

74LVC14A

Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 5 — 23 December 2011

Product data sheet

1. General description

The 74LVC14A provides six inverting buffers with Schmitt trigger input. It is capable of transforming slowly-changing input signals into sharply defined, jitter-free output signals.

The inputs switch at different points for positive and negative-going signals. The difference between the positive voltage V_{T+} and the negative voltage V_{T-} is defined as the input hysteresis voltage V_H .

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device as a translator in mixed 3.3 V and 5 V applications.

2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- 5 V tolerant input for interfacing with 5 V logic
- CMOS low-power consumption
- Direct interface with TTL levels
- Unlimited input rise and fall times
- Inputs accept voltages up to 5.5 V
- Complies with JEDEC standard 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
- 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. Applications

- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators



4. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74LVC14AD | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74LVC14ADB | -40 °C to +125 °C | SSOP14 | plastic thin shrink small outline package; 14 leads; body width 5.3 mm | SOT337-1 |
| 74LVC14APW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74LVC14ABQ | -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 |

5. Functional diagram

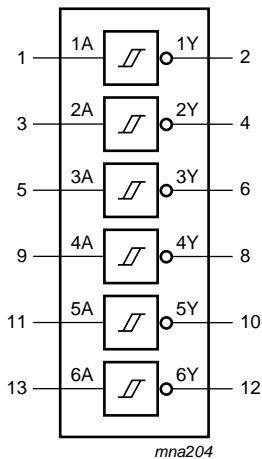


Fig 1. Logic symbol

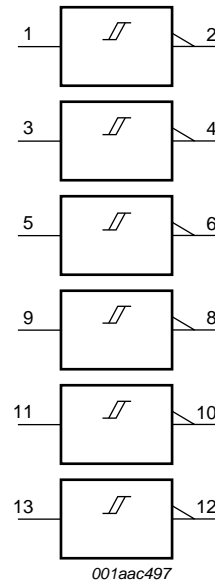


Fig 2. IEC logic symbol

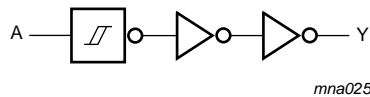
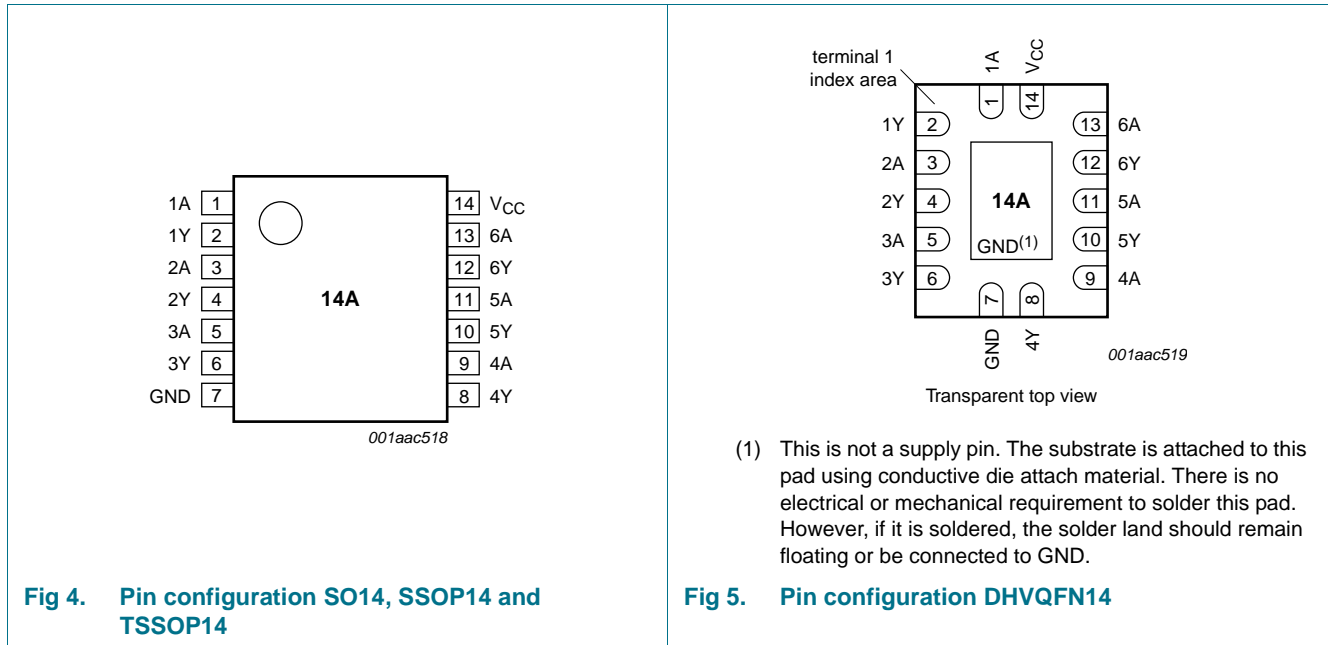


