

# 74LVC06A

## Hex inverter with open-drain outputs

Rev. 6 — 10 November 2011

Product data sheet

### 1. General description

The 74LVC06A provides six inverting buffers. The outputs are open-drain and can be connected to other open-drain outputs to implement active-LOW wired-OR or active-HIGH wired-AND functions.

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 applications.

### 2. Features and benefits

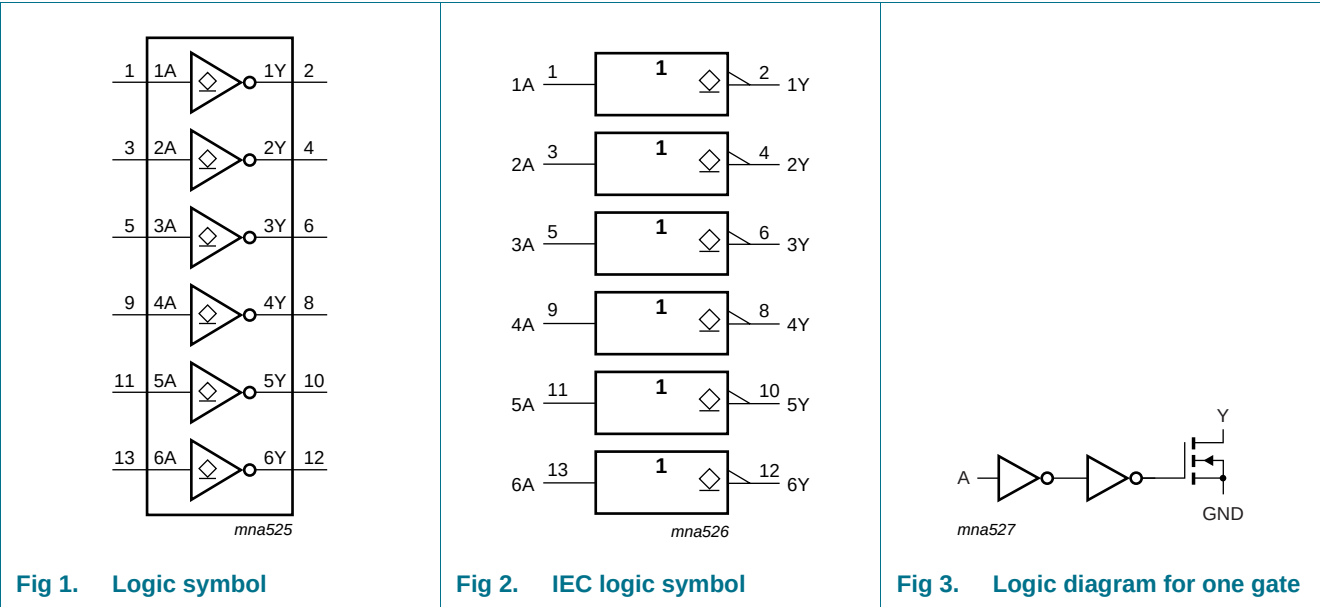
- 5 V tolerant inputs and outputs (open-drain) for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)
  - ◆ JESD8-C/JESD36 (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

