

74LVC14A-Q100

Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 3 — 24 July 2020

Product data sheet

1. General description

The 74LVC14A-Q100 is a hex inverter with Schmitt-trigger inputs. 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 environments.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- 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:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

3. Applications

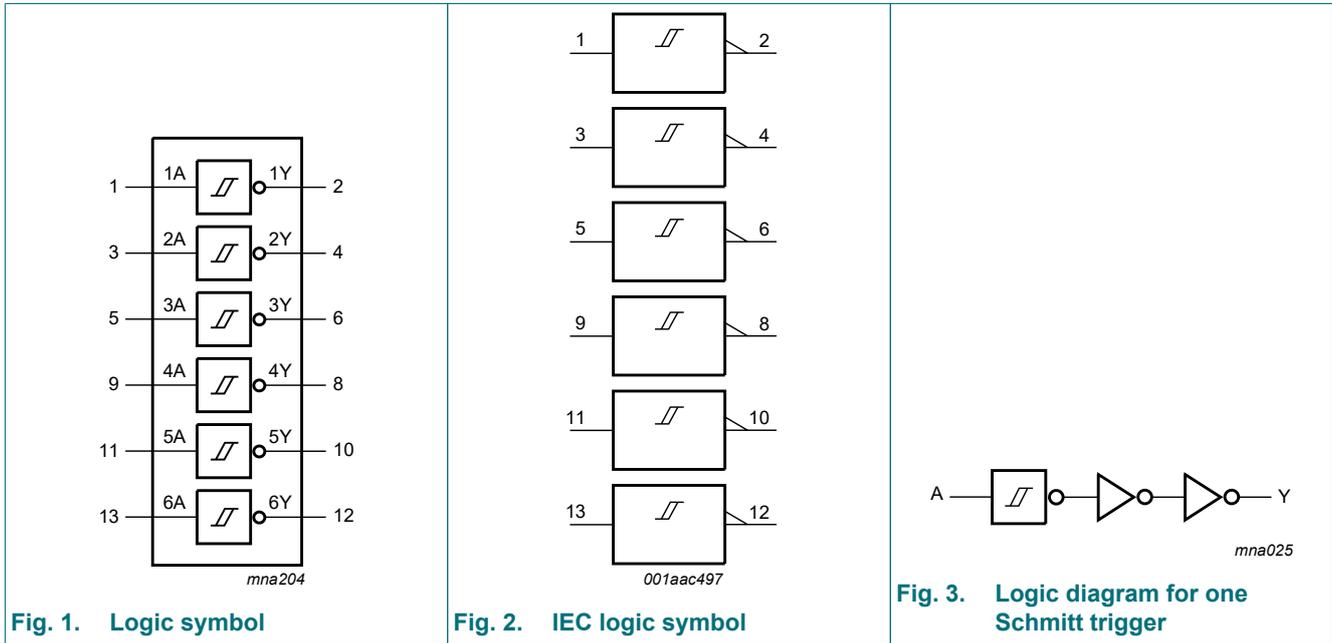
- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

