

# 74AHC1G86-Q100; 74AHCT1G86-Q100

2-input EXCLUSIVE-OR gate

Rev. 1 — 16 July 2012

Product data sheet

## 1. General description

74AHC1G86-Q100 and 74AHCT1G86-Q100 are high-speed Si-gate CMOS devices. They provide a 2-input EXCLUSIVE-OR function.

The AHC device has CMOS input switching levels and supply voltage range 2 V to 5.5 V.

The AHCT device has TTL input switching levels and supply voltage range 4.5 V to 5.5 V.

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

## 3. Ordering information

Table 1. Ordering information

| Type number                           | Package                                                         |        |                                                                           |          |
|---------------------------------------|-----------------------------------------------------------------|--------|---------------------------------------------------------------------------|----------|
|                                       | Temperature range                                               | Name   | Description                                                               | Version  |
| 74AHC1G86GW-Q100<br>74AHCT1G86GW-Q100 | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP5 | plastic thin shrink small outline package; 5 leads;<br>body width 1.25 mm | SOT353-1 |
| 74AHC1G86GV-Q100<br>74AHCT1G86GV-Q100 | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SC-74A | plastic surface-mounted package; 5 leads                                  | SOT753   |

4. Marking

Table 2. Marking codes

| Type number       | Marking code <sup>[1]</sup> |
|-------------------|-----------------------------|
| 74AHC1G86GW-Q100  | AH                          |
| 74AHCT1G86GW-Q100 | CH                          |
| 74AHC1G86GV-Q100  | A86                         |
| 74AHCT1G86GV-Q100 | C86                         |

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

5. Functional diagram

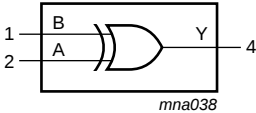


Fig 1. Logic symbol

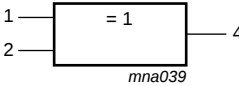


Fig 2. IEC logic symbol

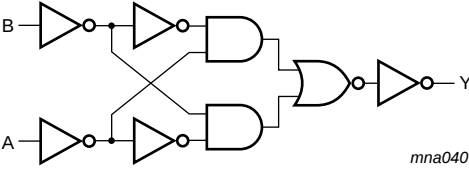


Fig 3. Logic diagram

6. Pinning information

6.1 Pinning

74AHC1G86-Q100  
74AHCT1G86-Q100

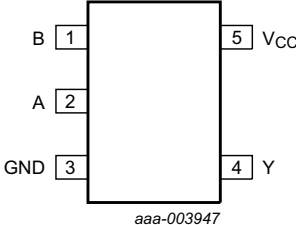


Fig 4. Pin configuration

## 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    |
| V <sub>I</sub>   | input voltage           |                                                                     | -0.5             | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</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 | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>O</sub>   | output current          | -0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V                   | -                | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                     | -                | 75   | mA   |
| I <sub>GND</sub> | ground 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                                | <sup>[2]</sup> - | 250  | mW   |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For both TSSOP5 and SC-74A packages: above 87.5 °C the value of P<sub>tot</sub> derates linearly with 4.0 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V).

| Symbol              | Parameter                           | Conditions                      | 74AHC1G86-Q100 |     |                 | 74AHCT1G86-Q100 |     |                 | Unit |
|---------------------|-------------------------------------|---------------------------------|----------------|-----|-----------------|-----------------|-----|-----------------|------|
|                     |                                     |                                 | Min            | Typ | Max             | Min             | Typ | Max             |      |
| V <sub>CC</sub>     | supply voltage                      |                                 | 2.0            | 5.0 | 5.5             | 4.5             | 5.0 | 5.5             | V    |
| V <sub>I</sub>      | input voltage                       |                                 | 0              | -   | 5.5             | 0               | -   | 5.5             | 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   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | V <sub>CC</sub> = 3.3 V ± 0.3 V | -              | -   | 100             | -               | -   | -               | ns/V |
|                     |                                     | V <sub>CC</sub> = 5.0 V ± 0.5 V | -              | -   | 20              | -               | -   | 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 |      |

