

# 74HC00-Q100; 74HCT00-Q100

Quad 2-input NAND gate

Rev. 1 — 12 July 2012

Product data sheet

## 1. General description

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The 74HC00-Q100; 74HCT00-Q100 are high-speed Si-gate CMOS devices that comply with JEDEC standard no. 7A. They are pin compatible with Low-power Schottky TTL (LSTTL).

The 74HC00-Q100; 74HCT00-Q100 provides a quad 2-input NAND function.

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

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- 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  $+125\text{ }^{\circ}\text{C}$
- Input levels:
  - ◆ For 74HC00-Q100: CMOS level
  - ◆ For 74HCT00-Q100: TTL level
- 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 pf, R = 0  $\Omega$ )
- Multiple package options



## 3. Ordering information

Table 1. Ordering information

| Type number                     | Package           |          |  | Version  |
|---------------------------------|-------------------|----------|--|----------|
|                                 | Temperature range | Name     | Description  |          |
| 74HC00D-Q100<br>74HCT00D-Q100   | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads; body width 3.9 mm   | SOT108-1 |
| 74HC00PW-Q100<br>74HCT00PW-Q100 | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads; body width 4.4 mm   | SOT402-1 |
| 74HC00BQ-Q100<br>74HCT00BQ-Q100 | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |

## 4. Functional diagram

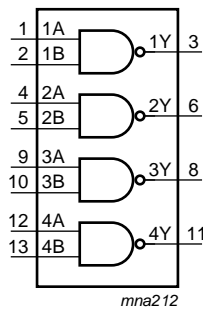


Fig 1. Logic symbol

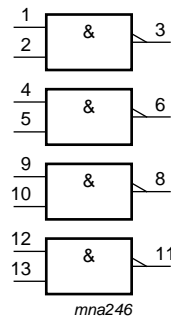


Fig 2. IEC logic symbol

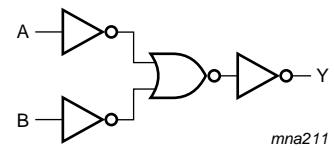
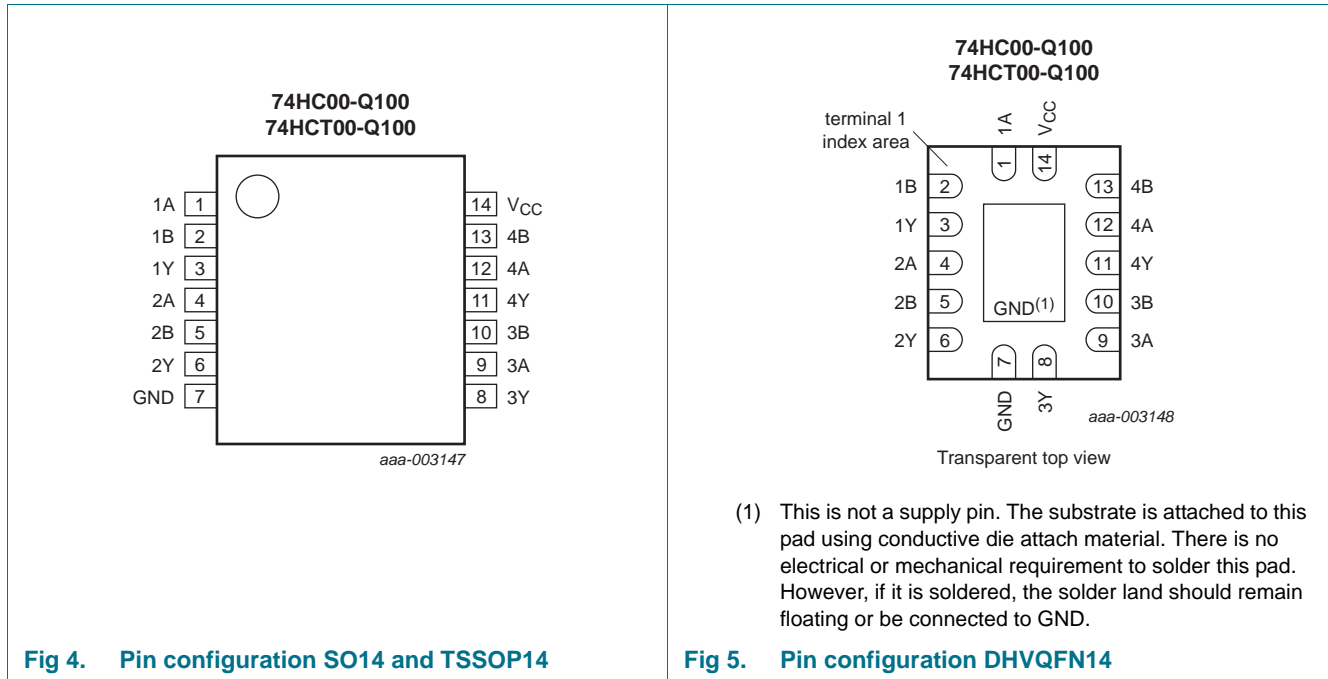