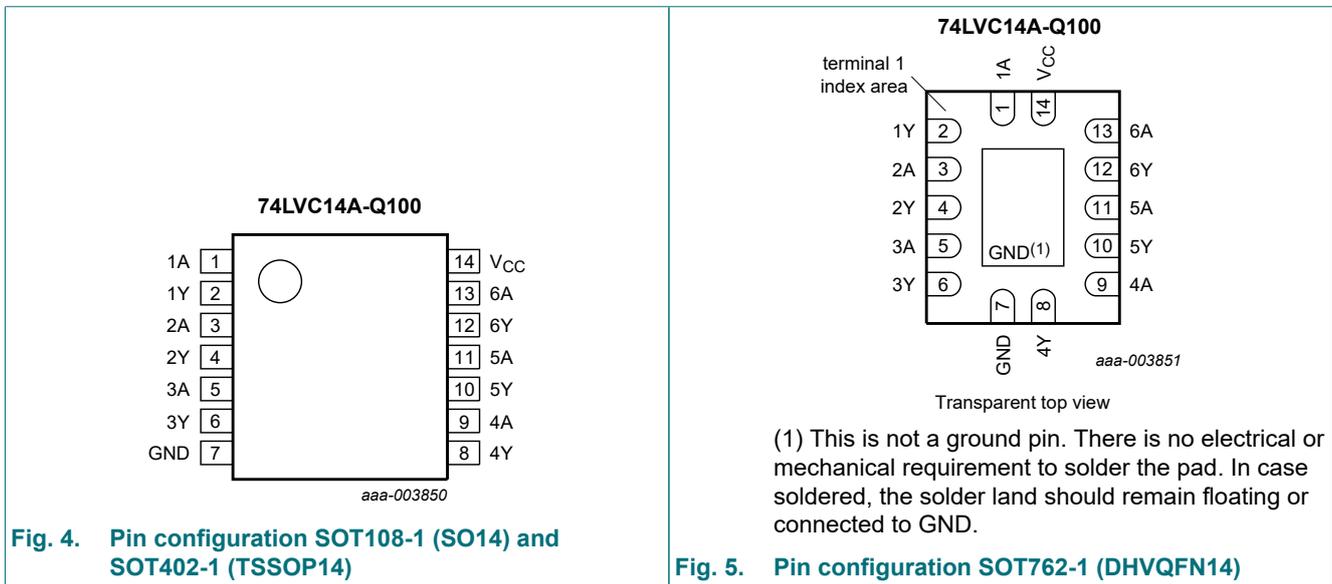
| Type number | Package | | | Version |
|-----------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74LVC14AD-Q100 | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74LVC14APW-Q100 | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74LVC14ABQ-Q100 | -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, 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

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 | +6.5 | V |
| V _I | input voltage | [1] | -0.5 | +6.5 | V |
| V _O | output voltage | [2] | -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 [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 SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.

For SOT402-1 (TSSOP14) package: P_{tot} derates linearly with 7.3 mW/K above 81 °C.

For SOT762-1 (DHVQFN14) package: P_{tot} derates linearly with 9.6 mW/K above 98 °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 |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | 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 Fig. 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 Fig. 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 |
| 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).

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

f_i = input frequency in MHz; f_o = output frequency in MHz

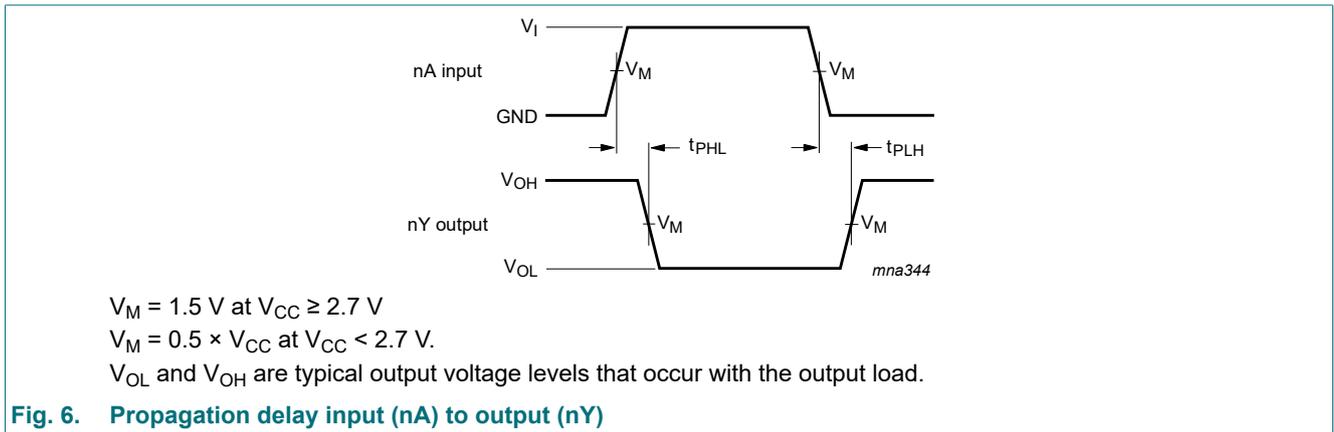
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

