

# 74LVC86A

## Quad 2-input EXCLUSIVE-OR gate

Rev. 6 — 19 August 2021

Product data sheet

### 1. General description

The 74LVC86A is a quad 2-input EXCLUSIVE-OR gate. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

### 2. Features and benefits

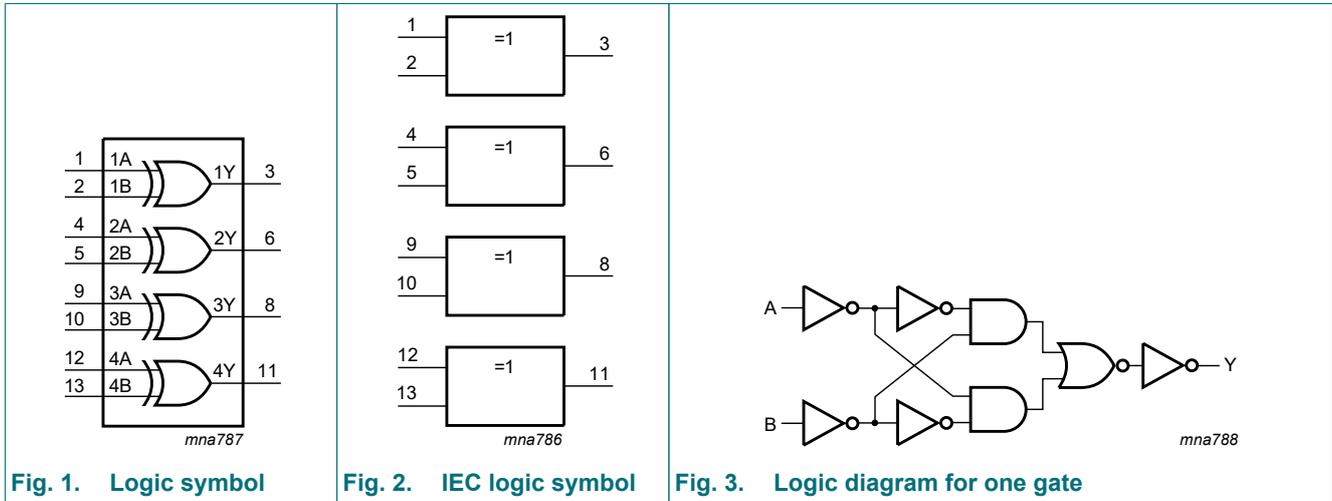
- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.2 to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-B exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to 125 °C

### 3. Ordering information

Table 1. Ordering information

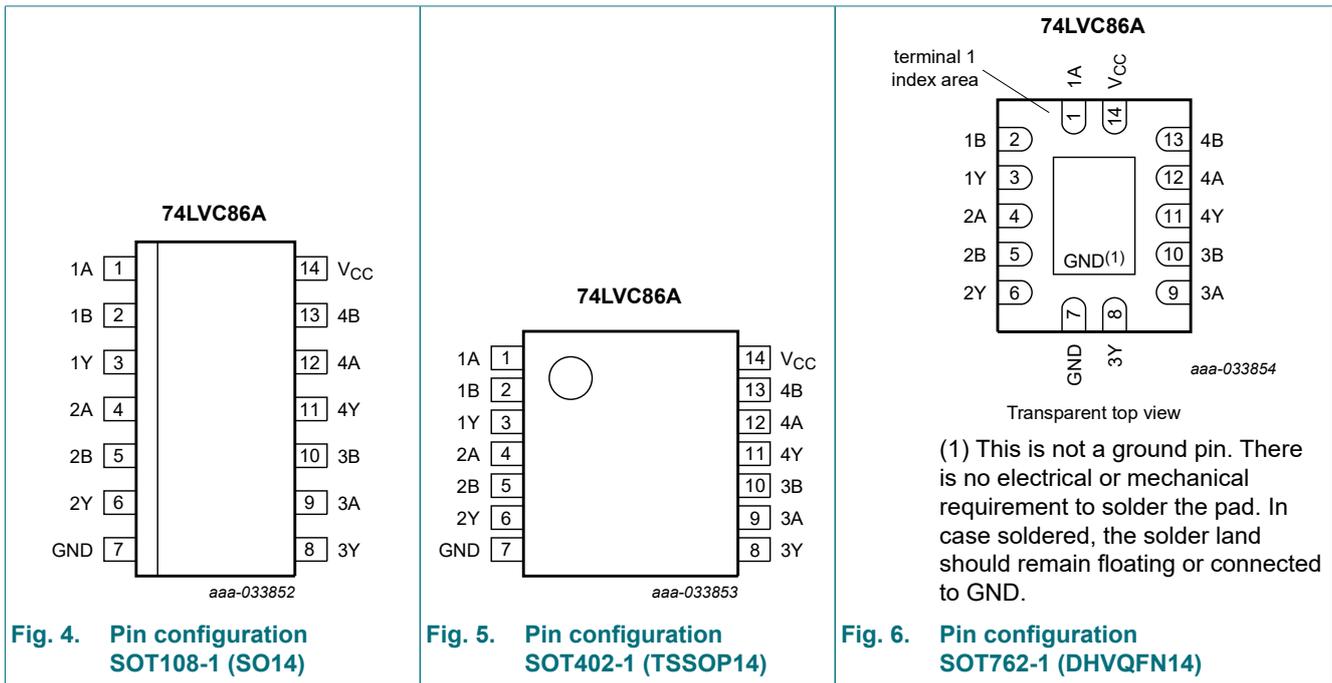
| Type number | Package           |          |  |          |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  | Version  |
| 74LVC86AD   | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads; body width 3.9 mm   | SOT108-1 |
| 74LVC86APW  | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads; body width 4.4 mm   | SOT402-1 |
| 74LVC86ABQ  | -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



