

# 74VHC08; 74VHCT08

## Quad 2-input AND gate

Rev. 2 — 8 April 2020

Product data sheet

## 1. General description

The 74VHC08; 74VHCT08 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard JESD7-A.

The 74VHC08; 74VHCT08 provide the quad 2-input AND function.

## 2. Features and benefits

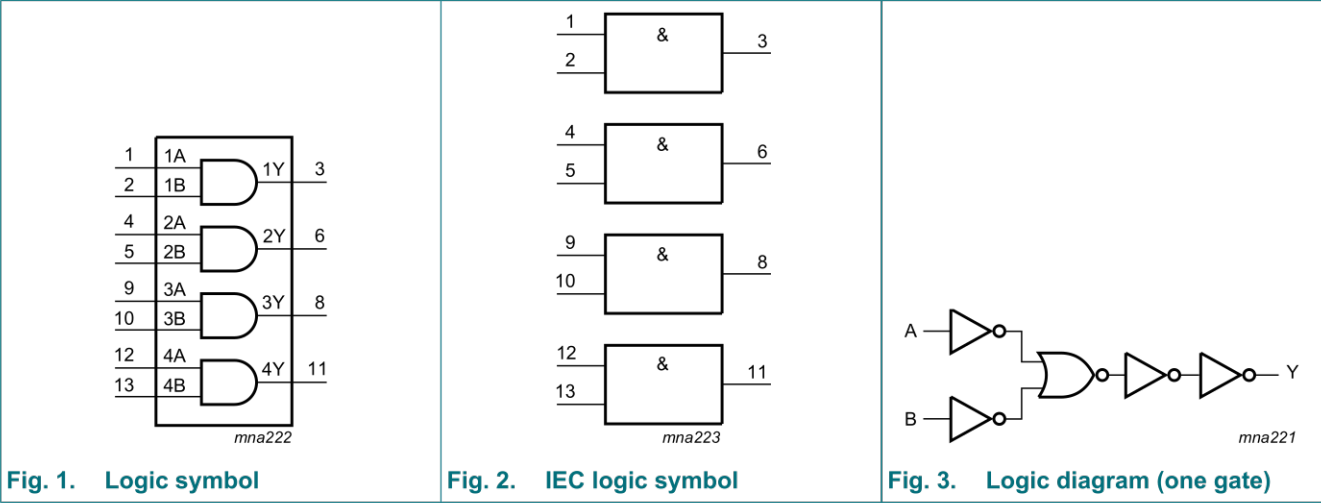
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than  $V_{CC}$
- Input levels:
  - The 74VHC08 operates with CMOS logic levels
  - The 74VHCT08 operates with TTL logic levels
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