Fig 3. Logic diagram for one Schmitt trigger

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|------------------------|--------------------|----------------|
| 1A, 2A, 3A, 4A, 5A, 6A | 1, 3, 5, 9, 11, 13 | data input |
| 1Y, 2Y, 3Y, 4Y, 5Y, 6Y | 2, 4, 6, 8, 10, 12 | data output |
| GND | 7 | ground (0 V) |
| V _{CC} | 14 | supply voltage |

7. Functional description

Table 3. Function table^[1]

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

[1] H = HIGH voltage level; L = LOW voltage level

8. 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 | +6.5 | V |
| V_I | input voltage | | [1] -0.5 | +6.5 | V |
| V_O | output voltage | | [2][3] -0.5 | $V_{CC} + 0.5$ | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| I_{OK} | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V | - | ± 50 | mA |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ± 50 | mA |
| I_{CC} | supply current | | - | 100 | mA |
| I_{GND} | ground current | | -100 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C | [4] - | 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] When $V_{CC} = 0$ V (Power-down mode), the output voltage can be 3.6 V in normal operation.

[4] For SO14 packages: 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.

9. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|---------------------|------------|------|-----|----------|------|
| V_{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | - | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |

10. 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 _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 3.6 V | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | V |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | V |
| V _{OL} | LOW-level voltage output | V _I = V _{T+} or V _{T-} | | | | | | |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V | - | - | 0.2 | - | 0.3 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | 0.65 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | 0.8 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | 0.6 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | 0.8 | V |
| I _I | input leakage current | V _{CC} = 3.6 V; V _I = 5.5 V or GND | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{CC} | supply current | V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A | - | 0.1 | 10 | - | 40 | μA |
| ΔI _{CC} | additional supply current | per input pin; V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} - 0.6 V; I _O = 0 A | - | 5 | 500 | - | 5000 | μA |
| C _I | input capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC} | - | 4.0 | - | - | - | pF |

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

11. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|--------------------|-------------------|---|------------------|--------------------|------|-------------------|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| t _{pd} | propagation delay | nA to nY; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 16 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.0 | 6.1 | 12.7 | 1.0 | 14.7 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.5 | 3.5 | 7.8 | 1.5 | 10.0 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.6 | 7.5 | 1.5 | 9.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 3.2 | 6.4 | 1.0 | 8.0 | ns |
| t _{sk(o)} | output skew time | V _{CC} = 3.0 V to 3.6 V ^[3] | - | - | 1.0 | - | 1.5 | ns |

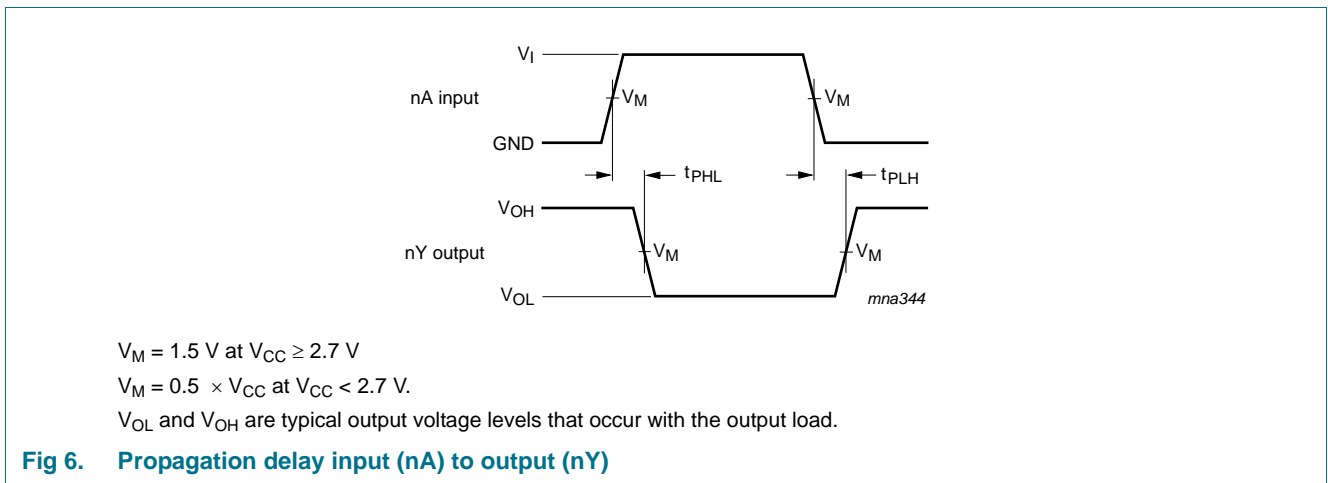
Table 7. Dynamic characteristics ...continued