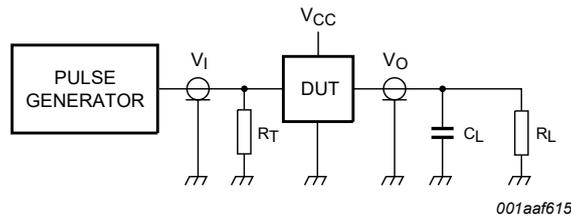
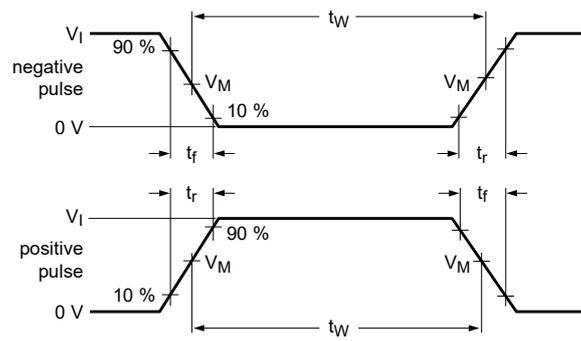
N = number of inputs switching

Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

11.1. Waveforms and test circuit



Hex inverting Schmitt trigger with 5 V tolerant input



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. Test circuit 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 |

12. Transfer characteristics

Table 9. Transfer characteristics

Voltages are referenced to GND (ground = 0 V); see Fig. 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 Fig. 9.

12.1. Waveforms transfer characteristics

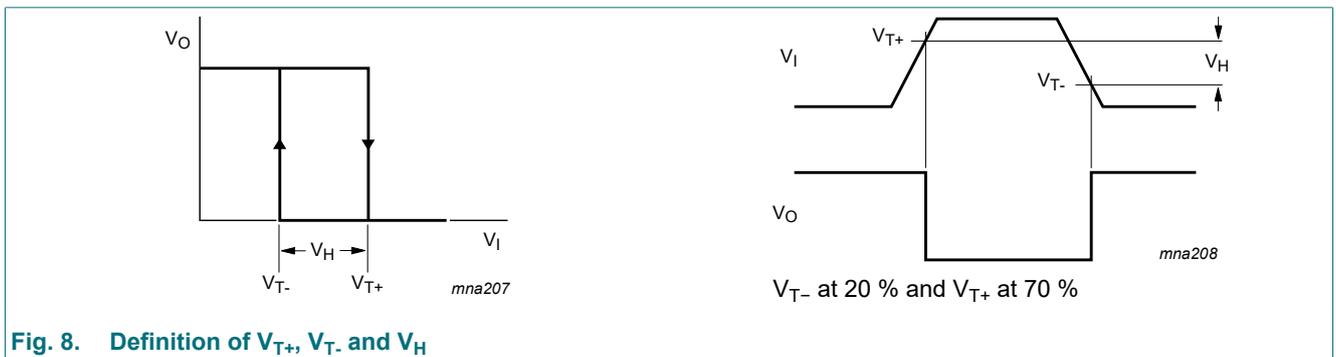
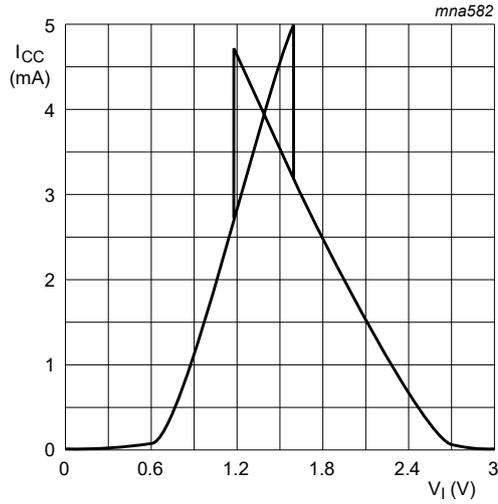


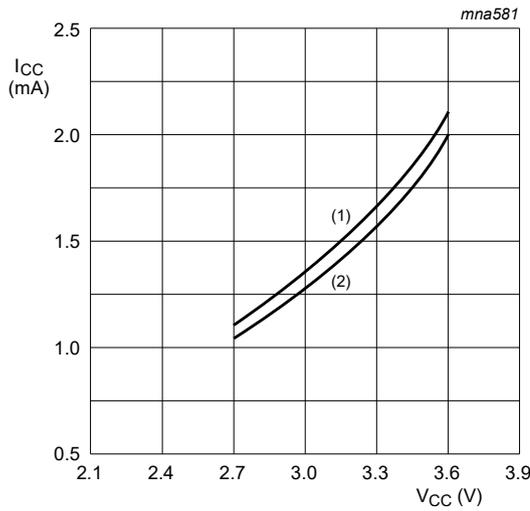
Fig. 8. Definition of V_{T+}, V_{T-} and V_H



$V_{CC} = 3.3 \text{ V}$.