Fig 3. Logic diagram (one gate)

## 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

| Symbol          | Pin          | Description    |
|-----------------|--------------|----------------|
| 1A to 4A        | 1, 4, 9, 12  | data input     |
| 1B to 4B        | 2, 5, 10, 13 | data input     |
| 1Y to 4Y        | 3, 6, 8, 11  | data output    |
| GND             | 7            | ground (0 V)   |
| V <sub>CC</sub> | 14           | supply voltage |

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

| Input |    | Output |
|-------|----|--------|
| nA    | nB | nY     |
| L     | X  | H      |
| X     | L  | H      |
| H     | H  | L      |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

## 7. Limiting values

**Table 4. 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   | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | [1] - | ±20  | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | [1] - | ±20  | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -     | ±25  | mA   |
| $I_{CC}$  | supply current          |  | -     | 50   | mA   |
| $I_{GND}$ | ground current          |  | -50   | -    | mA   |
| $T_{stg}$ | storage temperature     |  | -65   | +150 | °C   |
| $P_{tot}$ | total power dissipation |  | [2] - | 500  | mW   |

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

[2] For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

For TSSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol              | Parameter                           | Conditions              | 74HC00-Q100 |      |          | 74HCT00-Q100 |      |          | 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 |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -           | 1.67 | 139      | -            | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -           | -    | 83       | -            | -    | -        | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

At recommended operating conditions; 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  |      |
| <b>74HC00-Q100</b> |                           |   |       |      |     |                  |      |                   |      |      |
| V <sub>IH</sub>    | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V   | -     | 1.2  | -   | 1.5              | -    | 1.5               | -    | V    |
|                    |                           | V <sub>CC</sub> = 4.5 V   | -     | 2.4  | -   | 3.15             | -    | 3.15              | -    | V    |
|                    |                           | V <sub>CC</sub> = 6.0 V   | -     | 3.2  | -   | 4.2              | -    | 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  | -     | 2.0  | -   | 1.9              | -    | 1.9               | -    | V    |
|                    |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V  | -     | 4.5  | -   | 4.4              | -    | 4.4               | -    | V    |
|                    |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V  | -     | 6.0  | -   | 5.9              | -    | 5.9               | -    | V    |
|                    |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V   | -     | 4.32 | -   | 3.84             | -    | 3.7               | -    | V    |
|                    |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V   | -     | 5.81 | -   | 5.34             | -    | 5.2               | -    | 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> = 4.0 mA; V <sub>CC</sub> = 4.5 V  | -     | 0.15 | -   | -                | 0.33 | -                 | 0.4  | V    |
|                    |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V  | -     | 0.16 | -   | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>     | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V                       | -     | -    | -   | -                | ±1   | -                 | ±1   | μA   |
| I <sub>CC</sub>    | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 6.0 V | -     | -    | -   | -                | 20   | -                 | 40   | μA   |
| C <sub>I</sub>     | input capacitance         |   | -     | 3.5  | -   | -                | -    | -                 | -    | pF   |