### For type 74AHC1G86-Q100

|                 |                           |                                                                                        |      |     |      |      |      |      |      |    |
|-----------------|---------------------------|----------------------------------------------------------------------------------------|------|-----|------|------|------|------|------|----|
| 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>OH</sub> | HIGH-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                                       | 1.9  | 2.0 | -    | 1.9  | -    | 1.9  | -    | V  |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 3.0 V                                       | 2.9  | 3.0 | -    | 2.9  | -    | 2.9  | -    | V  |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 4.5 V                                       | 4.4  | 4.5 | -    | 4.4  | -    | 4.4  | -    | V  |
|                 |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V                                      | 2.58 | -   | -    | 2.48 | -    | 2.40 | -    | V  |
| V <sub>OL</sub> | LOW-level output voltage  | I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V                                      | 3.94 | -   | -    | 3.8  | -    | 3.70 | -    | V  |
|                 |                           | 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>I</sub>  | input leakage current     | 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  |
|                 |                           | 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>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   | -    | 40   | µA |
| C <sub>I</sub>  | input capacitance         |                                                                                        | -    | 1.5 | 10   | -    | 10   | -    | 10   | pF |

**Table 7. Static characteristics ...continued**  
 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  |      |
| For type 74AHCT1G86-Q100 |                           |                                                                                                                              |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub>          | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                             | 2.0   | -   | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub>          | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                             | -     | -   | 0.8  | -                | 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> ; V <sub>CC</sub> = 4.5 V                                                |       |     |      |                  |      |                   |      |      |
|                          |                           | I <sub>O</sub> = –50 µA                                                                                                      | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                          |                           | I <sub>O</sub> = –8.0 mA                                                                                                     | 3.94  | -   | -    | 3.8              | -    | 3.70              | -    | V    |
| V <sub>OL</sub>          | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V                                                |       |     |      |                  |      |                   |      |      |
|                          |                           | I <sub>O</sub> = 50 µA                                                                                                       | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                          |                           | I <sub>O</sub> = 8.0 mA                                                                                                      | -     | -   | 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>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   | -                 | 40   | µA   |
| ΔI <sub>CC</sub>         | additional supply current | per input pin; V <sub>I</sub> = 3.4 V; other inputs at V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V | -     | -   | 1.35 | -                | 1.5  | -                 | 1.5  | mA   |
| C <sub>I</sub>           | input capacitance         |                                                                                                                              | -     | 1.5 | 10   | -                | 10   | -                 | 10   | pF   |

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**  
 $GND = 0 \text{ V}; t_r = t_f = \leq 3.0 \text{ ns}$ . For waveform see [Figure 5](#). 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 |      |    |
| For type 74AHC1G86-Q100 |                               |                                                                                              |       |     |     |                  |     |                   |     |      |    |
| t <sub>pd</sub>         | propagation delay             | A and B to Y                                                                                 | [1]   |     |     |                  |     |                   |     |      |    |
|                         |                               | V <sub>CC</sub> = 3.0 V to 3.6 V                                                             | [2]   |     |     |                  |     |                   |     |      |    |
|                         |                               | C <sub>L</sub> = 15 pF                                                                       |       | -   | 4.0 | 11.0             | 1.0 | 13.0              | 1.0 | 14.0 | ns |
|                         |                               | C <sub>L</sub> = 50 pF                                                                       |       | -   | 5.8 | 14.5             | 1.0 | 16.5              | 1.0 | 18.5 | ns |
|                         |                               | V <sub>CC</sub> = 4.5 V to 5.5 V                                                             | [3]   |     |     |                  |     |                   |     |      |    |
|                         |                               | C <sub>L</sub> = 15 pF                                                                       |       | -   | 3.4 | 6.8              | 1.0 | 8.0               | 1.0 | 8.5  | ns |
|                         |                               | C <sub>L</sub> = 50 pF                                                                       |       | -   | 4.9 | 8.8              | 1.0 | 10.0              | 1.0 | 11.5 | ns |
| C <sub>PD</sub>         | power dissipation capacitance | per buffer;<br>C <sub>L</sub> = 50 pF; f = 1 MHz;<br>V <sub>I</sub> = GND to V <sub>CC</sub> | [4]   | -   | 9   | -                | -   | -                 | -   | pF   |    |

