

74LV14

Hex inverting Schmitt trigger

Rev. 7 — 9 December 2015

Product data sheet

1. General description

The 74LV14 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC14 and 74HCT14.

The 74LV14 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 .

2. Features and benefits

- Wide operating voltage: 1.0 V to 5.5 V
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between $V_{CC} = 2.7$ V and $V_{CC} = 3.6$ V
- Typical output ground bounce < 0.8 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- Typical HIGH-level output voltage (V_{OH}) undershoot: > 2 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

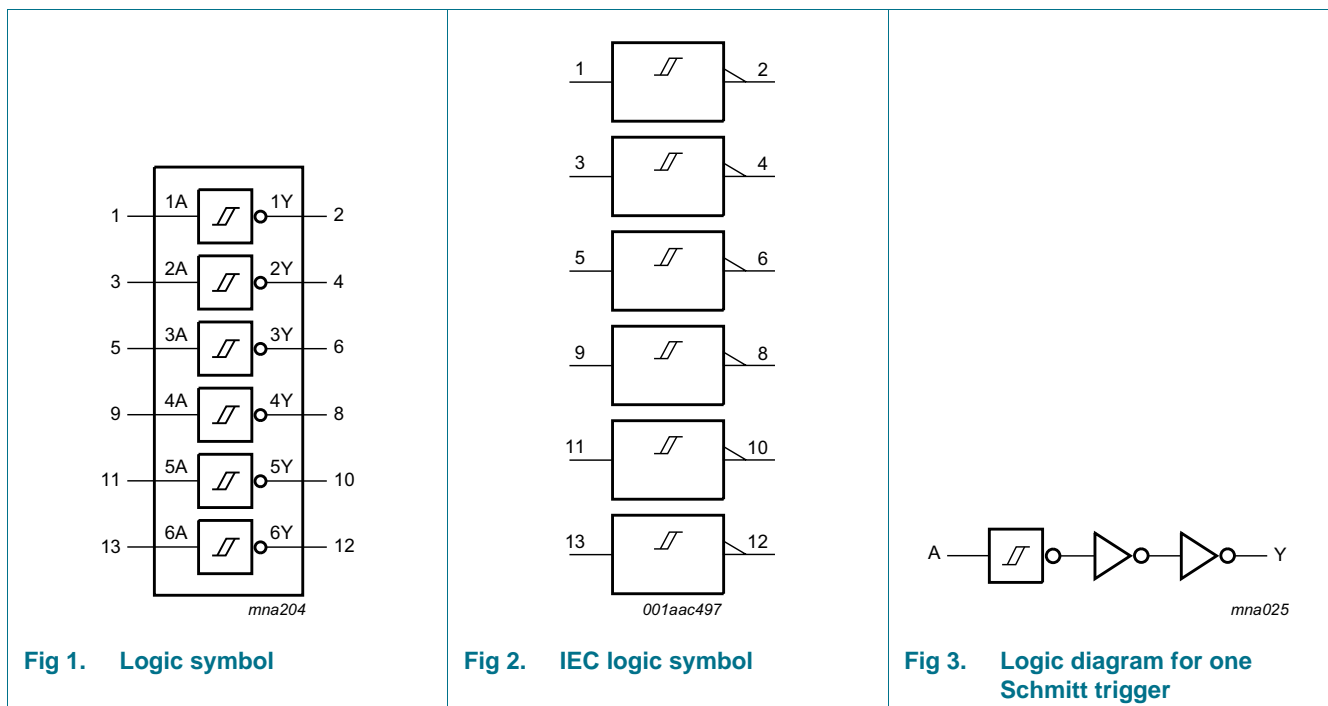
- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