**Table 6. Static characteristics ...continued**

At recommended operating conditions; 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 |      |
| <b>74HCT00-Q100</b> |                           |   |       |      |     |                  |      |                   |     |      |
| V <sub>IH</sub>     | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V  | -     | 1.6  | -   | 2.0              | -    | 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> ; V <sub>CC</sub> = 4.5 V   |       |      |     |                  |      |                   |     |      |
|                     |                           | I <sub>O</sub> = -20 μA   | -     | 4.5  | -   | 4.4              | -    | 4.4               | -   | V    |
|                     |                           | I <sub>O</sub> = -4.0 mA  | -     | 4.32 | -   | 3.84             | -    | 3.7               | -   | 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> = 20 μA; V <sub>CC</sub> = 4.5 V   | -     | 0    | -   | -                | 0.1  | -                 | 0.1 | V    |
|                     |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 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   | -                 | ±1  | 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> = 6.0 V  | -     | -    | -   | -                | 20   | -                 | 40  | μA   |
| ΔI <sub>CC</sub>    | additional supply current | per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V | -     | 150  | -   | -                | 675  | -                 | 735 | μA   |
| C <sub>I</sub>      | input capacitance         |   | -     | 3.5  | -   | -                | -    | -                 | -   | pF   |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

GND = 0 V; C<sub>L</sub> = 50 pF; for load circuit see [Figure 7](#).

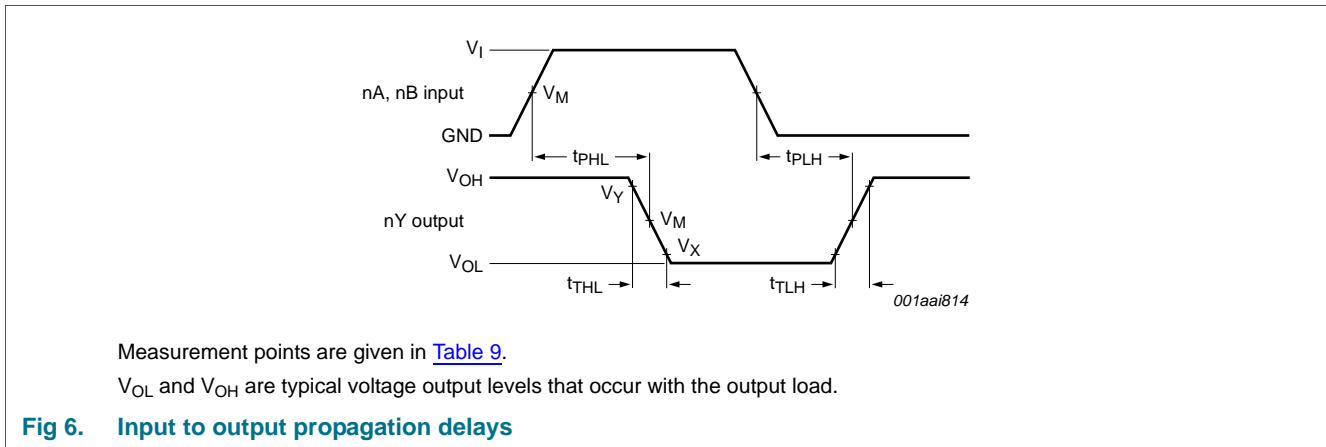
| Symbol             | Parameter                     | Conditions   | 25 °C |                     |     | -40 °C to +125 °C |              | Unit |    |
|--------------------|-------------------------------|--|-------|---------------------|-----|-------------------|--------------|------|----|
|                    |                               |  | Min   | Typ                 | Max | Max (85 °C)       | Max (125 °C) |      |    |
| <b>74HC00-Q100</b> |                               |  |       |                     |     |                   |              |      |    |
| t <sub>pd</sub>    | propagation delay             | nA, nB to nY; see <a href="#">Figure 6</a>           |       | <a href="#">[1]</a> |     |                   |              |      |    |
|                    |                               | V <sub>CC</sub> = 2.0 V                              | -     | 25                  | -   | 115               | 135          | ns   |    |
|                    |                               | V <sub>CC</sub> = 4.5 V                              | -     | 9                   | -   | 23                | 27           | ns   |    |
|                    |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF      | -     | 7                   | -   | -                 | -            | ns   |    |
|                    |                               | V <sub>CC</sub> = 6.0 V                              | -     | 7                   | -   | 20                | 23           | ns   |    |
| t <sub>t</sub>     | transition time               | see <a href="#">Figure 6</a>                         |       | <a href="#">[2]</a> |     |                   |              |      |    |
|                    |                               | V <sub>CC</sub> = 2.0 V                              | -     | 19                  | -   | 95                | 110          | ns   |    |
|                    |                               | V <sub>CC</sub> = 4.5 V                              | -     | 7                   | -   | 19                | 22           | ns   |    |
|                    |                               | V <sub>CC</sub> = 6.0 V                              | -     | 6                   | -   | 16                | 19           | ns   |    |
| C <sub>PD</sub>    | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> |       | <a href="#">[3]</a> | -   | 22                | -            | -    | pF |

