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Team Nexperia

74LVC02A

Quad 2-input NOR gate

Rev. 8 — 16 November 2011

Product data sheet

1. General description

The 74LVC02A provides four 2-input NOR gates.

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 for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V 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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|---|----------|---|----------|
| | Temperature range | Name | Description | Version |
| 74LVC02AD | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74LVC02ADB | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SSOP14 | plastic shrink small outline package; 14 leads; body width 5.3 mm | SOT337-1 |
| 74LVC02APW | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74LVC02ABQ | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85\text{ mm}$ | SOT762-1 |



4. Functional diagram

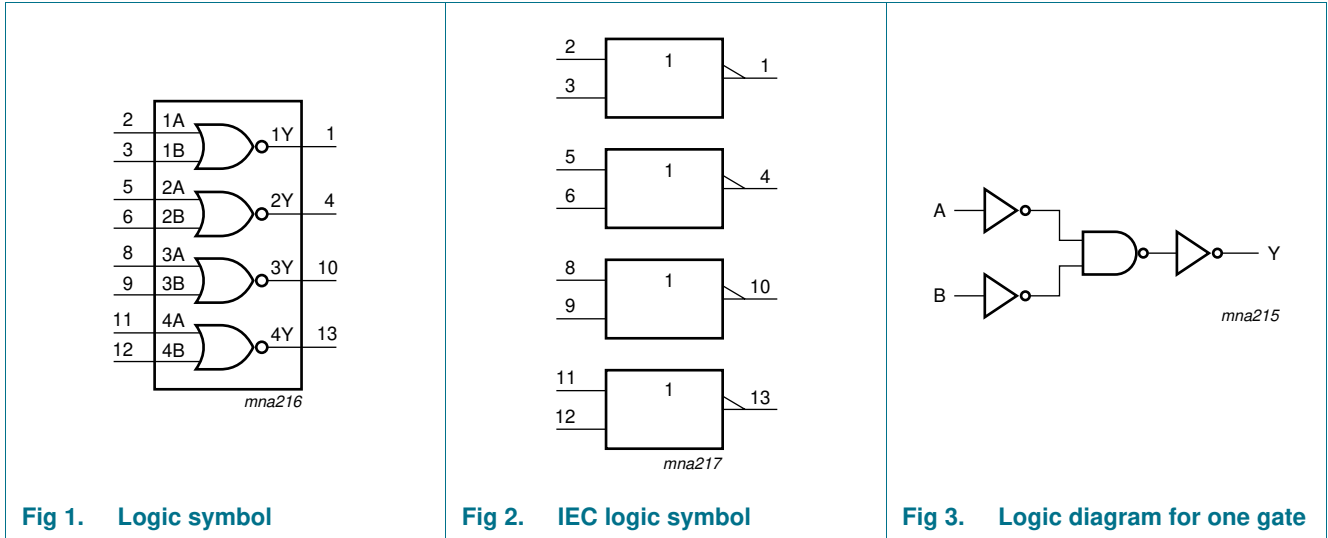


Fig 1. Logic symbol

Fig 2. IEC logic symbol

Fig 3. Logic diagram for one gate

