

# 74LVT02

## 3.3 V Quad 2-input NOR gate

Rev. 3 — 7 April 2017

Product data sheet

### 1 General description

The 74LVT02 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

The 74LVT02 is a quad 2-input NOR gate.

### 2 Features and benefits

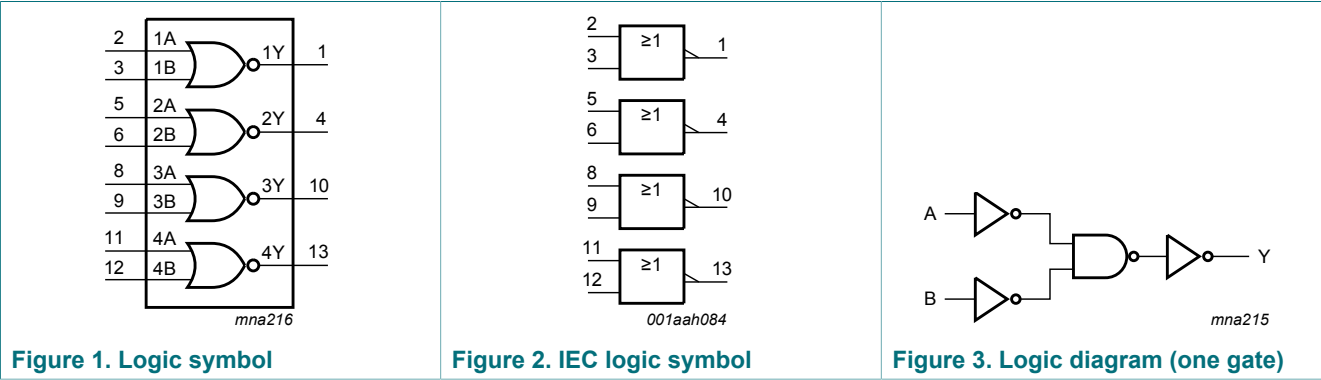
- Wide supply voltage range from 2.7 V to 3.6 V
- Output capability: +64 mA and -32 mA
- TTL input and output switching levels
- Latch-up protection
  - JESD78 Class II exceeds 500 mA
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to 85 °C

### 3 Ordering information

Table 1. Ordering information

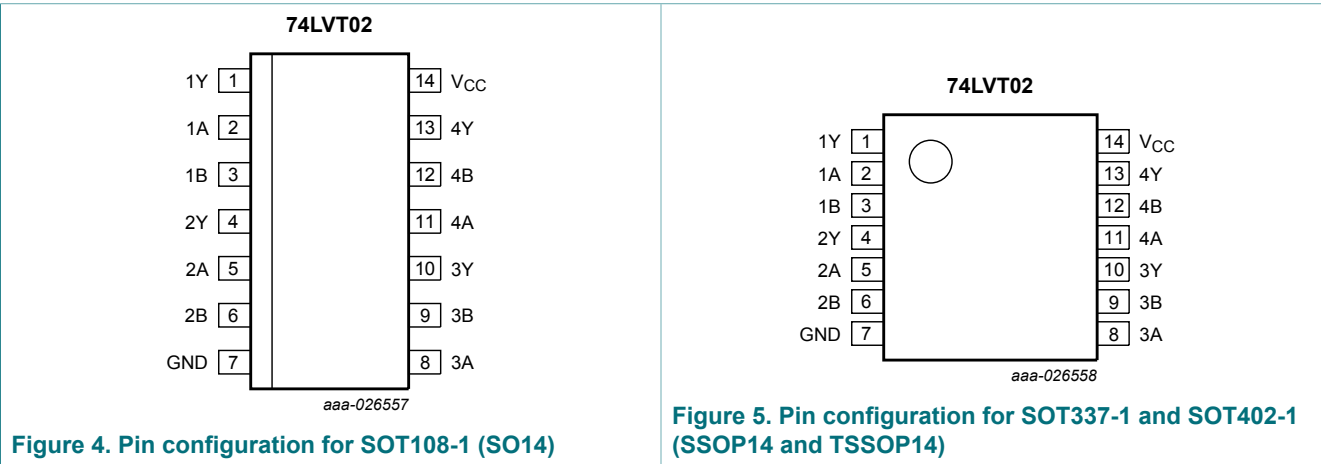
| Type number | Package           |         |                                                                        |          |
|-------------|-------------------|---------|------------------------------------------------------------------------|----------|
|             | Temperature range | Name    | Description                                                            | Version  |
| 74LVT02D    | -40 °C to +85 °C  | SO14    | plastic small outline package; 14 leads; body width 3.9 mm             | SOT108-1 |
| 74LVT02DB   | -40 °C to +85 °C  | SSOP14  | plastic shrink small outline package; 14 leads; body width 5.3 mm      | SOT337-1 |
| 74LVT02PW   | -40 °C to +85 °C  | TSSOP14 | plastic thin shrink small outline package; 14 leads; 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    |
|-----------------|--------------|----------------|
| 1Y to 4Y        | 1, 4, 10, 13 | data output    |
| 1A to 4A        | 2, 5, 8, 11  | data input     |
| 1B to 4B        | 3, 6, 9, 12  | data input     |
| GND             | 7            | ground (0 V)   |
| V <sub>CC</sub> | 14           | supply voltage |

