

74AHCV14A

Hex inverting Schmitt trigger

Rev. 3 — 17 November 2016

Product data sheet

1. General description

The 74AHCV14A is a hex inverter with Schmitt-trigger inputs, capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

This device is fully specified for partial power down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

2. Features and benefits

- Wide supply voltage range from 1.8 V to 5.5 V
- Typical t_{pd} of 3.2 ns at 5 V
- Typical $V_{OL(p)} < 0.8$ V at $V_{CC} = 3.3$ V, $T_{amb} = 25$ °C
- Typical $V_{OH(v)} > 2.3$ V at $V_{CC} = 3.3$ V, $T_{amb} = 25$ °C
- Supports mixed-mode voltage operation on all ports
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
 - ◆ HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3 kV
 - ◆ MM JESD22-A115-A exceeds 200 V
 - ◆ CDM JESD22-C101E exceeds 2 kV
- Specified from -40 °C to $+85$ °C and from -40 °C to $+125$ °C

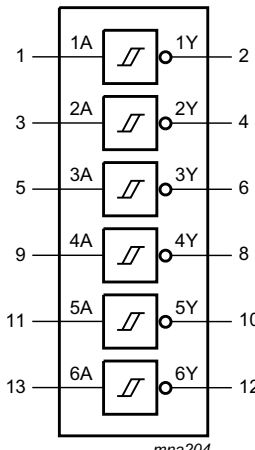
nexperia

3. Ordering information

Table 1. Ordering information

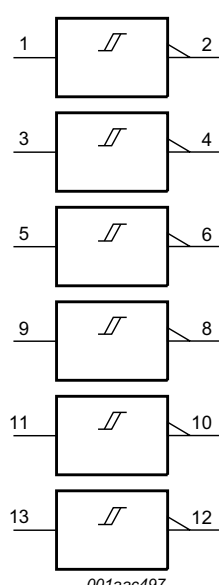
| Type number | Package | | | Version |
|-------------|-------------------|---------|--|----------|
| | Temperature range | Name | Description | |
| 74AHCV14APW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

4. Functional diagram



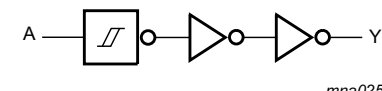
mna204

Fig 1. Logic symbol



001aac497

Fig 2. IEC logic symbol



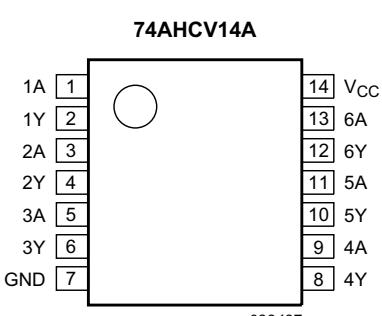
mna025

Fig 3. Logic diagram (one Schmitt-trigger)

5. Pinning information

5.1 Pinning

74AHCV14A



aaa-023437

Fig 4. Pin configuration TSSOP14

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 _{CC} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

| Input | Output |
|-------|--------|
| nA | nY |
| 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 _{CC} | supply voltage | | -0.5 | +7.0 | V |
| V _I | input voltage | | -0.5 | +7.0 | V |
| V _O | output voltage | output HIGH or LOW state | -0.5 | V _{CC} + 0.5 | V |
| | | output power-down | -0.5 | +7.0 | V |
| I _{IK} | input clamping current | V _I < 0 V | -50 | - | mA |
| I _{OK} | output clamping current | 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 | - | 500 | mW |

- [1] If the input current ratings are observed, the minimum input voltage ratings may be exceeded.
 [2] If the output current ratings are observed, the output voltage ratings may be exceeded.
 [3] This value is limited to 7 V maximum.
 [4] For TSSOP14 packages: above 75 °C, the value of P_{tot} derates linearly at 7 mW/K.