### 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. Functional table

H = HIGH voltage level; L = LOW voltage level

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

## 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     | +6.5                  | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < 0                                     | -50      | -                     | mA   |
| V <sub>I</sub>   | input voltage           |  | [1] -0.5 | +6.5                  | V    |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 | -        | ±50                   | mA   |
| V <sub>O</sub>   | output voltage          |  | [2] -0.5 | V <sub>CC</sub> + 0.5 | V    |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = 0 V to V <sub>CC</sub>                | -        | ±50                   | mA   |
| I <sub>CC</sub>  | supply current          |  | -        | 100                   | mA   |
| I <sub>GND</sub> | ground current          |  | -100     | -                     | 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                   | [3] -    | 500                   | mW   |

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] 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

| Symbol           | Parameter                           | Conditions                        | Min  | Typ | Max             | Unit |
|------------------|-------------------------------------|-----------------------------------|------|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage                      |                                   | 1.65 | -   | 3.6             | V    |
|                  |                                     | functional                        | 1.2  | -   | -               | V    |
| V <sub>I</sub>   | input voltage                       |                                   | 0    | -   | 5.5             | V    |
| V <sub>O</sub>   | output voltage                      |                                   | 0    | -   | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 | in free air                       | -40  | -   | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 1.65 V to 2.7 V | 0    | -   | 20              | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.7 V to 3.6 V  | 0    | -   | 10              | ns/V |

## 9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

| Symbol  | Parameter                 | Conditions  | -40 °C to +85 °C      |         |                     | -40 °C to +125 °C     |                     | Unit |
|---|---------------------------|---|-----------------------|---------|---------------------|-----------------------|---------------------|------|
|   |                           |   | Min                   | Typ [1] | Max                 | Min                   | Max                 |      |
| V <sub>IH</sub>                                 | HIGH-level input voltage  | V <sub>CC</sub> = 1.2 V                                     | 1.08                  | -       | -                   | 1.08                  | -                   | V    |
|   |                           | V <sub>CC</sub> = 1.65 V to 1.95 V                          | 0.65V <sub>CC</sub>   | -       | -                   | 0.65V <sub>CC</sub>   | -                   | V    |
|   |                           | V <sub>CC</sub> = 2.3 V to 2.7 V                            | 1.7                   | -       | -                   | 1.7                   | -                   | V    |
|   |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                            | 2.0                   | -       | -                   | 2.0                   | -                   | V    |
| V <sub>IL</sub>                                 | LOW-level input voltage   | V <sub>CC</sub> = 1.2 V                                     | -                     | -       | 0.12                | -                     | 0.12                | V    |
|   |                           | V <sub>CC</sub> = 1.65 V to 1.95 V                          | -                     | -       | 0.35V <sub>CC</sub> | -                     | 0.35V <sub>CC</sub> | V    |
|   |                           | V <sub>CC</sub> = 2.3 V to 2.7 V                            | -                     | -       | 0.7                 | -                     | 0.7                 | V    |
|   |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                            | -                     | -       | 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> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V | V <sub>CC</sub> - 0.2 | -       | -                   | V <sub>CC</sub> - 0.3 | -                   | V    |
|   |                           | I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V            | 1.2                   | -       | -                   | 1.05                  | -                   | V    |
|   |                           | I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V             | 1.8                   | -       | -                   | 1.65                  | -                   | V    |
|   |                           | I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V            | 2.2                   | -       | -                   | 2.05                  | -                   | V    |
|   |                           | I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V            | 2.4                   | -       | -                   | 2.25                  | -                   | V    |
| V <sub>OL</sub>                                 | LOW-level output voltage  | I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V            | 2.2                   | -       | -                   | 2.0                   | -                   | V    |
|   |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>         |                       |         |                     |                       |                     |      |
|   |                           | I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V  | -                     | -       | 0.2                 | -                     | 0.3                 | V    |
|   |                           | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V             | -                     | -       | 0.45                | -                     | 0.65                | V    |
|   |                           | I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V              | -                     | -       | 0.6                 | -                     | 0.8                 | V    |
| I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V | -                         | -   | 0.4                   | -       | 0.6                 | V                     |                     |      |
| I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V | -                         | -   | 0.55                  | -       | 0.8                 | V                     |                     |      |