5. Pinning information

5.1 Pinning

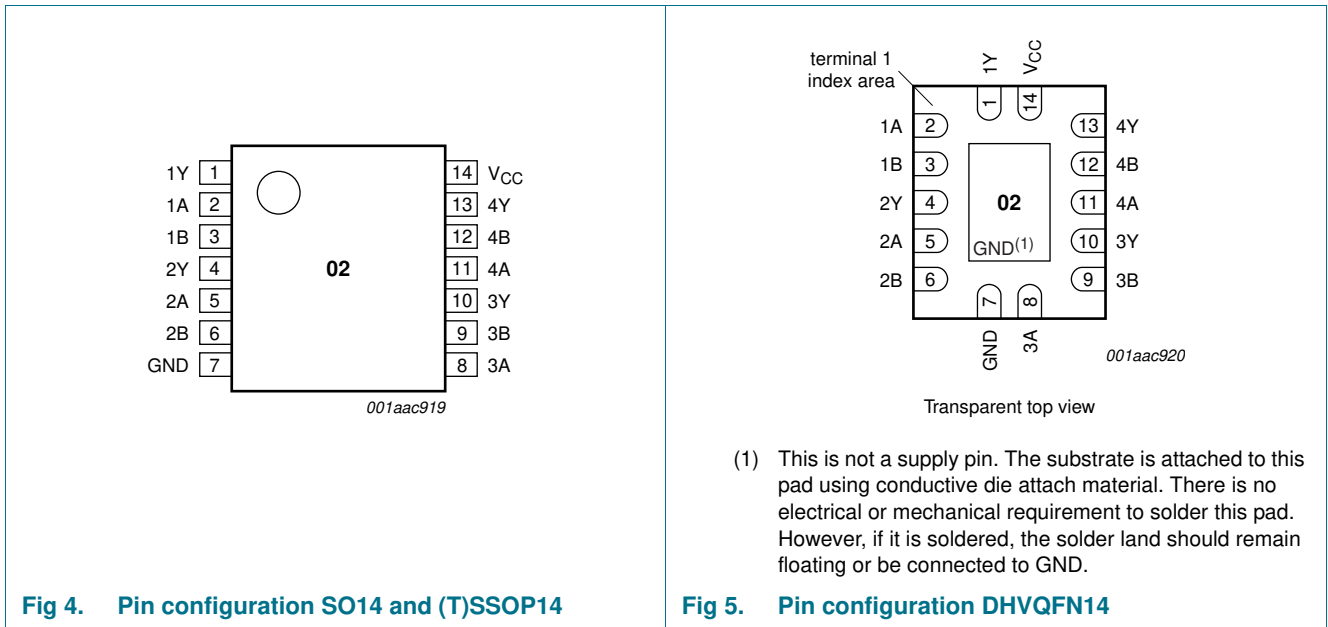


Fig 4. Pin configuration SO14 and (T)SSOP14

Fig 5. Pin configuration DHVQFN14

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

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 _{CC} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

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

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care

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 _{CC} | supply voltage | | -0.5 | +6.5 | V |
| I _{IK} | input clamping current | V _I < 0 V | -50 | - | mA |
| V _I | input voltage | | [1] -0.5 | +6.5 | V |
| I _{OK} | output clamping current | V _O > V _{CC} or V _O < 0 V | - | ±50 | mA |
| V _O | output voltage | output in HIGH or LOW-state | [2] -0.5 | V _{CC} + 0.5 | V |
| 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 |
| P _{tot} | total power dissipation | T _{amb} = -40 °C to +125 °C | [3] - | 500 | mW |
| T _{stg} | storage temperature | | -65 | +150 | °C |