8. 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 | | 1.8 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW state | 0 | - | V_{CC} | V |
| | | output power-down | 0 | - | 5.5 | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | - | - | 50 | ms/V |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | - | - | 20 | ms/V |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | - | - | 1 | ms/V |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|----------|--|---|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 1.8\text{ V}$ | - | - | 1.65 | - | 1.65 | - | 1.65 | V |
| | | $V_{CC} = 2.3\text{ V}$ | - | - | 1.85 | - | 1.85 | - | 1.85 | V |
| | | $V_{CC} = 3.0\text{ V}$ | - | - | 2.2 | - | 2.2 | - | 2.2 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | - | 3.15 | - | 3.15 | - | 3.15 | V |
| | | $V_{CC} = 5.5\text{ V}$ | - | - | 3.85 | - | 3.85 | - | 3.85 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 1.8\text{ V}$ | 0.15 | - | - | 0.15 | - | 0.15 | - | V |
| | | $V_{CC} = 2.3\text{ V}$ | 0.45 | - | - | 0.45 | - | 0.45 | - | V |
| | | $V_{CC} = 3.0\text{ V}$ | 0.9 | - | - | 0.9 | - | 0.9 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 1.35 | - | - | 1.35 | - | 1.35 | - | V |
| | | $V_{CC} = 5.5\text{ V}$ | 1.65 | - | - | 1.65 | - | 1.65 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 1.8\text{ V}$ | 0.15 | - | 1.05 | 0.15 | 1.05 | 0.15 | 1.05 | V |
| | | $V_{CC} = 2.3\text{ V}$ | 0.2 | - | 1.1 | 0.2 | 1.1 | 0.2 | 1.1 | V |
| | | $V_{CC} = 3.0\text{ V}$ | 0.3 | - | 1.2 | 0.3 | 1.2 | 0.3 | 1.2 | V |
| | | $V_{CC} = 4.5\text{ V}$ | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.4 | 1.4 | V |
| | | $V_{CC} = 5.5\text{ V}$ | 0.5 | - | 1.6 | 0.5 | 1.6 | 0.5 | 1.6 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{T+}$ or V_{T-} | | | | | | | | |
| | | $I_O = -50\ \mu\text{A}; V_{CC} = 1.8\text{ V}$ | 1.7 | 1.8 | - | 1.7 | - | 1.7 | - | V |
| | | $I_O = -50\ \mu\text{A}; V_{CC} = 3.0\text{ V}$ | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | $I_O = -50\ \mu\text{A}; V_{CC} = 4.5\text{ V}$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -8\text{ mA}; V_{CC} = 3.0\text{ V}$ | 2.58 | - | - | 2.48 | - | 2.48 | - | V |
| | $I_O = -16\text{ mA}; V_{CC} = 4.5\text{ V}$ | 3.94 | - | - | 3.80 | - | 3.80 | - | V | |

Table 6. Static characteristics ...continued
 Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---------------------------|---|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | I _O = 50 μA; V _{CC} = 1.8 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 8 mA; V _{CC} = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.44 | V |
| I _O = 16 mA; V _{CC} = 4.5 V | - | - | 0.44 | - | 0.55 | - | 0.55 | V | | |
| I _{OFF} | power-off leakage current | V _I or V _O = GND to 5.5 V; V _{CC} = 0 V | - | - | 0.5 | - | 5 | - | 5 | μA |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 0 V to 5.5 V | - | - | ±0.1 | - | ±1 | - | ±1 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 2 | - | 20 | - | 20 | μA |