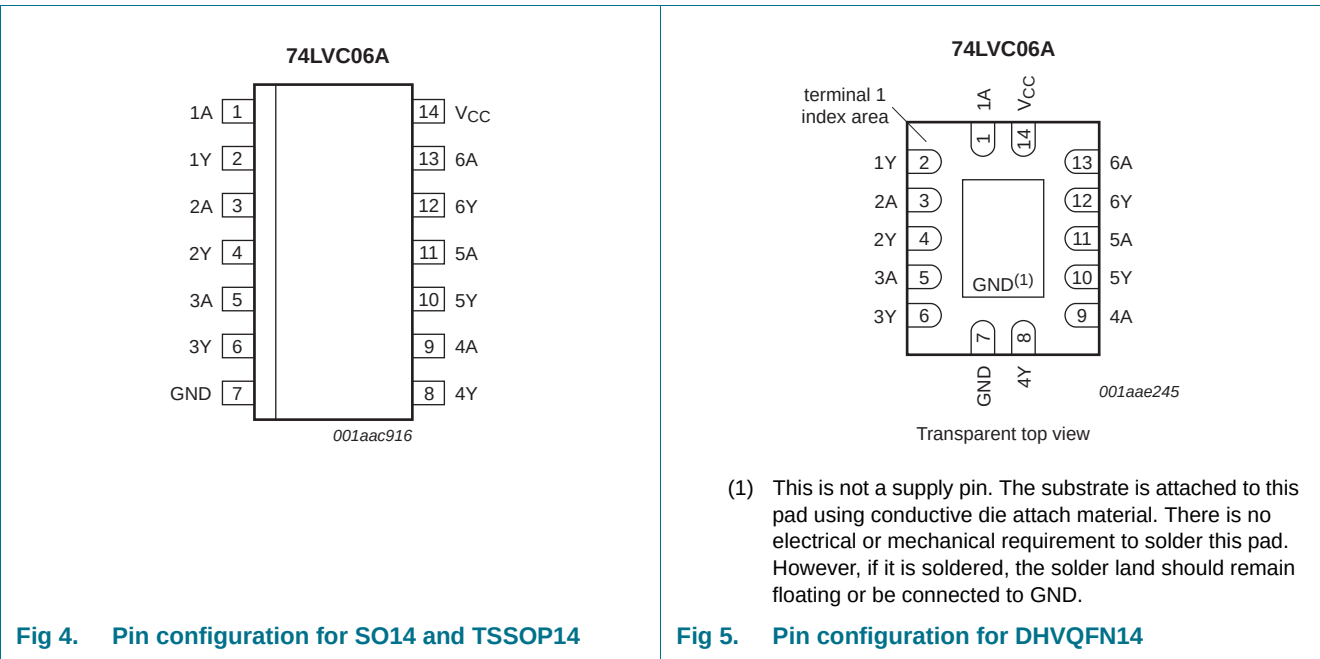
| Type number | Package           |          |                                                                                                                                    |          |
|-------------|-------------------|----------|------------------------------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range | Name     | Description                                                                                                                        | Version  |
| 74LVC06AD   | –40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm                                                                      | SOT108-1 |
| 74LVC06APW  | –40 °C to +125 °C | TSSOP14  | plastic thin shrink outline package; 14 leads;<br>body width 4.4 mm                                                                | SOT402-1 |
| 74LVC06ABQ  | –40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very<br>thin quad flat package; no leads; 14 terminals;<br>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, 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 <sub>CC</sub>        | 14                 | supply voltage |

## 6. Functional description

Table 3. Function selection [1]