[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 (T)SSOP14 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_{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | - | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW state | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65 \text{ V to } 2.7 \text{ V}$ | 0 | - | 20 | ns/V |
| | | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | 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_{IH} | HIGH-level input voltage | $V_{CC} = 1.2 \text{ V}$ | 1.08 | - | - | 1.08 | - | V |
| | | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | $0.65 \times V_{CC}$ | - | - | $0.65 \times V_{CC}$ | - | V |
| | | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$ | 1.7 | - | - | 1.7 | - | V |
| | | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | 2.0 | - | - | 2.0 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 1.2 \text{ V}$ | - | - | 0.12 | - | 0.12 | V |
| | | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | - | - | $0.35 \times V_{CC}$ | - | $0.35 \times V_{CC}$ | V |
| | | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$ | - | - | 0.7 | - | 0.7 | V |
| | | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | - | - | 0.8 | - | 0.8 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}$ | | | | | | |
| | | $I_O = -100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$ | $V_{CC} - 0.2$ | - | - | $V_{CC} - 0.3$ | - | V |
| | | $I_O = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$ | 1.2 | - | - | 1.05 | - | V |
| | | $I_O = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$ | 1.8 | - | - | 1.65 | - | V |
| | | $I_O = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$ | 2.2 | - | - | 2.05 | - | V |
| | | $I_O = -18 \text{ mA}; V_{CC} = 3.0 \text{ V}$ | 2.4 | - | - | 2.25 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}$ | | | | | | |
| | | $I_O = 100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$ | - | - | 0.2 | - | 0.3 | V |
| | | $I_O = 4 \text{ mA}; V_{CC} = 1.65 \text{ V}$ | - | - | 0.45 | - | 0.65 | V |
| | | $I_O = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$ | - | - | 0.6 | - | 0.8 | V |
| | | $I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$ | - | - | 0.4 | - | 0.6 | V |
| | | $I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$ | - | - | 0.55 | - | 0.8 | V |
| I_I | input leakage current | $V_{CC} = 3.6 \text{ V}; V_I = 5.5 \text{ V or GND}$ | - | ± 0.1 | ± 5 | - | ± 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 ^[1] | Max | Min | Max | |
| 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.

10. 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, nB to nY; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 14 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 0.5 | 4.0 | 8.6 | 0.5 | 10.1 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 2.4 | 4.9 | 1.0 | 5.7 | ns |
| | | V _{CC} = 2.7 V | 1.0 | 2.5 | 5.1 | 1.0 | 6.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 2.2 | 4.4 | 1.0 | 5.5 | ns |
| t _{sk(o)} | output skew time | V _{CC} = 3.0 V to 3.6 V ^[3] | - | - | 1.0 | - | 1.5 | ns |
| C _{PD} | power dissipation capacitance | per gate; V _I = GND to V _{CC} ^[4] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 2.5 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 5.7 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 8.5 | - | - | - | 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).