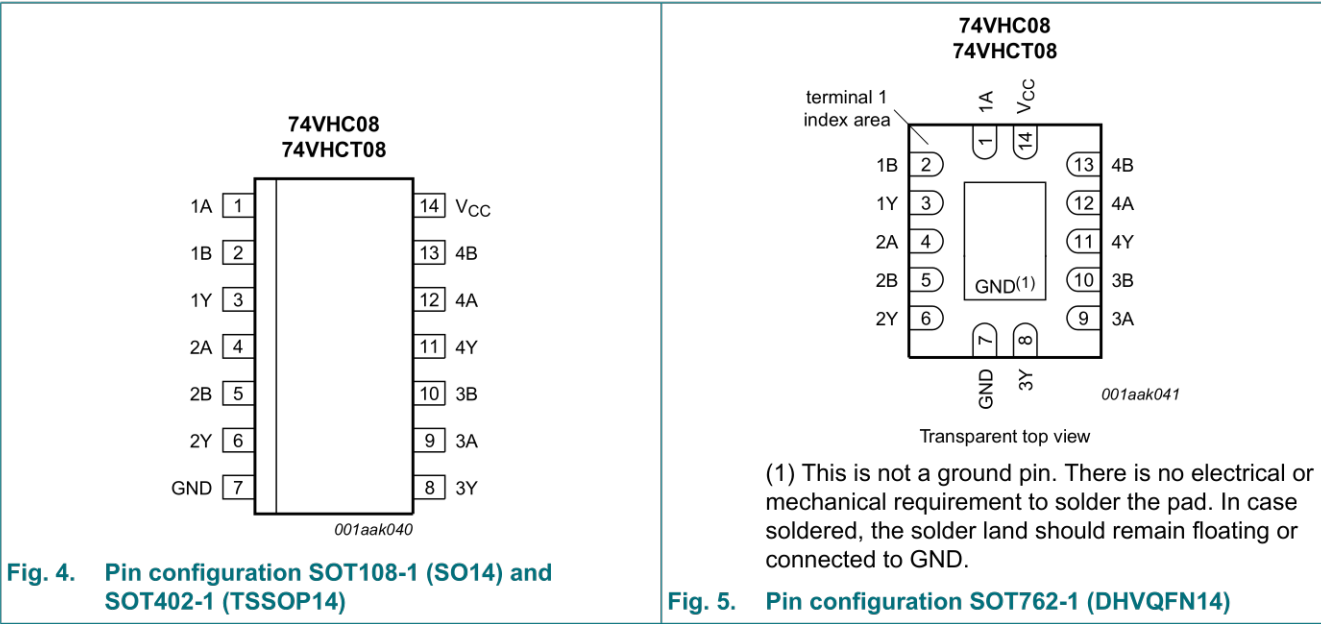
| Type number | Package           |          |                                                                                                                                    |          |
|-------------|-------------------|----------|------------------------------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range | Name     | Description                                                                                                                        | Version  |
| 74VHC08D    | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm                                                                      | SOT108-1 |
| 74VHCT08D   |                   |          |                                                                                                                                    |          |
| 74VHC08PW   | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads;<br>body width 4.4 mm                                                          | SOT402-1 |
| 74VHCT08PW  |                   |          |                                                                                                                                    |          |
| 74VHC08BQ   | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads; 14 terminals;<br>body 2.5 × 3 × 0.85 mm | SOT762-1 |
| 74VHCT08BQ  |                   |          |                                                                                                                                    |          |

4. Functional diagram



5. Pinning information

5.1. Pinning



## 5.2. Pin description

Table 2. Pin description

| Symbol          | Pin          | Description    |
|-----------------|--------------|----------------|
| 1A, 2A, 3A, 4A  | 1, 4, 9, 12  | data input     |
| 1B, 2B, 3B, 4B  | 2, 5, 10, 13 | data input     |
| 1Y, 2Y, 3Y, 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 selection

H = HIGH voltage level; L = LOW voltage level; X = don't care

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

## 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 | +7.0 | V    |
| V <sub>I</sub>   | input voltage           |                                                                         | -0.5 | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V [1]                                             | -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 [1] | -    | ±20  | mA   |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = -0.5 V to (V <sub>CC</sub> + 0.5 V)                    | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                         | -    | 75   | mA   |
| I <sub>GND</sub> | ground current          |                                                                         | -75  | -    | 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 [2]                                | -    | 500  | mW   |

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

[2] For SOT108-1 (SO14) package: P<sub>tot</sub> derates linearly with 10.1 mW/K above 100 °C.  
 For SOT402-1 (TSSOP14) package: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.  
 For SOT762-1 (DHVQFN14) package: P<sub>tot</sub> derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