**Table 7. Dynamic characteristics ...continued**  
 GND = 0 V; C<sub>L</sub> = 50 pF; for load circuit see [Figure 7](#).

| Symbol              | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +125 °C |              | Unit |    |
|---------------------|-------------------------------|--|-------|-----|-----|-------------------|--------------|------|----|
|                     |                               |  | Min   | Typ | Max | Max (85 °C)       | Max (125 °C) |      |    |
| <b>74HCT00-Q100</b> |                               |  |       |     |     |                   |              |      |    |
| t <sub>pd</sub>     | propagation delay             | nA, nB to nY; see <a href="#">Figure 6</a>                   | [1]   |     |     |                   |              |      |    |
|                     |                               | V <sub>CC</sub> = 4.5 V                                      | -     | 12  | -   | 24                | 29           | ns   |    |
|                     |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF              | -     | 10  | -   | -                 | -            | ns   |    |
| t <sub>t</sub>      | transition time               | V <sub>CC</sub> = 4.5 V; see <a href="#">Figure 6</a>        | [2]   | -   | -   | -                 | 29           | 22   | ns |
| C <sub>PD</sub>     | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V | [3]   | -   | 22  | -                 | -            | -    | pF |

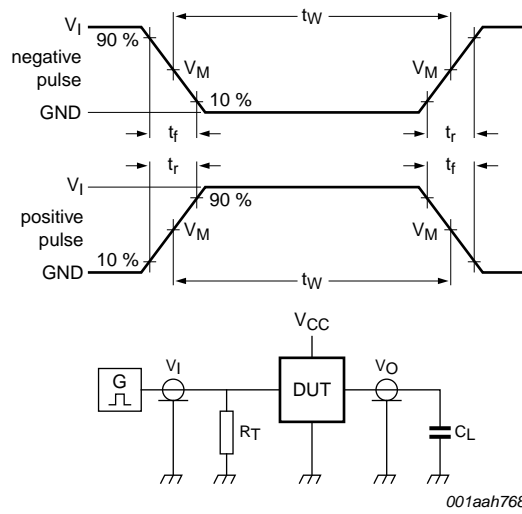
- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V;  
 N = number of inputs switching;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## 11. Waveforms



**Table 8. Measurement points**

| Type         | Input              | Output             |                    |                    |
|--------------|--------------------|--------------------|--------------------|--------------------|
|              | V <sub>M</sub>     | V <sub>M</sub>     | V <sub>X</sub>     | V <sub>Y</sub>     |
| 74HC00-Q100  | 0.5V <sub>CC</sub> | 0.5V <sub>CC</sub> | 0.1V <sub>CC</sub> | 0.9V <sub>CC</sub> |
| 74HCT00-Q100 | 1.3 V              | 1.3 V              | 0.1V <sub>CC</sub> | 0.9V <sub>CC</sub> |



Test data is given in [Table 9](#).

