

# 74HC21

## Dual 4-input AND gate

Rev. 6 — 8 February 2013

Product data sheet

### 1. General description

The 74HC21 is a high-speed Si-gate CMOS device and is pin compatible with low-power Schottky TTL (LSTTL).

The 74HC21 provide the 4-input AND function.

### 2. Features and benefits

- Low-power dissipation
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

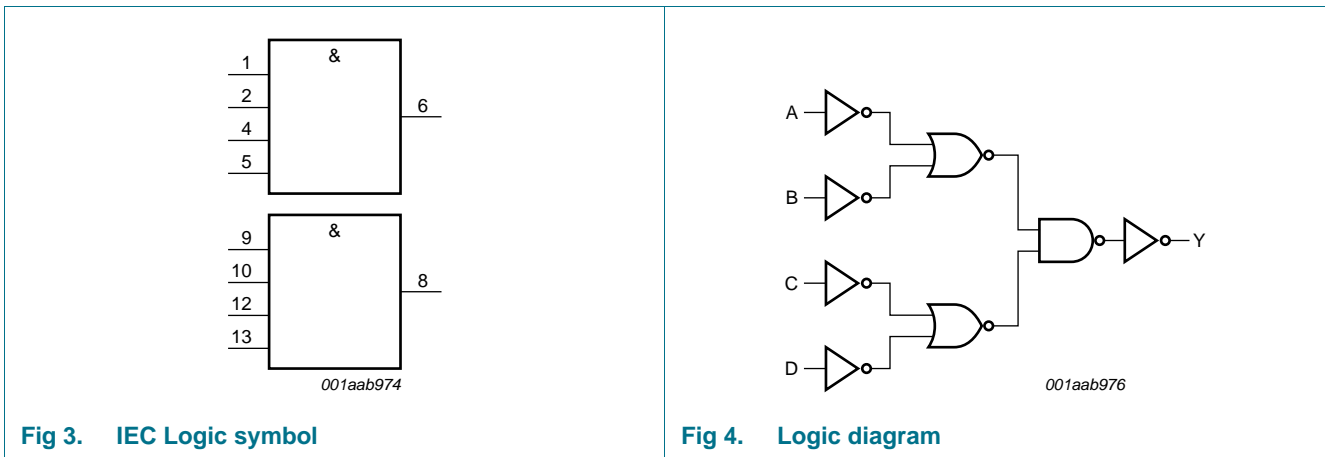
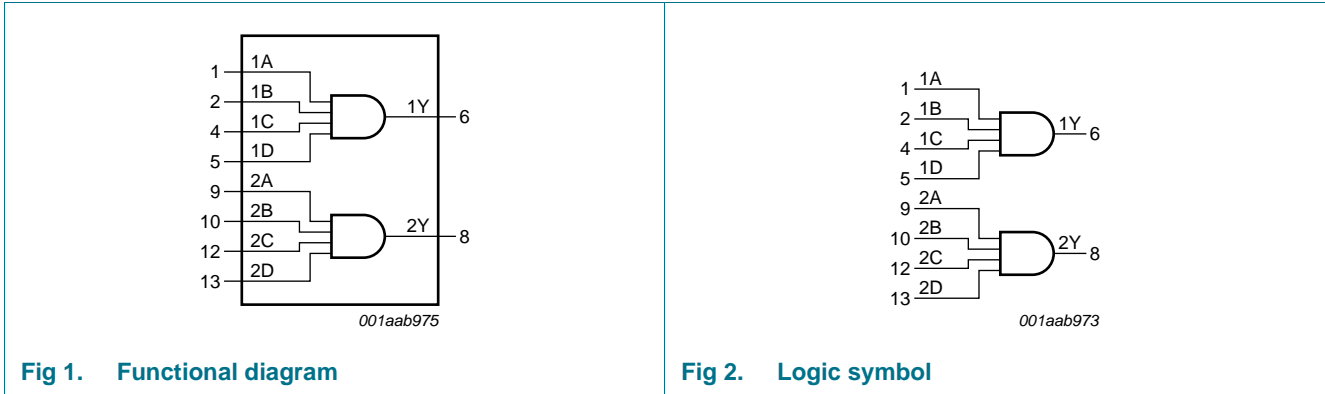
### 3. Ordering information