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

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

11. AC waveforms

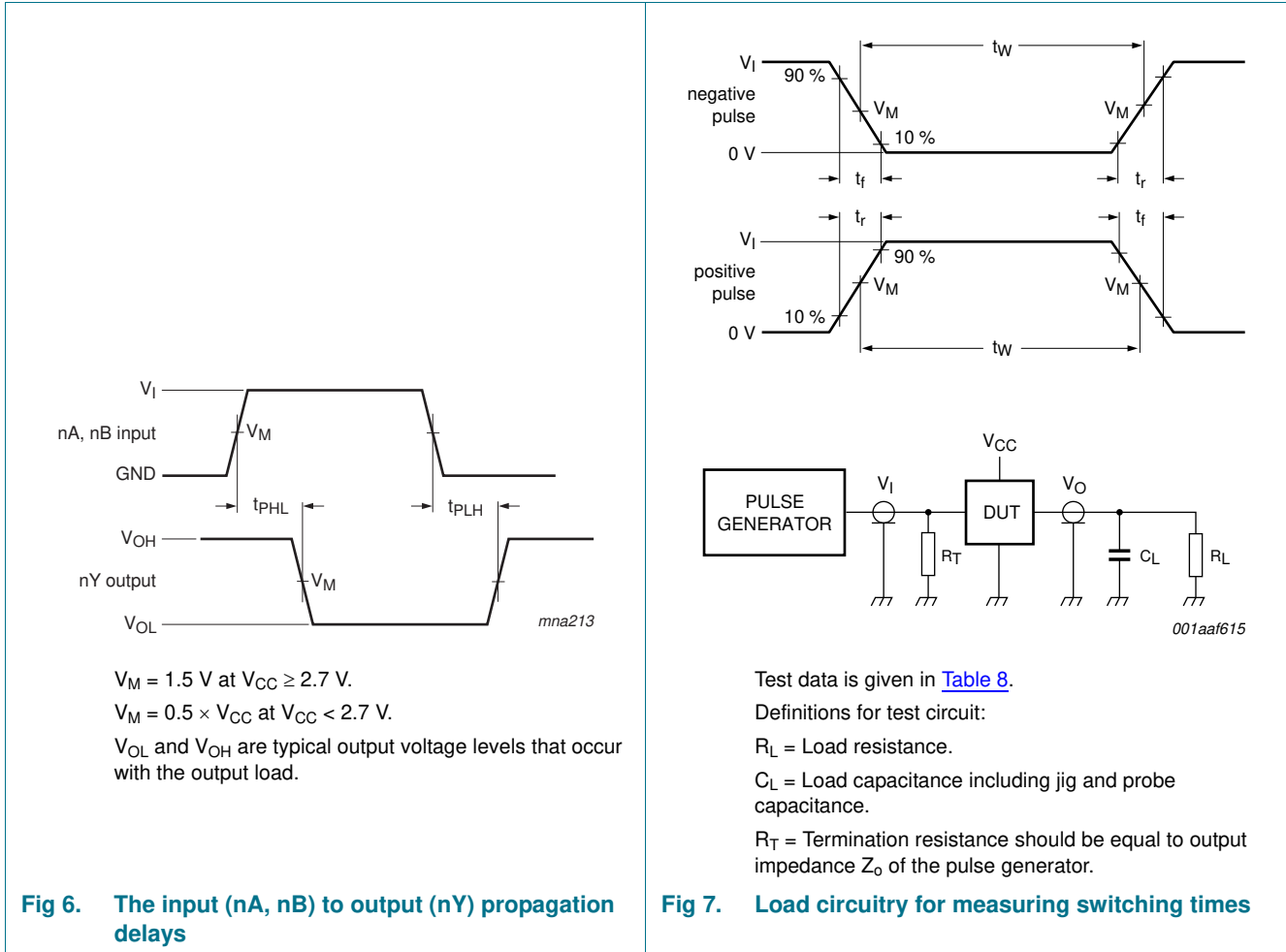


Table 8. Test data

| 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 Ω |
| 1.65 V to 1.95 V | V_{CC} | $\leq 2\text{ ns}$ | 30 pF | 1 k Ω |
| 2.3 V to 2.7 V | V_{CC} | $\leq 2\text{ ns}$ | 30 pF | 500 Ω |
| 2.7 V | 2.7 V | $\leq 2.5\text{ ns}$ | 50 pF | 500 Ω |
| 3.0 V to 3.6 V | 2.7 V | $\leq 2.5\text{ ns}$ | 50 pF | 500 Ω |

