

# 74HC1G04; 74HCT1G04

## Inverter

Rev. 04 — 16 July 2007

Product data sheet

## 1. General description

74HC1G04 and 74HCT1G04 are high-speed Si-gate CMOS devices. They provide an inverting buffer.

The HC device has CMOS input switching levels and supply voltage range 2 V to 6 V.

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

The standard output currents are half those of the 74HC04 and 74HCT04.

## 2. Features

- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options

## 3. Ordering information

Table 1. Ordering information

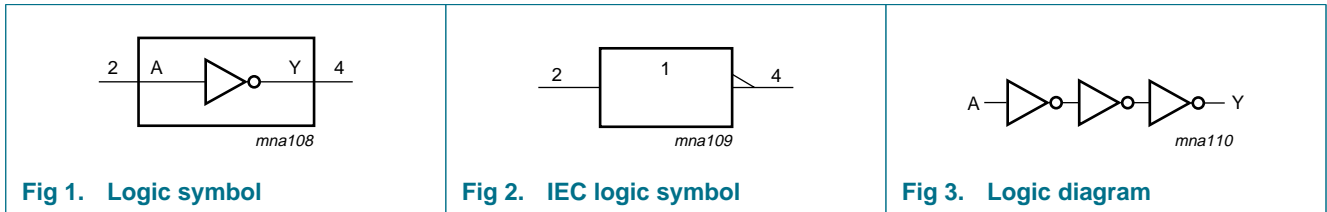
| Type number               | Package           |        |   |          |
|---------------------------|-------------------|--------|---|----------|
|                           | Temperature range | Name   | Description   | Version  |
| 74HC1G04GW<br>74HCT1G04GW | -40 °C to +125 °C | TSSOP5 | plastic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

## 4. Marking

Table 2. Marking codes

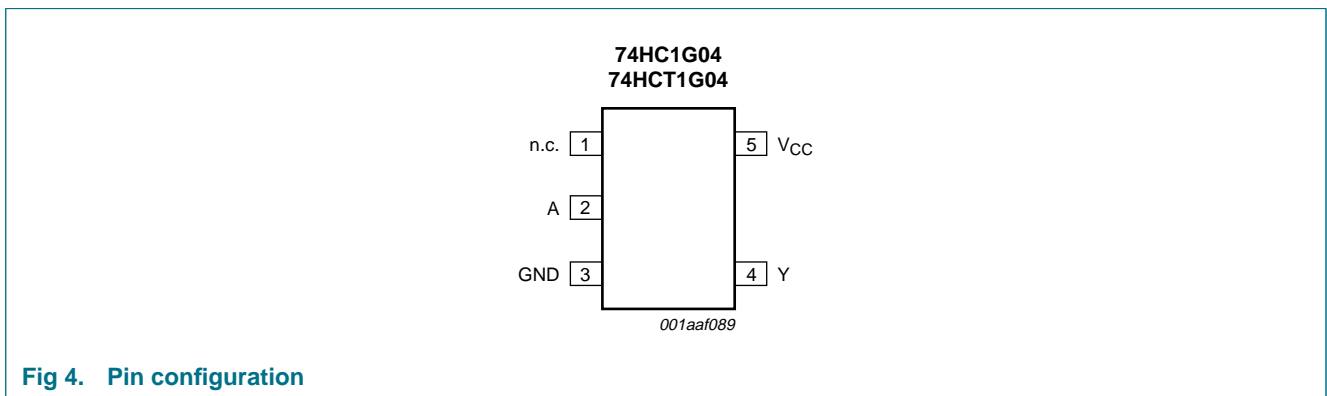
| Type number | Marking |
|-------------|---------|
| 74HC1G04GW  | HC      |
| 74HCT1G04GW | TC      |
| 74HC1G04GV  | H04     |
| 74HCT1G04GV | T04     |