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

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state

## 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> < 0                      | −50      | -    | mA   |
| V <sub>O</sub>   | output voltage          | active mode                             | [2] −0.5 | +6.5 | V    |
|                  |                         | high-impedance mode                     | [2] −0.5 | +6.5 | 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 SO14 packages: above 70 °C derate linearly with 8 mW/K.  
 For TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.  
 For DHVQFN14 packages: above 60 °C derate linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol           | Parameter                           | Conditions                        | Min  | Typ | Max  | Unit |
|------------------|-------------------------------------|-----------------------------------|------|-----|------|------|
| V <sub>CC</sub>  | supply voltage                      |                                   | 1.65 | -   | 5.5  | V    |
|                  |                                     | functional                        | 1.2  | -   | -    | V    |
| V <sub>I</sub>   | input voltage                       |                                   | 0    | -   | 5.5  | V    |
| V <sub>O</sub>   | output voltage                      | active mode                       | 0    | -   | 5.5  | V    |
|                  |                                     | high-impedance mode               | 0    | -   | 5.5  | V    |
| T <sub>amb</sub> | ambient temperature                 |                                   | -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 5.5 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 <sup>[1]</sup> | 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                                                                  | 0.65 × V <sub>CC</sub> | -                  | -                      | 0.65 × V <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>CC</sub> = 4.5 V to 5.5 V                                                                    | 0.7 × V <sub>CC</sub>  | -                  | -                      | 0.7 × V <sub>CC</sub>  | -                      | 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                                                                  | -                      | -                  | 0.35 × V <sub>CC</sub> | -                      | 0.35 × V <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>CC</sub> = 4.5 V to 5.5 V                                                                    | -                      | -                  | 0.30 × V <sub>CC</sub> | -                      | 0.30 × V <sub>CC</sub> | 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> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V                                          | -                      | -                  | 0.20                   | -                      | 0.3                    | V    |
|                  |                           | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V                                                     | -                      | -                  | 0.45                   | -                      | 0.6                    | V    |
|                  |                           | I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V                                                      | -                      | -                  | 0.3                    | -                      | 0.75                   | 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    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V                                    | -                      | ±0.1               | ±5                     | -                      | ±20                    | μA   |
|                  |                           |                                                                                                     |                        |                    |                        |                        |                        |      |
| I <sub>OZ</sub>  | OFF-state output current  | V <sub>I</sub> = V <sub>IH</sub> ; V <sub>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V | -                      | ±0.1               | ±10                    | -                      | ±20                    | μA   |
| I <sub>OFF</sub> | power-off leakage current | V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V                                     | -                      | ±0.1               | ±10                    | -                      | ±20                    | μA   |

**Table 6.** Static characteristics ...continued

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 <sup>[1]</sup> | Max | Min               | Max  |      |
| 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                             | -                | 0.1                | 10  | -                 | 40   | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>V <sub>I</sub> = V <sub>CC</sub> – 0.6 V; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 2.7 V to 5.5 V | -                | 5                  | 500 | -                 | 5000 | μA   |
| C <sub>I</sub>   | input capacitance         | V <sub>CC</sub> = 0 V to 5.5 V;<br>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 characteristicsVoltages 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 <sup>[1]</sup> | Max | Min               | Max |      |
| t <sub>PZL</sub> | OFF-state to LOW propagation delay | nA to nY; see <a href="#">Figure 6</a>                             |                  |                    |     |                   |     |      |
|                  |                                    | V <sub>CC</sub> = 1.2 V                                            | -                | 9                  | -   | -                 | -   | ns   |
|                  |                                    | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | 0.5              | 2.8                | 5.7 | 0.5               | 6.7 | ns   |
|                  |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | 0.5              | 1.9                | 3.1 | 0.5               | 4.0 | ns   |
|                  |                                    | V <sub>CC</sub> = 2.7 V                                            | 0.5              | 1.8                | 3.9 | 0.5               | 5.0 | ns   |
|                  |                                    | V <sub>CC</sub> = 3.0 V to 3.6 V                                   | 0.5              | 1.8                | 3.7 | 0.5               | 5.0 | ns   |
| t <sub>PLZ</sub> | LOW to OFF-state propagation delay | V <sub>CC</sub> = 4.5 V to 5.5 V                                   | 0.7              | 1.5                | 2.5 | 0.7               | 3.5 | ns   |
|                  |                                    | nA to nY; see <a href="#">Figure 6</a>                             |                  |                    |     |                   |     |      |
|                  |                                    | V <sub>CC</sub> = 1.2 V                                            | -                | 10                 | -   | -                 | -   | ns   |
|                  |                                    | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | 0.5              | 2.6                | 5.7 | 0.5               | 6.7 | ns   |
|                  |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | 0.5              | 1.4                | 3.1 | 0.5               | 4.0 | ns   |
|                  |                                    | V <sub>CC</sub> = 2.7 V                                            | 0.5              | 2.6                | 3.9 | 0.5               | 5.0 | ns   |
| C <sub>PD</sub>  | power dissipation capacitance      | per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[2]</sup> |                  |                    |     |                   |     |      |
|                  |                                    | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | -                | 6.5                | -   | -                 | -   | pF   |
|                  |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | -                | 6.9                | -   | -                 | -   | pF   |
|                  |                                    | V <sub>CC</sub> = 3.0 V to 3.6 V                                   | -                | 7.2                | -   | -                 | -   | 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, 3.3 V and 5.0 V respectively.[2] 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 MHzC<sub>L</sub> = output load capacitance in pFV<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

