

# 74HC1G04-Q100; 74HCT1G04-Q100

## Inverter

Rev. 1 — 25 September 2013

Product data sheet

## 1. General description

The 74HC1G04-Q100; 74HCT1G04-Q100 is a single inverter. Inputs include clamp diodes that enable 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  $-40\text{ °C}$  to  $+85\text{ °C}$  and from  $-40\text{ °C}$  to  $+125\text{ °C}$
- Wide supply voltage range from 2.0 V to 6.0 V
- Input levels:
  - ◆ For 74HC1G04-Q100: CMOS level
  - ◆ For 74HCT1G04-Q100: TTL level
- 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 ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

## 3. Ordering information

Table 1. Ordering information

| Type number      | Package                             |        |  |          |
|------------------|-------------------------------------|--------|--|----------|
|                  | Temperature range                   | Name   | Description  | Version  |
| 74HC1G04GW-Q100  | $-40\text{ °C}$ to $+125\text{ °C}$ | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| 74HCT1G04GW-Q100 |                                     |        |  |          |
| 74HC1G04GV-Q100  | $-40\text{ °C}$ to $+125\text{ °C}$ | SC-74A | plastic surface-mounted package; 5 leads                               | SOT753   |
| 74HCT1G04GV-Q100 |                                     |        |  |          |

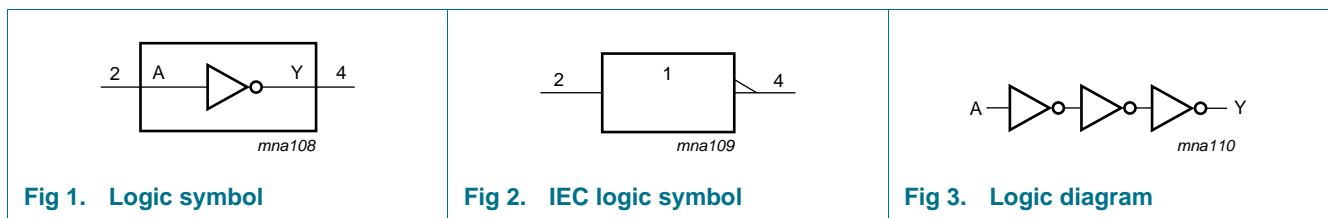
## 4. Marking

Table 2. Marking codes

| Type number      | Marking <sup>[1]</sup> |
|------------------|------------------------|
| 74HC1G04GW-Q100  | HC                     |
| 74HCT1G04GW-Q100 | TC                     |
| 74HC1G04GV-Q100  | H04                    |
| 74HCT1G04GV-Q100 | T04                    |

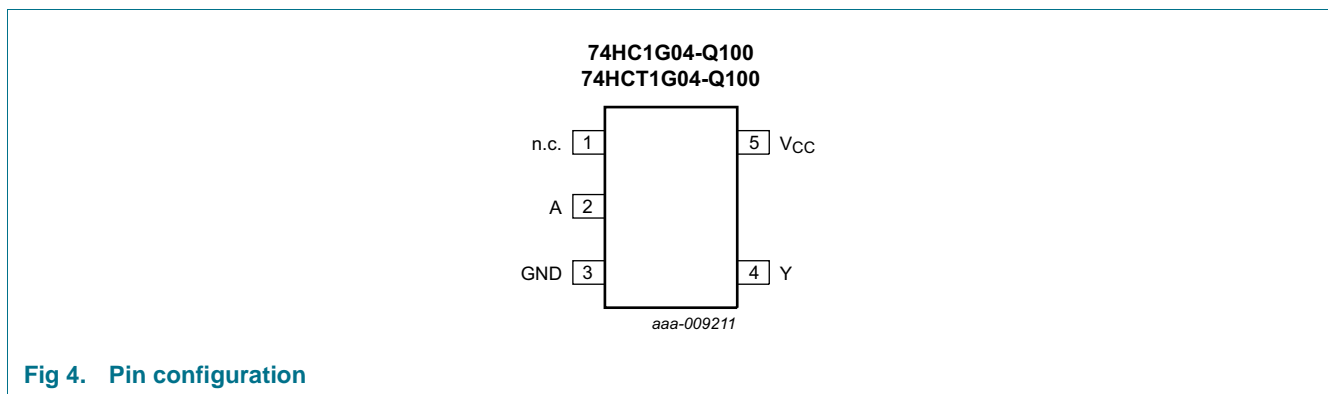
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 5. Functional diagram



## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3. Pin description

| Symbol          | Pin | Description    |
|-----------------|-----|----------------|
| n.c.            | 1   | not connected  |
| 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

| Input | Output |
|-------|--------|
| A     | Y      |
| L     | 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). [\[1\]](#)

| 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                   | -                     | ±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                                | <a href="#">[2]</a> - | 200   | mW   |

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

[2] Above 55 °C, the value of P<sub>tot</sub> derates linearly with 2.5 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

| Symbol           | Parameter                           | Conditions              | 74HC1G04-Q100 |     |                 | 74HCT1G04-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  $T_{amb} = 25\text{ °C}$ .

| Symbol                         | Parameter                 | Conditions   | -40 °C to +85 °C |      |      | -40 °C to +125 °C |      | Unit |
|--------------------------------|---------------------------|--|------------------|------|------|-------------------|------|------|
|                                |                           |  | Min              | Typ  | Max  | Min               | Max  |      |
| <b>For type 74HC1G04-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    |
| 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>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   |
|                                |                           | 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   |
| <b>For type 74HCT1G04-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   |

**Table 7. Static characteristics ...continued**

Voltages are referenced to GND (ground = 0 V). All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

| Symbol          | Parameter                 | Conditions   | -40 °C to +85 °C |     |     | -40 °C to +125 °C |     | Unit          |
|-----------------|---------------------------|--|------------------|-----|-----|-------------------|-----|---------------|
|                 |                           |  | Min              | Typ | Max | Min               | Max |               |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ;<br>$V_{CC} = 5.5\text{ V}$                                       | -                | -   | 10  | -                 | 20  | $\mu\text{A}$ |
| $\Delta I_{CC}$ | additional supply current | per input; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ ;<br>$V_I = V_{CC} - 2.1\text{ V}$ ; $I_O = 0\text{ A}$ | -                | -   | 500 | -                 | 850 | $\mu\text{A}$ |
| $C_I$           | input capacitance         |  | -                | 1.5 | -   | -                 | -   | pF            |

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f \leq 6.0\text{ ns}$ ; All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ . For test circuit see [Figure 6](#)

| Symbol | Parameter | Conditions | -40 °C to +85 °C |     |     | -40 °C to +125 °C |     | Unit |
|--------|-----------|------------|------------------|-----|-----|-------------------|-----|------|
|        |           |            | Min              | Typ | Max | Min               | Max |      |

### For type 74HC1G04-Q100

|          |                               |  |     |    |     |   |     |    |
|----------|-------------------------------|--|-----|----|-----|---|-----|----|
| $t_{pd}$ | propagation delay             | A to Y; see <a href="#">Figure 5</a>           | [1] |    |     |   |     |    |
|          |                               | $V_{CC} = 2.0\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 25 | 105 | - | 135 | ns |
|          |                               | $V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 9  | 21  | - | 27  | ns |
|          |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 7  | -   | - | -   | ns |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND$ to $V_{CC}$                        | [2] | 16 | -   | - | -   | pF |
|          |                               |  |     |    |     |   |     |    |

### For type 74HCT1G04-Q100

|          |                               |  |     |    |    |   |    |    |
|----------|-------------------------------|--|-----|----|----|---|----|----|
| $t_{pd}$ | propagation delay             | A to Y; see <a href="#">Figure 5</a>           | [1] |    |    |   |    |    |
|          |                               | $V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 10 | 24 | - | 27 | ns |
|          |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 8  | -  | - | -  | ns |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND$ to $V_{CC} - 1.5\text{ V}$         | [2] | 18 | -  | - | -  | pF |

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

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

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

$f_i$  = input frequency in MHz

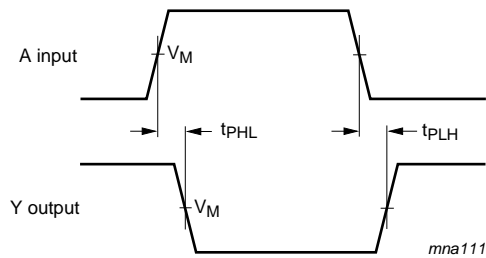
$f_o$  = output frequency in MHz

$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

$\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs

## 12. Waveforms

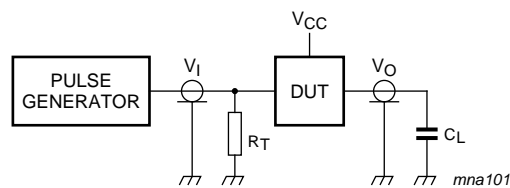


Measurement points are given in [Table 9](#).