Table 1. Ordering information

| Type number | Package   |         |   |          |
|-------------|---|---------|---|----------|
|             | Temperature range   | Name    | Description   | Version  |
| 74HC21N     | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | DIP14   | plastic dual in-line package; 14 leads (300 mil)                          | SOT27-1  |
| 74HC21D     | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO14    | plastic small outline package; 14 leads;<br>body width 3.9 mm             | SOT108-1 |
| 74HC21DB    | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SSOP14  | plastic shrink small outline package; 14 leads;<br>body width 5.3 mm      | SOT337-1 |
| 74HC21PW    | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP14 | plastic thin shrink small outline package; 14 leads;<br>body width 4.4 mm | SOT402-1 |

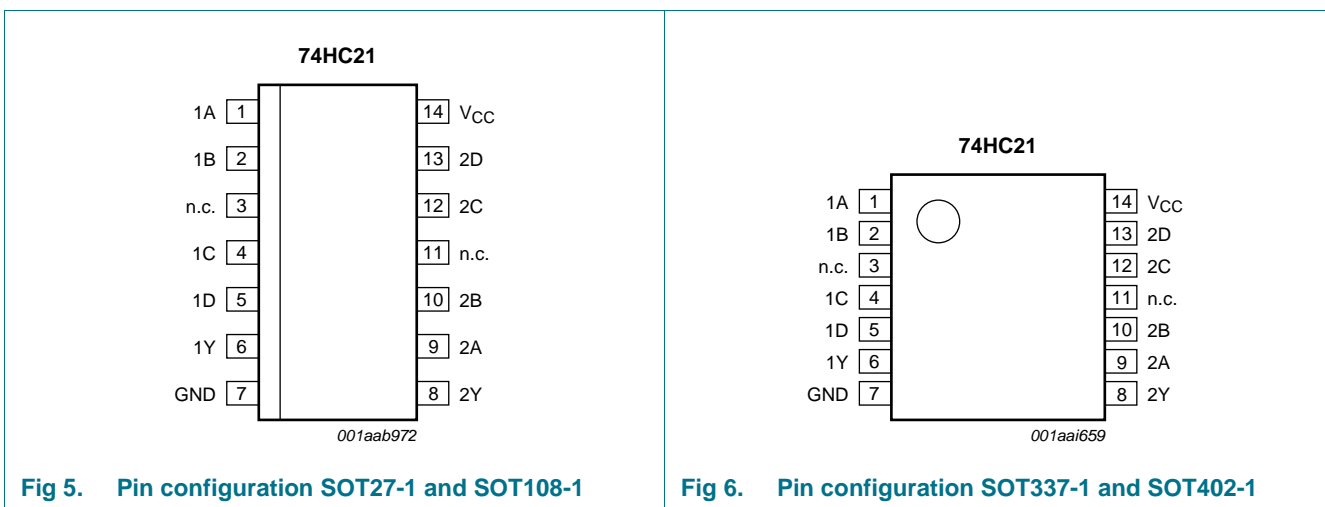


## 4. Functional diagram



## 5. Pinning information

### 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

| Symbol          | Pin           | Description    |
|-----------------|---------------|----------------|
| 1A, 1B, 1C, 1D  | 1, 2, 4, 5    | data input     |
| n.c.            | 3, 11         | not connected  |
| 1Y              | 6             | data output    |
| GND             | 7             | ground (0 V)   |
| 2Y              | 8             | data output    |
| 2A, 2B, 2C, 2D  | 9, 10, 12, 13 | data input     |
| V <sub>CC</sub> | 14            | supply voltage |

## 6. Functional description

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

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

[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 <sub>CC</sub>  | supply voltage              |  | -0.5 | +7   | V    |
| I <sub>IK</sub>  | input clamping current      | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | [1]  | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current     | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | [1]  | ±20  | mA   |
| I <sub>O</sub>   | output current              | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current              |  | -    | 50   | mA   |
| I <sub>GND</sub> | ground current              |  | -50  | -    | mA   |
| T <sub>stg</sub> | storage temperature         |  | -65  | +150 | °C   |
| P <sub>tot</sub> | total power dissipation     |  | [2]  |      |      |
|                  | DIP14 package               |  | -    | 750  | mW   |
|                  | SO14 and (T)SSOP14 packages |  | -    | 500  | mW   |