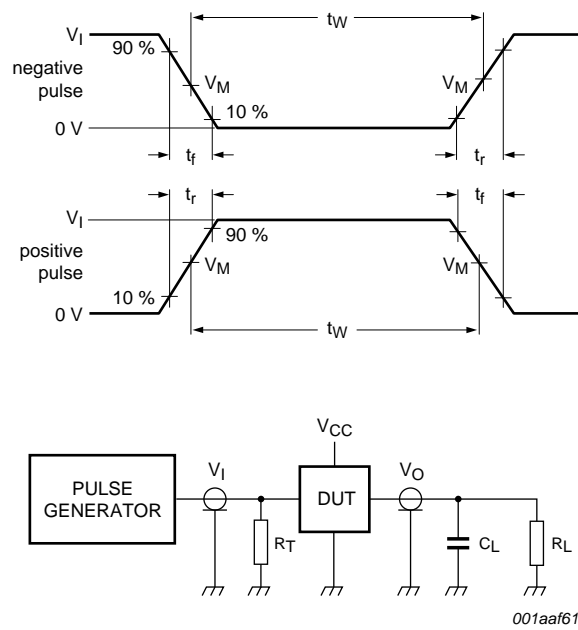
Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|------------------|--------------------|-----|-------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| C _{PD} | power dissipation capacitance | per buffer; V _I = GND to V _{CC} ^[4] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 9.0 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 12.5 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 15.6 | - | - | - | pF |

- [1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 Volts
 N = number of inputs switching
 Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

12. Waveforms





Test data is given in [Table 8](#). Definitions for test circuit:

R_L = Load resistance

C_L = Load capacitance including jig and probe capacitance

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

Fig 7. Load circuitry for measuring switching times

Table 8. Test data

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

13. Transfer characteristics

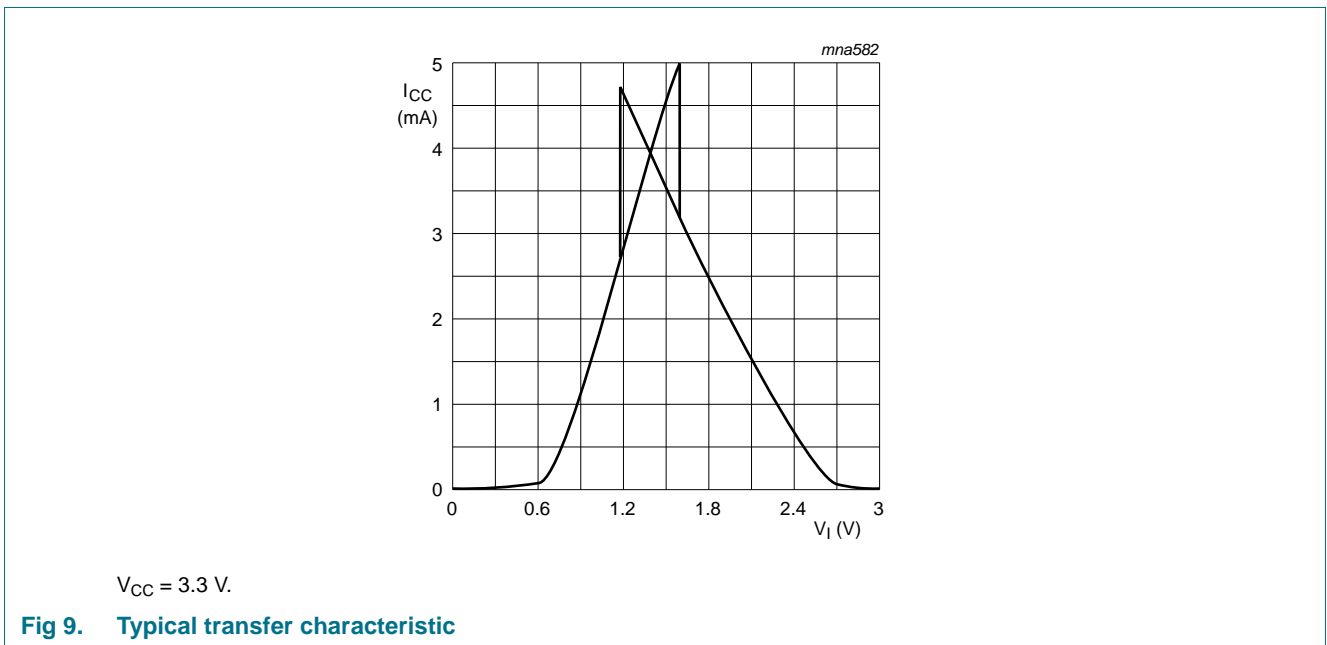
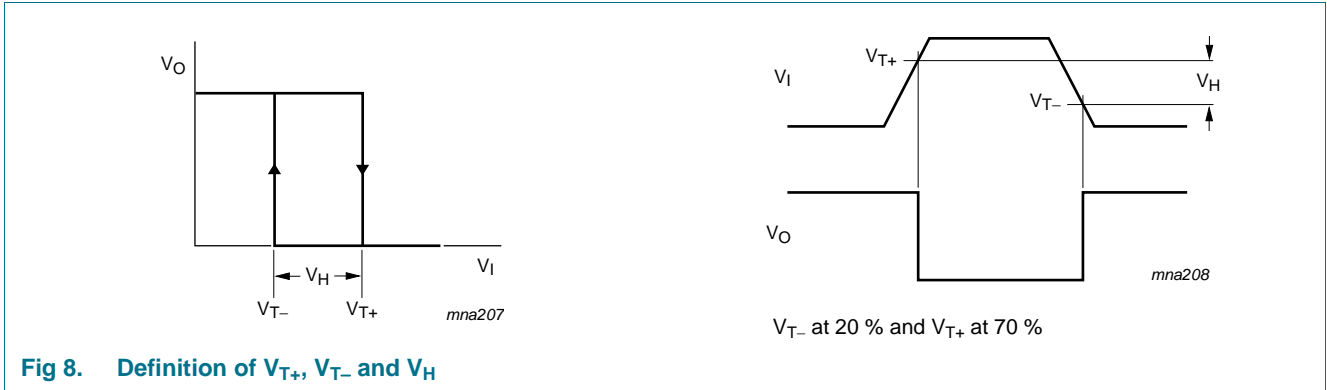
Table 9. Transfer characteristics