Fig. 9. Typical transfer characteristic

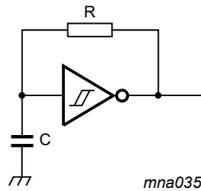
13. Application information



- (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

14. Package outline

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

SOT108-1

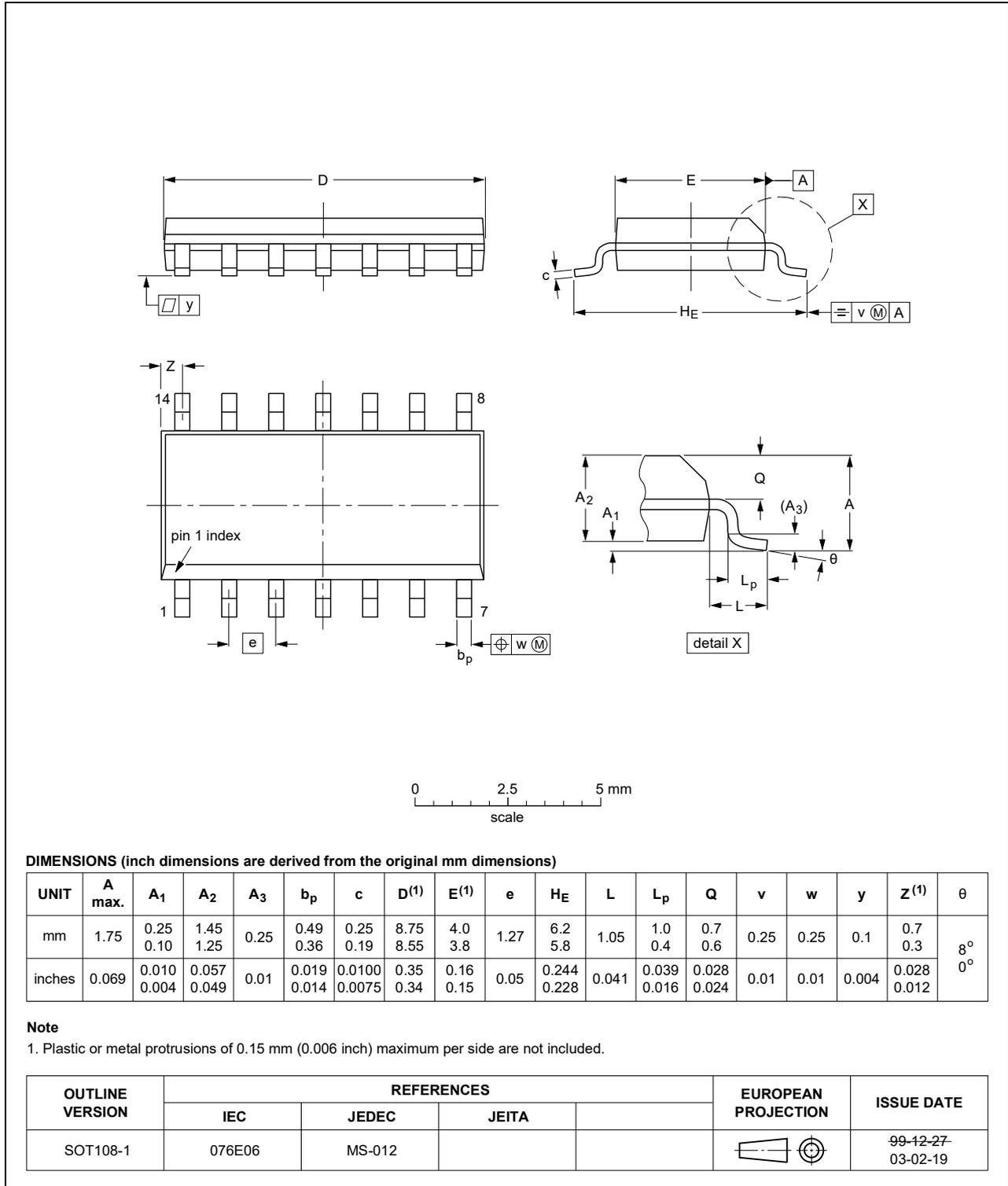


Fig. 12. Package outline SOT108-1 (SO14)