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

[2] For DIP14 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

For SO14 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

For (T)SSOP14 packages: P<sub>tot</sub> derates linearly with 5.5 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       | Min | Typ  | Max      | Unit |
|---------------------|-------------------------------------|------------------|-----|------|----------|------|
| $V_{CC}$            | supply voltage                      |                  | 2.0 | 5.0  | 6.0      | V    |
| $V_I$               | input voltage                       |                  | 0   | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                  | 0   | -    | $V_{CC}$ | V    |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0$ V | -   | -    | 625      | ns/V |
|                     |                                     | $V_{CC} = 4.5$ V | -   | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0$ V | -   | -    | 83       | ns/V |
| $T_{amb}$           | ambient temperature                 |                  | -40 | -    | +125     | °C   |

## 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     |         |
| $V_{IH}$ | HIGH-level input voltage  | $V_{CC} = 2.0$ V  | 1.5   | 1.2  | -         | 1.5              | -       | 1.5               | -       | V       |
|          |                           | $V_{CC} = 4.5$ V  | 3.15  | 2.4  | -         | 3.15             | -       | 3.15              | -       | V       |
|          |                           | $V_{CC} = 6.0$ V  | 4.2   | 3.2  | -         | 4.2              | -       | 4.2               | -       | V       |
| $V_{IL}$ | LOW-level input voltage   | $V_{CC} = 2.0$ V  | -     | 0.8  | 0.5       | -                | 0.5     | -                 | 0.5     | V       |
|          |                           | $V_{CC} = 4.5$ V  | -     | 2.1  | 1.35      | -                | 1.35    | -                 | 1.35    | V       |
|          |                           | $V_{CC} = 6.0$ V  | -     | 2.8  | 1.8       | -                | 1.8     | -                 | 1.8     | V       |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$                              |       |      |           |                  |         |                   |         |         |
|          |                           | $I_O = -20$ $\mu$ A; $V_{CC} = 2.0$ V                   | 1.9   | 2.0  | -         | 1.9              | -       | 1.9               | -       | V       |
|          |                           | $I_O = -20$ $\mu$ A; $V_{CC} = 4.5$ V                   | 4.4   | 4.5  | -         | 4.4              | -       | 4.4               | -       | V       |
|          |                           | $I_O = -20$ $\mu$ A; $V_{CC} = 6.0$ V                   | 5.9   | 6.0  | -         | 5.9              | -       | 5.9               | -       | V       |
|          |                           | $I_O = -4.0$ mA; $V_{CC} = 4.5$ V                       | 3.98  | 4.32 | -         | 3.84             | -       | 3.7               | -       | V       |
|          |                           | $I_O = -5.2$ mA; $V_{CC} = 6.0$ V                       | 5.48  | 5.81 | -         | 5.34             | -       | 5.2               | -       | V       |
| $V_{OL}$ | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$                              |       |      |           |                  |         |                   |         |         |
|          |                           | $I_O = 20$ $\mu$ A; $V_{CC} = 2.0$ V                    | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V       |
|          |                           | $I_O = 20$ $\mu$ A; $V_{CC} = 4.5$ V                    | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V       |
|          |                           | $I_O = 20$ $\mu$ A; $V_{CC} = 6.0$ V                    | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V       |
|          |                           | $I_O = 4.0$ mA; $V_{CC} = 4.5$ V                        | -     | 0.15 | 0.26      | -                | 0.33    | -                 | 0.4     | V       |
|          |                           | $I_O = 5.2$ mA; $V_{CC} = 6.0$ V                        | -     | 0.16 | 0.26      | -                | 0.33    | -                 | 0.4     | V       |
| $I_I$    | input leakage current     | $V_I = V_{CC}$ or GND;<br>$V_{CC} = 6.0$ V              | -     | -    | $\pm 0.1$ | -                | $\pm 1$ | -                 | $\pm 1$ | $\mu$ A |
| $I_{CC}$ | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 6.0$ V | -     | -    | 2.0       | -                | 20      | -                 | 40      | $\mu$ A |
| $C_I$    | input capacitance         |   | -     | 3.5  | -         | -                | -       | -                 | -       | pF      |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ; test circuit see [Figure 8](#).