Voltages are referenced to GND (ground = 0 V); see [Figure 8](#).

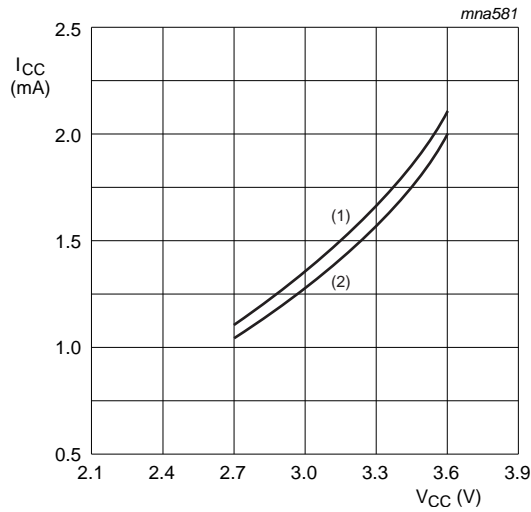
| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | T _{amb} = -40 °C to +125 °C | | Unit |
|-----------------|---|--|-------------------------------------|------|--------------------------------------|------|------|
| | | | Min | Max | Min | Max | |
| V _{T+} | positive-going threshold voltage | V _{CC} = 1.2 V | 0.2 | 1.0 | 0.2 | 1.0 | V |
| | | V _{CC} = 1.65 V | 0.4 | 1.3 | 0.4 | 1.3 | V |
| | | V _{CC} = 1.95 V | 0.6 | 1.5 | 0.6 | 1.5 | V |
| | | V _{CC} = 2.3 V | 0.8 | 1.7 | 0.8 | 1.7 | V |
| | | V _{CC} = 2.5 V | 0.9 | 1.7 | 0.9 | 1.7 | V |
| | | V _{CC} = 2.7 V | 1.1 | 2 | 1.1 | 2 | V |
| | | V _{CC} = 3 V | 1.2 | 2 | 1.2 | 2 | V |
| | | V _{CC} = 3.6 V | 1.2 | 2 | 1.2 | 2 | V |
| V _{T-} | negative-going threshold voltage | V _{CC} = 1.2 V | 0.12 | 0.75 | 0.12 | 0.75 | V |
| | | V _{CC} = 1.65 V | 0.15 | 0.85 | 0.15 | 0.85 | V |
| | | V _{CC} = 1.95 V | 0.25 | 0.95 | 0.25 | 0.95 | V |
| | | V _{CC} = 2.3 V | 0.4 | 1.1 | 0.4 | 1.1 | V |
| | | V _{CC} = 2.5 V | 0.4 | 1.2 | 0.4 | 1.2 | V |
| | | V _{CC} = 2.7 V | 0.8 | 1.4 | 0.8 | 1.4 | V |
| | | V _{CC} = 3 V | 0.8 | 1.5 | 0.8 | 1.5 | V |
| | | V _{CC} = 3.6 V | 0.8 | 1.5 | 0.8 | 1.5 | V |
| V _H | hysteresis voltage (V _{T+} - V _{T-}) | V _{CC} = 1.2 V | 0.1 | 1.0 | 0.1 | 1.0 | V |
| | | V _{CC} = 1.65 V | 0.2 | 1.15 | 0.2 | 1.15 | V |
| | | V _{CC} = 1.95 V | 0.2 | 1.25 | 0.2 | 1.25 | V |
| | | V _{CC} = 2.3 V | 0.3 | 1.3 | 0.3 | 1.3 | V |
| | | V _{CC} = 2.5 V | 0.3 | 1.3 | 0.3 | 1.3 | V |
| | | V _{CC} = 2.7 V | 0.3 | 1.1 | 0.3 | 1.1 | V |
| | | V _{CC} = 3 V | 0.3 | 1.2 | 0.3 | 1.2 | V |
| | | V _{CC} = 3.6 V ^[1] | 0.3 | 1.2 | 0.3 | 1.2 | V |