| Symbol           | Parameter                 | Conditions  | -40 °C to +85 °C |         |     | -40 °C to +125 °C |      | Unit |
|------------------|---------------------------|---|------------------|---------|-----|-------------------|------|------|
|                  |                           |   | Min              | Typ [1] | Max | Min               | Max  |      |
| I <sub>I</sub>   | input leakage current     | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND  | -                | ±0.1    | ±5  | -                 | ±20  | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A                          | -                | 0.1     | 10  | -                 | 40   | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A | -                | 5       | 500 | -                 | 5000 | µA   |
| C <sub>I</sub>   | input capacitance         | V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>   | -                | 5.0     | -   | -                 | -    | pF   |

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 8.

| Symbol             | Parameter                     | Conditions  | -40 °C to +85 °C |         |     | -40 °C to +125 °C |      | Unit |
|--------------------|-------------------------------|---|------------------|---------|-----|-------------------|------|------|
|                    |                               |   | Min              | Typ [1] | Max | Min               | Max  |      |
| t <sub>pd</sub>    | propagation delay             | nA, nB to nY; see Fig. 7 [2]                          |                  |         |     |                   |      |      |
|                    |                               | V <sub>CC</sub> = 1.2 V                               | -                | 11.0    | -   | -                 | -    | ns   |
|                    |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                    | 0.5              | 4.1     | 9.8 | 0.5               | 11.4 | ns   |
|                    |                               | V <sub>CC</sub> = 2.3 V to 2.7 V                      | 1.0              | 2.4     | 5.6 | 1.0               | 6.5  | ns   |
|                    |                               | V <sub>CC</sub> = 2.7 V                               | 1.0              | 2.5     | 5.8 | 1.0               | 7.0  | ns   |
|                    |                               | V <sub>CC</sub> = 3.0 V to 3.6 V                      | 1.0              | 2.2     | 5.0 | 1.0               | 6.0  | ns   |
| t <sub>sk(o)</sub> | output skew time              | V <sub>CC</sub> = 3.0 V to 3.6 V [3]                  | -                | -       | 1.0 | -                 | 1.5  | ns   |
| C <sub>PD</sub>    | power dissipation capacitance | per gate; V <sub>I</sub> = GND to V <sub>CC</sub> [4] |                  |         |     |                   |      |      |
|                    |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                    | -                | 12.5    | -   | -                 | -    | pF   |
|                    |                               | V <sub>CC</sub> = 2.3 V to 2.7 V                      | -                | 16.3    | -   | -                 | -    | pF   |
|                    |                               | V <sub>CC</sub> = 3.0 V to 3.6 V                      | -                | 19.7    | -   | -                 | -    | pF   |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in µW).