## 6 Functional description

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

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

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

## 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 | +4.6 | V    |
| V <sub>I</sub>   | input voltage           |                                   | -0.5 | +7.0 | V    |
| V <sub>O</sub>   | output voltage          | output in OFF-state or HIGH-state | -0.5 | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < 0 V              | -50  | -    | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < 0 V              | -50  | -    | mA   |
| I <sub>O</sub>   | output current          | output in LOW-state               | -    | 64   | mA   |
|                  |                         | output in HIGH-state              | -32  | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                   | -65  | +150 | °C   |
| T <sub>j</sub>   | junction temperature    |                                   | -    | 150  | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 to +85 °C  | -    | 500  | mW   |

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

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

[3] For SO14 packages: above 70 °C derate linearly with 8 mW/K.  
For SSOP14 and TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.

## 8 Recommended operating conditions

Table 5. Operating conditions

| Symbol           | Parameter                           | Conditions      | Min | Typ | Max | Unit |
|------------------|-------------------------------------|-----------------|-----|-----|-----|------|
| V <sub>CC</sub>  | supply voltage                      |                 | 2.7 | -   | 3.6 | V    |
| V <sub>I</sub>   | input voltage                       |                 | 0   | -   | 5.5 | V    |
| I <sub>OH</sub>  | HIGH-level output current           |                 | -20 | -   | -   | mA   |
| I <sub>OL</sub>  | LOW-level output current            |                 | -   | -   | 32  | mA   |
| T <sub>amb</sub> | ambient temperature                 | in free-air     | -40 | -   | +85 | °C   |
| Δt/ΔV            | input transition rise and fall rate | outputs enabled | -   | -   | 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                                                                                                                                                   | Min            | Typ <sup>[1]</sup> | Max       | Unit          |
|------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------|-----------|---------------|
| $T_{amb} = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ |                           |                                                                                                                                                              |                |                    |           |               |
| $V_{IK}$                                                               | input clamping voltage    | $V_{CC} = 2.7\text{ V}; I_{IK} = -18\text{ mA}$                                                                                                              | -1.2           |                    | -         | V             |
| $V_{IH}$                                                               | HIGH-level input voltage  |                                                                                                                                                              | 2.0            | -                  | -         | V             |
| $V_{IL}$                                                               | LOW-level input voltage   |                                                                                                                                                              | -              | -                  | 0.8       | V             |
| $V_{OH}$                                                               | HIGH-level output voltage | $V_{CC} = 2.7\text{ V to }3.6\text{ V}; I_{OH} = -100\text{ }\mu\text{A}$                                                                                    | $V_{CC} - 0.2$ |                    | -         | V             |
|                                                                        |                           | $V_{CC} = 2.7\text{ V}; I_{OH} = -6\text{ mA}$                                                                                                               | 2.4            | -                  | -         | V             |
|                                                                        |                           | $V_{CC} = 3.0\text{ V}; I_{OH} = -20\text{ mA}$                                                                                                              | 2.0            | -                  | -         | V             |
| $V_{OL}$                                                               | LOW-level output voltage  | $V_{CC} = 2.7\text{ V}; I_{OL} = 100\text{ }\mu\text{A}$                                                                                                     | -              |                    | 0.2       | V             |
|                                                                        |                           | $V_{CC} = 2.7\text{ V}; I_{OL} = 24\text{ mA}$                                                                                                               | -              |                    | 0.5       | V             |
|                                                                        |                           | $V_{CC} = 3.0\text{ V}; I_{OL} = 32\text{ mA}$                                                                                                               | -              |                    | 0.5       | V             |
| $I_I$                                                                  | input leakage current     | $V_{CC} = 0\text{ V or }3.6\text{ V}; V_I = 5.5\text{ V}$                                                                                                    | -              | -                  | 10        | $\mu\text{A}$ |
|                                                                        |                           | $V_{CC} = 3.6\text{ V}; V_I = V_{CC}\text{ or GND}$                                                                                                          |                | -                  | $\pm 1$   | $\mu\text{A}$ |
| $I_{OFF}$                                                              | power-off leakage current | $V_{CC} = 0\text{ V}; V_I\text{ or }V_O = 0\text{ V to }4.5\text{ V}$                                                                                        |                |                    | $\pm 100$ | $\mu\text{A}$ |
| $I_{CC}$                                                               | supply current            | $V_{CC} = 3.6\text{ V}; V_I = \text{GND or }V_{CC}; I_O = 0\text{ A}$                                                                                        |                |                    |           |               |
|                                                                        |                           | output HIGH                                                                                                                                                  | -              | -                  | 0.02      | mA            |
|                                                                        |                           | output LOW                                                                                                                                                   | -              | 1                  | 2         | mA            |
| $\Delta I_{CC}$                                                        | additional supply current | per input pin; $V_{CC} = 3.0\text{ V to }3.6\text{ V};$<br>one input at $V_{CC} - 0.6\text{ V}$<br>and other inputs at $V_{CC}\text{ or GND}$ <sup>[2]</sup> | -              |                    | 0.2       | $\mu\text{A}$ |
| $C_I$                                                                  | input capacitance         | $V_I = 0\text{ V or }3.0\text{ V}$                                                                                                                           | -              | 3                  | -         | pF            |