9.1 Transfer characteristics waveforms

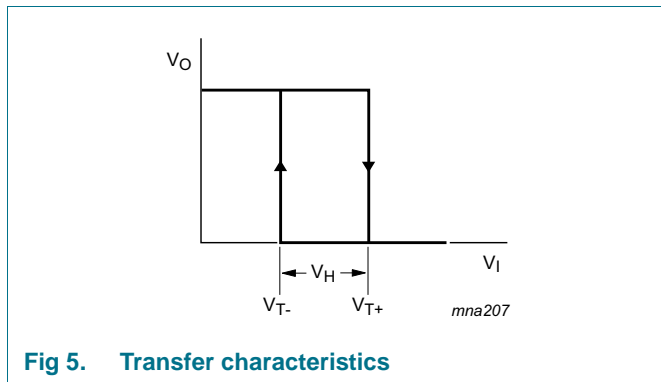


Fig 5. Transfer characteristics

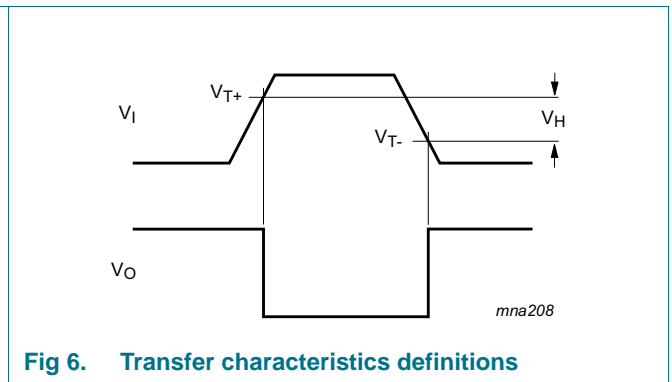
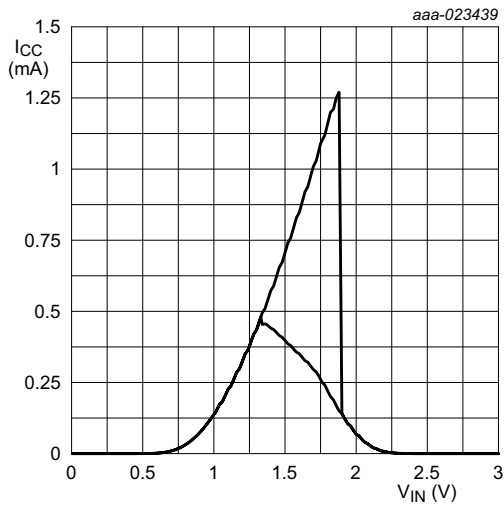
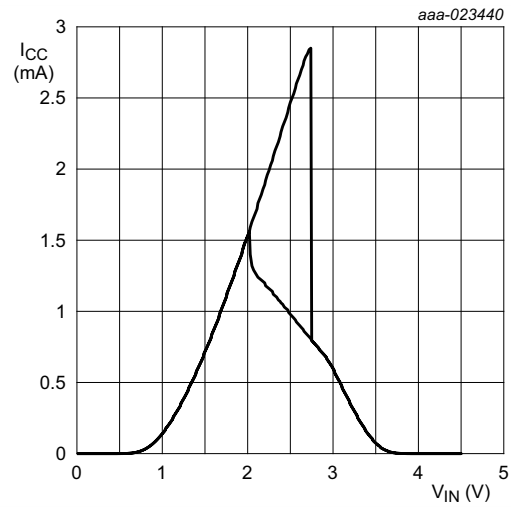


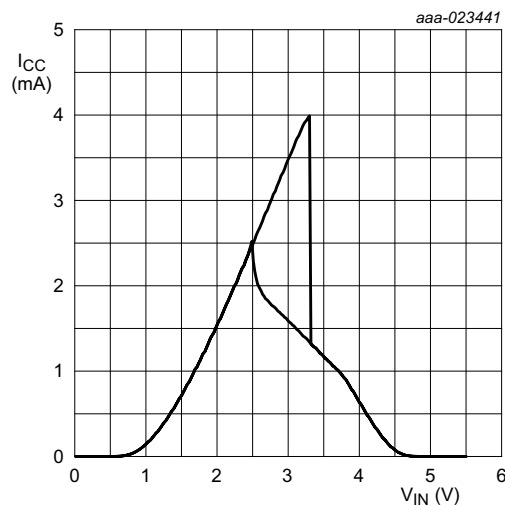
Fig 6. Transfer characteristics definitions



