

74HC00; 74HCT00

Quad 2-input NAND gate

Rev. 7 — 25 November 2015

Product data sheet

1. General description

The 74HC00; 74HCT00 is a quad 2-input NAND gate. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

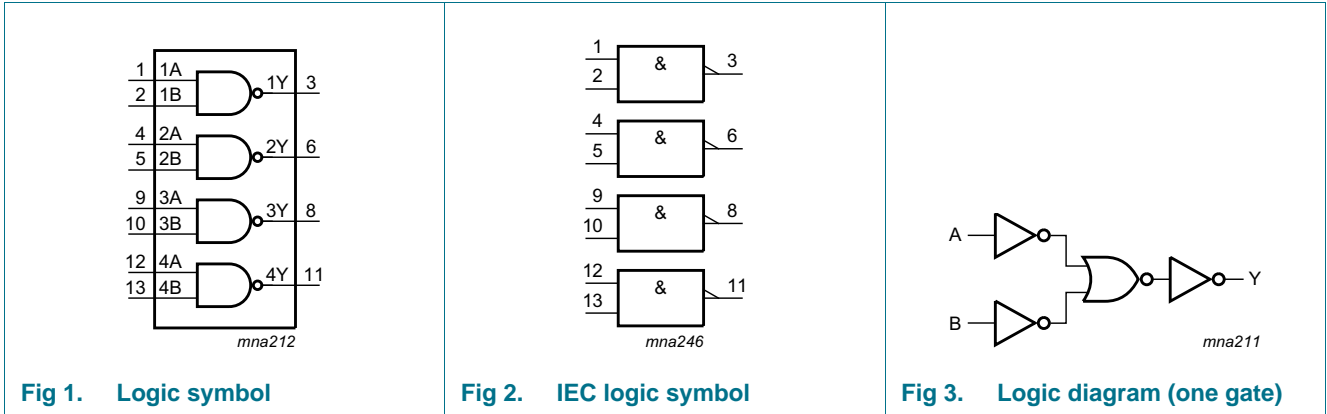
- Input levels:
 - ◆ For 74HC00: CMOS level
 - ◆ For 74HCT00: TTL level
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to $+85\text{ °C}$ and from -40 °C to $+125\text{ °C}$

3. Ordering information

Table 1. Ordering information

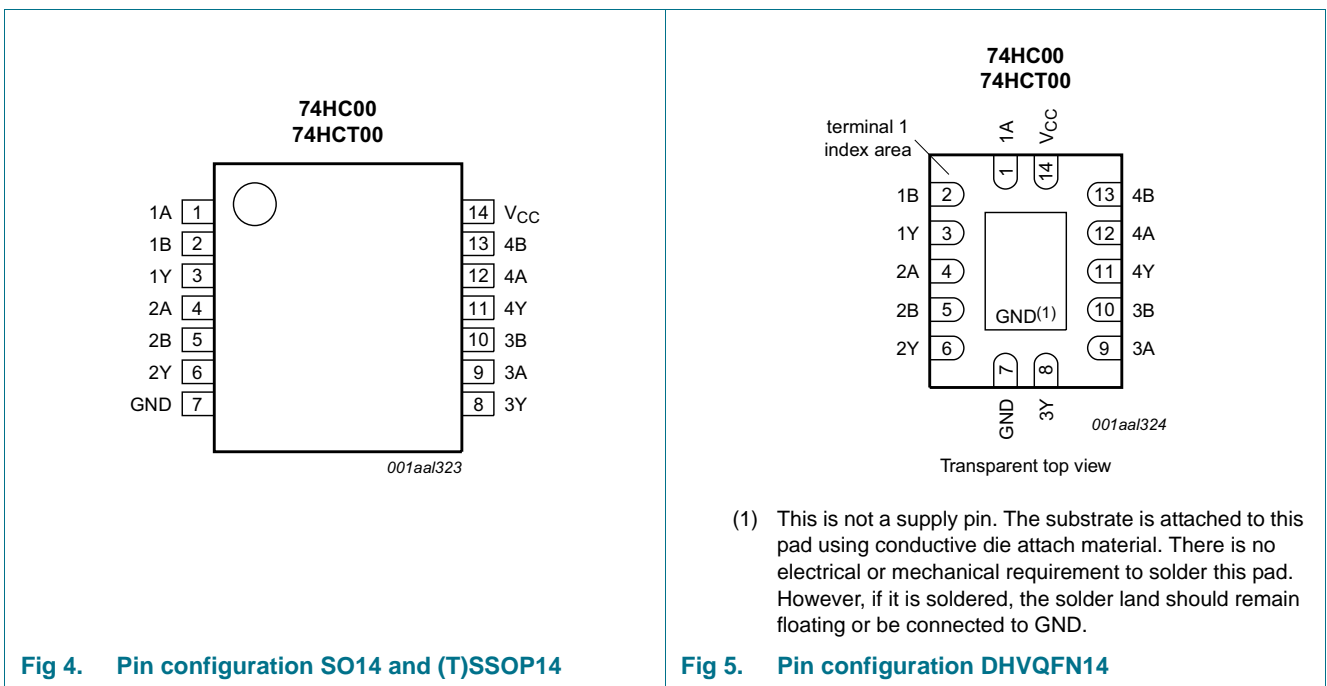
| Type number | Package | | | |
|-------------|-------------------------------------|----------|---|----------|
| | Temperature range | Name | Description | Version |
| 74HC00D | -40 °C to $+125\text{ °C}$ | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74HCT00D | | | | |
| 74HC00DB | -40 °C to $+125\text{ °C}$ | SSOP14 | plastic shrink small outline package; 14 leads; body width 5.3 mm | SOT337-1 |
| 74HCT00DB | | | | |
| 74HC00PW | -40 °C to $+125\text{ °C}$ | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74HCT00PW | | | | |
| 74HC00BQ | -40 °C to $+125\text{ °C}$ | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85\text{ mm}$ | SOT762-1 |
| 74HCT00BQ | | | | |