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

| Symbol           | Parameter                           | Conditions                      | 74VHC08 |     |                 | 74VHCT08 |     |                 | Unit |
|------------------|-------------------------------------|---------------------------------|---------|-----|-----------------|----------|-----|-----------------|------|
|                  |                                     |                                 | Min     | Typ | Max             | Min      | Typ | Max             |      |
| V <sub>CC</sub>  | supply voltage                      |                                 | 2.0     | 5.0 | 5.5             | 4.5      | 5.0 | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                                 | 0       | -   | 5.5             | 0        | -   | 5.5             | 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> = 3.3 V ± 0.3 V | -       | -   | 100             | -        | -   | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 5.0 V ± 0.5 V | -       | -   | 20              | -        | -   | 20              | 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  |      |
| For type 74VHC08 |                           |                                                                                           |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                   | 1.5   | -   | -    | 1.5              | -    | 1.5               | -    | V    |
|                  |                           | V <sub>CC</sub> = 3.0 V                                                                   | 2.1   | -   | -    | 2.1              | -    | 2.1               | -    | V    |
|                  |                           | V <sub>CC</sub> = 5.5 V                                                                   | 3.85  | -   | -    | 3.85             | -    | 3.85              | -    | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                   | -     | -   | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                  |                           | V <sub>CC</sub> = 3.0 V                                                                   | -     | -   | 0.9  | -                | 0.9  | -                 | 0.9  | V    |
|                  |                           | V <sub>CC</sub> = 5.5 V                                                                   | -     | -   | 1.65 | -                | 1.65 | -                 | 1.65 | 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> = -50 μA; V <sub>CC</sub> = 2.0 V                                          | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                  |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V                                          | 2.9   | 3.0 | -    | 2.9              | -    | 2.9               | -    | V    |
|                  |                           | I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V                                          | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V                                         | 2.58  | -   | -    | 2.48             | -    | 2.4               | -    | V    |
|                  |                           | I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V                                         | 3.94  | -   | -    | 3.8              | -    | 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> = 50 μA; V <sub>CC</sub> = 2.0 V                                           | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V                                           | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V                                           | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V                                          | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
|                  |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V                                          | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                          | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | 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> = 5.5 V | -     | -   | 2.0  | -                | 20   | -                 | 40   | μA   |
| C <sub>I</sub>   | input capacitance         |                                                                                           | -     | 3.0 | 10   | -                | 10   | -                 | 10   | pF   |

| Symbol            | Parameter                 | Conditions                                                                                                                                            | 25 °C |     |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|------|------------------|------|-------------------|------|------|
|                   |                           |                                                                                                                                                       | Min   | Typ | Max  | Min              | Max  | Min               | Max  |      |
| For type 74VHCT08 |                           |                                                                                                                                                       |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub>   | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                      | 2.0   | -   | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub>   | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                      | -     | -   | 0.8  | -                | 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> = -50 µA                                                                                                                               | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                   |                           | I <sub>O</sub> = -8.0 mA                                                                                                                              | 3.94  | -   | -    | 3.8              | -    | 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> = 50 µA                                                                                                                                | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                   |                           | I <sub>O</sub> = 8.0 mA                                                                                                                               | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>    | input leakage current     | V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V                                                                                         | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | 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> = 5.5 V                                                                | -     | -   | 2.0  | -                | 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 pins at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V | -     | -   | 1.35 | -                | 1.5  | -                 | 1.5  | mA   |
| C <sub>I</sub>    | input capacitance         |                                                                                                                                                       | -     | 3.0 | 10   | -                | 10   | -                 | 10   | pF   |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7.

| Symbol           | Parameter                     | Conditions                                                                                  | 25 °C |         |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|------------------|-------------------------------|---------------------------------------------------------------------------------------------|-------|---------|------|------------------|------|-------------------|------|------|
|                  |                               |                                                                                             | Min   | Typ [1] | Max  | Min              | Max  | Min               | Max  |      |
| For type 74VHC08 |                               |                                                                                             |       |         |      |                  |      |                   |      |      |
| t <sub>pd</sub>  | propagation delay             | nA, nB to nY; see Fig. 6 [2]                                                                |       |         |      |                  |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF                                    | -     | 4.0     | 8.8  | 1.0              | 10.5 | 1.0               | 11.0 | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF                                    | -     | 5.6     | 12.3 | 1.0              | 14   | 1.0               | 15.5 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF                                    | -     | 3.0     | 5.9  | 1.0              | 7.0  | 1.0               | 7.5  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF                                    |       | 4.2     | 7.9  | 1.0              | 9.0  | 1.0               | 10.0 | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [3] | -     | 10.0    | -    | -                | -    | -                 | -    | pF   |