| Symbol   | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|----------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
|          |                               |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_{pd}$ | propagation delay             | nA, nB, nC or nD to nY; see <a href="#">Figure 7</a> <a href="#">[1]</a> |       |     |     |                  |     |                   |     |      |
|          |                               | $V_{CC} = 2.0\text{ V}$  | -     | 33  | 110 | -                | 140 | -                 | 165 | ns   |
|          |                               | $V_{CC} = 4.5\text{ V}$  | -     | 12  | 22  | -                | 28  | -                 | 33  | ns   |
|          |                               | $V_{CC} = 6.0\text{ V}$  | -     | 10  | 19  | -                | 24  | -                 | 28  | ns   |
|          |                               | $V_{CC} = 5.0\text{ V}; C_L = 15\text{ pF}$                              | -     | 10  | -   | -                | -   | -                 | -   | ns   |
| $t_t$    | transition time               | nY output; see <a href="#">Figure 7</a> <a href="#">[2]</a>              |       |     |     |                  |     |                   |     |      |
|          |                               | $V_{CC} = 2.0\text{ V}$  | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|          |                               | $V_{CC} = 4.5\text{ V}$  | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|          |                               | $V_{CC} = 6.0\text{ V}$  | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND\text{ to }V_{CC}$ <a href="#">[3]</a>                         | -     | 15  | -   | -                | -   | -                 | -   | 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  $\mu\text{W}$ ):

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

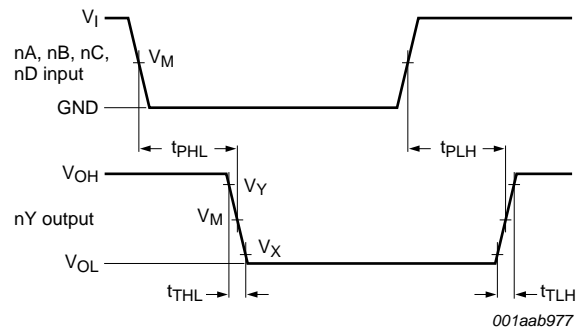
$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

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

## 11. Waveforms



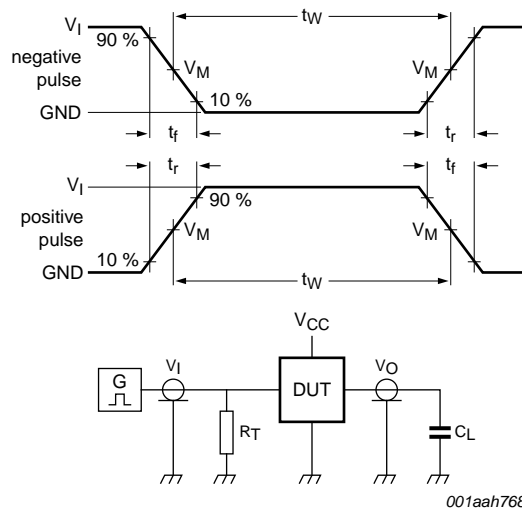
Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 7. Waveforms showing the input (nA, nB, nC, nD) to output (nY) propagation delays and the output transition times**

**Table 8. Measurement points**

| Type   | Input       | Output      |             |             |
|--------|-------------|-------------|-------------|-------------|
|        | $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| 74HC21 | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |



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 8. Test circuit for measuring switching times**

**Table 9. Test data**

| Type   | Input    |            | Load         | Test               |
|--------|----------|------------|--------------|--------------------|
|        | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC21 | $V_{CC}$ | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

12. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

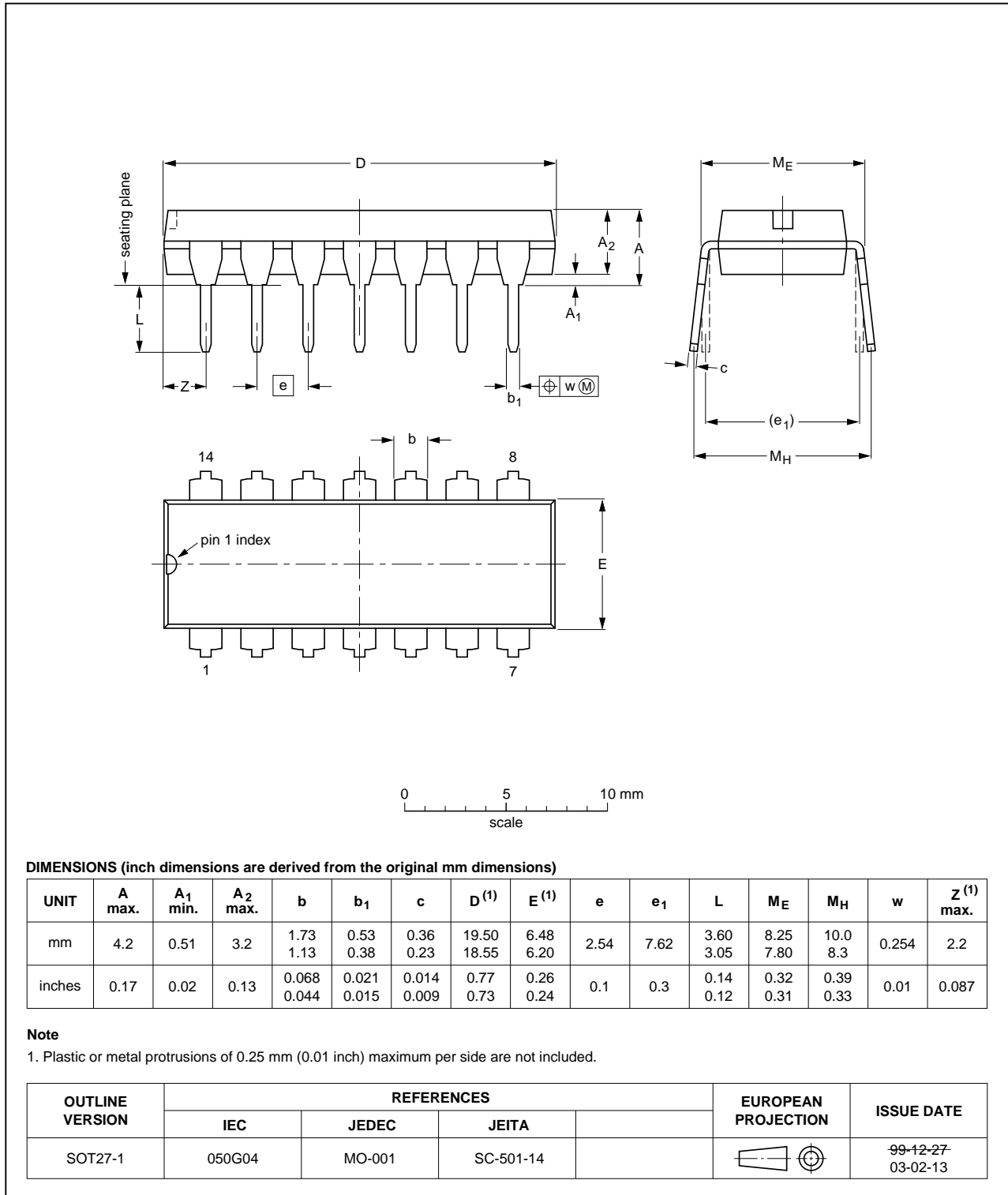


Fig 9. Package outline SOT27-1 (DIP14)