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

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

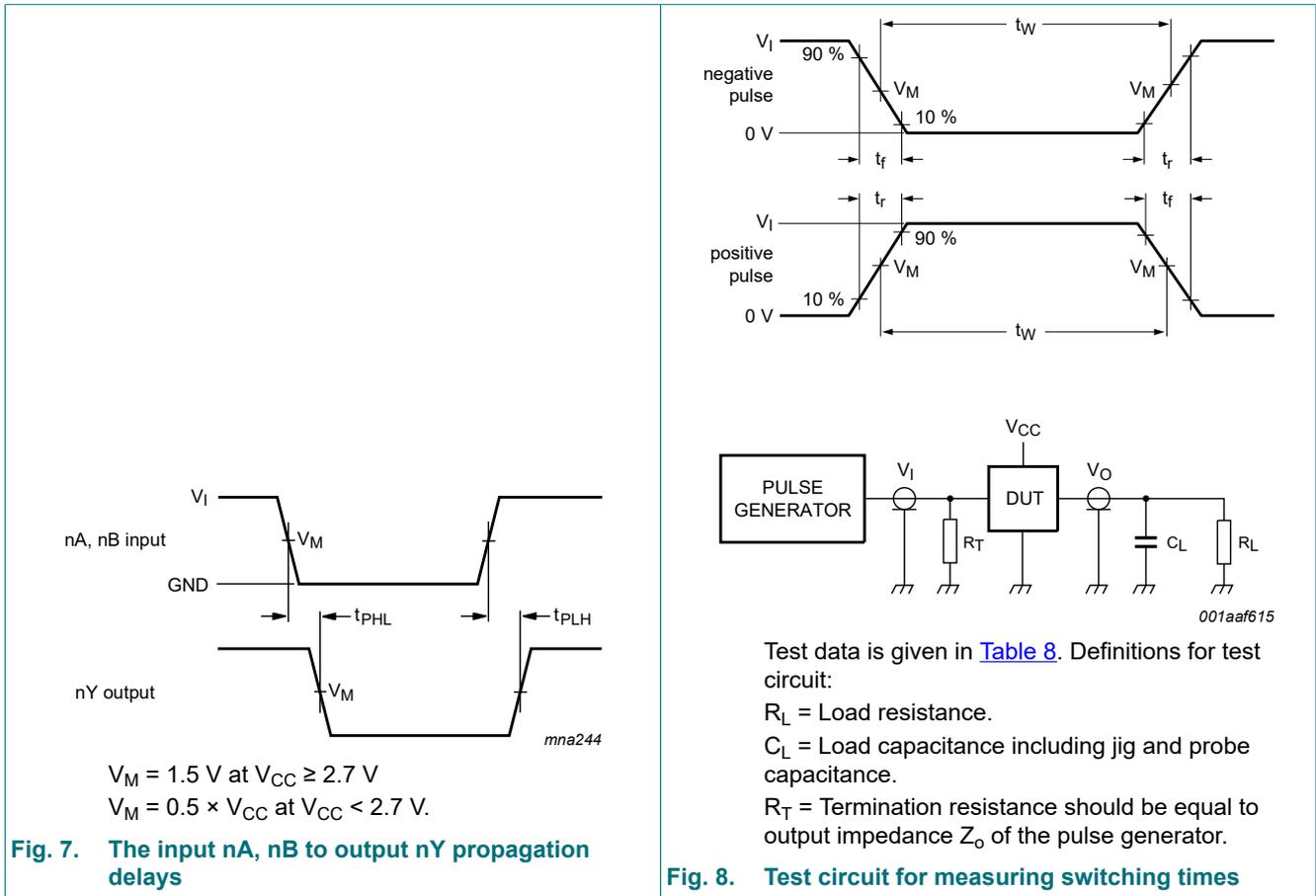


Table 8. Test data

| Supply voltage   | Input    |                      | Load  |              |
|------------------|----------|----------------------|-------|--------------|
|                  | $V_I$    | $t_r, t_f$           | $C_L$ | $R_L$        |
| 1.2 V            | $V_{CC}$ | $\leq 2\text{ ns}$   | 30 pF | 1 k $\Omega$ |
| 1.65 V to 1.95 V | $V_{CC}$ | $\leq 2\text{ ns}$   | 30 pF | 1 k $\Omega$ |
| 2.3 V to 2.7 V   | $V_{CC}$ | $\leq 2\text{ ns}$   | 30 pF | 500 $\Omega$ |
| 2.7 V            | 2.7 V    | $\leq 2.5\text{ ns}$ | 50 pF | 500 $\Omega$ |
| 3.0 V to 3.6 V   | 2.7 V    | $\leq 2.5\text{ ns}$ | 50 pF | 500 $\Omega$ |