[1] Typical transfer characteristic is displayed in [Figure 9](#).

14. Waveforms transfer characteristics



15. Application information



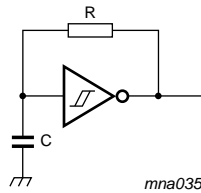
(1) Positive-going edge.

(2) Negative going-edge.

Linear change of V_I between 0.8 V to 2.0 V.

All values given are typical unless otherwise specified.

Fig 10. Average supply current as a function of supply voltage



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC} \text{ at } V_{CC} = 3.0 \text{ V}$$

Fig 11. Relaxation oscillator

16. Package outline

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

SOT108-1

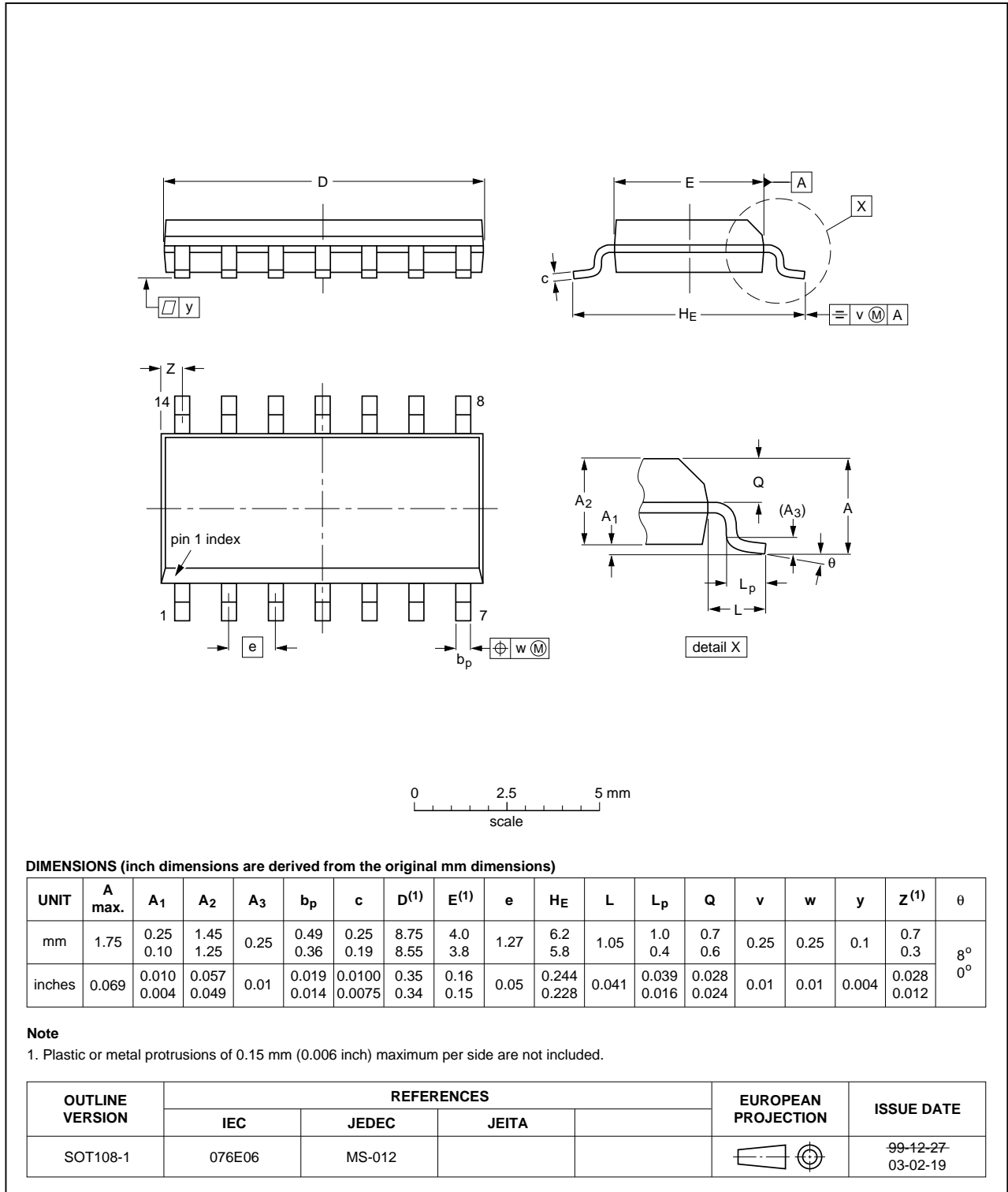


Fig 12. Package outline SOT108-1 (SO14)