4. Functional diagram



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 _{CC} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

| 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] | | |
| | SO14, (T)SSOP14 and DHVQFN14 packages | | - | 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 (T)SSOP14 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 | | | 74HCT00 | | | 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 |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 2.0 V | - | - | 625 | - | - | - | ns/V |
| | | V _{CC} = 4.5 V | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | V _{CC} = 6.0 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 | |
| 74HC00 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | - | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 4.5 V | - | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | V _{CC} = 6.0 V | - | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | 0.8 | - | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 4.5 V | - | 2.1 | - | - | 1.35 | - | 1.35 | V |
| | | V _{CC} = 6.0 V | - | 2.8 | - | - | 1.8 | - | 1.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = -20 μA; V _{CC} = 2.0 V | - | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -20 μA; V _{CC} = 4.5 V | - | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 μA; V _{CC} = 6.0 V | - | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = -4.0 mA; V _{CC} = 4.5 V | - | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -5.2 mA; V _{CC} = 6.0 V | - | 5.81 | - | 5.34 | - | 5.2 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 20 μA; V _{CC} = 2.0 V | - | 0 | - | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 4.5 V | - | 0 | - | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 6.0 V | - | 0 | - | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | - | - | 0.33 | - | 0.4 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.16 | - | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | - | - | ±1 | - | ±1 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | - | - | - | 20 | - | 40 | μA |

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 | |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| 74HCT00 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.6 | - | 2.0 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | - | - | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = -20 µA | - | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -4.0 mA | - | 4.32 | - | 3.84 | - | 3.7 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = 20 µA; V _{CC} = 4.5 V | - | 0 | - | - | 0.1 | - | 0.1 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.15 | - | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | - | - | ±1 | - | ±1 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | - | - | - | 20 | - | 40 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V | - | 150 | - | - | 675 | - | 735 | µA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristicsGND = 0 V; C_L = 50 pF; for test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------|--|-------|-----|-----|-------------------|--------------|------|
| | | | Min | Typ | Max | Max (85 °C) | Max (125 °C) | |
| 74HC00 | | | | | | | | |
| t _{pd} | propagation delay | nA, nB to nY; see Figure 6 [1] | | | | | | |
| | | V _{CC} = 2.0 V | - | 25 | - | 115 | 135 | ns |
| | | V _{CC} = 4.5 V | - | 9 | - | 23 | 27 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 7 | - | - | - | ns |
| | | V _{CC} = 6.0 V | - | 7 | - | 20 | 23 | ns |
| t _t | transition time | see Figure 6 [2] | | | | | | |
| | | V _{CC} = 2.0 V | - | 19 | - | 95 | 110 | ns |
| | | V _{CC} = 4.5 V | - | 7 | - | 19 | 22 | ns |
| | | V _{CC} = 6.0 V | - | 6 | - | 16 | 19 | ns |