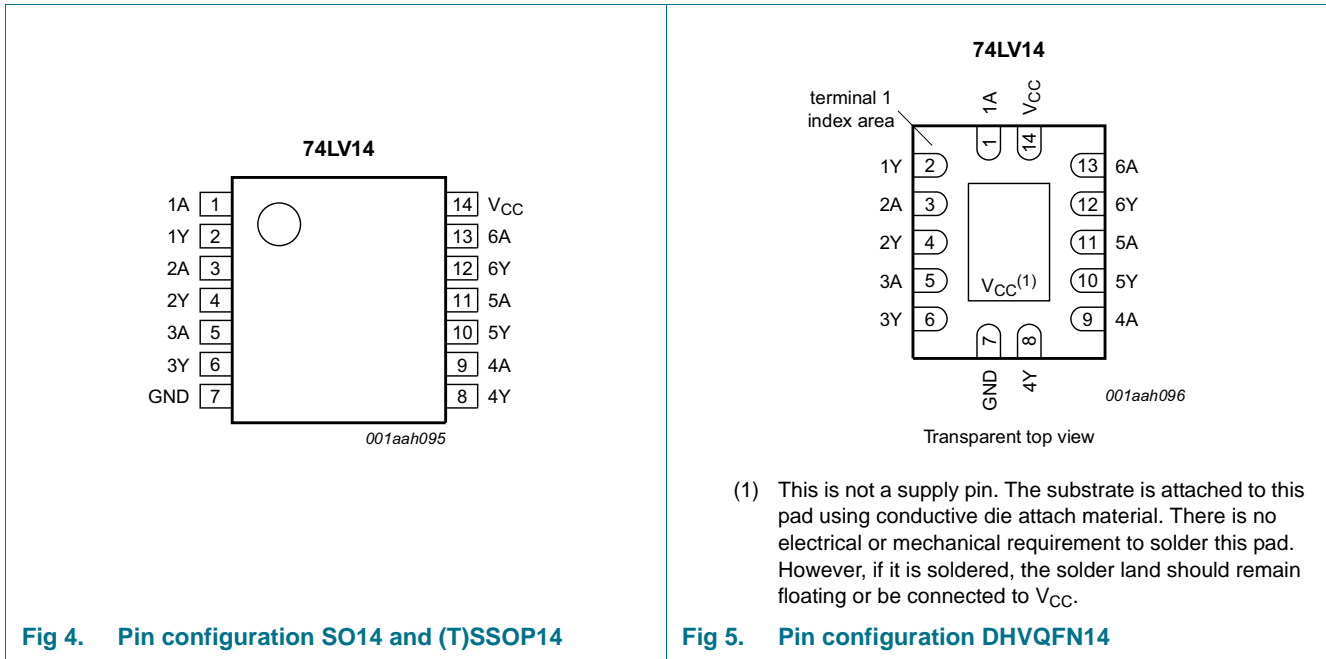
| Type number | Package | | | Version |
|-------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74LV14D | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74LV14DB | -40 °C to +125 °C | SSOP14 | plastic shrink small outline package; 14 leads; body width 5.3 mm | SOT337-1 |
| 74LV14PW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74LV14BQ | -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



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

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

7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level.

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

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 | +7.0 | 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] | - | ±50 | mA |
| I_O | output current | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$ | - | ±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 | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ | | | |
| | | SO14 package [2] | - | 500 | mW |
| | | (T)SSOP14 package [3] | - | 500 | mW |
| | | DHVQFN14 package [4] | - | 500 | mW |

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

[2] P_{tot} derates linearly with 8 mW/K above 70 °C.

[3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

[4] P_{tot} derates linearly with 4.5 mW/K above 60 °C.

9. 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 | [1] | 1.0 | 3.3 | 5.5 | V |
| V_I | input voltage | | 0 | - | V_{CC} | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |

[1] The static characteristics are guaranteed from $V_{CC} = 1.2\text{ V}$ to $V_{CC} = 5.5\text{ V}$, but LV devices are guaranteed to function down to $V_{CC} = 1.0\text{ V}$ (with input levels GND or V_{CC}).

10. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | T _{amb} = -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} = 1.2 V | - | 1.2 | - | - | - | V |
| | | I _O = -100 μA; V _{CC} = 2.0 V | 1.8 | 2.0 | - | 1.8 | - | V |
| | | I _O = -100 μA; V _{CC} = 2.7 V | 2.5 | 2.7 | - | 2.5 | - | V |
| | | I _O = -100 μA; V _{CC} = 3.0 V | 2.8 | 3.0 | - | 2.8 | - | V |
| | | I _O = -100 μA; V _{CC} = 4.5 V | 4.3 | 4.5 | - | 4.3 | - | V |
| | | I _O = -6 mA; V _{CC} = 3.0 V | 2.4 | 2.82 | - | 2.2 | - | V |
| | | I _O = -12 mA; V _{CC} = 4.5 V | 3.6 | 4.2 | - | 3.5 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | |
| | | I _O = 100 μA; V _{CC} = 1.2 V | - | 0 | - | - | - | V |
| | | I _O = 100 μA; V _{CC} = 2.0 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 100 μA; V _{CC} = 2.7 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 100 μA; V _{CC} = 3.0 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 100 μA; V _{CC} = 4.5 V | - | 0 | 0.2 | - | 0.2 | V |
| | | I _O = 6 mA; V _{CC} = 3.0 V | - | 0.25 | 0.40 | - | 0.50 | V |
| | | I _O = 12 mA; V _{CC} = 4.5 V | - | 0.35 | 0.55 | - | 0.65 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | 1.0 | - | 1.0 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 20.0 | - | 40 | μA |
| ΔI _{CC} | additional supply current | per input; V _I = V _{CC} - 0.6 V; V _{CC} = 2.7 V to 3.6 V | - | - | 500 | - | 850 | μA |
| C _I | input capacitance | | - | 3.5 | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 25 °C.

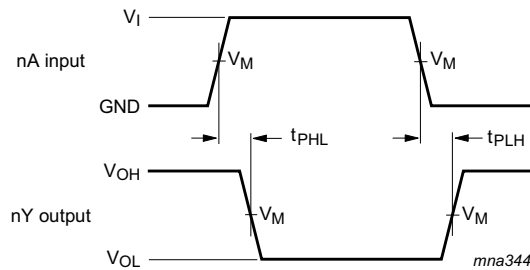
11. Dynamic characteristics

Table 7. Dynamic characteristics
GND = 0 V; For test circuit see Figure 7.