11. Waveforms

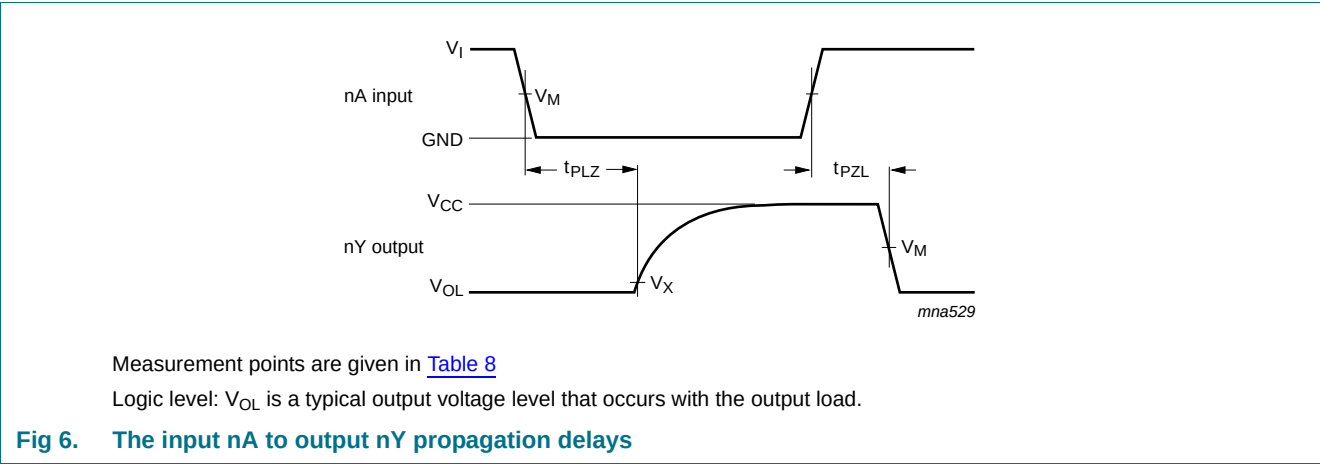
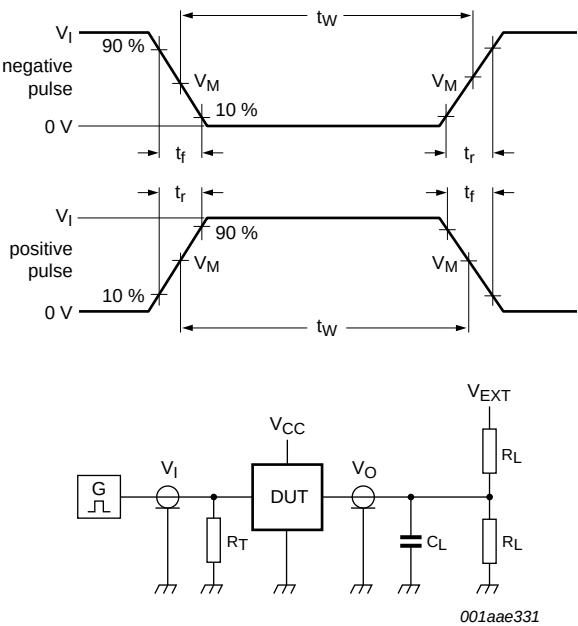


Table 8. Measurement points

| Supply voltage                       | Input               | Output                   |
|--------------------------------------|---------------------|--------------------------|
| $V_{CC}$                             | $V_M$               | $V_X$                    |
| $< 2.7\text{ V}$                     | $0.5 \times V_{CC}$ | $V_{OL} + 0.15\text{ V}$ |
| $\geq 2.7\text{ V to } 3.6\text{ V}$ | $1.5\text{ V}$      | $V_{OL} + 0.3\text{ V}$  |
| $\geq 4.5\text{ V to } 5.5\text{ V}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.3\text{ V}$  |



Test data is given in [Table 9](#).  
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.  
 $V_{EXT}$  = External voltage for measuring switching times.