12. Package outline

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

SOT108-1

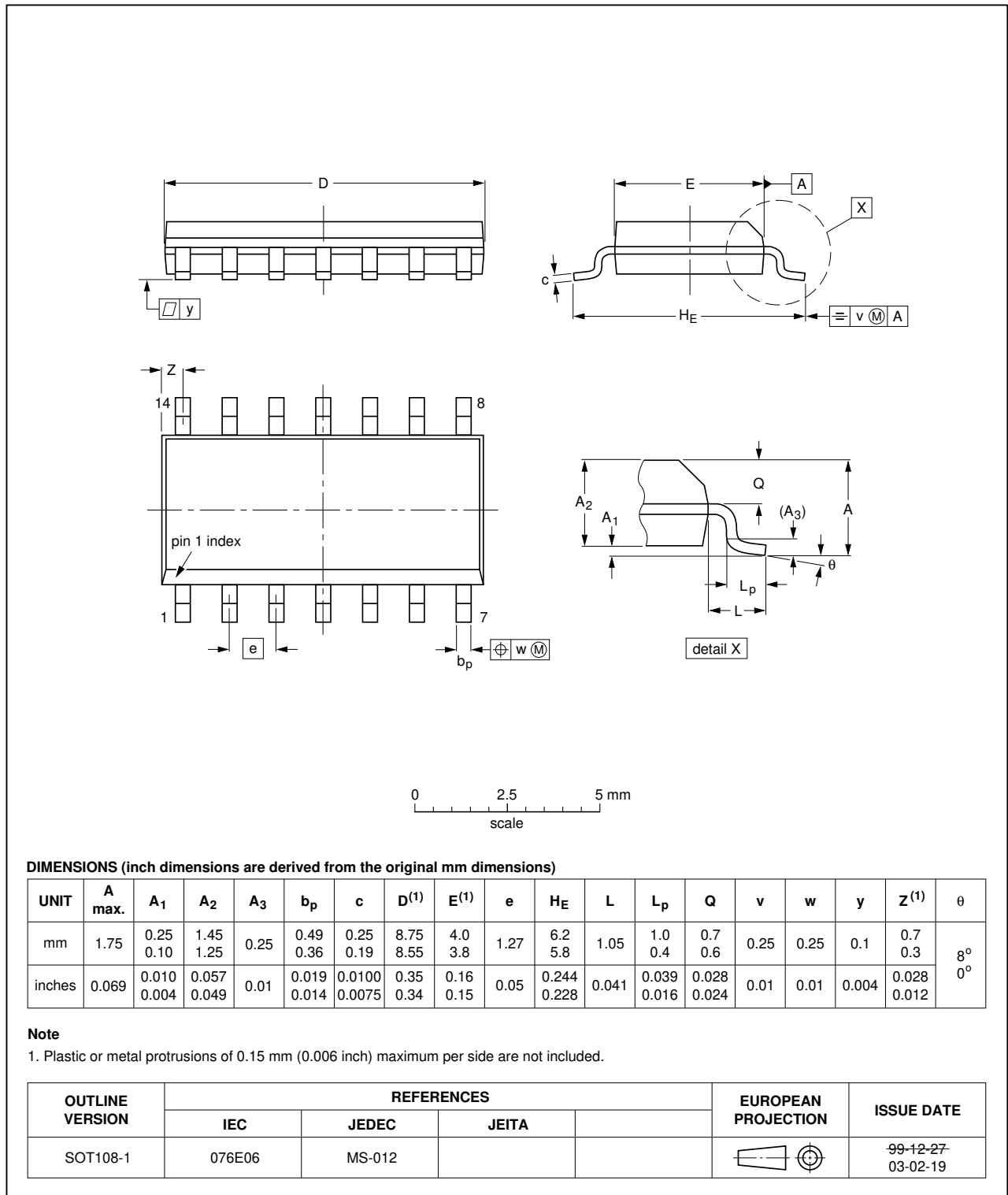


Fig 8. Package outline SOT108-1 (SO14)