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | T _{amb} = -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 | - | 80 | - | - | - | ns |
| | | V _{CC} = 2.0 V | - | 27 | 37 | - | 48 | ns |
| | | V _{CC} = 2.7 V | - | 20 | 28 | - | 35 | ns |
| | | V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF ^[3] | - | 13 | - | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[3] | - | 15 | 22 | - | 28 | ns |
| C _{PD} | power dissipation capacitance | C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} ^[4] | - | 15 | - | - | - | pF |
| | | | | | | | | |

- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V).
- [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 V
 N = number of inputs switching
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

12. 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 6. The input (nA) to output (nY) propagation delays

Table 8. Measurement points

| Supply voltage | Input | Output |
|----------------|-------------|-------------|
| V_{CC} | V_M | V_M |
| < 2.7 V | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 2.7 V to 3.6 V | 1.5 V | 1.5 V |
| ≥ 4.5 V | $0.5V_{CC}$ | $0.5V_{CC}$ |

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.

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

Fig 7. Test circuit for measuring switching times

Table 9. Test data

| Supply voltage | Input | |
|----------------|----------|---------------|
| V_{CC} | V_I | t_r, t_f |
| < 2.7 V | V_{CC} | ≤ 2.5 ns |
| 2.7 V to 3.6 V | 2.7 V | ≤ 2.5 ns |
| ≥ 4.5 V | V_{CC} | ≤ 2.5 ns |

13. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 8](#) and [Figure 9](#).

| Symbol | Parameter | Conditions | $T_{amb} = -40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$ | | | $T_{amb} = -40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$ | | Unit |
|----------|----------------------------------|------------------|--|--------------------|------|---|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 1.2$ V | - | 0.70 | - | - | - | V |
| | | $V_{CC} = 2.0$ V | 0.8 | 1.10 | 1.4 | 0.8 | 1.4 | V |
| | | $V_{CC} = 2.7$ V | 1.0 | 1.45 | 2.0 | 1.0 | 2.0 | V |
| | | $V_{CC} = 3.0$ V | 1.2 | 1.60 | 2.2 | 1.2 | 2.2 | V |
| | | $V_{CC} = 3.6$ V | 1.5 | 1.95 | 2.4 | 1.5 | 2.4 | V |
| | | $V_{CC} = 4.5$ V | 1.7 | 2.50 | 3.15 | 1.7 | 3.15 | V |
| | | $V_{CC} = 5.5$ V | 2.1 | 3.00 | 3.85 | 2.1 | 3.85 | V |

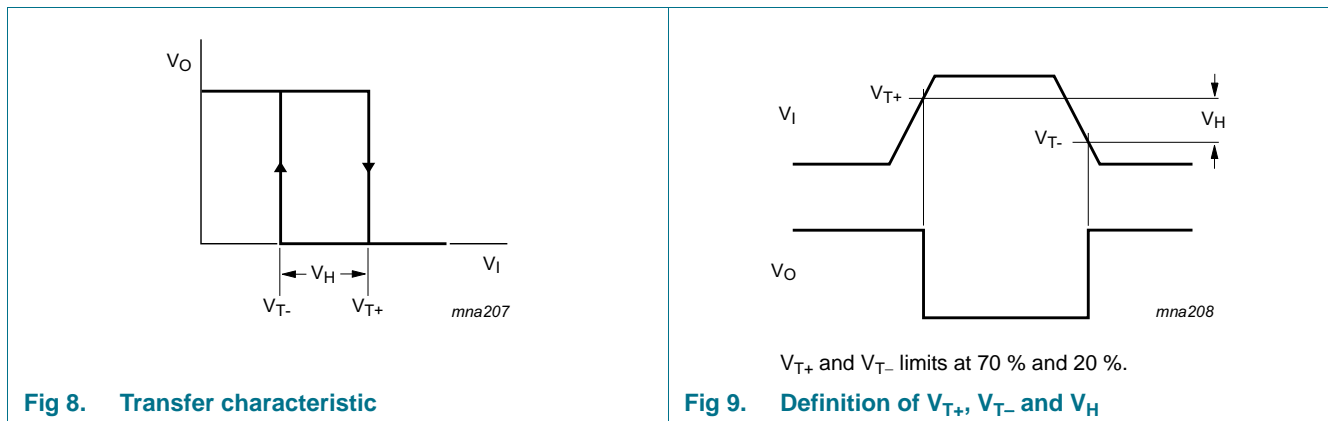
Table 10. Transfer characteristics ...continued

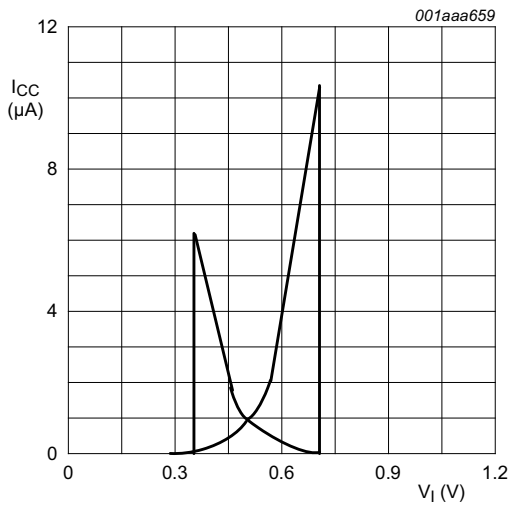
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 8](#) and [Figure 9](#).