| Symbol            | Parameter                     | Conditions                                                                                  | 25 °C |         |     | -40 °C to +85 °C |     | -40 °C to +125 °C |      | Unit |
|-------------------|-------------------------------|---------------------------------------------------------------------------------------------|-------|---------|-----|------------------|-----|-------------------|------|------|
|                   |                               |                                                                                             | Min   | Typ [1] | Max | Min              | Max | Min               | Max  |      |
| For type 74VHCT08 |                               |                                                                                             |       |         |     |                  |     |                   |      |      |
| t <sub>pd</sub>   | propagation delay             | nA, nB to nY; see Fig. 6 [2]                                                                |       |         |     |                  |     |                   |      |      |
|                   |                               | V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF                                    | -     | 3.2     | 6.9 | 1.0              | 8.0 | 1.0               | 9.0  | ns   |
|                   |                               | V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF                                    | -     | 4.2     | 7.9 | 1.0              | 9.0 | 1.0               | 10.0 | ns   |
| C <sub>PD</sub>   | power dissipation capacitance | C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [3] | -     | 12.0    | -   | -                | -   | -                 | -    | pF   |

- [1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).
- [2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) 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 Volts  
N = number of inputs switching  
Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

10.1. Waveforms and test circuit

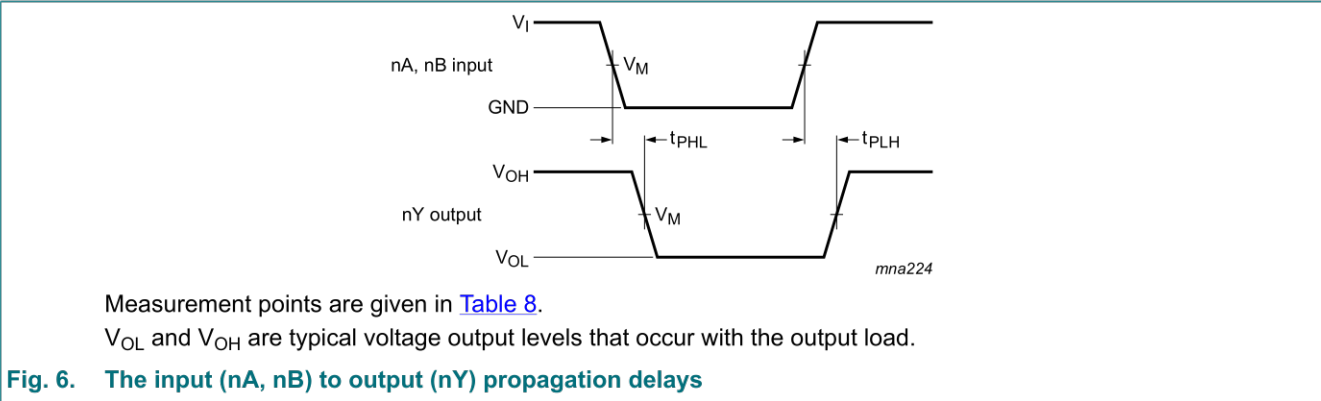


Table 8. Measurement points

| Type     | Input              | Output             |
|----------|--------------------|--------------------|
|          | V <sub>M</sub>     | V <sub>M</sub>     |
| 74VHC08  | 0.5V <sub>CC</sub> | 0.5V <sub>CC</sub> |
| 74VHCT08 | 1.5 V              | 0.5V <sub>CC</sub> |