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

SOT108-1

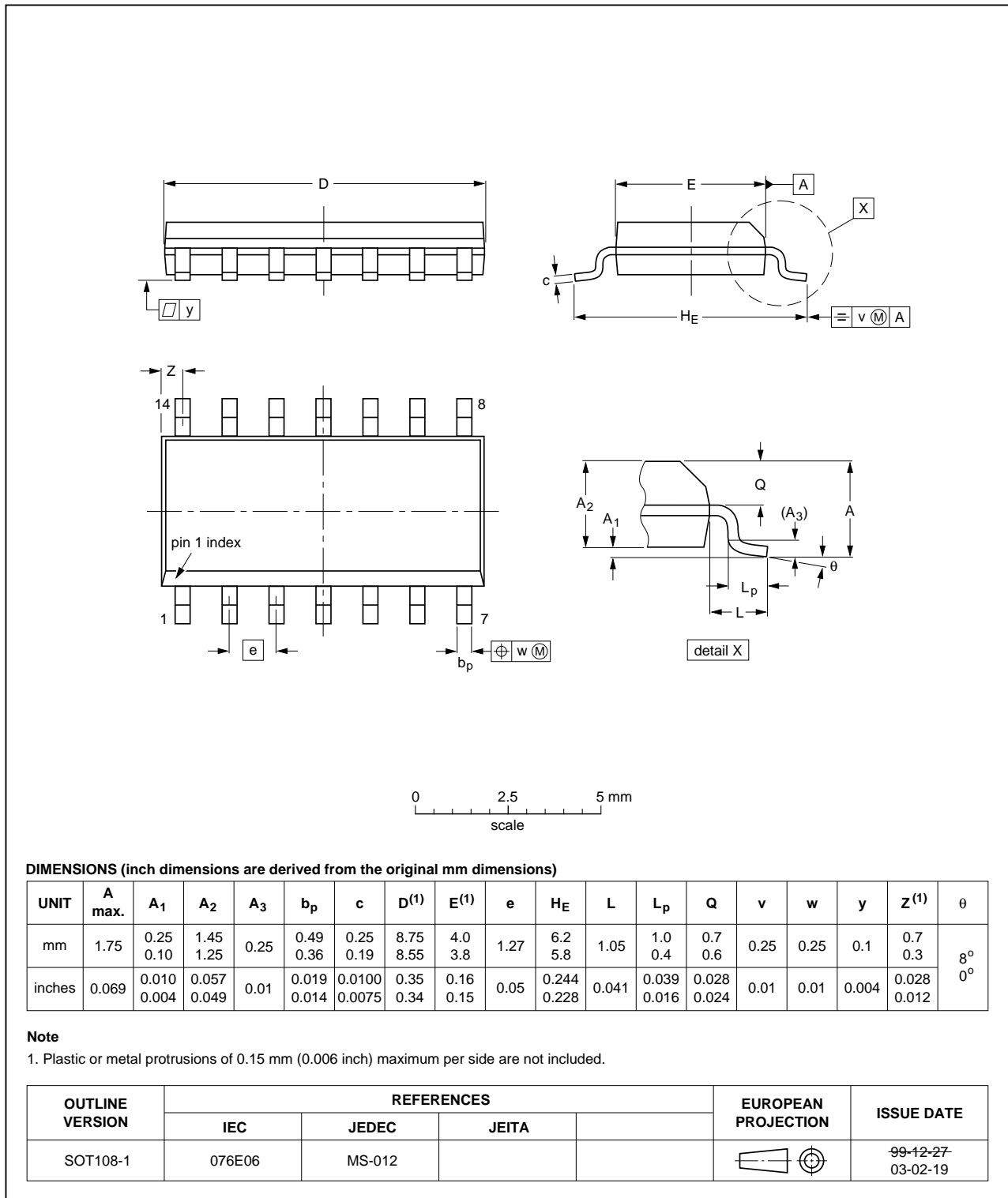


Fig 10. Package outline SOT108-1 (SO14)