Fig 7. Load circuitry for switching times

Table 9. Test data

| Supply voltage   | Input           |                                 | Load           |                | V <sub>EXT</sub>                    |                                     |                                     |
|------------------|-----------------|---------------------------------|----------------|----------------|-------------------------------------|-------------------------------------|-------------------------------------|
|                  | V <sub>I</sub>  | t <sub>r</sub> , t <sub>f</sub> | C <sub>L</sub> | R <sub>L</sub> | t <sub>PLH</sub> , t <sub>PHL</sub> | t <sub>PLZ</sub> , t <sub>PZL</sub> | t <sub>PHZ</sub> , t <sub>PZH</sub> |
| 1.2 V            | V <sub>CC</sub> | ≤ 2 ns                          | 30 pF          | 1 kΩ           | open                                | 2 × V <sub>CC</sub>                 | GND                                 |
| 1.65 V to 1.95 V | V <sub>CC</sub> | ≤ 2 ns                          | 30 pF          | 1 kΩ           | open                                | 2 × V <sub>CC</sub>                 | GND                                 |
| 2.3 V to 2.7 V   | V <sub>CC</sub> | ≤ 2 ns                          | 30 pF          | 500 Ω          | open                                | 2 × V <sub>CC</sub>                 | GND                                 |
| 2.7 V            | 2.7 V           | ≤ 2.5 ns                        | 50 pF          | 500 Ω          | open                                | 2 × V <sub>CC</sub>                 | GND                                 |
| 3.0 V to 3.6 V   | 2.7 V           | ≤ 2.5 ns                        | 50 pF          | 500 Ω          | open                                | 2 × V <sub>CC</sub>                 | GND                                 |
| 4.5 V to 5.5 V   | V <sub>CC</sub> | ≤ 2.5 ns                        | 50 pF          | 500 Ω          | open                                | 2 × V <sub>CC</sub>                 | GND                                 |