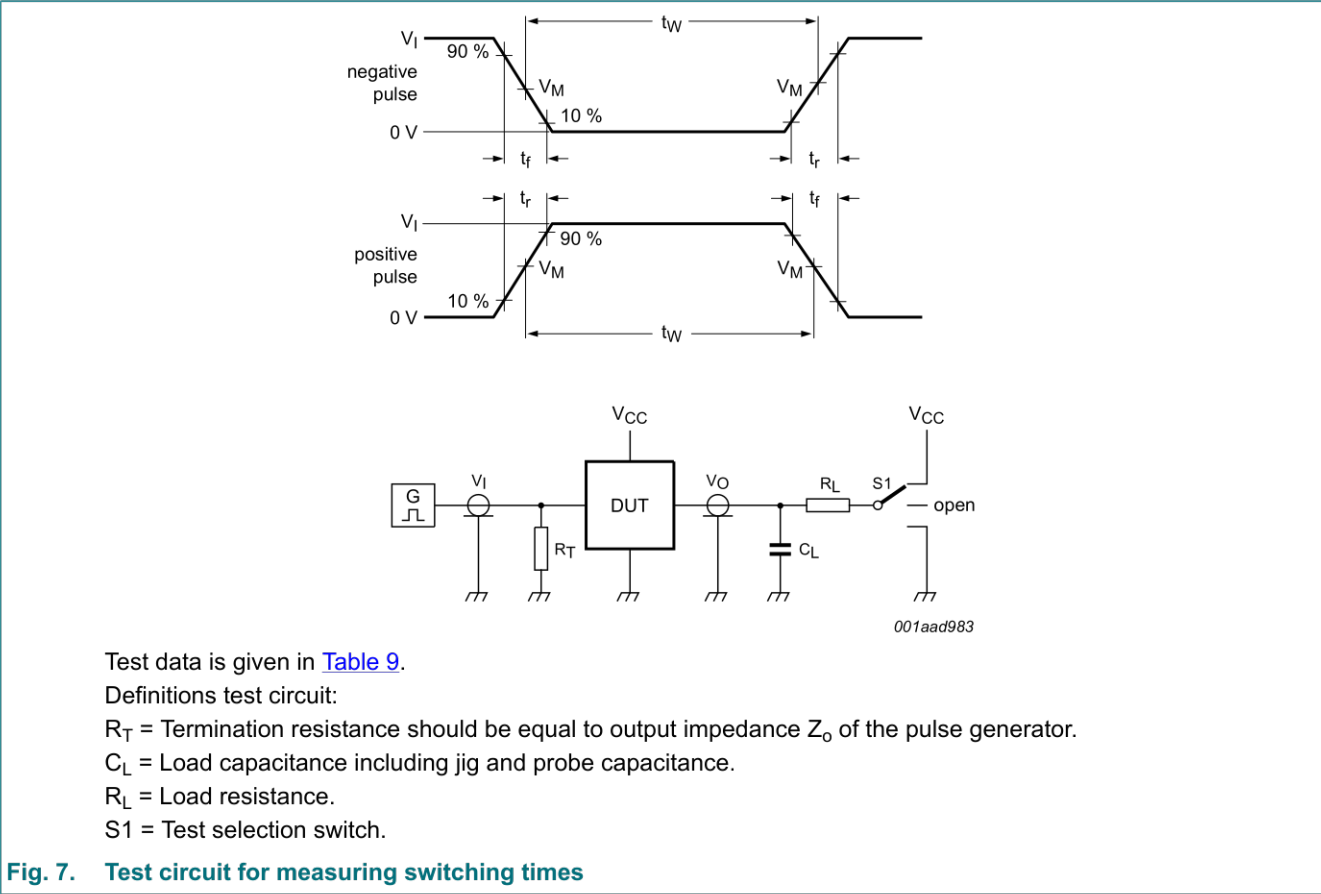


Fig. 7. Test circuit for measuring switching times

Table 9. Test data

| Type     | Input    |                       | Load         |              | S1 position        |                    |                    |
|----------|----------|-----------------------|--------------|--------------|--------------------|--------------------|--------------------|
|          | $V_I$    | $t_r, t_f$            | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74VHC08  | $V_{CC}$ | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |
| 74VHCT08 | 3.0 V    | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |

11. Package outline

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

SOT108-1

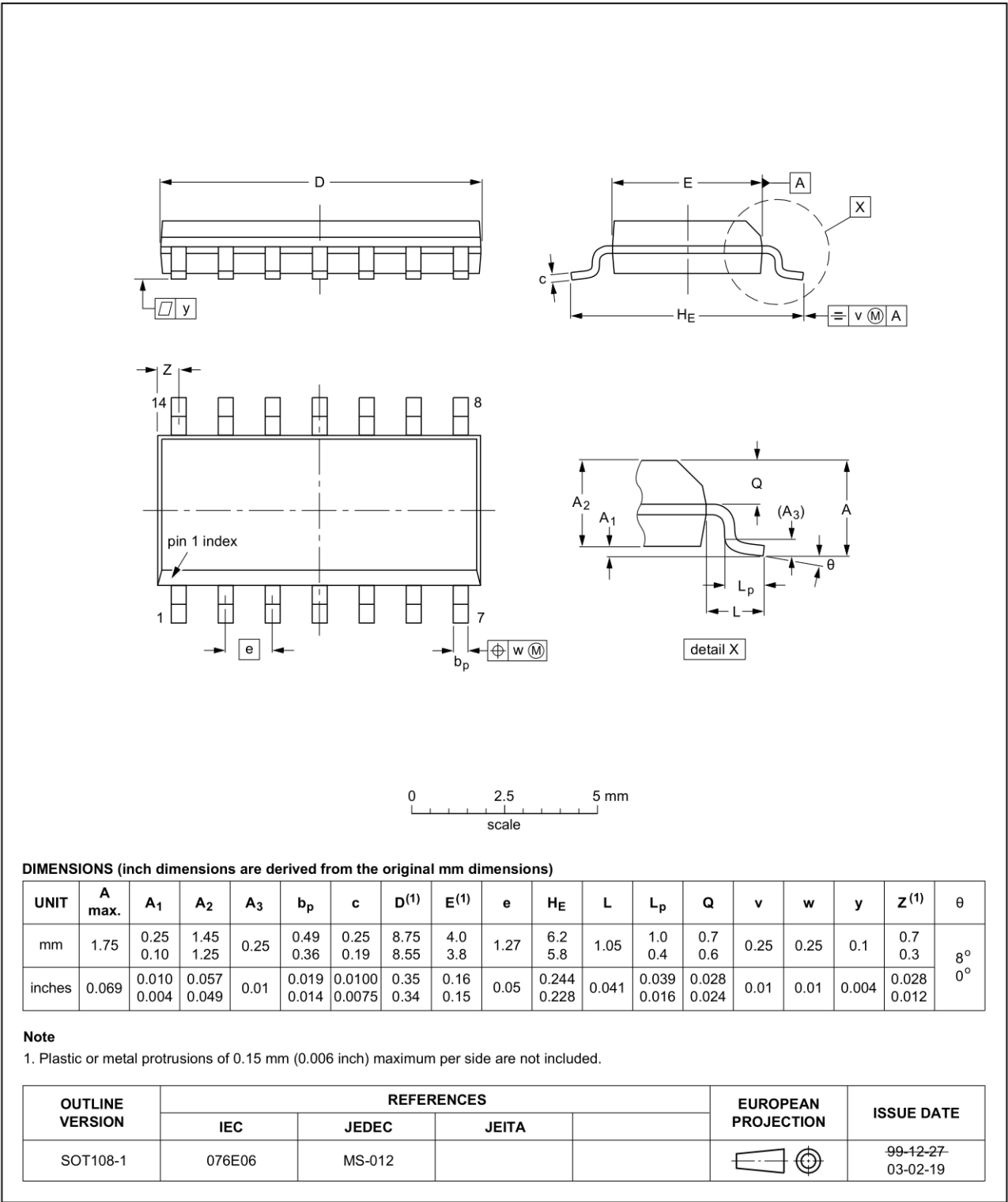


Fig. 8. Package outline SOT108-1 (SO14)