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | T _{amb} = -40 °C to +125 °C | | Unit |
|-----------------|----------------------------------|-------------------------|-------------------------------------|--------------------|-----|--------------------------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| V _{T-} | negative-going threshold voltage | V _{CC} = 1.2 V | - | 0.34 | - | - | - | V |
| | | V _{CC} = 2.0 V | 0.3 | 0.65 | 0.9 | 0.3 | 0.9 | V |
| | | V _{CC} = 2.7 V | 0.4 | 0.90 | 1.4 | 0.4 | 1.4 | V |
| | | V _{CC} = 3.0 V | 0.6 | 1.05 | 1.5 | 0.6 | 1.5 | V |
| | | V _{CC} = 3.6 V | 0.8 | 1.30 | 1.8 | 0.8 | 1.8 | V |
| | | V _{CC} = 4.5 V | 0.9 | 1.60 | 2.0 | 0.9 | 2.0 | V |
| | | V _{CC} = 5.5 V | 1.1 | 2.00 | 2.6 | 1.1 | 2.6 | V |
| V _H | hysteresis voltage | V _{CC} = 1.2 V | - | 0.3 | - | - | - | V |
| | | V _{CC} = 2.0 V | 0.2 | 0.55 | 0.8 | 0.2 | 0.8 | V |
| | | V _{CC} = 2.7 V | 0.3 | 0.60 | 1.1 | 0.3 | 1.1 | V |
| | | V _{CC} = 3.0 V | 0.4 | 0.65 | 1.2 | 0.4 | 1.2 | V |
| | | V _{CC} = 3.6 V | 0.4 | 0.70 | 1.2 | 0.4 | 1.2 | V |
| | | V _{CC} = 4.5 V | 0.4 | 0.80 | 1.4 | 0.4 | 1.4 | V |
| | | V _{CC} = 5.5 V | 0.6 | 1.00 | 1.5 | 0.6 | 1.5 | V |

[1] All typical values are measured at T_{amb} = 25 °C.

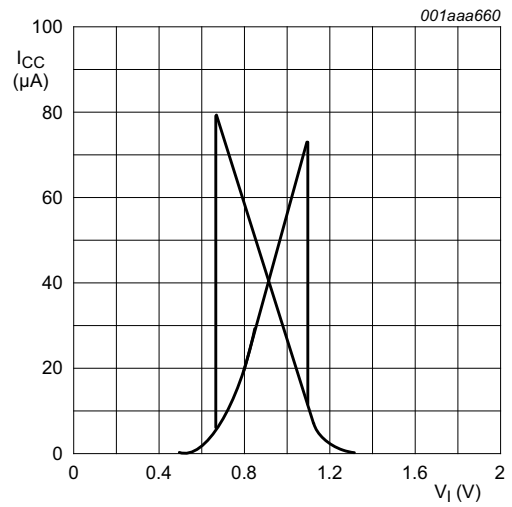
14. Waveforms transfer characteristics





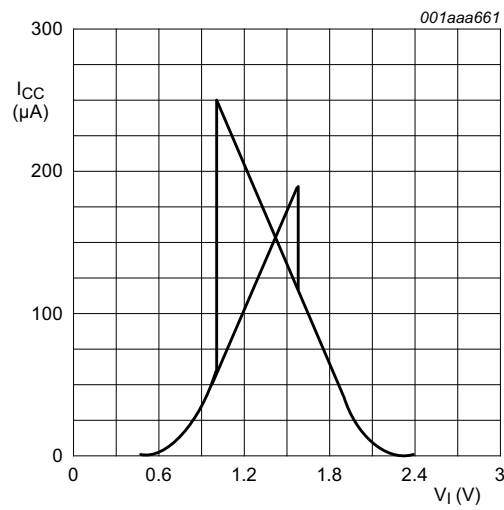
$V_{CC} = 1.2$ V.

Fig 10. Typical 74LV14 transfer characteristics



$V_{CC} = 2.0$ V.

Fig 11. Typical 74LV14 transfer characteristics



$V_{CC} = 3.0$ V.