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

SOT337-1

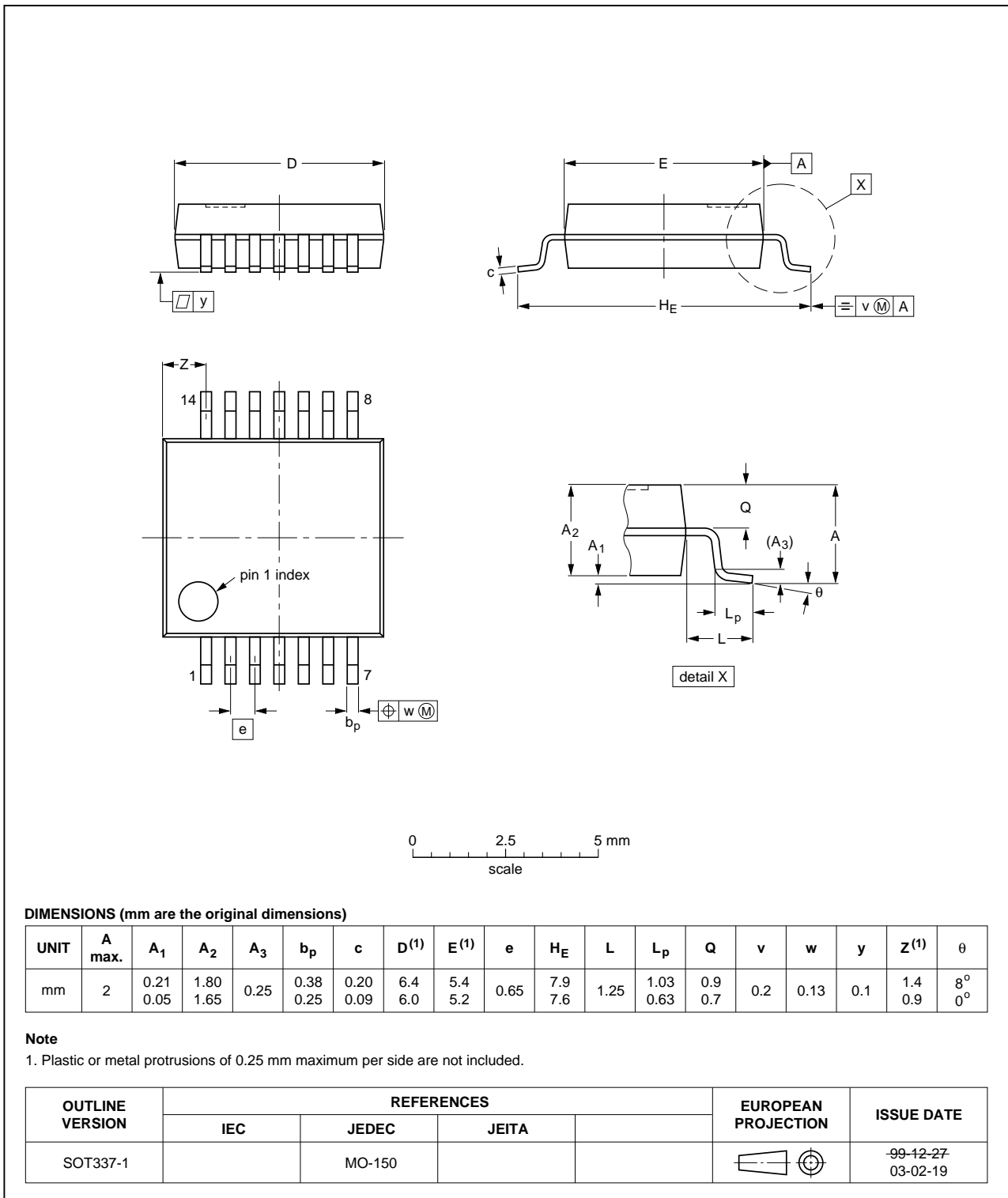