[1] Typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$  and  $V_{CC} = 3.3\text{ V}$ .

[2] This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND.

10 Dynamic characteristics

Table 7. Dynamic characteristics

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

| Symbol                              | Parameter                     | Conditions                                   | Min | Typ <sup>[1]</sup> | Max | Unit |
|-------------------------------------|-------------------------------|----------------------------------------------|-----|--------------------|-----|------|
| T <sub>amb</sub> = -40 °C to +85 °C |                               |                                              |     |                    |     |      |
| t <sub>PLH</sub>                    | LOW to HIGH propagation delay | nA or nB to nY; see <a href="#">Figure 6</a> |     |                    |     |      |
|                                     |                               | V <sub>CC</sub> = 2.7 V                      | -   | -                  | 5.2 | ns   |
|                                     |                               | V <sub>CC</sub> = 3.0 V to 3.6 V             | 1   | 2.8                | 4.4 | ns   |
| t <sub>PHL</sub>                    | HIGH to LOW propagation delay | nA or nB to nY; see <a href="#">Figure 6</a> |     |                    |     |      |
|                                     |                               | V <sub>CC</sub> = 2.7 V                      | -   | -                  | 3.4 | ns   |
|                                     |                               | V <sub>CC</sub> = 3.0 V to 3.6 V             | 1   | 2.6                | 3.6 | ns   |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 3.3 V.