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

**Table 9. Measurement points**

| Type           | $V_I$           | $V_M$               |
|----------------|-----------------|---------------------|
| 74HC1G04-Q100  | GND to $V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT1G04-Q100 | GND to 03 V     | 1.3 V               |



Test data is given in [Table 8](#). Definitions for test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator

$C_L$  = Load capacitance including jig and probe capacitance

**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

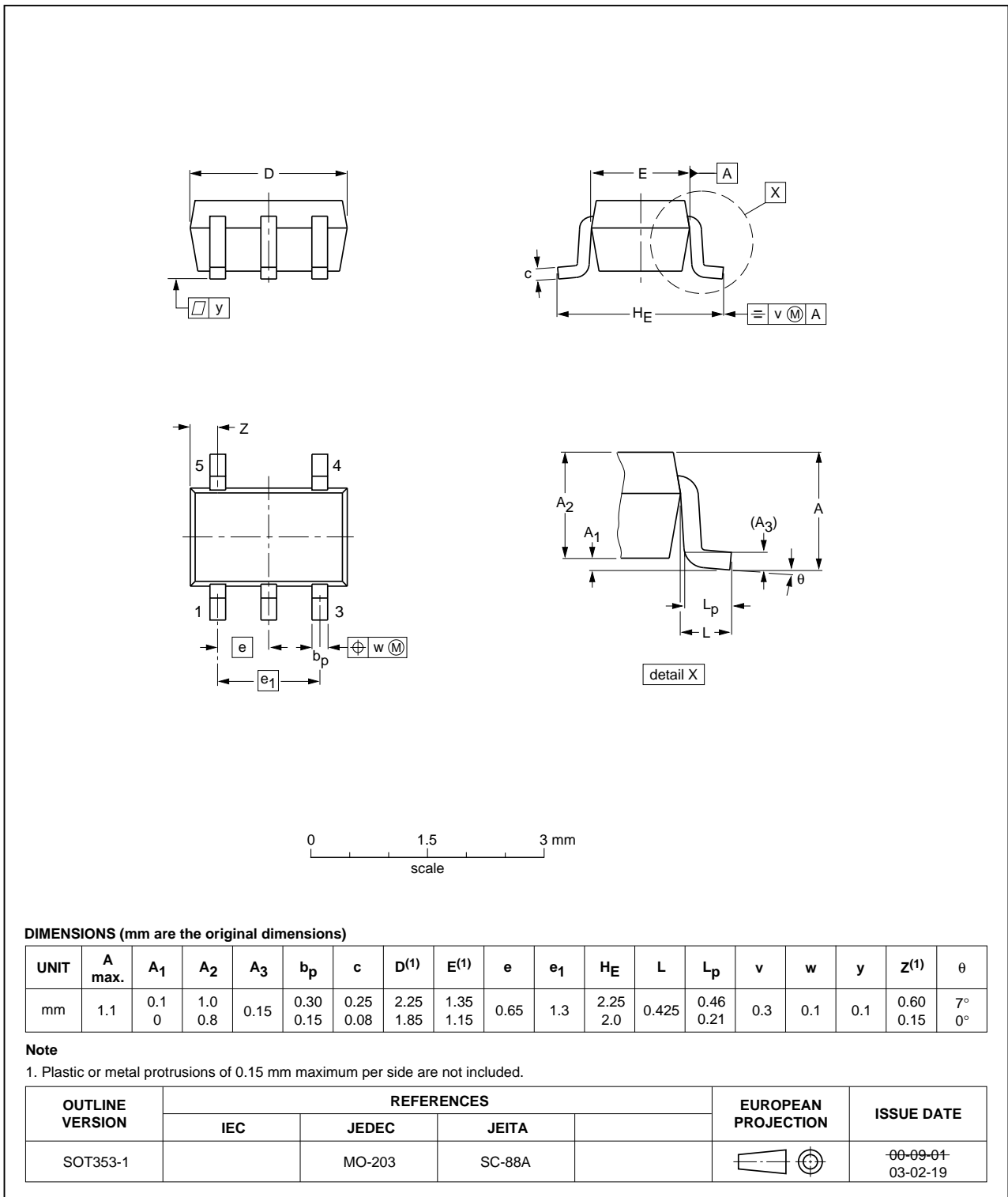


Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

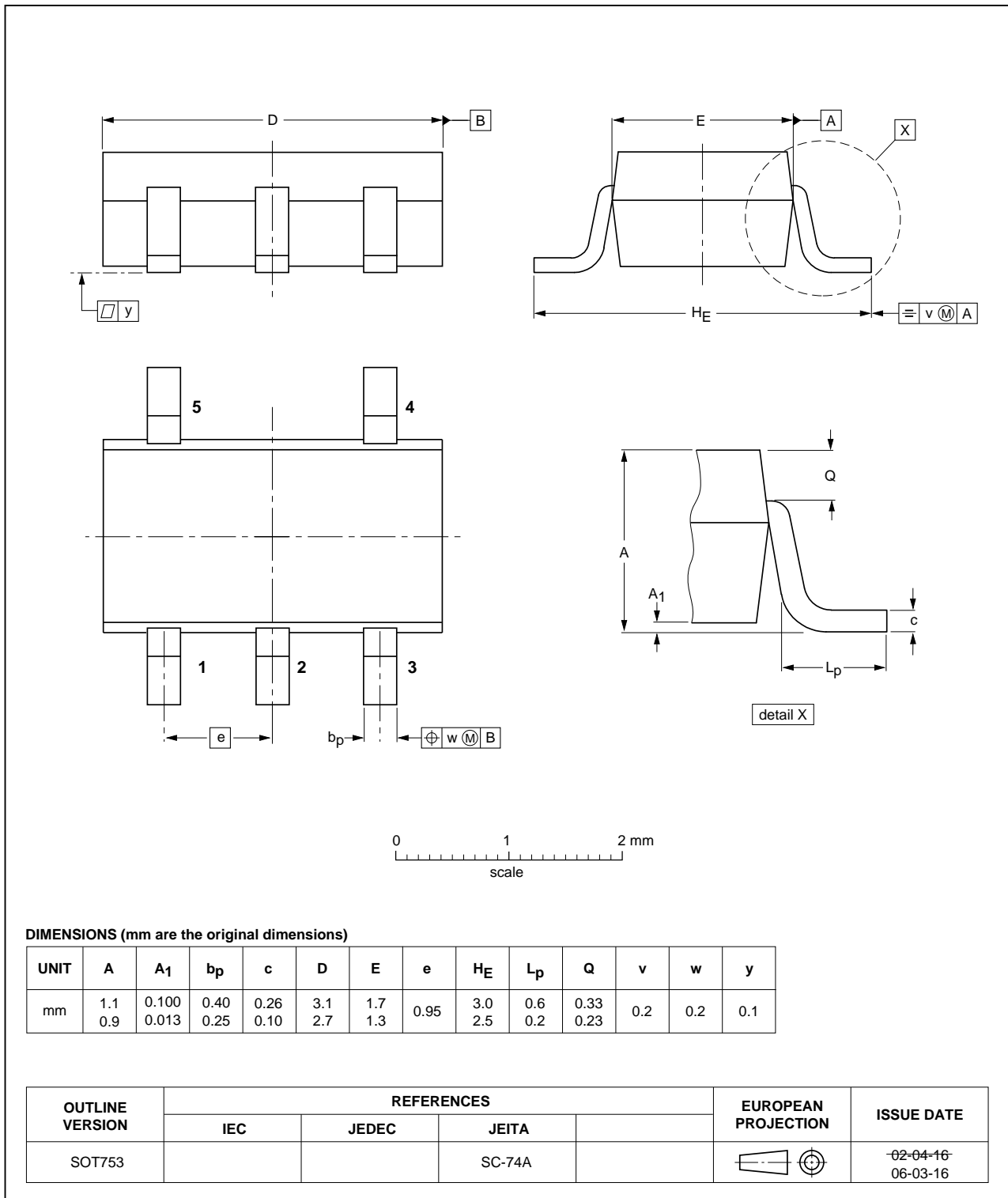


Fig 8. Package outline SOT753 (SC-74A)



## 14. Abbreviations

Table 10. Abbreviations

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

## 15. Revision history

Table 11. Revision history

| Document ID           | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------------|--------------|--------------------|---------------|------------|
| 74HC_HCT1G04_Q100 v.1 | 20130925     | 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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