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

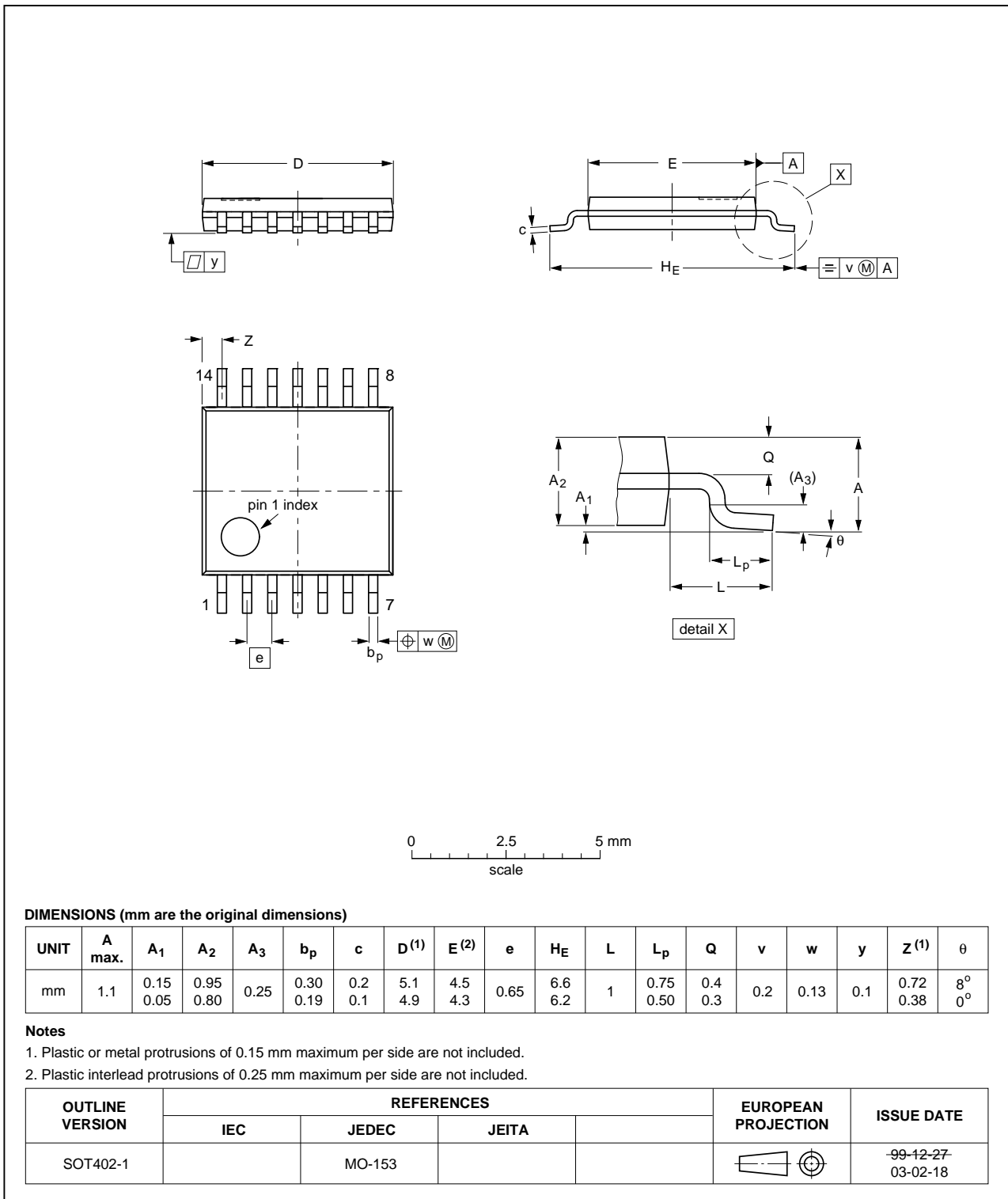


Fig 14. Package outline SOT402-1 (TSSOP14)