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

SOT337-1

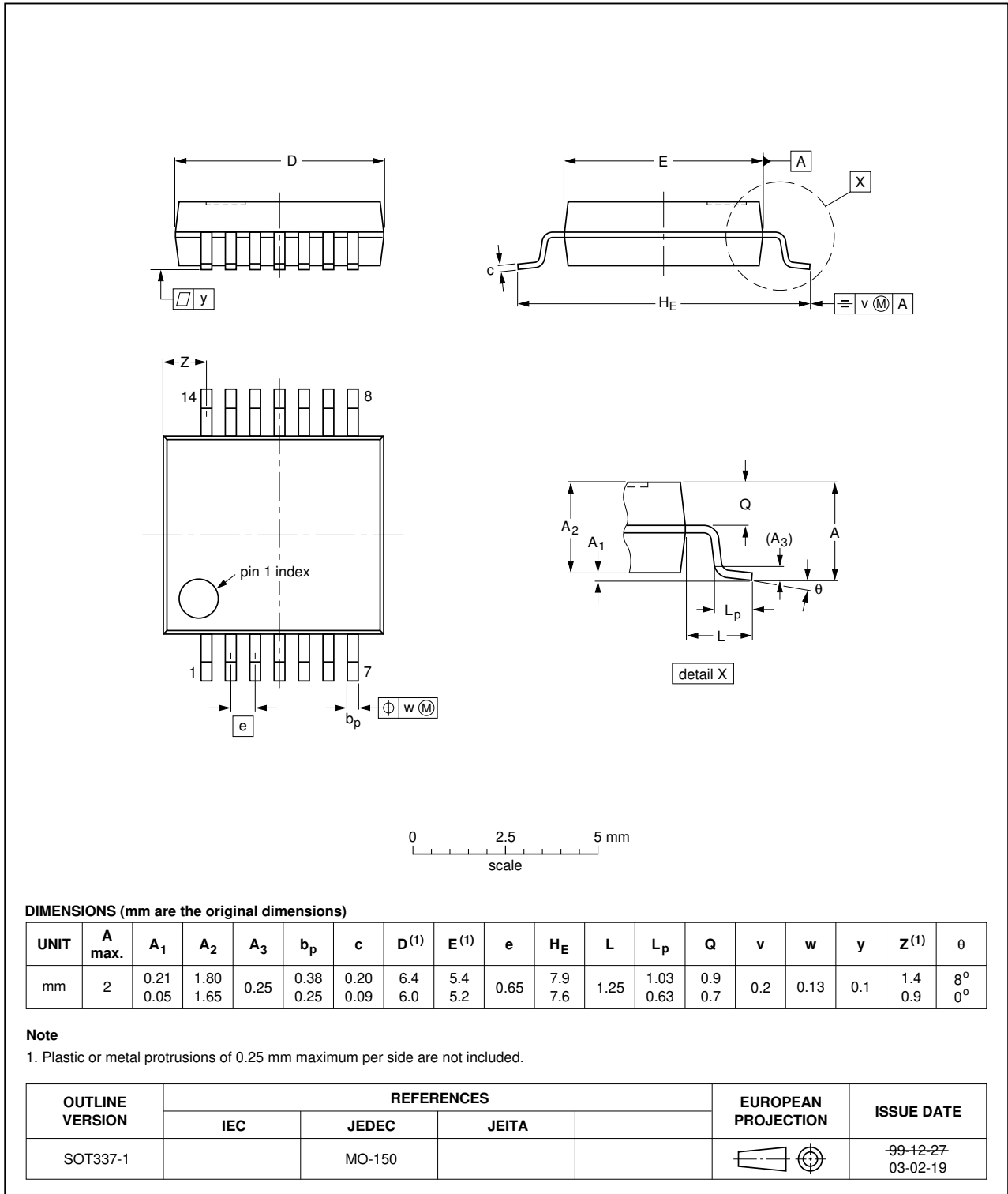


Fig 9. Package outline SOT337-1 (SSOP14)