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

SOT402-1

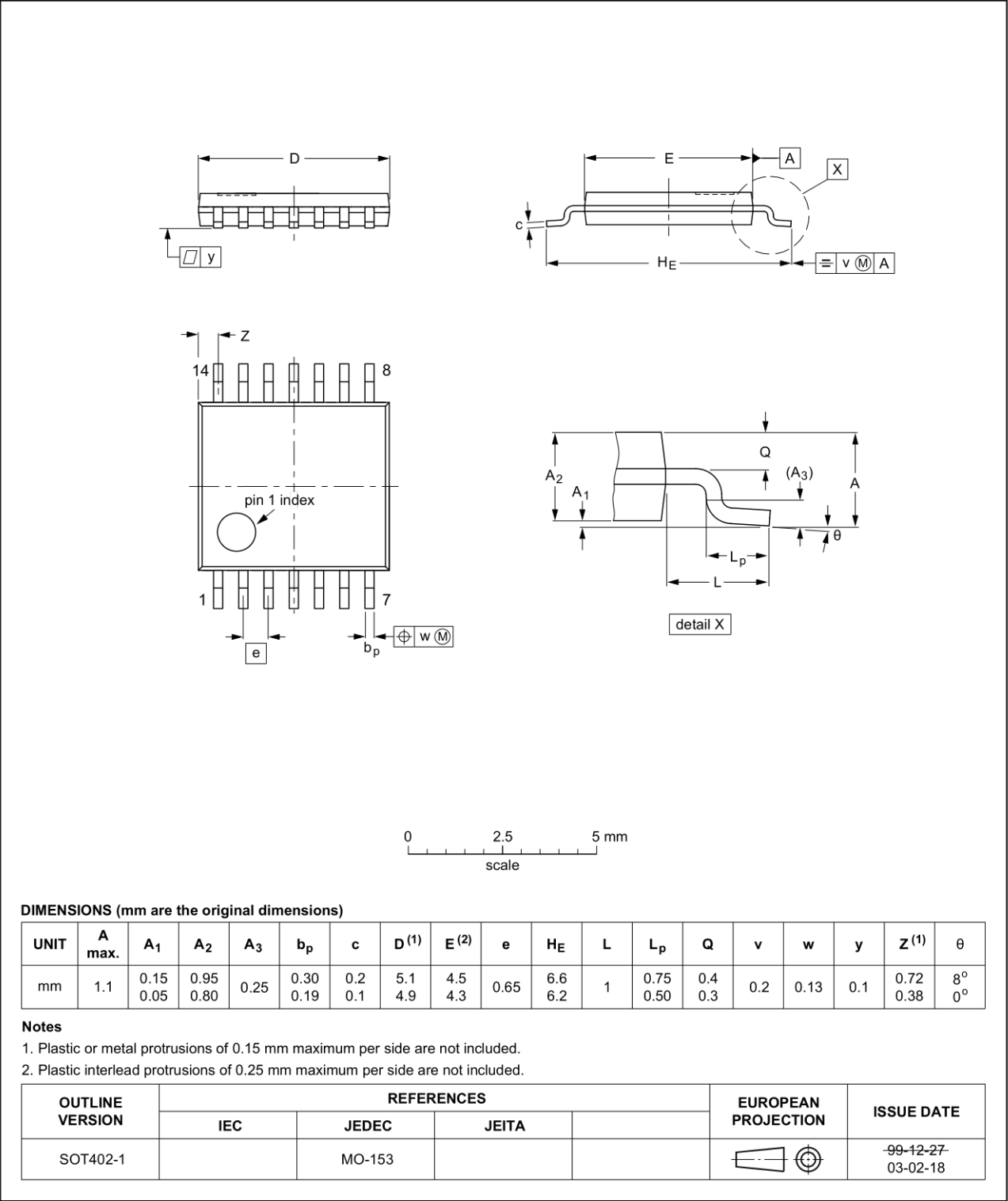


Fig. 9. Package outline SOT402-1 (TSSOP14)