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

SOT337-1

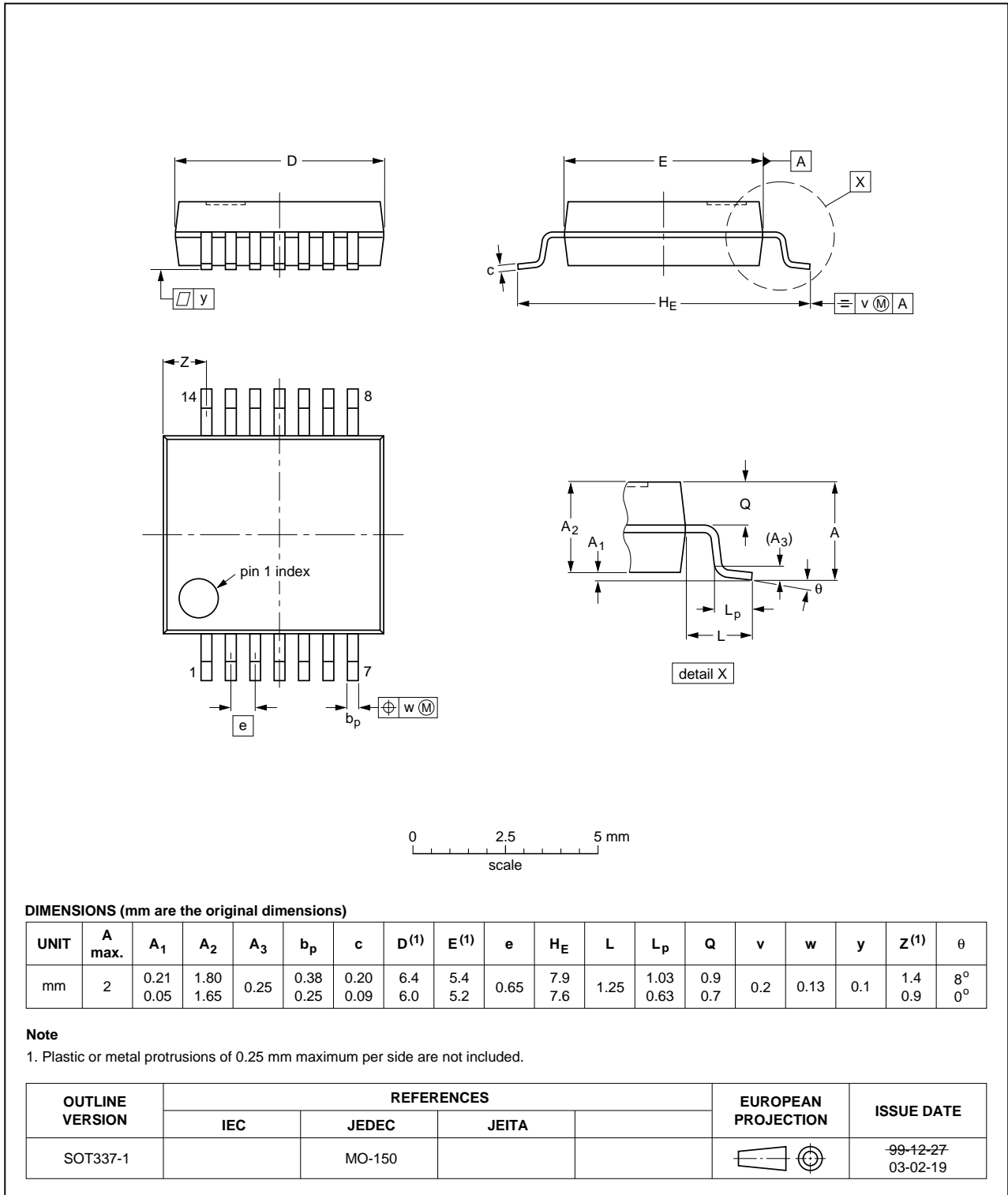


Fig 11. Package outline SOT337-1 (SSOP14)