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

SOT402-1

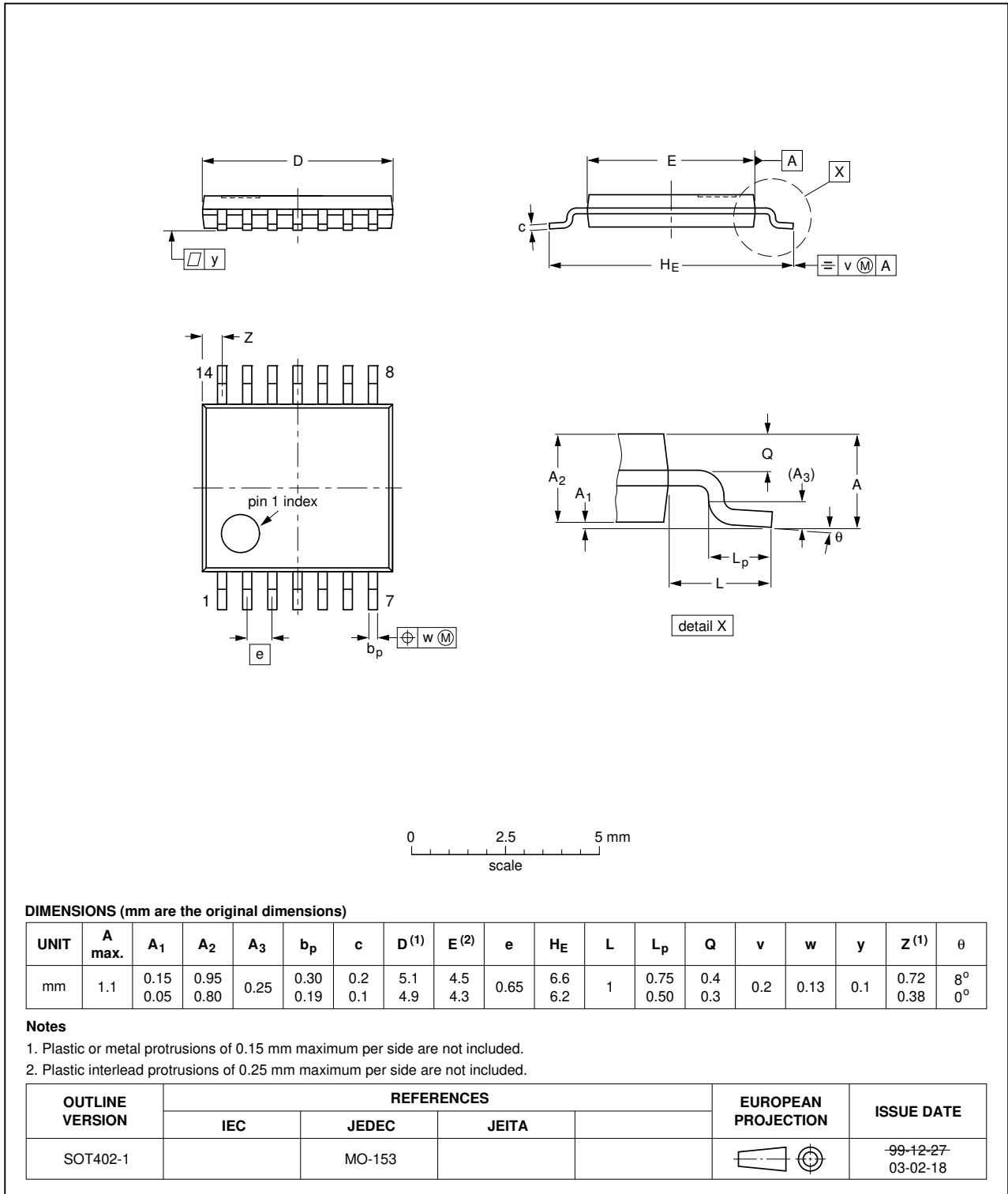


Fig 10. Package outline SOT402-1 (TSSOP14)