Table 7. Dynamic characteristics ...continued
GND = 0 V; C_L = 50 pF; for test circuit see Figure 7.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|-------|-----|-----|-------------------|--------------|------|
| | | | Min | Typ | Max | Max (85 °C) | Max (125 °C) | |
| C _{PD} | power dissipation capacitance | per package; V _I = GND to V _{CC} [3] | - | 22 | - | - | - | pF |
| 74HCT00 | | | | | | | | |
| t _{pd} | propagation delay | nA, nB to nY; see Figure 6 [1] | | | | | | |
| | | V _{CC} = 4.5 V | - | 12 | - | 24 | 29 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 10 | - | - | - | ns |
| t _t | transition time | V _{CC} = 4.5 V; see Figure 6 [2] | - | - | - | 29 | 22 | ns |
| C _{PD} | power dissipation capacitance | per package; V _I = GND to V _{CC} - 1.5 V [3] | - | 22 | - | - | - | pF |

- [1] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [2] t_t is the same as t_{THL} and t_{TLH}.
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ 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 V;
 N = number of inputs switching;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms

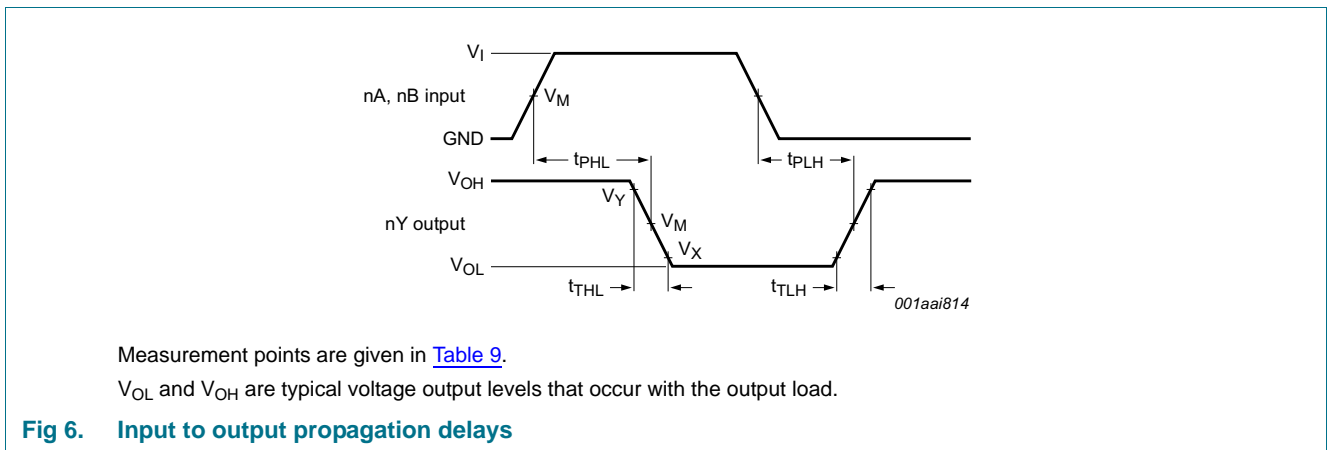
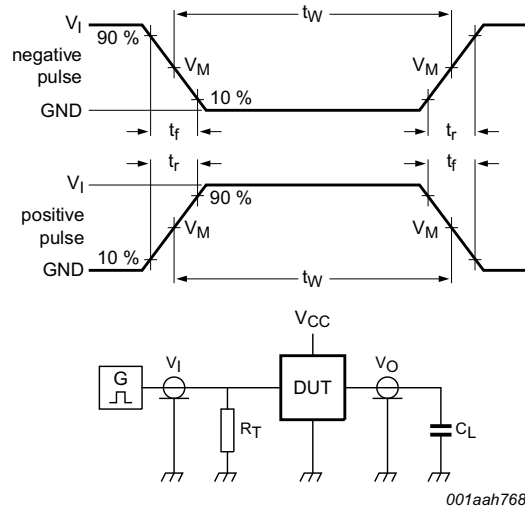


Table 8. Measurement points

| Type | Input | Output | | |
|---------|--------------------|--------------------|--------------------|--------------------|
| | V _M | V _M | V _X | V _Y |
| 74HC00 | 0.5V _{CC} | 0.5V _{CC} | 0.1V _{CC} | 0.9V _{CC} |
| 74HCT00 | 1.3 V | 1.3 V | 0.1V _{CC} | 0.9V _{CC} |



001aah768

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 | V_{CC} | 6.0 ns | 15 pF, 50 pF | t_{PLH}, t_{PHL} |
| 74HCT00 | 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)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