12. Package outline

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

SOT108-1

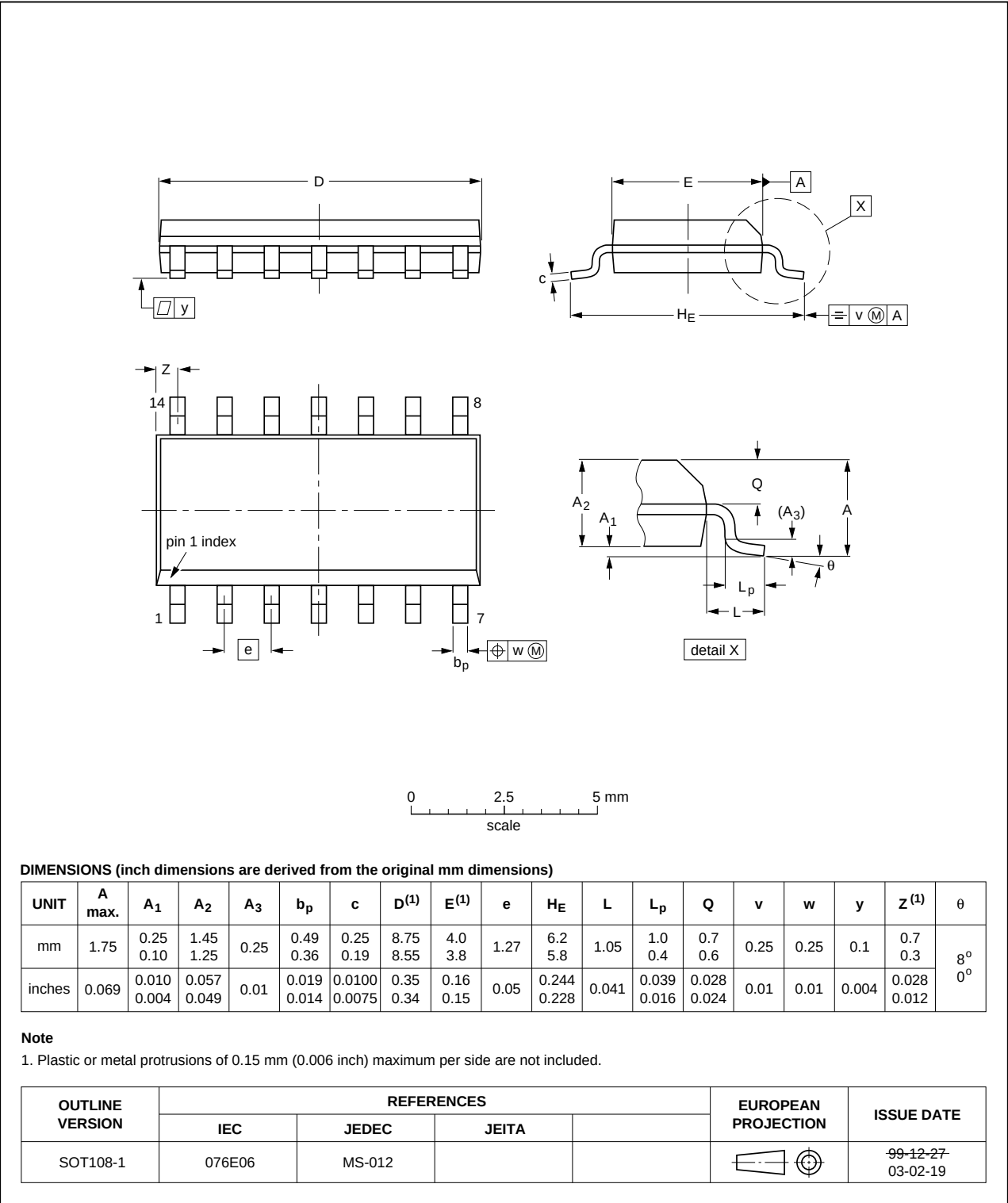


Fig 8. Package outline SOT108-1 (SO14)