Definitions 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 7. Test circuit for measuring switching times**

**Table 9. Test data**

| Type         | Input    |            | Load         | Test               |
|--------------|----------|------------|--------------|--------------------|
|              | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC00-Q100  | $V_{CC}$ | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT00-Q100 | 3.0 V    | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |



12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

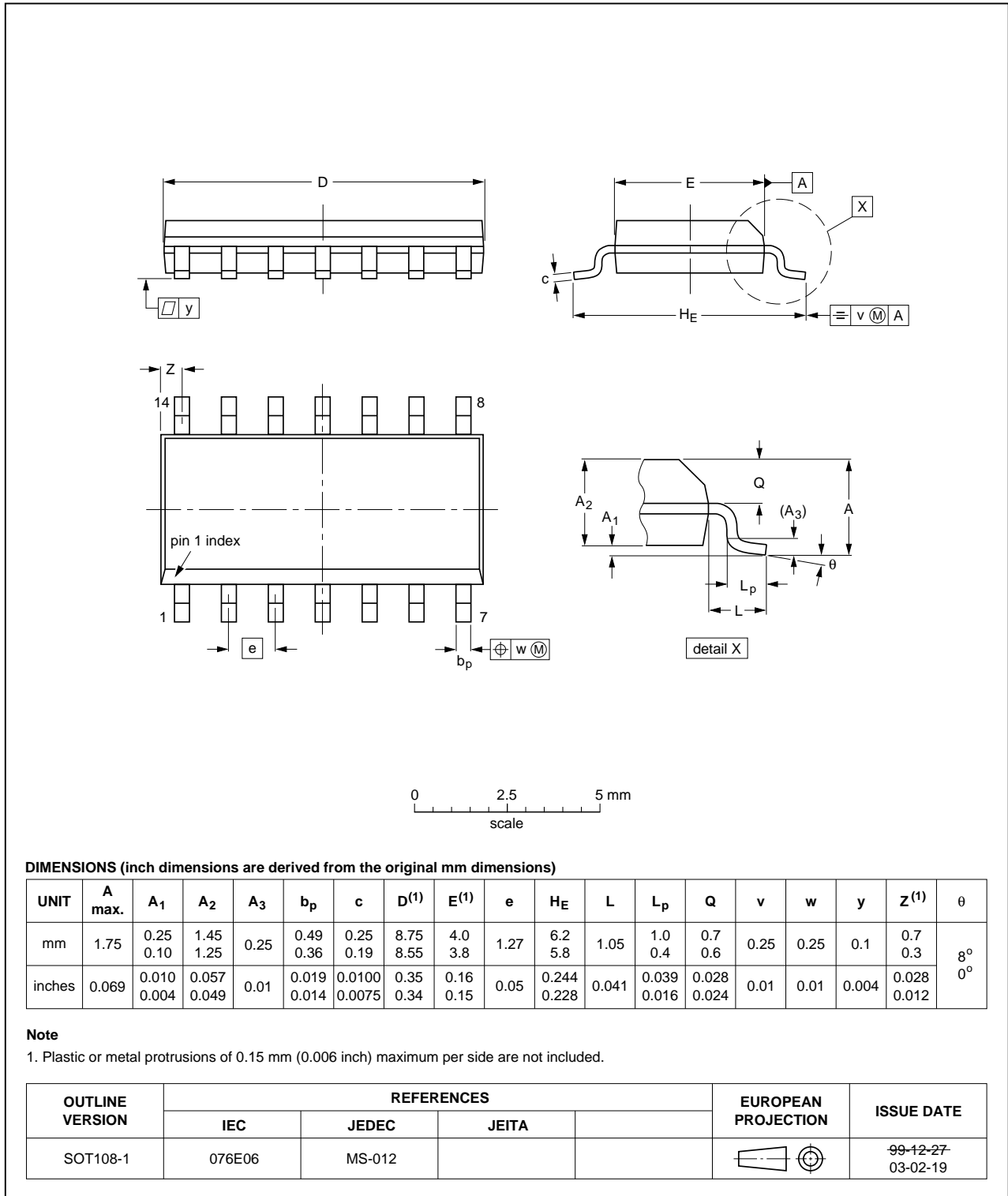


Fig 8. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