Fig 12. Typical 74LV14 transfer characteristics

15. Application information

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$$P_{\text{add}} = f_i \times (t_r \times \Delta I_{\text{CC(AV)}} + t_f \times \Delta I_{\text{CC(AV)}}) \times V_{\text{CC}} \text{ where:}$$

P_{add} = additional power dissipation (μW);

f_i = input frequency (MHz);

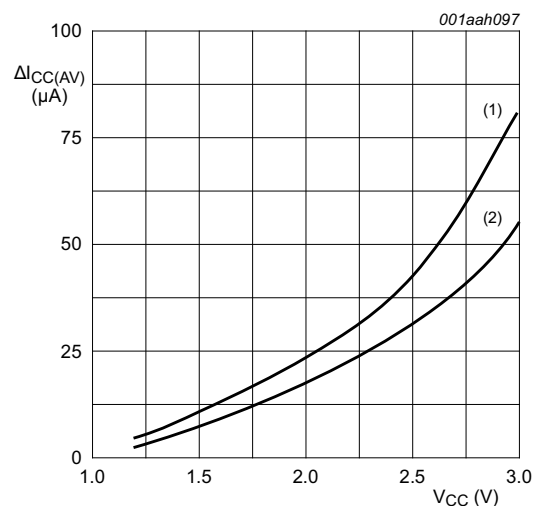
t_r = rise time (ns); 10 % to 90 %;

t_f = fall time (ns); 90 % to 10 %;

$\Delta I_{\text{CC(AV)}}$ = average additional supply current (μA).

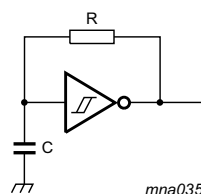
Average $\Delta I_{\text{CC(AV)}}$ differs with positive or negative input transitions, as shown in [Figure 13](#).

An example of a relaxation circuit using the 74LV14 is shown in [Figure 14](#).



- (1) Positive-going edge.
- (2) Negative-going edge.