10.1 Waveforms and test circuit

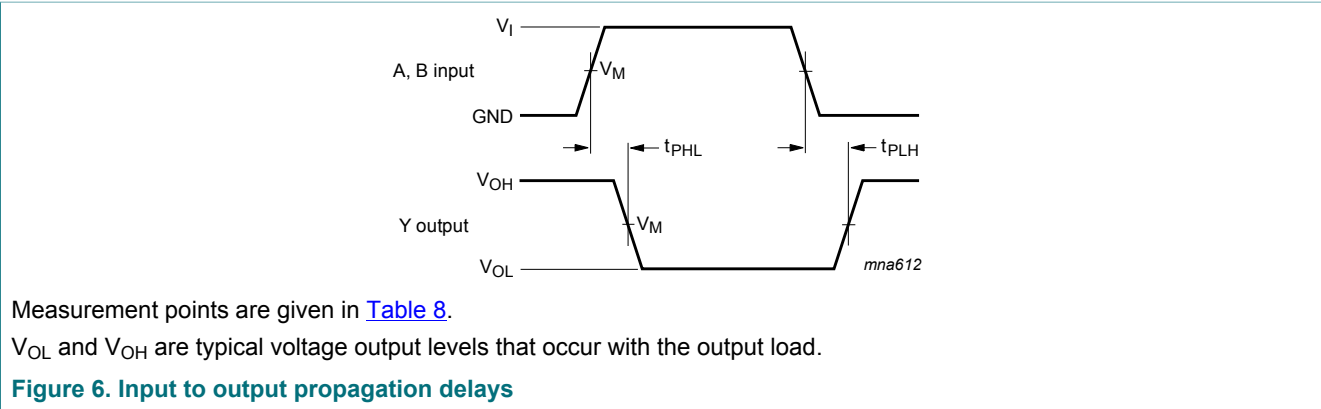
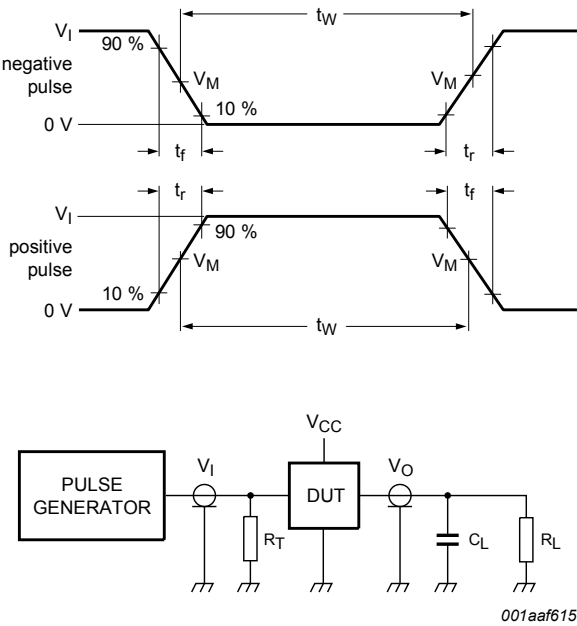


Table 8. Measurement points

| Input          |                | Output         |
|----------------|----------------|----------------|
| V <sub>M</sub> | V <sub>I</sub> | V <sub>M</sub> |
| 1.5 V          | 2.7 V          | 1.5 V          |



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.

$R_L$  = load resistance.

Figure 7. Test circuit for measuring switching times

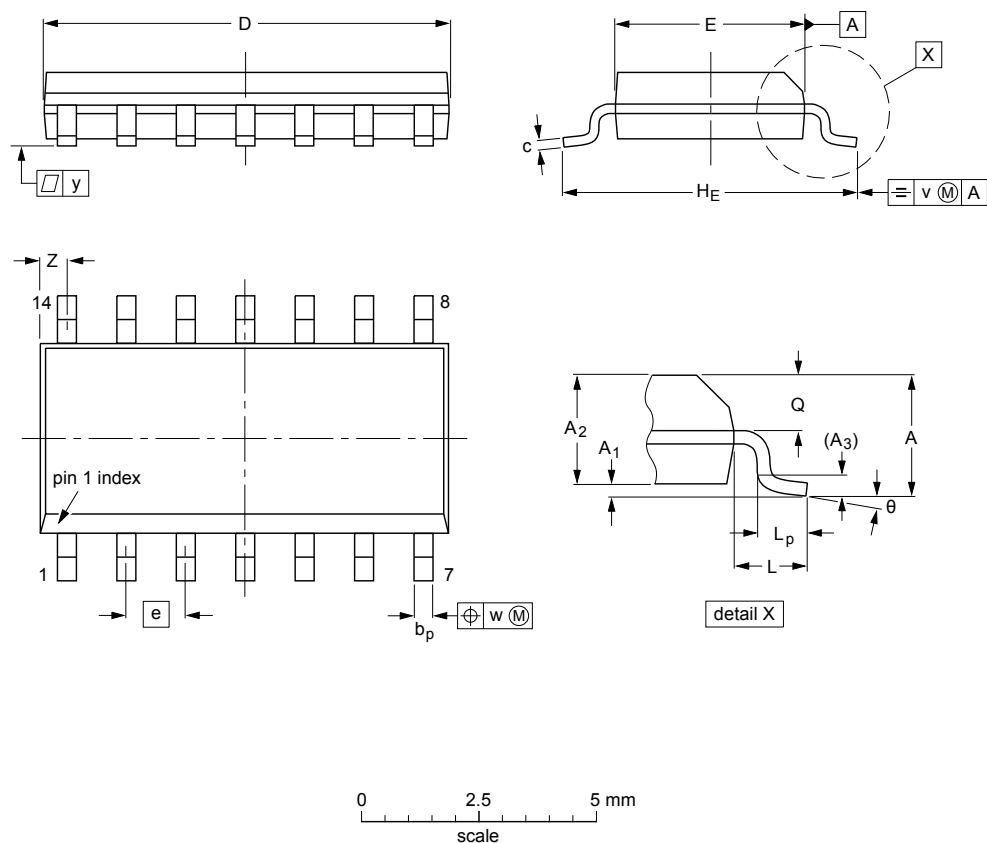
Table 9. Test data

| Input |               |        |               | Load  |              | Test               |
|-------|---------------|--------|---------------|-------|--------------|--------------------|
| $V_I$ | $f_i$         | $t_W$  | $t_r, t_f$    | $C_L$ | $R_L$        |                    |
| 2.7 V | $\leq 10$ MHz | 500 ns | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ | $t_{PLH}, t_{PHL}$ |