## 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 |
|-----------|-------------------------|--|-----------------------|------------|------|
| $V_{CC}$  | supply voltage          |  | -0.5                  | +7.0       | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | -                     | $\pm 20$   | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | -                     | $\pm 20$   | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -                     | $\pm 12.5$ | mA   |
| $I_{CC}$  | supply current          |  | -                     | 25         | mA   |
| $I_{GND}$ | ground current          |  | -25                   | -          | mA   |
| $T_{stg}$ | storage temperature     |  | -65                   | +150       | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$          | <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  $P_{tot}$  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 |     |          | 74HCT1G04 |     |          | Unit |
|---------------------|-------------------------------------|-------------------------|----------|-----|----------|-----------|-----|----------|------|
|                     |                                     |                         | Min      | Typ | Max      | Min       | Typ | Max      |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0      | 5.0 | 6.0      | 4.5       | 5.0 | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0        | -   | $V_{CC}$ | 0         | -   | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0        | -   | $V_{CC}$ | 0         | -   | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |                         | -40      | +25 | +125     | -40       | +25 | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -        | -   | 625      | -         | -   | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -        | -   | 139      | -         | -   | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -        | -   | 83       | -         | -   | -        | ns/V |

10. Static characteristics

Table 7. Static characteristics

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

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

|          |                               |  |     |    |     |   |     |    |
|----------|-------------------------------|--|-----|----|-----|---|-----|----|
| $t_{pd}$ | 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 |
|          |                               | $V_{CC} = 6.0\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 8  | 18  | - | 23  | ns |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND$ to $V_{CC}$                        | [2] | 16 | -   | - | -   | pF |

### For type 74HCT1G04

|          |                               |  |     |    |    |   |    |    |
|----------|-------------------------------|--|-----|----|----|---|----|----|
| $t_{pd}$ | 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

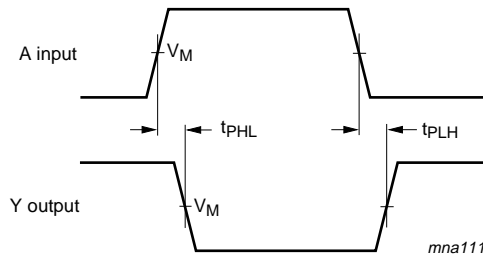
$f_o$  = output frequency in MHz

$C_L$  = 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

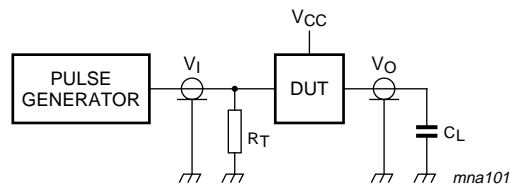


Measurement points are given in [Table 9](#).

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

Table 9. Measurement points

| Type      | V <sub>I</sub>         | V <sub>M</sub>        |
|-----------|------------------------|-----------------------|
| 74HC1G04  | GND to V <sub>CC</sub> | 0.5 × V <sub>CC</sub> |
| 74HCT1G04 | GND to 03 V            | 1.3 V                 |



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

R<sub>T</sub> = Termination resistance should be equal to output impedance Z<sub>o</sub> of the pulse generator