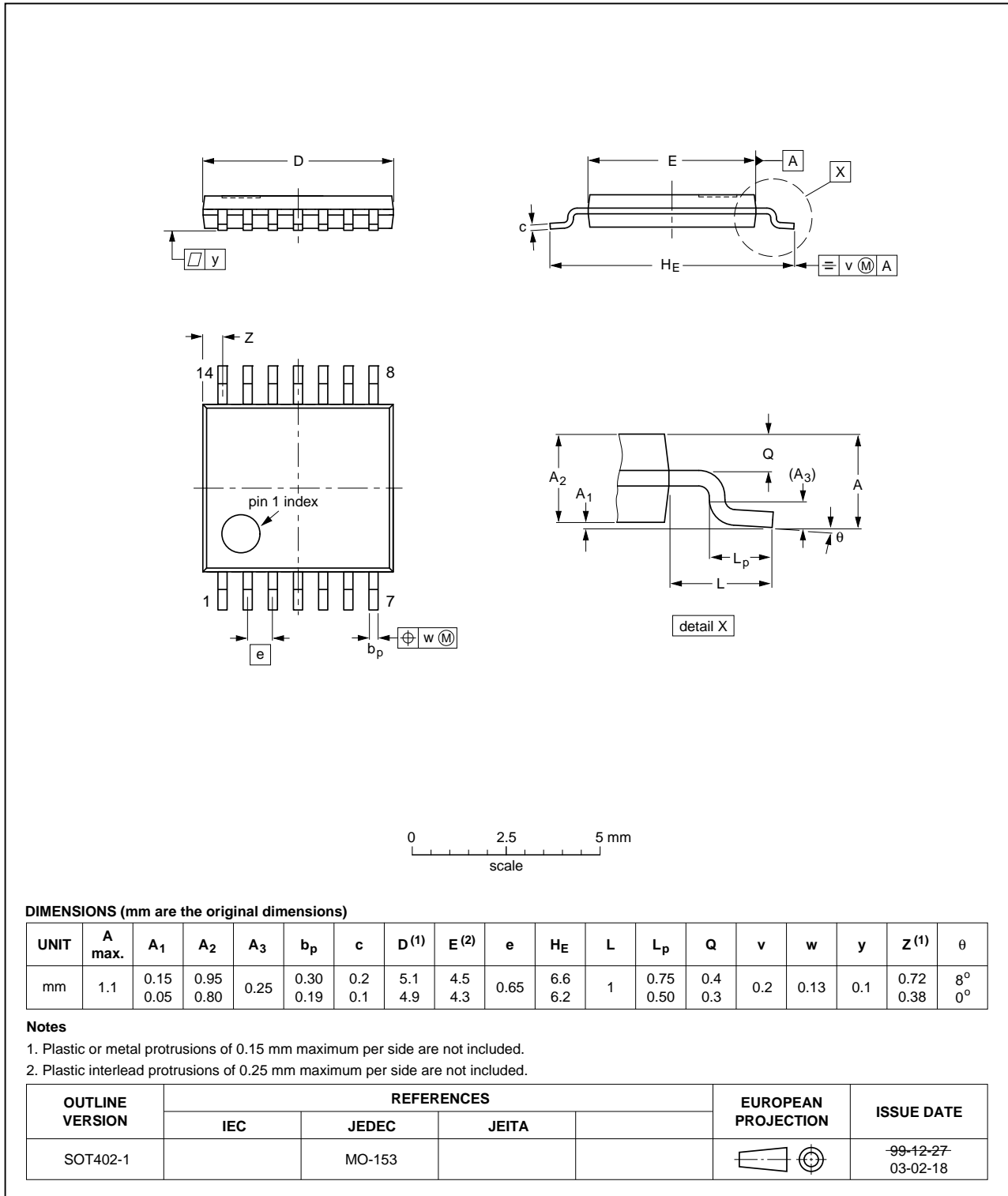
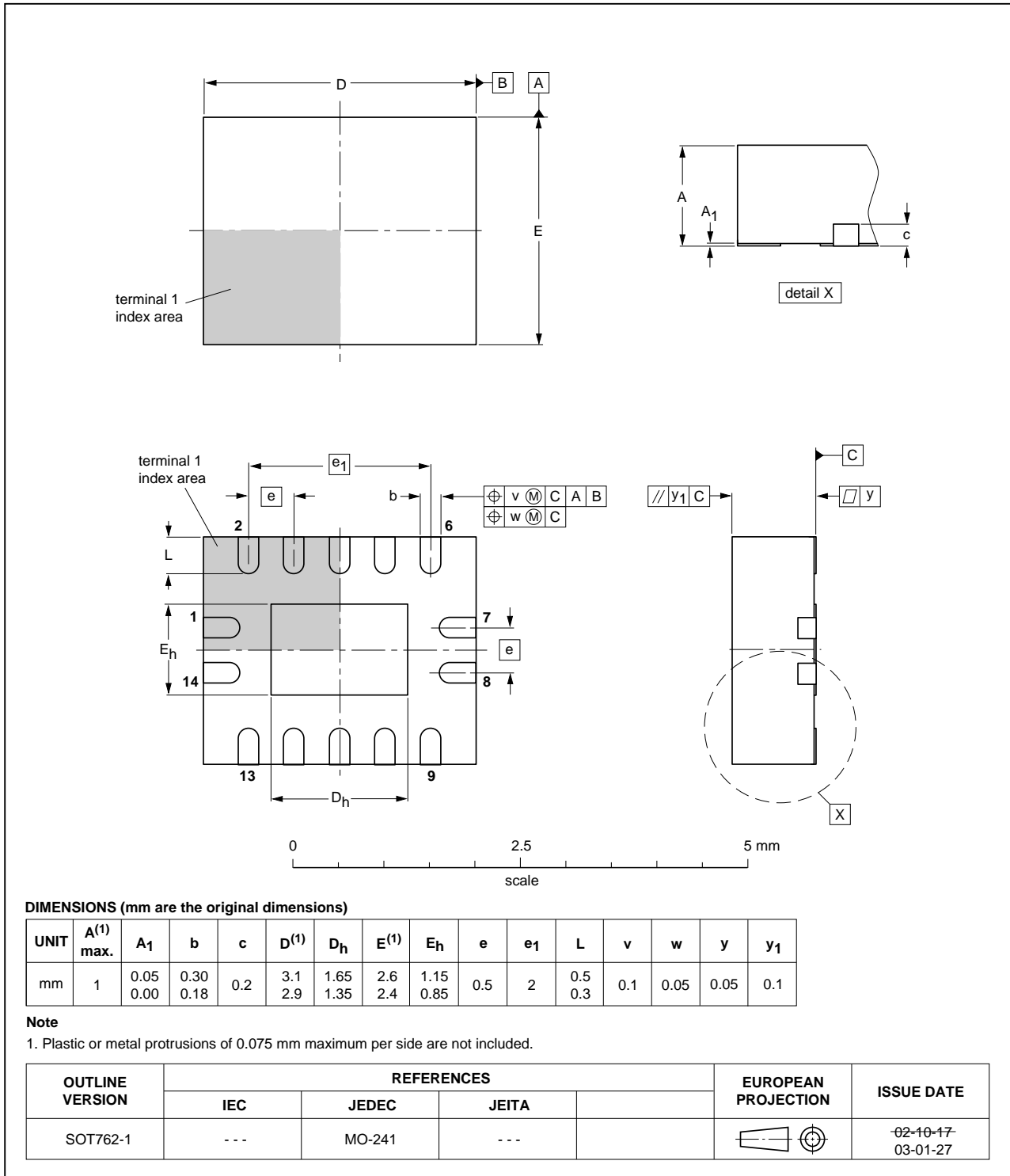


Fig 9. Package outline SOT402-1 (TSSOP14)

**DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm**

**SOT762-1**



**Fig 10. Package outline SOT762-1 (DHVQFN14)**

## 13. Abbreviations

Table 10. Abbreviations

| Acronym | Description                                    |
|---------|--|
| CMOS    | Complementary Metal-Oxide Semiconductor        |
| DUT     | Device Under Test                              |
| ESD     | ElectroStatic Discharge                        |
| HBM     | Human Body Model                               |
| LSTTL   | Low-power Schottky Transistor-Transistor Logic |
| MM      | Machine Model                                  |
| TTL     | Transistor-Transistor Logic                    |
| MIL     | Military                                       |

## 14. Revision history

Table 11. Revision history

| Document ID         | Release date | Data sheet status  | Change notice | Supersedes |
|---------------------|--------------|--------------------|---------------|------------|
| 74HC_HCT00_Q100 v.1 | 20120712     | Product data sheet | -             | -          |

## 15. Legal information

### 15.1 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.nxp.com>.

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