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

SOT402-1

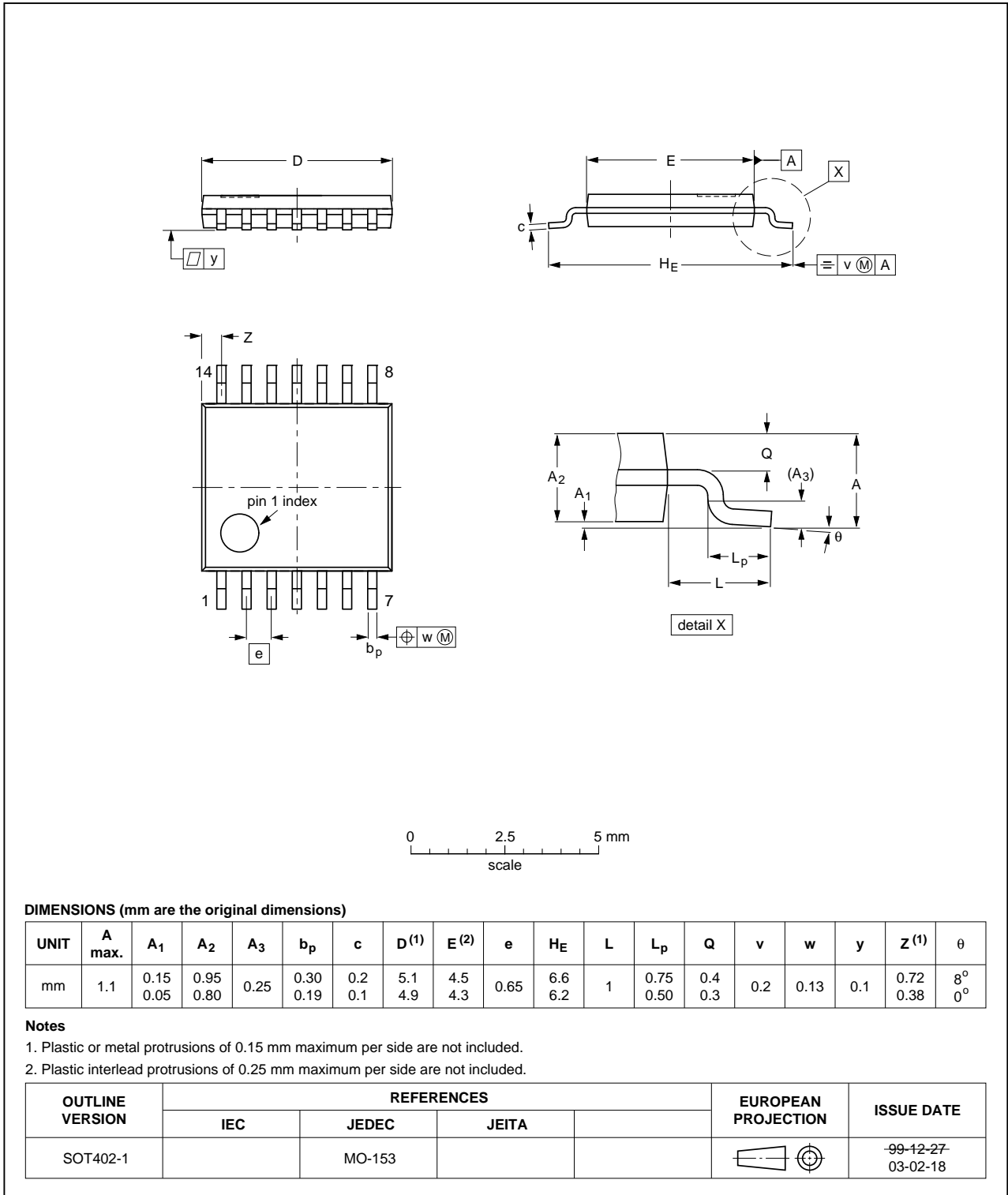


Fig 12. Package outline SOT402-1 (TSSOP14)

## 13. Abbreviations

Table 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

| Document ID        | Release date   | Data sheet status     | Change notice | Supersedes         |
|--------------------|--|-----------------------|---------------|--------------------|
| 74HC21 v.6         | 20130208   | Product data sheet    | -             | 74HC21 v.5         |
| Modifications:     | <a href="#">Section 2</a> : Typo corrected in the specified temperature range.   |                       |               |                    |
| 74HC21 v.5         | 20090507   | Product data sheet    | -             | 74HC21 v.4         |
| Modifications:     | <a href="#">Table 1</a> : Type number 74HCT21PW changed to 74HC21PW.   |                       |               |                    |
| 74HC21 v.4         | 20090407   | Product data sheet    | -             | 74HC21 v.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>Added type number 74HC21PW (TSSOP14 package).</li> </ul> |                       |               |                    |
| 74HC21 v.3         | 20041112   | Product data sheet    | -             | 74HC_HCT21_CNV v.2 |
| 74HC_HCT21_CNV v.2 | 19970828   | Product specification | -             | 74HC_HCT21 v.1     |
| 74HC_HCT21 v.1     | 19901201   | Product specification | -             | -                  |

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### 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".

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For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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