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

SOT402-1

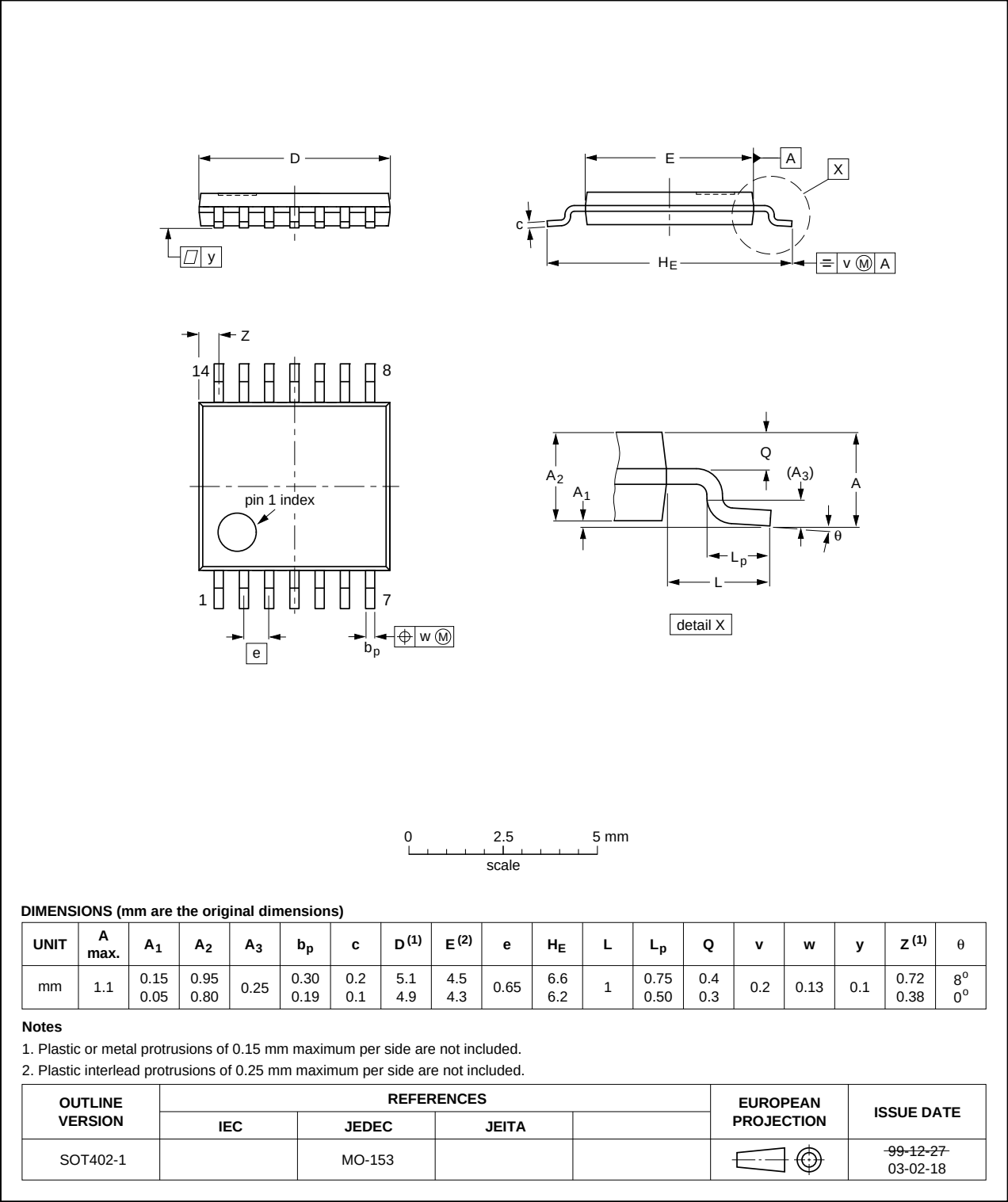


Fig 9. Package outline SOT402-1 (TSSOP14)