**Table 8.** Dynamic characteristics ...continued

$GND = 0\text{ V}$ ;  $t_r = t_f = \leq 3.0\text{ ns}$ . For waveform see [Figure 5](#). 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  |      |
| For type 74AHCT1G86-Q100 |                               |                                                                                              |       |     |     |                  |     |                   |      |      |
| t <sub>pd</sub>          | propagation delay             | A and B to Y                                                                                 | [1]   |     |     |                  |     |                   |      |      |
|                          |                               | V <sub>CC</sub> = 4.5 V to 5.5 V                                                             | [3]   |     |     |                  |     |                   |      |      |
|                          |                               | C <sub>L</sub> = 15 pF                                                                       | -     | 3.5 | 6.9 | 1.0              | 8.0 | 1.0               | 9.0  | ns   |
|                          |                               | C <sub>L</sub> = 50 pF                                                                       | -     | 5.0 | 7.9 | 1.0              | 9.0 | 1.0               | 10.5 | ns   |
| C <sub>PD</sub>          | power dissipation capacitance | per buffer;<br>C <sub>L</sub> = 50 pF; f = 1 MHz;<br>V <sub>I</sub> = GND to V <sub>CC</sub> | [4]   | -   | 11  | -                | -   | -                 | -    | pF   |

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[2] Typical values are measured at  $V_{CC} = 3.3\text{ V}$ .

[3] Typical values are measured at  $V_{CC} = 5.0\text{ V}$ .

[4]  $C_{PD}$  is used to determine the dynamic power dissipation  $P_D$  ( $\mu\text{W}$ ).

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

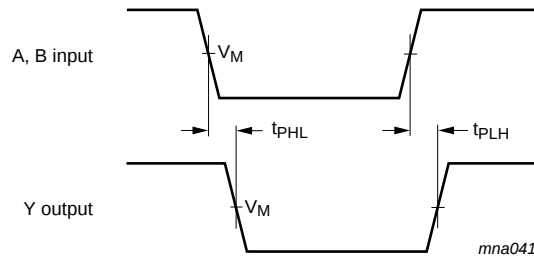
$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts.

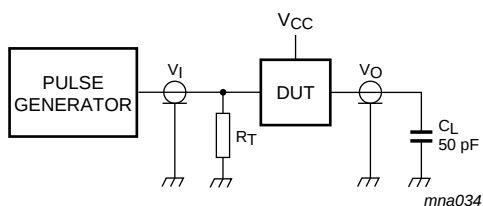
## 12. Waveforms



Measurement points are given in [Table 9](#).

**Fig 5.** The input (A and B) to output (Y) propagation delays**Table 9.** Measurement points

| Type            | Input                 |                     | Output              |
|-----------------|-----------------------|---------------------|---------------------|
|                 | $V_I$                 | $V_M$               | $V_M$               |
| 74AHC1G86-Q100  | GND to $V_{CC}$       | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74AHCT1G86-Q100 | GND to $3.0\text{ V}$ | $1.5\text{ V}$      | $0.5 \times V_{CC}$ |



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 the output impedance  $Z_o$  of the pulse generator.