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

SOT402-1

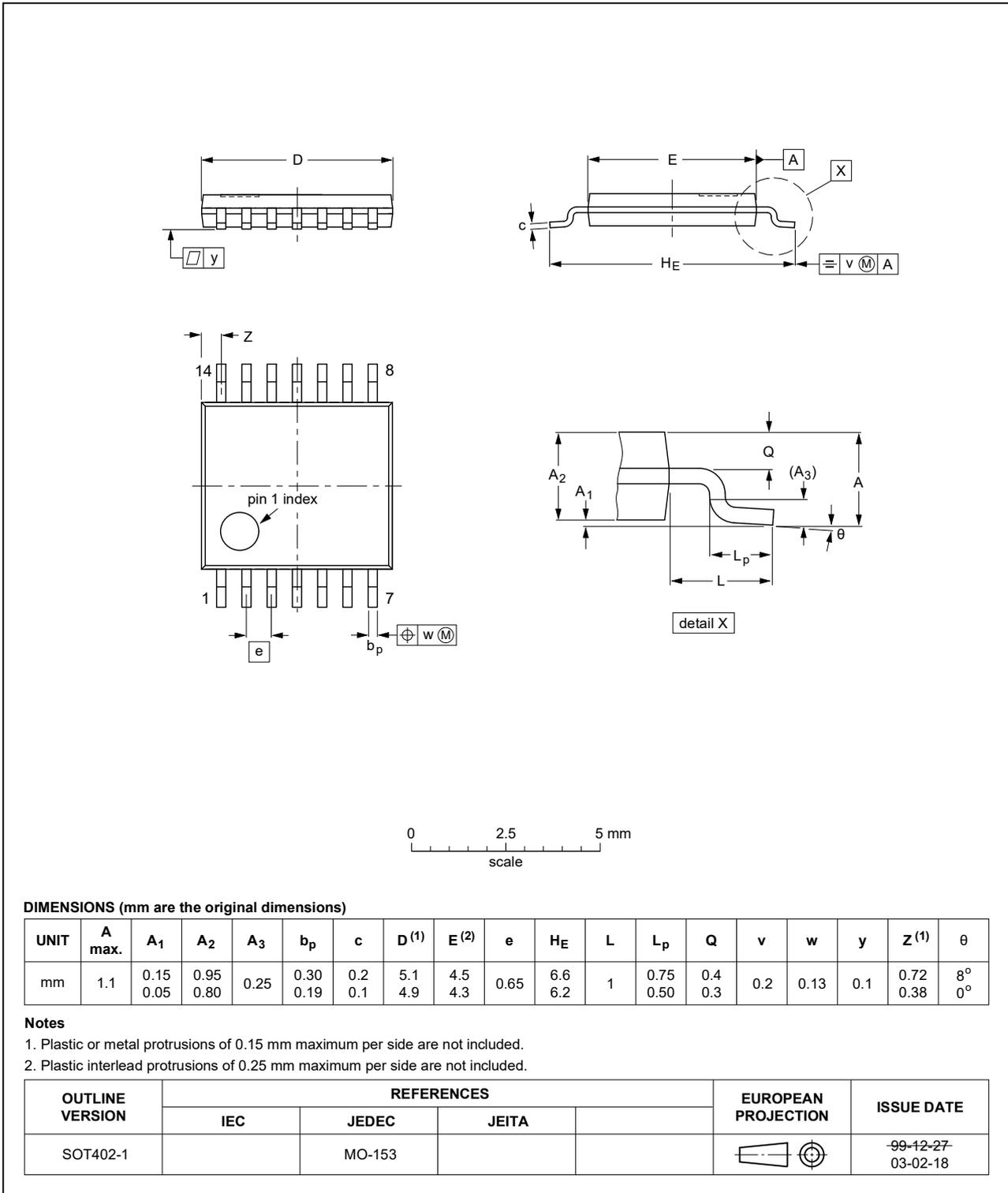


Fig. 13. Package outline SOT402-1 (TSSOP14)