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

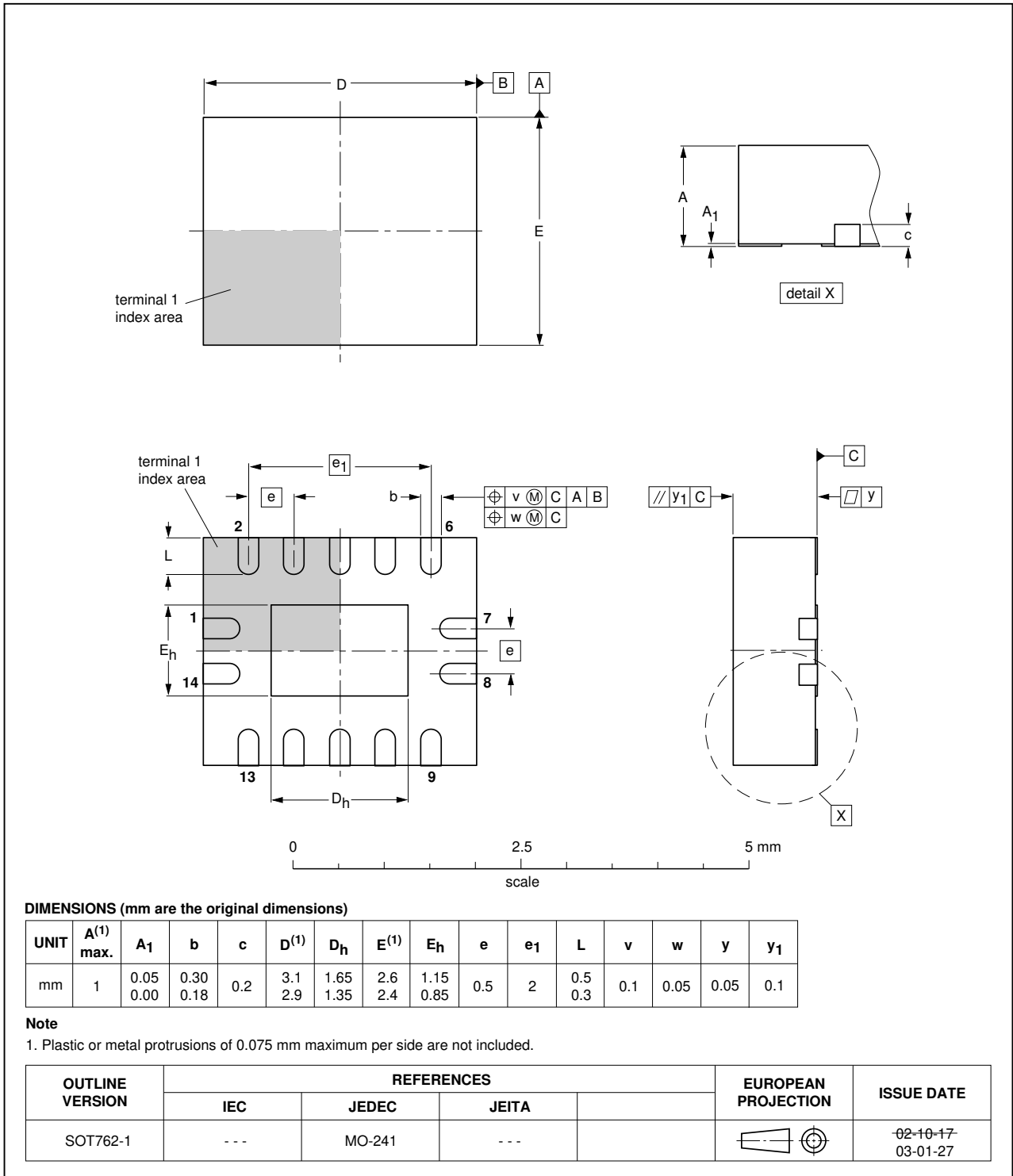


Fig 11. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 9. 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 10. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|--------------|
| 74LVC02A v.8 | 20111116 | Product data sheet | - | 74LVC02A v.7 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. Table 6, bodyrow ΔI_{CC}: condition V_{CC} changed. | | | |
| 74LVC02A v.7 | 20111019 | Product data sheet | - | 74LVC02A v.6 |
| 74LVC02A v.6 | 20110809 | Product data sheet | - | 74LVC02A v.5 |
| 74LVC02A v.5 | 20040312 | Product specification | - | 74LVC02A v.4 |
| 74LVC02A v.4 | 20030501 | Product specification | - | 74LVC02A v.3 |
| 74LVC02A v.3 | 20020305 | Product specification | - | 74LVC02A v.2 |
| 74LVC02A v.2 | 19980428 | Product specification | - | 74LVC02A v.1 |
| 74LVC02A v.1 | 19970811 | Product specification | - | - |

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|-----------------------------------|-------------------------------|---|
| 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. |
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[2] The term 'short data sheet' is explained in section "Definitions".

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Date of release: 16 November 2011

Document identifier: 74LVC02A