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

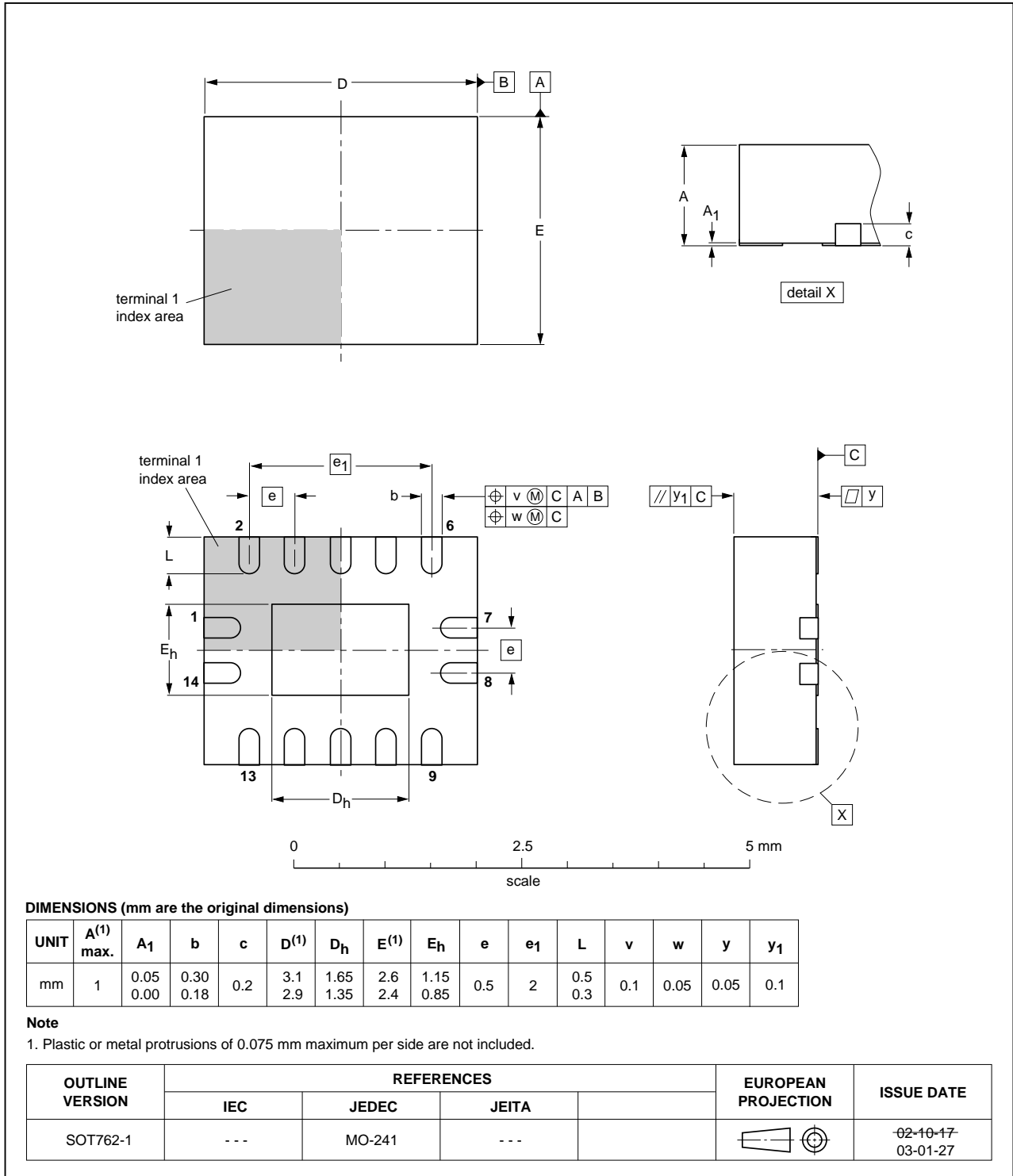


Fig 15. Package outline SOT762-1 (DHVQFN14)

17. Abbreviations

Table 10. Abbreviations

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

18. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|--------------|
| 74LVC14A v.5 | 20111223 | Product data sheet | - | 74LVC14A v.4 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Table 4, Table 5, Table 6, Table 7 and Table 8: values added for lower voltage ranges. | | | |
| 74LVC14A v.4 | 20050215 | Product data sheet | - | 74LVC14A v.3 |
| 74LVC14A v.3 | 20030228 | Product specification | - | 74LVC14A v.2 |
| 74LVC14A v.2 | 20020315 | Product specification | - | 74LVC14A v.1 |
| 74LVC14A v.1 | 19980428 | Product specification | - | - |

19. Legal information

19.1 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. |
| 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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