Fig 13. Average additional supply current as a function of V_{CC}



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$$

Fig 14. Relaxation oscillator

16. Package outline

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

SOT108-1

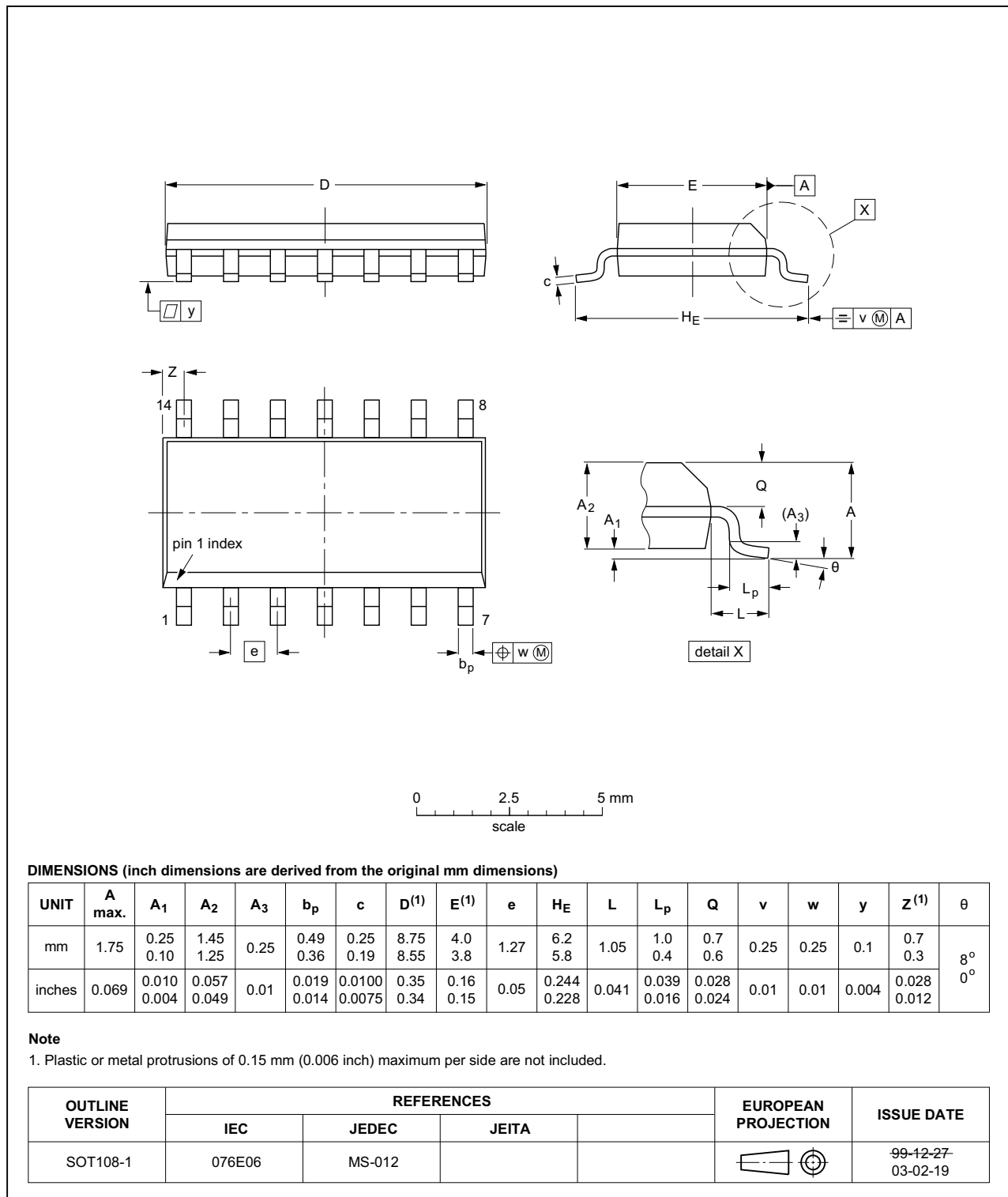


Fig 15. Package outline SOT108-1 (SO14)

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

SOT337-1

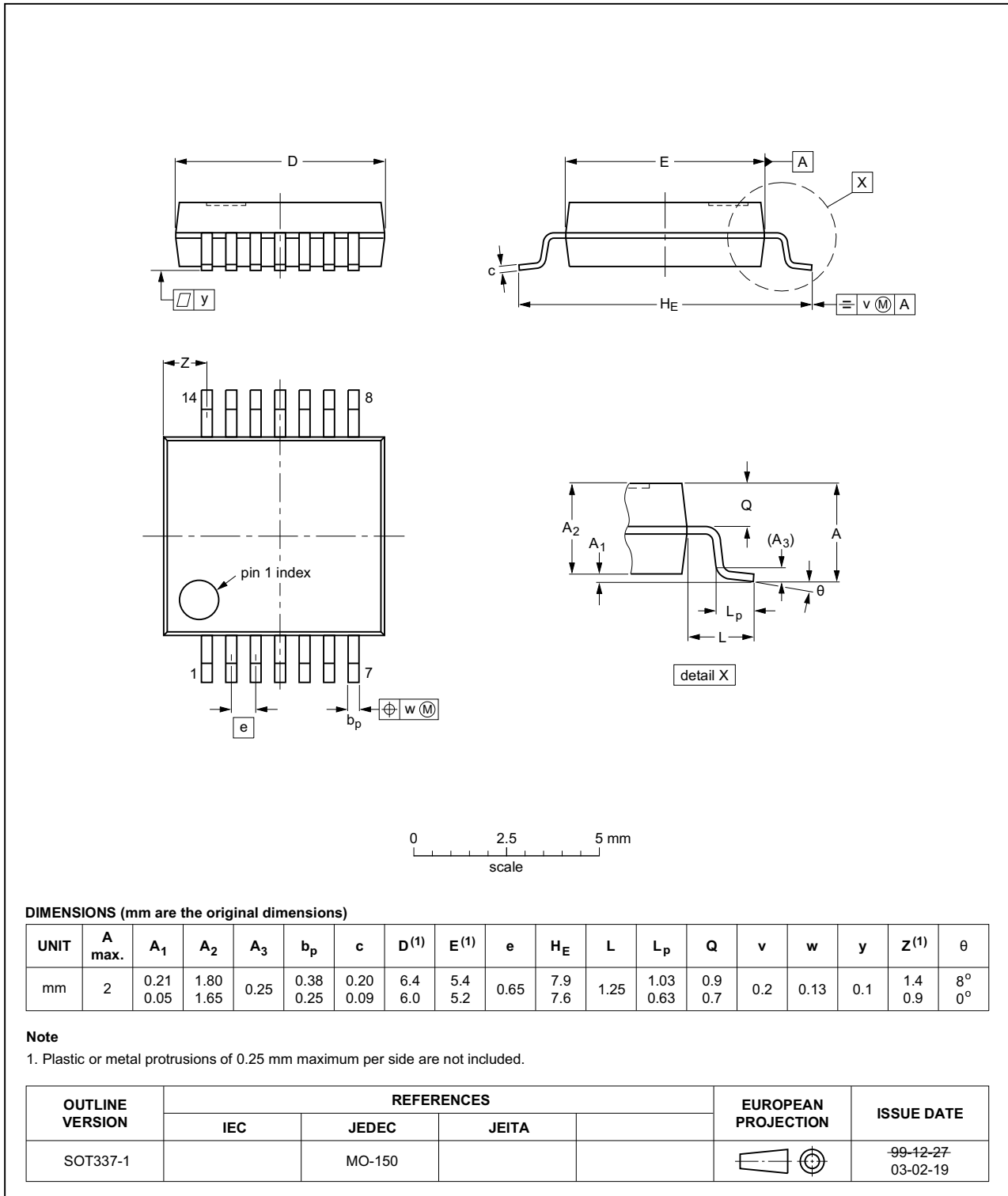


Fig 16. Package outline SOT337-1 (SSOP14)