### 11. Package outline

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

SOT108-1

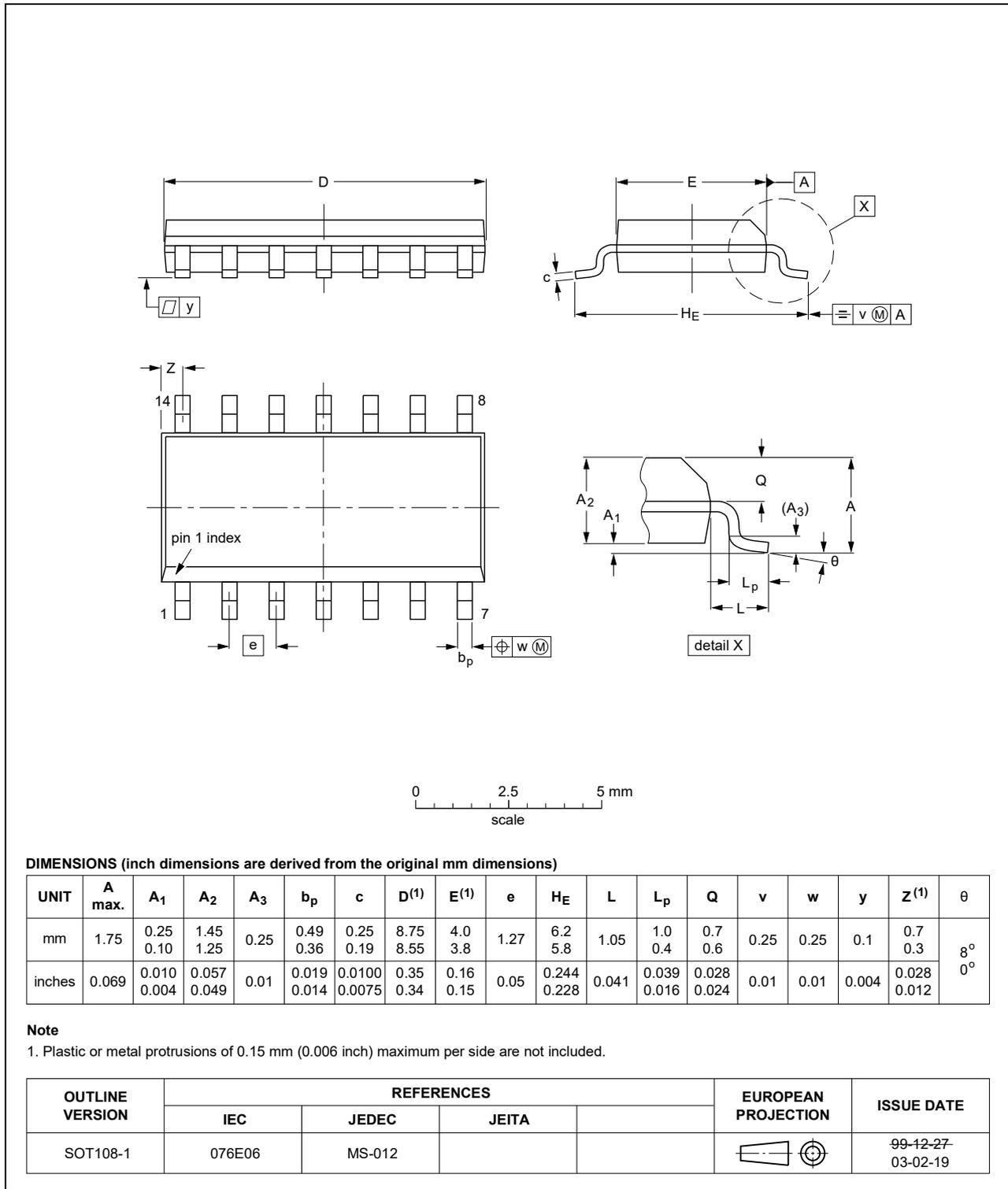


Fig. 9. Package outline SOT108-1 (SO14)