11 Package outline

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

SOT108-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75      | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 8.75<br>8.55     | 4.0<br>3.8       | 1.27 | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069     | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34     | 0.16<br>0.15     | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

**Note**  
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT108-1           | 076E06     | MS-012 |       |  |                        | 99-12-27<br>03-02-19 |

Figure 8. Package outline SOT108-1 (SO14)

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

SOT337-1

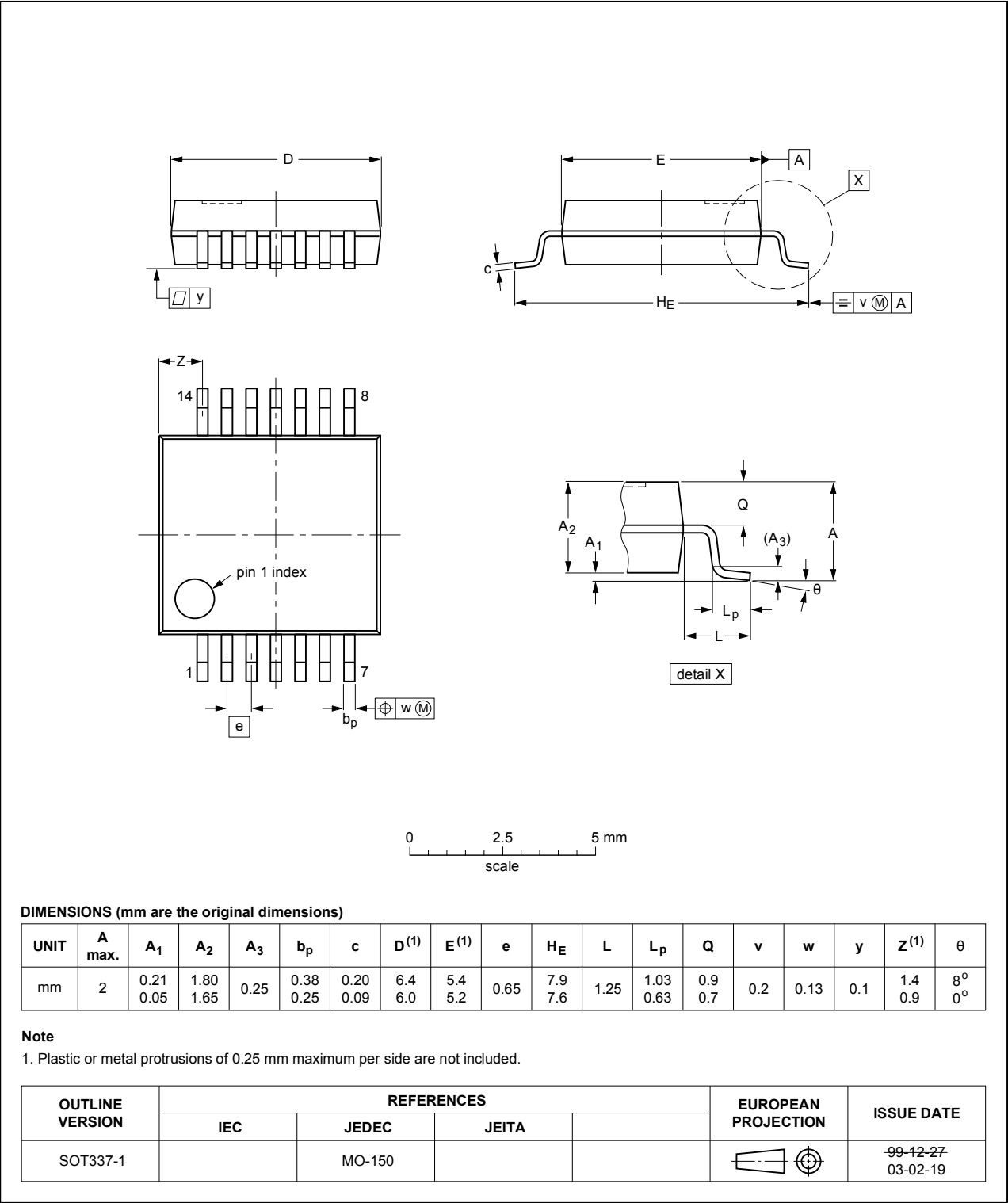
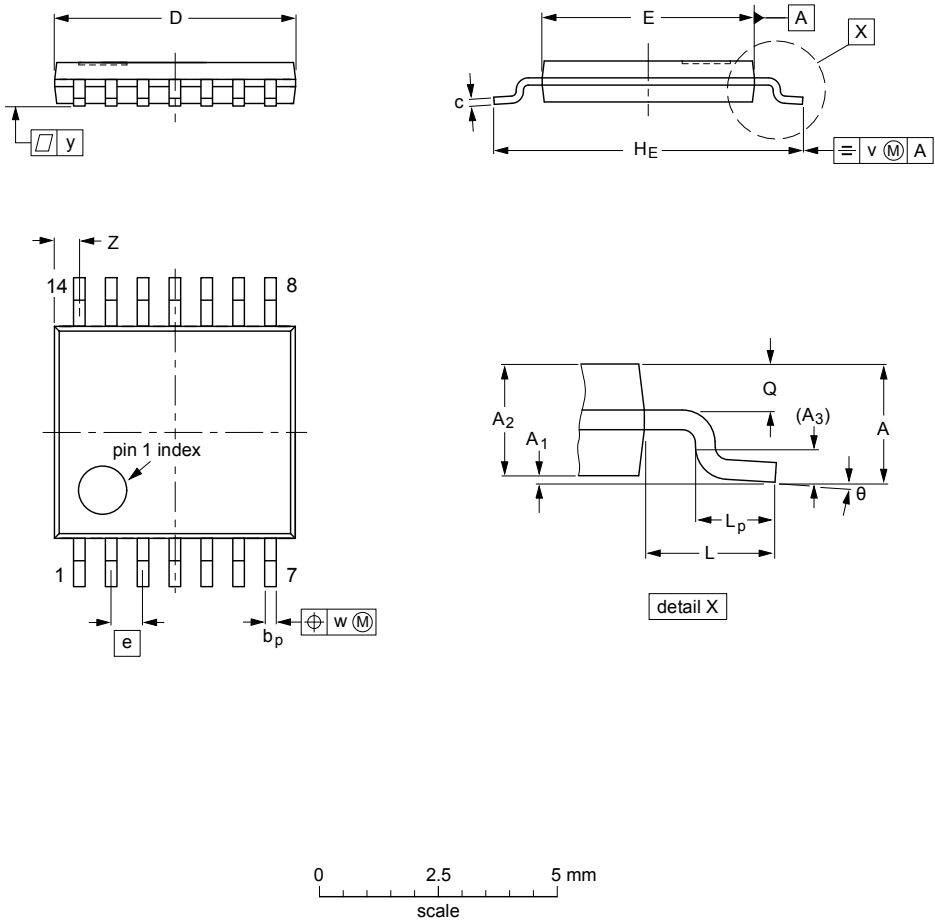


Figure 9. Package outline SOT337-1 (SSOP14)

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

SOT402-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A <sub>max.</sub> | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | Z <sup>(1)</sup> | θ        |
|------|-------------------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1               | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 5.1<br>4.9       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38     | 8°<br>0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE             |
|--------------------|------------|--------|-------|--|------------------------|------------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                        |
| SOT402-1           |            | MO-153 |       |  |                        | -99-12-27-<br>03-02-18 |

Figure 10. Package outline SOT402-1 (TSSOP14)

## 12 Abbreviations

Table 10. Abbreviations

| Acronym | Description                                     |
|---------|-------------------------------------------------|
| BiCMOS  | Bipolar 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 11. Revision history

| Document ID    | Release date                                                                                                                                                                                                                           | Data sheet status     | Change notice | Supersedes  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|-------------|
| 74LVT02 v.3    | 20170324                                                                                                                                                                                                                               | Product data sheet    | -             | 74LVT02 v.2 |
| 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></ul> |                       |               |             |
| 74LVT02 v.2    | 19960815                                                                                                                                                                                                                               | Product specification | -             | 74LVT02 v.1 |

## 14 Legal information

### 14.1 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".

[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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