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

SOT402-1

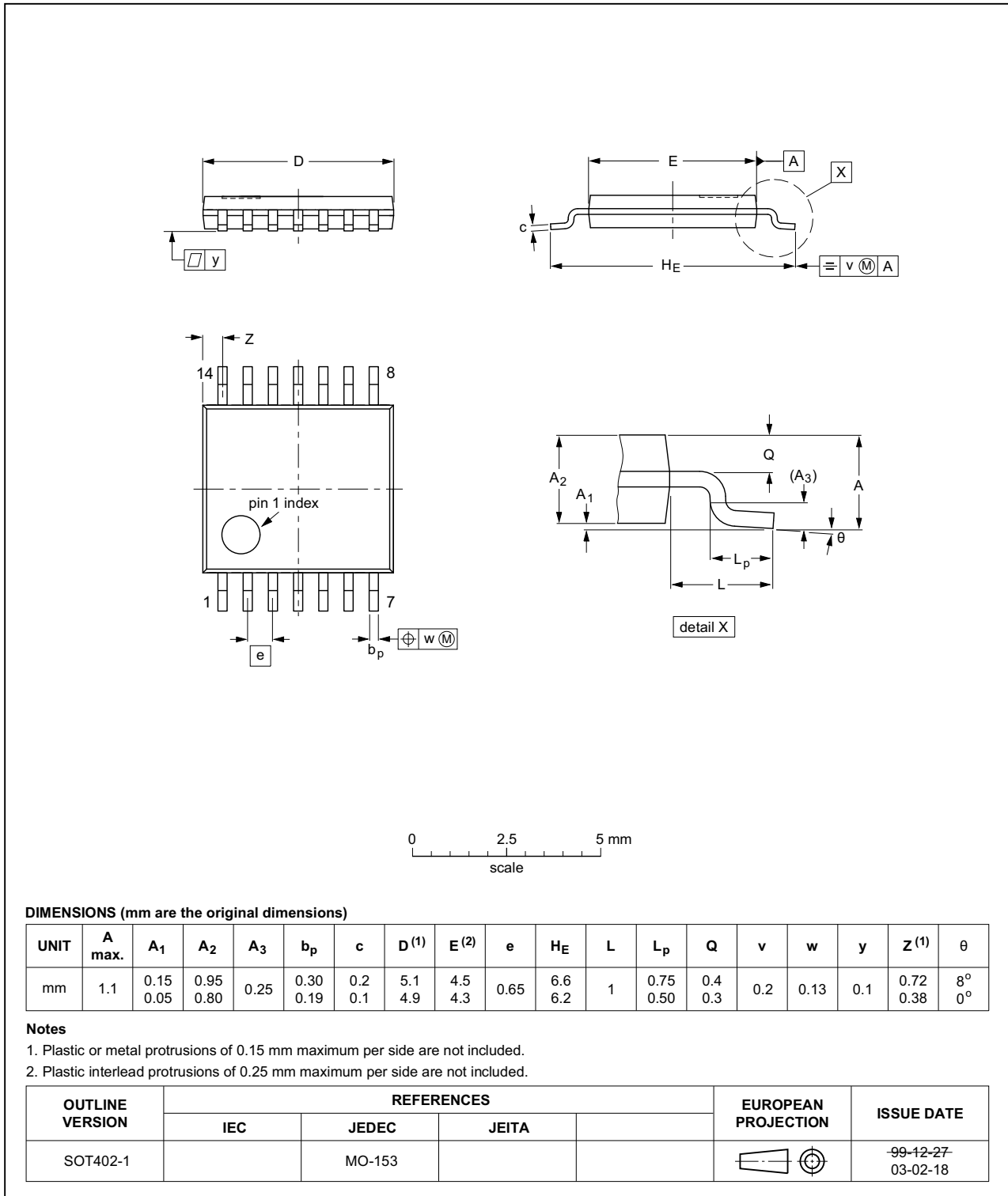


Fig 17. Package outline SOT402-1 (TSSOP14)