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

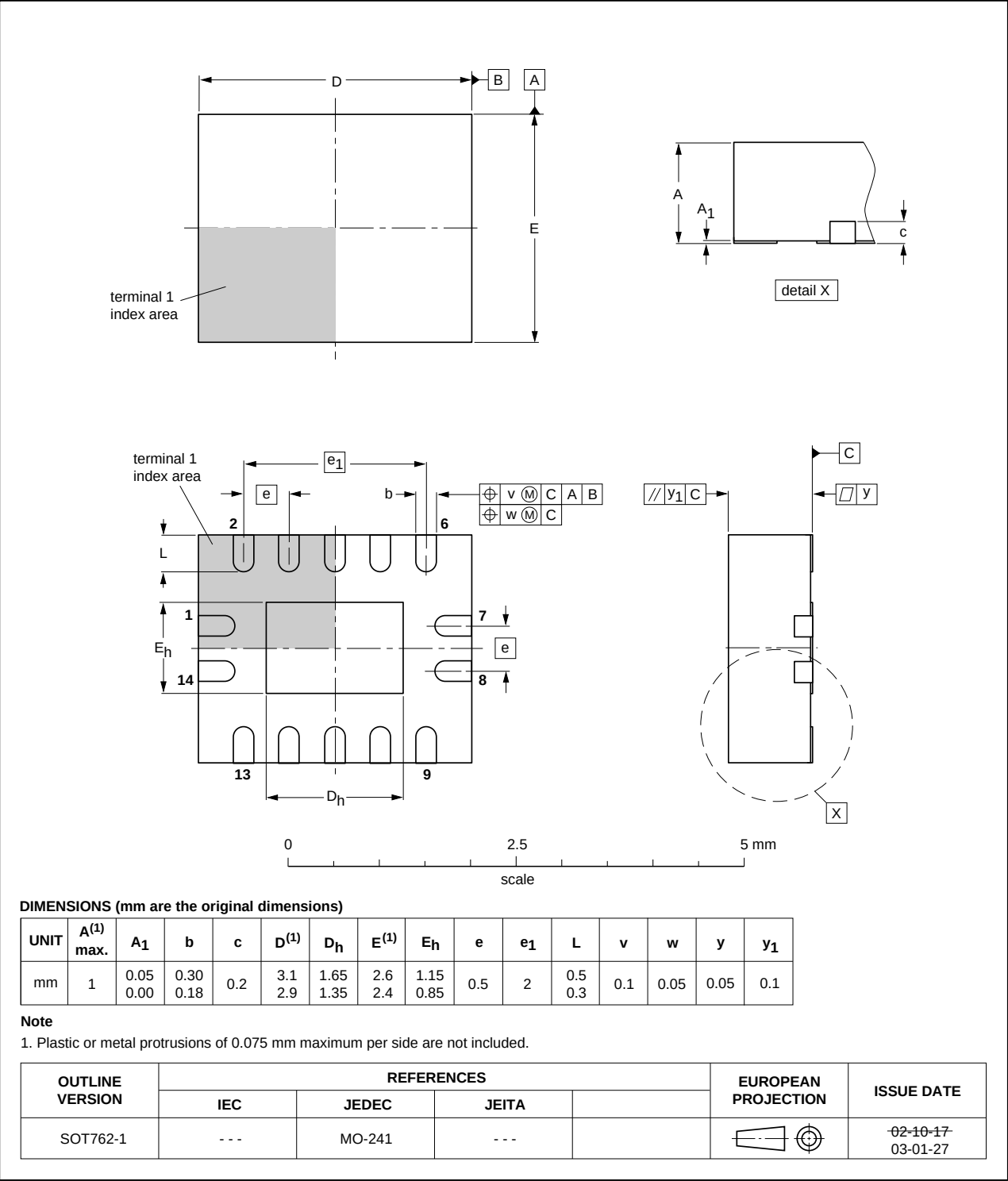


Fig 10. Package outline SOT762-1 (DHVQFN14)

## 13. 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 |

## 14. Revision history

Table 11. Revision history

| Document ID    | Release date                                                                                                                                                                                                                                                                                                                                               | Data sheet status     | Change notice | Supersedes   |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|--------------|
| 74LVC06A v.6   | 20111110                                                                                                                                                                                                                                                                                                                                                   | Product data sheet    | -             | 74LVC06A v.5 |
| Modifications: | <ul style="list-style-type: none"><li>• <a href="#">Table 6</a>: Conditions column, additional supply current <math>V_{CC}</math> range updated</li></ul>                                                                                                                                                                                                  |                       |               |              |
| 74LVC06A v.5   | 20111024                                                                                                                                                                                                                                                                                                                                                   | Product data sheet    | -             | 74LVC06A v.4 |
| Modifications: | <ul style="list-style-type: none"><li>• Table 7: values added for lower voltage ranges</li></ul>                                                                                                                                                                                                                                                           |                       |               |              |
| 74LVC06A v.4   | 20110810                                                                                                                                                                                                                                                                                                                                                   | Product data sheet    | -             | 74LVC06A v.3 |
| 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>• Table 4, Table 5, Table 6, Table 7, and Table 9: values added for lower voltage ranges.</li></ul> |                       |               |              |
| 74LVC06A v.3   | 20031127                                                                                                                                                                                                                                                                                                                                                   | Product specification | -             | 74LVC06A v.2 |
| 74LVC06A v.2   | 20030828                                                                                                                                                                                                                                                                                                                                                   | Product specification | -             | 74LVC06A v.1 |
| 74LVC06A v.1   | 20000307                                                                                                                                                                                                                                                                                                                                                   | Product specification | -             | -            |

## 15. Legal information

### 15.1 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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