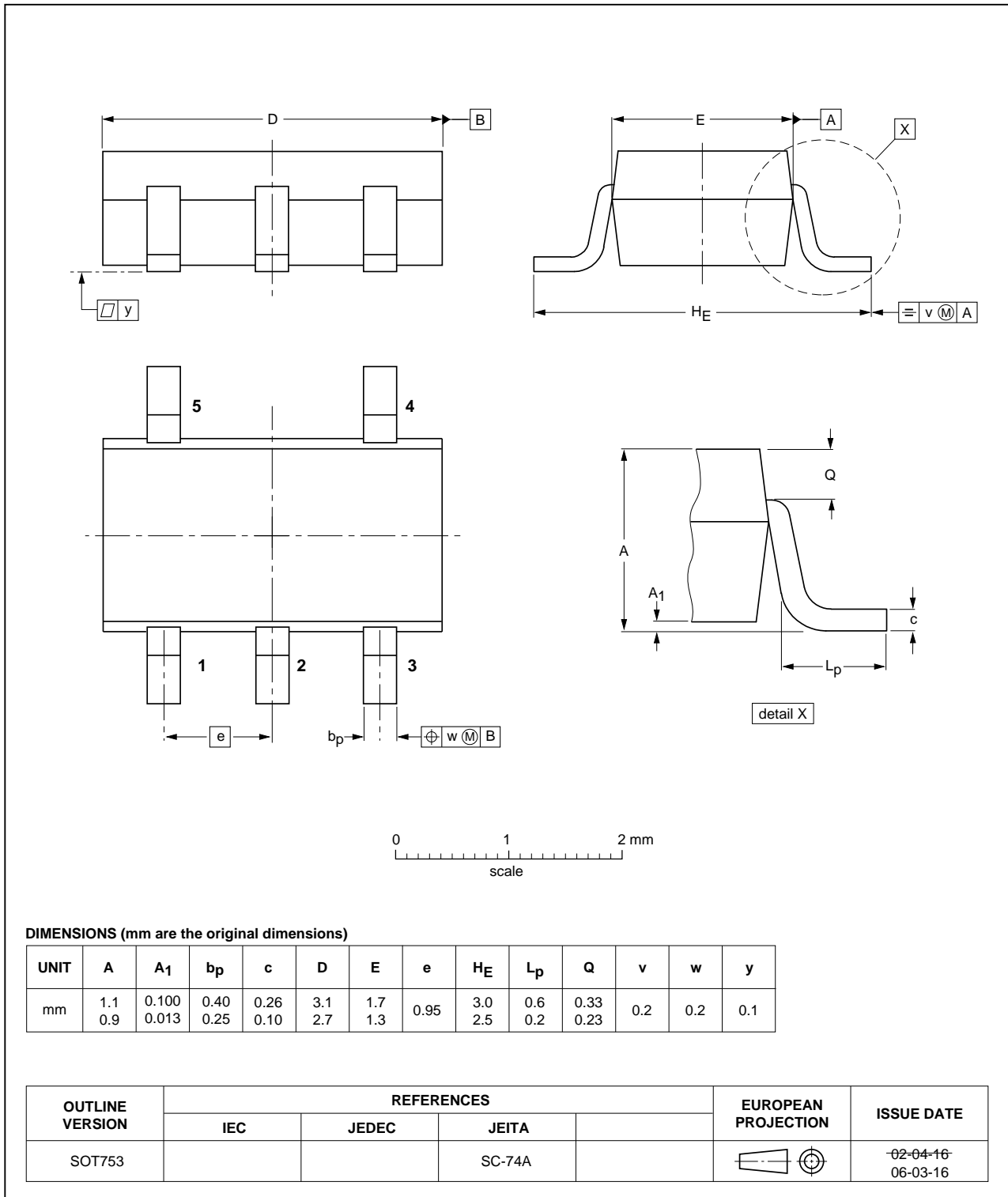


Fig 8. Package outline SOT753 (SC-74A)

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 ^{[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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