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

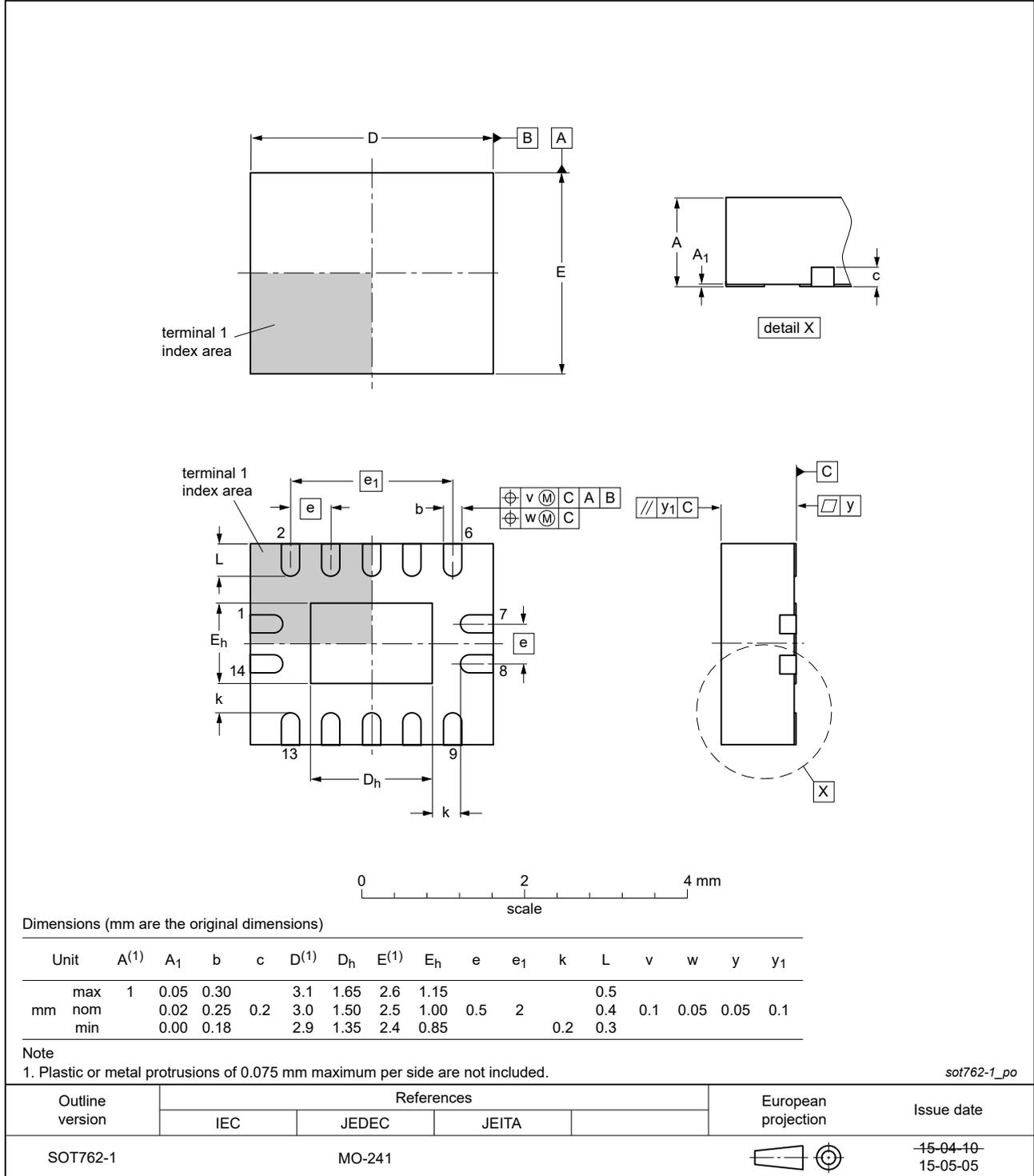


Fig. 14. Package outline SOT762-1 (DHVQFN14)

15. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MIL | Military |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

16. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------------|---|--------------------|---------------|-------------------|
| 74LVC14A_Q100 v.3 | 20200724 | Product data sheet | - | 74LVC14A_Q100 v.2 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Section 1 and Section 2 updated. Table 4: Derating values for P_{tot} total power dissipation updated. | | | |
| 74LVC14A_Q100 v.2 | 20160610 | Product data sheet | - | 74LVC14A_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> Table 4: table note removed (errata). | | | |
| 74LVC14A_Q100 v.1 | 20120807 | Product data sheet | - | - |

17. Legal information

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. |

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