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

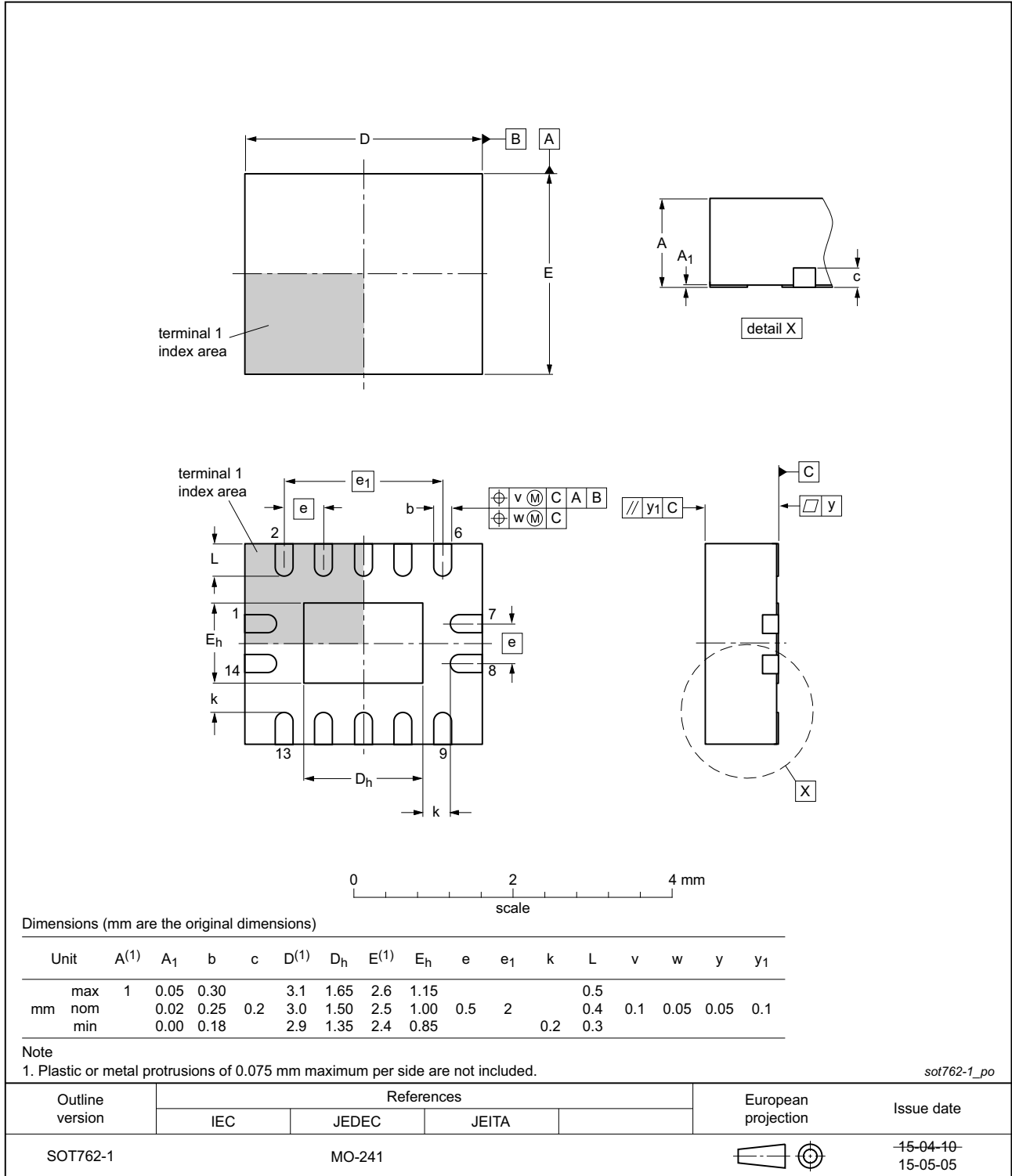


Fig 18. Package outline SOT762-1 (DHVQFN14)

17. Abbreviations

Table 11. 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 |

18. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|-----------------------|---------------|------------|
| 74LV14 v.7 | 20151209 | Product data sheet | - | 74LV14 v.6 |
| Modifications: | <ul style="list-style-type: none"> Type number 74LV14N (SOT27-1) removed. | | | |
| 74LV14 v.6 | 20111212 | Product data sheet | - | 74LV14 v.5 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. | | | |
| 74LV14 v.5 | 20110105 | Product data sheet | - | 74LV14 v.4 |
| 74LV14 v.4 | 20090702 | Product data sheet | - | 74LV14 v.3 |
| 74LV14 v.3 | 20071220 | Product data sheet | - | 74LV14 v.2 |
| 74LV14 v.2 | 19980420 | Product specification | - | 74LV14 v.1 |
| 74LV14 v.1 | 19970203 | 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.nexperia.com>.

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21. Contents

| | | |
|------|--|----|
| 1 | General description | 1 |
| 2 | Features and benefits | 1 |
| 3 | Applications | 1 |
| 4 | Ordering information | 2 |
| 5 | Functional diagram | 2 |
| 6 | Pinning information | 3 |
| 6.1 | Pinning | 3 |
| 6.2 | Pin description | 3 |
| 7 | Functional description | 4 |
| 8 | Limiting values | 4 |
| 9 | Recommended operating conditions | 4 |
| 10 | Static characteristics | 5 |
| 11 | Dynamic characteristics | 6 |
| 12 | Waveforms | 6 |
| 13 | Transfer characteristics | 7 |
| 14 | Waveforms transfer characteristics | 8 |
| 15 | Application information | 10 |
| 16 | Package outline | 11 |
| 17 | Abbreviations | 15 |
| 18 | Revision history | 15 |
| 19 | Legal information | 16 |
| 19.1 | Data sheet status | 16 |
| 19.2 | Definitions | 16 |
| 19.3 | Disclaimers | 16 |
| 19.4 | Trademarks | 17 |
| 20 | Contact information | 17 |
| 21 | Contents | 18 |



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