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

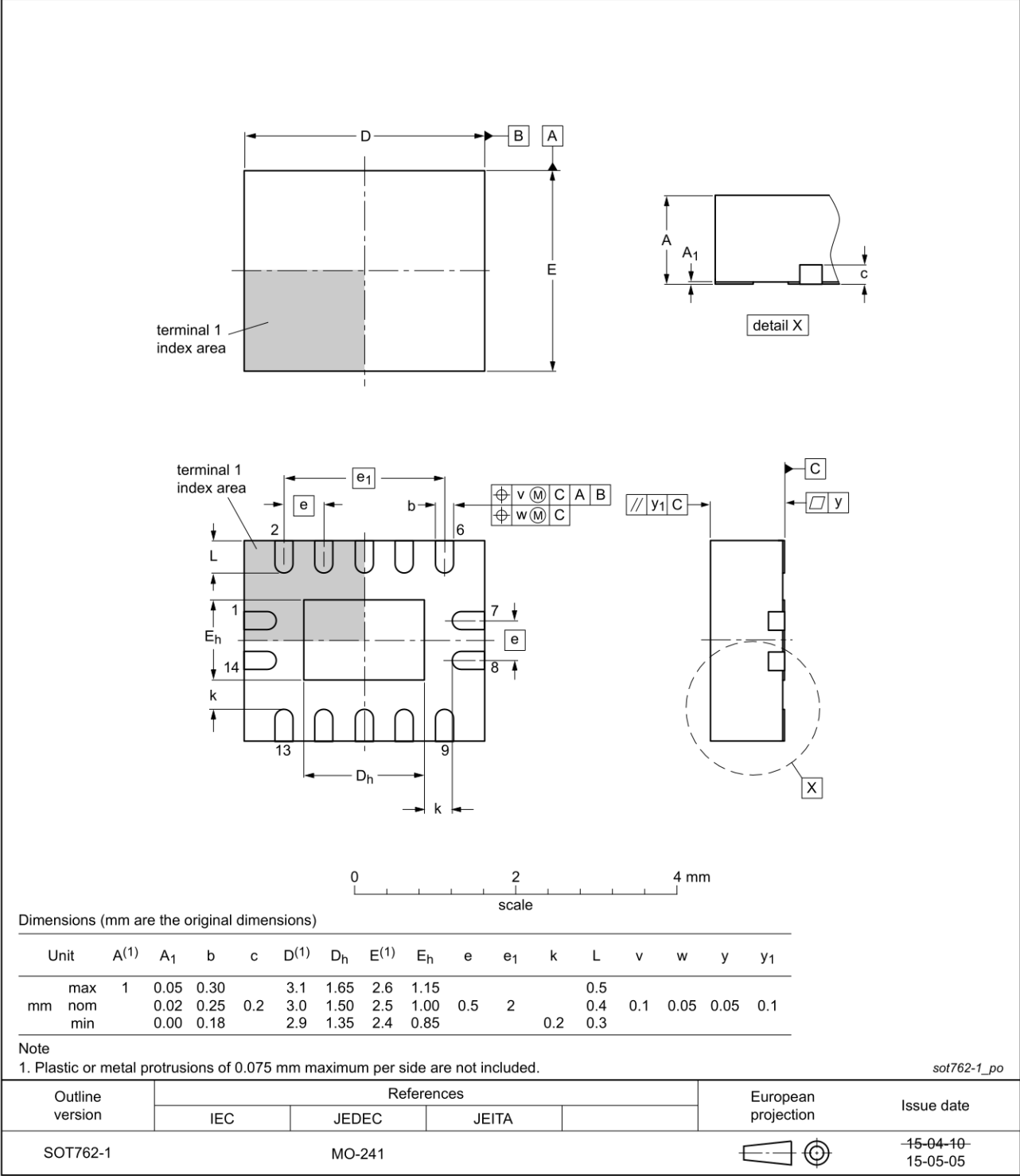


Fig. 10. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 10. Abbreviations

| Acronym | Description                                    |
|---------|------------------------------------------------|
| CDM     | Charged Device Model                           |
| 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                    |

## 13. Revision history

Table 11. Revision history

| Document ID      | Release date                                                                                                                                                                                                                                                                                                                                                                                                                   | Data sheet status  | Change notice | Supersedes     |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|----------------|
| 74VHC_VHCT08 v.2 | 20200408                                                                                                                                                                                                                                                                                                                                                                                                                       | Product data sheet | -             | 74VHC_VHCT08_1 |
| Modifications:   | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li><li>Package outline drawing <a href="#">SOT762-1</a> (DHVQFN14) updated.</li></ul> |                    |               |                |
| 74VHC_VHCT08_1   | 20090630                                                                                                                                                                                                                                                                                                                                                                                                                       | Product data sheet | -             | -              |

## 14. Legal information

### Data sheet status

| Document status<br>[1][2]      | Product status [3] | 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.                                     |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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