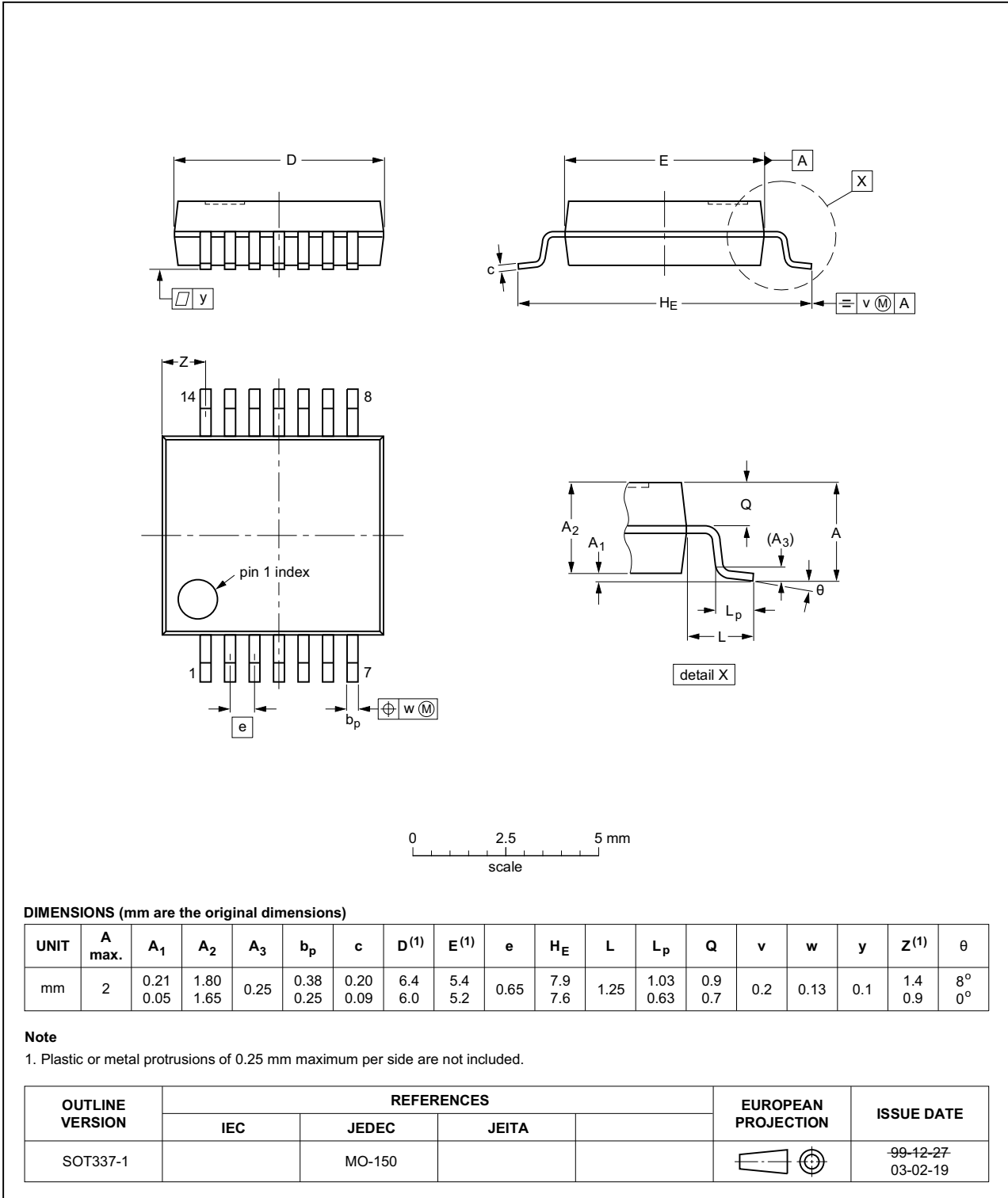


Fig 9. Package outline SOT337-1 (SSOP14)

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

SOT402-1



Fig 10. 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 11. 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 |

14. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------|--|-----------------------|---------------|--------------------|
| 74HC_HCT00 v.7 | 20151125 | Product data sheet | - | 74HC_HCT00 v.6 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74HC00N and 74HCT00N (SOT27-1) removed. | | | |
| 74HC_HCT00 v.6 | 20111214 | Product data sheet | - | 74HC_HCT00 v.5 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. | | | |
| 74HC_HCT00 v.5 | 20101125 | Product data sheet | - | 74HC_HCT00 v.4 |
| 74HC_HCT00 v.4 | 20100111 | Product data sheet | - | 74HC_HCT00 v.3 |
| 74HC_HCT00 v.3 | 20030630 | Product data sheet | - | 74HC_HCT00_CNV v.2 |
| 74HC_HCT00_CNV v.2 | 19970826 | Product specification | - | - |

15. Legal information

15.1 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. |
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[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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