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

SOT402-1

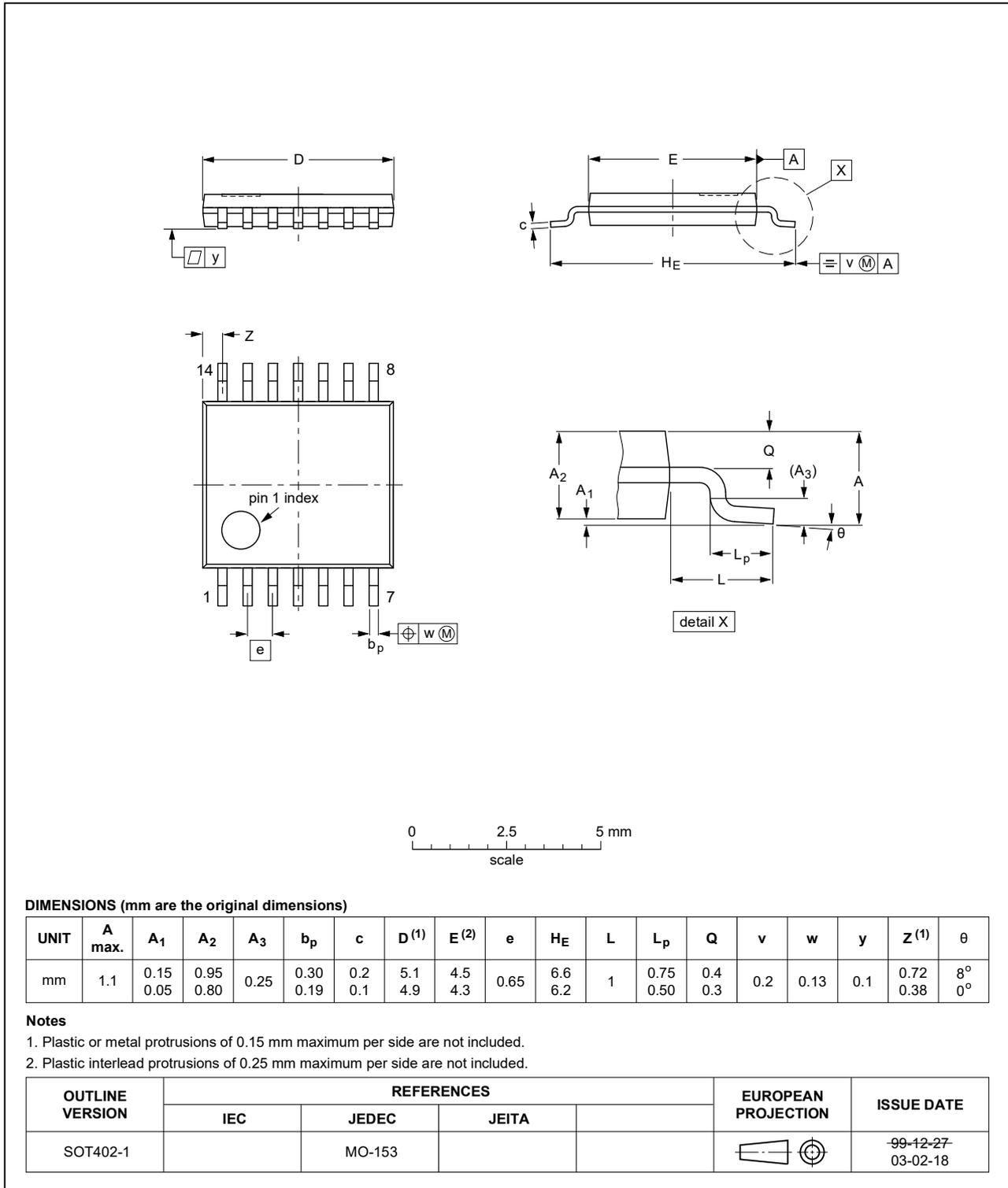


Fig. 10. Package outline SOT402-1 (TSSOP14)