**Fig 6. Load circuitry for switching times**

13. Package outline

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

SOT353-1

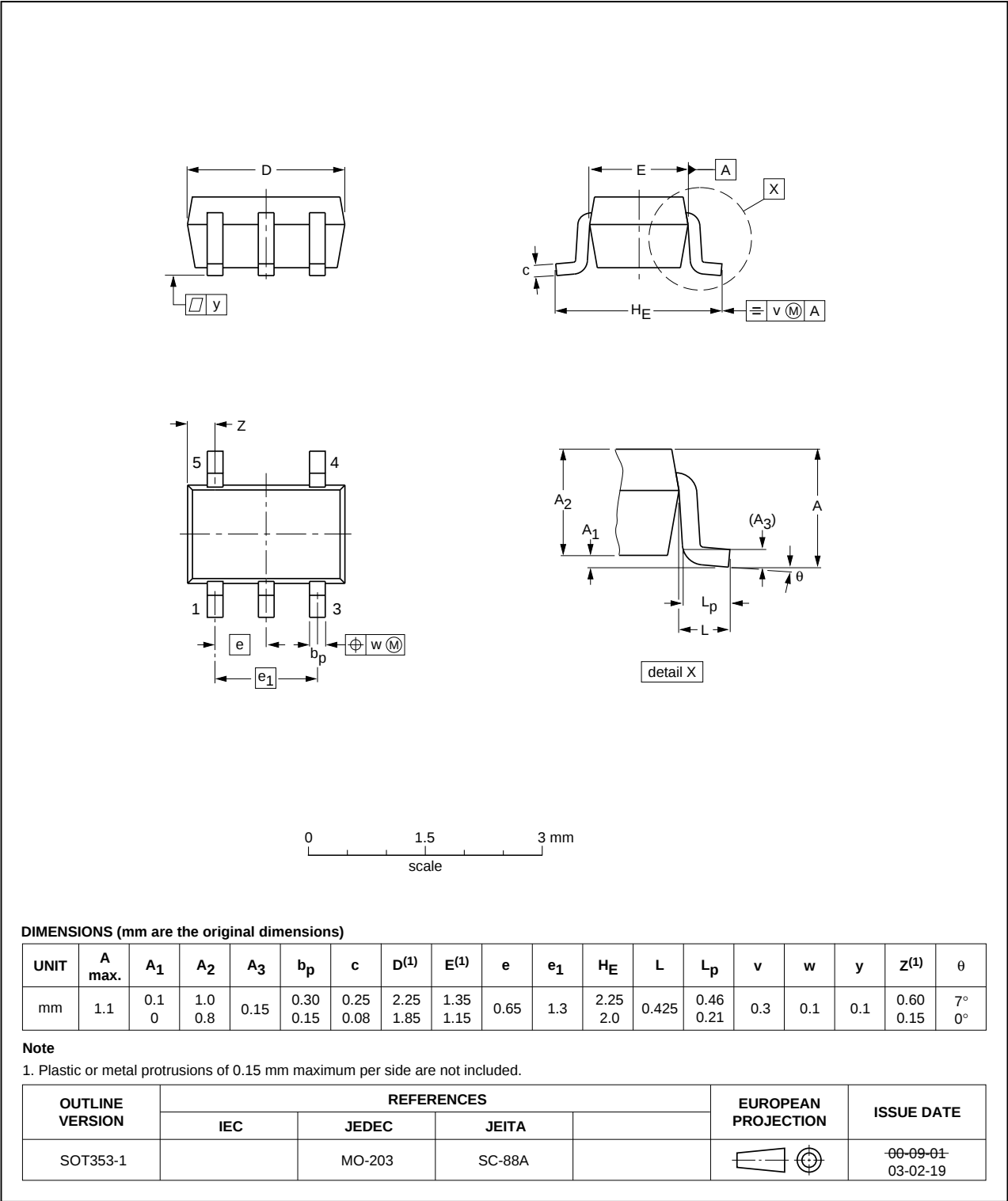


Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

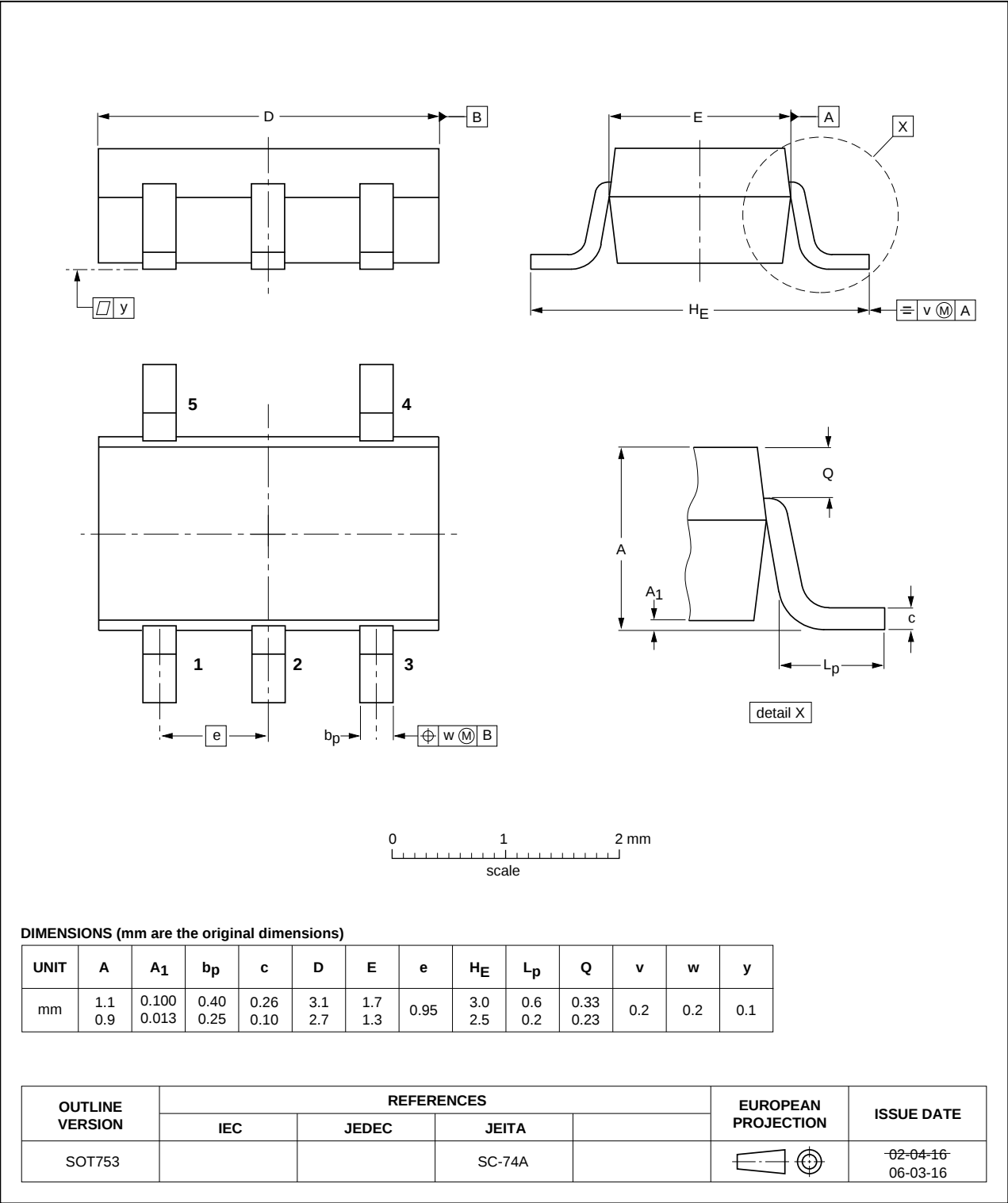


Fig 8. Package outline SOT753 (SC-74A)

## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Description                 |
|---------|-----------------------------|
| CDM     | Charged Device Model        |
| DUT     | Device Under Test           |
| ESD     | ElectroStatic Discharge     |
| HBM     | Human Body Model            |
| MM      | Machine Model               |
| TTL     | Transistor-Transistor Logic |
| MIL     | Military                    |

## 15. Revision history

Table 11. Revision history

| Document ID             | Release date | Data sheet status  | Change notice | Supersedes |
|-------------------------|--------------|--------------------|---------------|------------|
| 74AHC_AHCT1G86_Q100 v.1 | 20120716     | 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

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## 17. Contact information

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For more information, please visit: <http://www.nexperia.com>

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