C<sub>L</sub> = 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

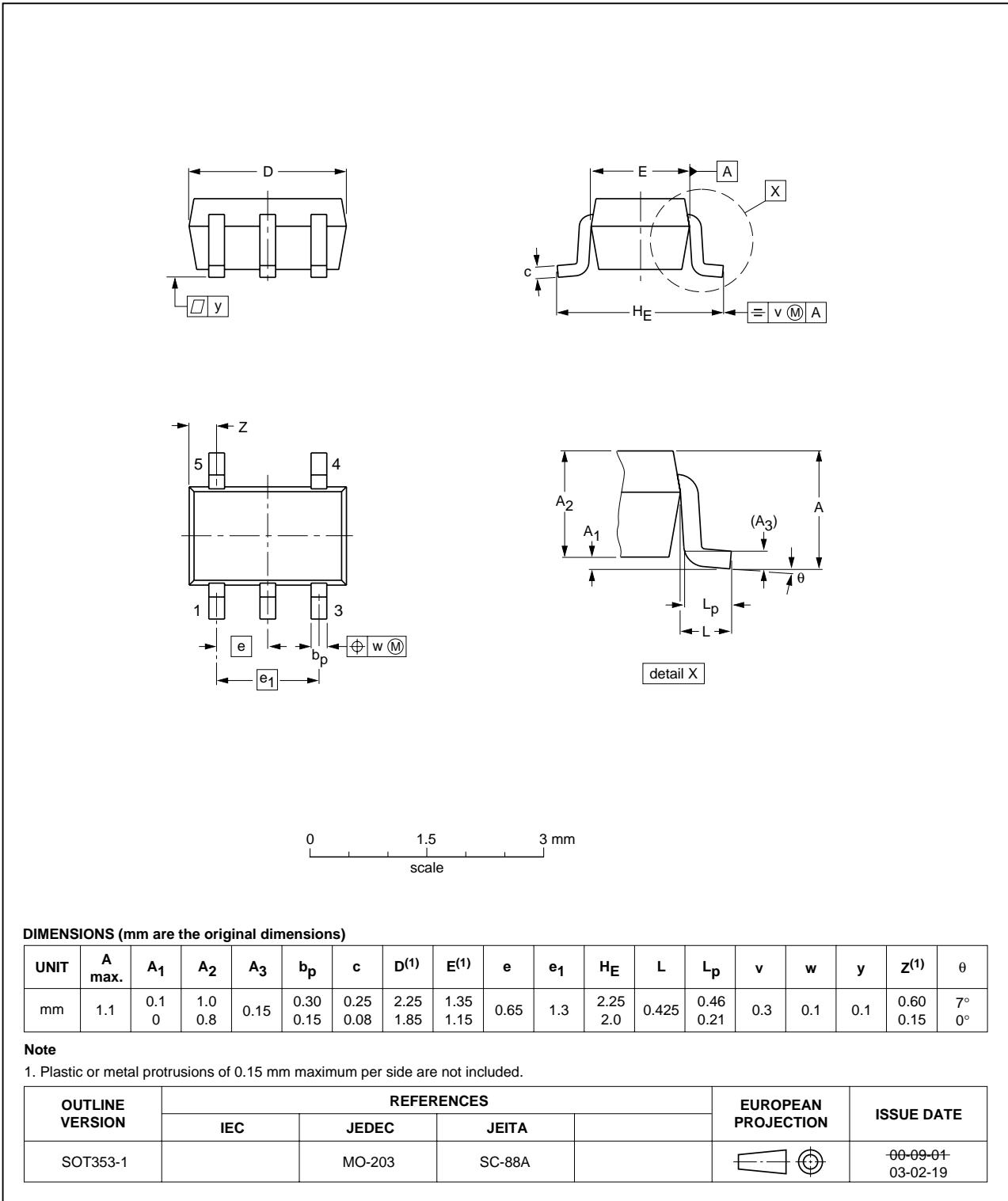


Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

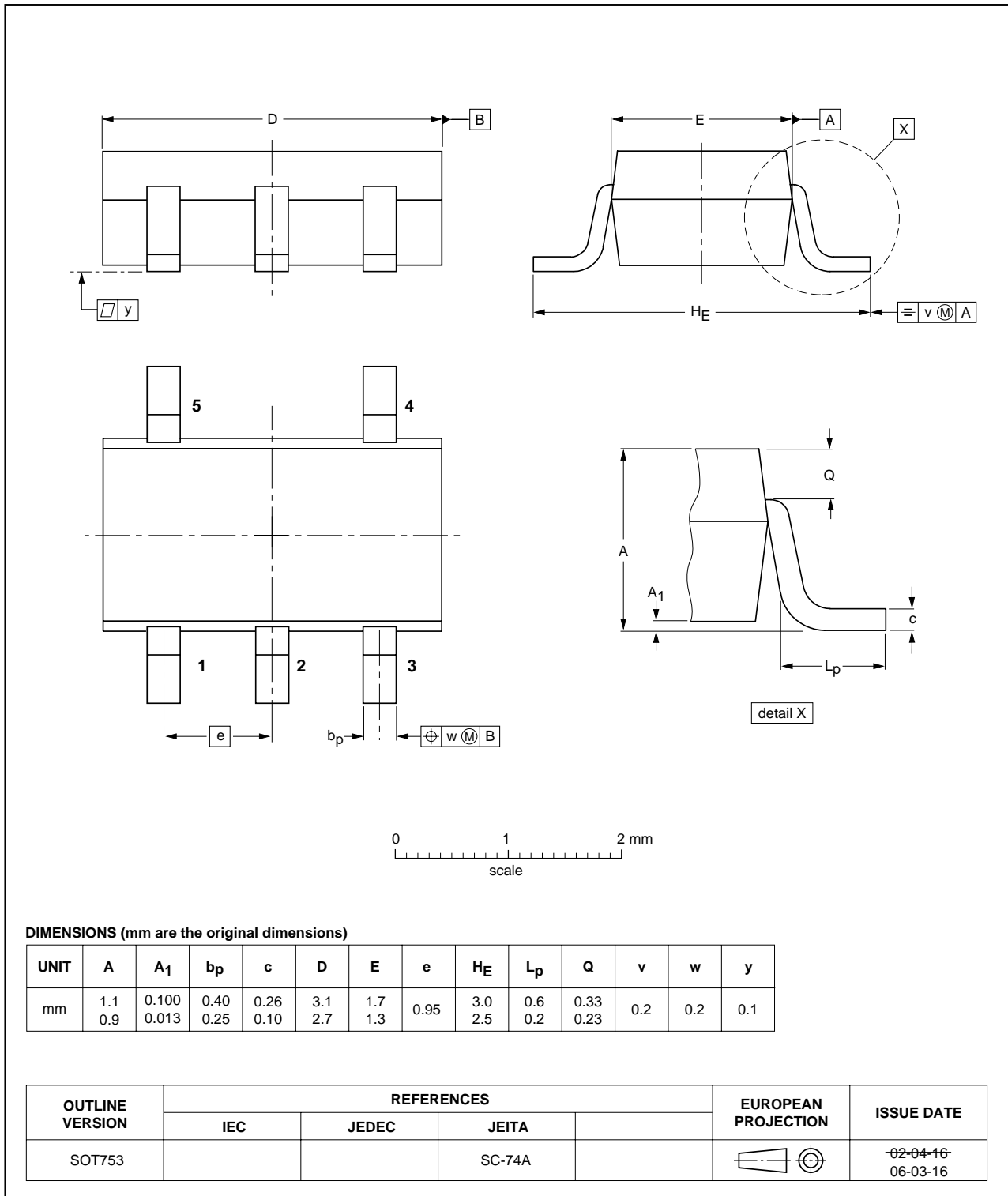


Fig 8. Package outline SOT753 (SC-74A)



## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Description                 |
|---------|-----------------------------|
| DUT     | Device Under Test           |
| TTL     | Transistor-Transistor Logic |

## 15. Revision history

Table 11. Revision history

| Document ID    | Release date  | Data sheet status         | Change notice | Supersedes     |
|----------------|---|---------------------------|---------------|----------------|
| 74HC_HCT1G04_4 | 20070716  | Product data sheet        | -             | 74HC_HCT1G04_3 |
| Modifications: | <ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• Package SOT353 changed to SOT353-1 in <a href="#">Table 1</a> and <a href="#">Figure 7</a>.</li> <li>• Quick Reference Data and Soldering sections removed.</li> <li>• <a href="#">Section 2 "Features"</a> updated.</li> </ul> |                           |               |                |
| 74HC_HCT1G04_3 | 20020517  | Product specification     | -             | 74HC_HCT1G04_2 |
| 74HC_HCT1G04_2 | 20010302  | Product specification     | -             | 74HC_HCT1G04_1 |
| 74HC_HCT1G04_1 | 19980831  | Preliminary specification | -             | -              |

## 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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