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

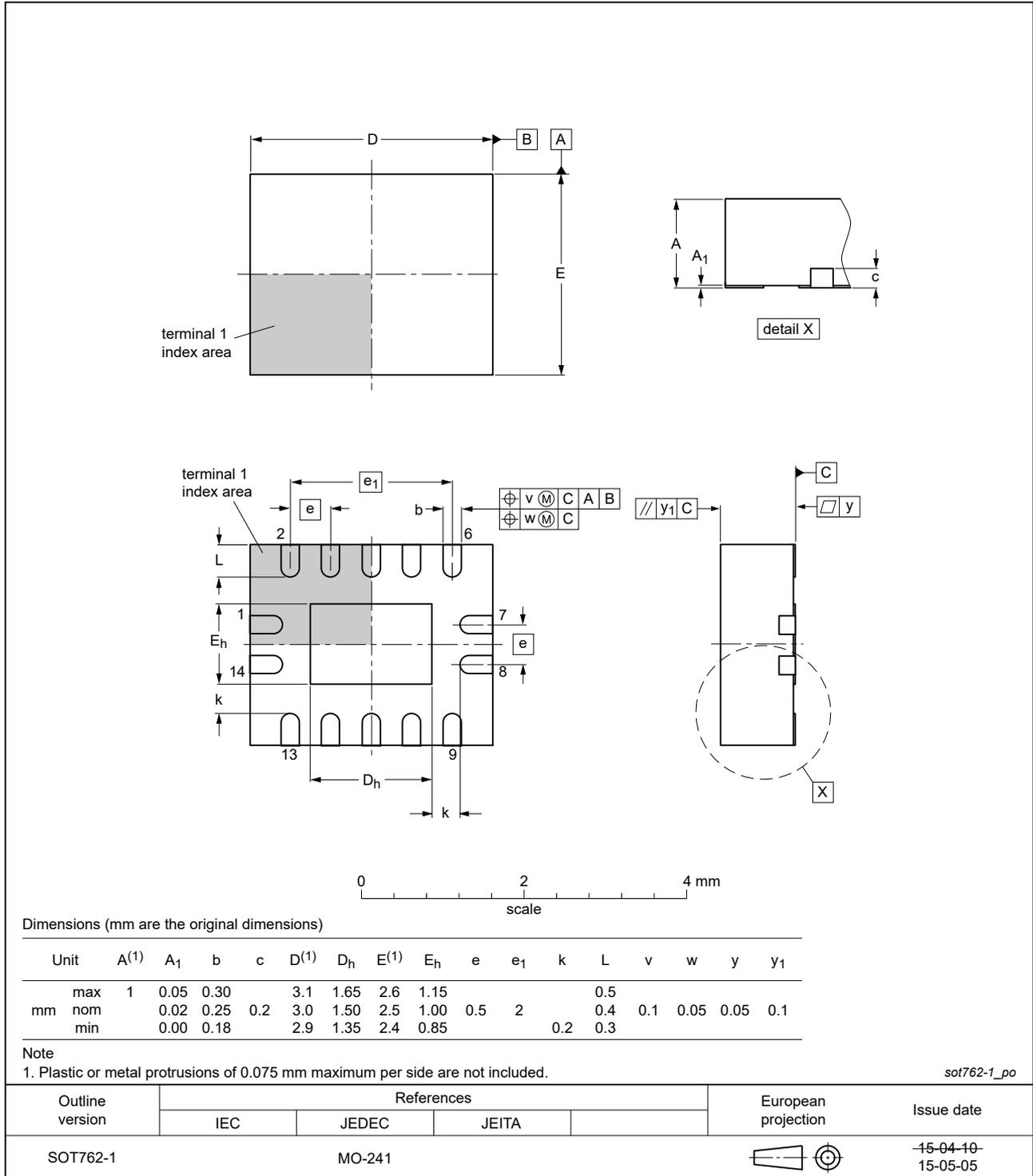


Fig. 11. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 9. Abbreviations

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

## 13. Revision history

Table 10. Revision history

| Document ID    | Release date  | Data sheet status     | Change notice | Supersedes   |
|----------------|---|-----------------------|---------------|--------------|
| 74LVC86A v.6   | 20210819  | Product data sheet    | -             | 74LVC86A v.5 |
| 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="#">Section 1</a> and <a href="#">Section 2</a> updated.</li> <li>Type number 74LVC86ADB (SOT337-1/SSOP14) removed.</li> <li><a href="#">Section 7</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li><a href="#">Fig. 11</a>: Package outline drawing SOT762-1 (DHVQFN14) updated.</li> </ul> |                       |               |              |
| 74LVC86A v.5   | 20111019  | Product data sheet    | -             | 74LVC86A v.4 |
| 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><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a> and <a href="#">Table 8</a>: values added for lower voltage ranges.</li> </ul>   |                       |               |              |
| 74LVC86A v.4   | 20040304  | Product specification | -             | 74LVC86A v.3 |
| 74LVC86A v.3   | 20031111  | Product specification | -             | 74LVC86A v.2 |
| 74LVC86A v.2   | 19980428  | Product specification | -             | 74LVC86A v.1 |
| 74LVC86A v.1   | -   | -                     | -             | -            |

## 14. Legal information

### 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. |
| 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 <https://www.nexperia.com>.

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