a. $V_{CC} = 3.0\text{ V}$



b. $V_{CC} = 4.5\text{ V}$



c. $V_{CC} = 5.5\text{ V}$

Fig 7. Typical transfer characteristics

10. Dynamic characteristics

Table 7. Dynamic characteristics
GND = 0 V. For test circuit, see Figure 9.

| Symbol | Parameter | Conditions | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit | |
|-----------------|-------------------------------|---|-------|--------------------|------|------------------|------|-------------------|------|------|--|
| | | | Min | Typ ^[1] | Max | Min | Max | Min | Max | | |
| t _{pd} | propagation delay | nA to nYn; see Figure 8 ^[2] | | | | | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | | | | | | | | | |
| | | C _L = 15 pF | - | 5.4 | 19.7 | 1 | 22 | 1 | 23.8 | ns | |
| | | C _L = 50 pF | - | 7.3 | 24 | 1 | 27 | 1 | 29.3 | ns | |
| | | V _{CC} = 3.0 V to 3.6 V | | | | | | | | | |
| | | C _L = 15 pF | - | 4.1 | 12.8 | 1 | 15 | 1 | 16.3 | ns | |
| | | C _L = 50 pF | - | 5.7 | 16.3 | 1 | 18.5 | 1 | 20.1 | ns | |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | | |
| | | C _L = 15 pF | - | 3.2 | 8.6 | 1 | 10 | 1 | 10.9 | ns | |
| | | C _L = 50 pF | - | 4.5 | 10.6 | 1 | 12 | 1 | 13.0 | ns | |
| C _I | input capacitance | V _I = V _{CC} or GND; V _{CC} = 3.3 V | - | 2 | 6 | - | 6 | - | 6 | pF | |
| C _O | output capacitance | V _O = V _{CC} or GND; V _{CC} = 3.3 V | - | 5 | - | - | - | - | - | pF | |
| C _{PD} | power dissipation capacitance | per buffer; ^[3] C _L = 0 pF; f = 10 MHz; V _{CC} = 5 V; V _I = GND to V _{CC} | - | 15 | - | - | - | - | - | pF | |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

[3] C_{PD} is used to determine the dynamic power dissipation P_D (μW).

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

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.

Table 8. Noise characteristics
GND = 0 V. For test circuit, see Figure 9.

| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | Unit |
|--|------------------------------------|------------|--------------------------|------|------|------|
| | | | Min | Typ | Max | |
| V_{CC} = 3.3 V; C_L = 50 pF | | | | | | |
| V _{OL(p)} | LOW-level output voltage (peak) | | - | 0.3 | 0.8 | V |
| V _{OL(v)} | LOW-level output voltage (valley) | | -0.8 | -0.1 | - | V |
| V _{OH(v)} | HIGH-level output voltage (valley) | | - | 3.0 | - | V |
| V _{IH(AC)} | AC HIGH-level input voltage | | 2.31 | - | - | V |
| V _{IL(AC)} | AC LOW-level input voltage | | - | - | 0.99 | V |
| V_{CC} = 5.0 V; C_L = 50 pF | | | | | | |
| V _{OL(p)} | LOW-level output voltage (peak) | | - | 0.6 | - | V |
| V _{OL(v)} | LOW-level output voltage (valley) | | - | -0.4 | - | V |
| V _{OH(v)} | HIGH-level output voltage (valley) | | - | 4.5 | - | V |
| V _{IH(AC)} | AC HIGH-level input voltage | | 3.5 | - | - | V |
| V _{IL(AC)} | AC LOW-level input voltage | | - | - | 1.5 | V |

11. Waveforms

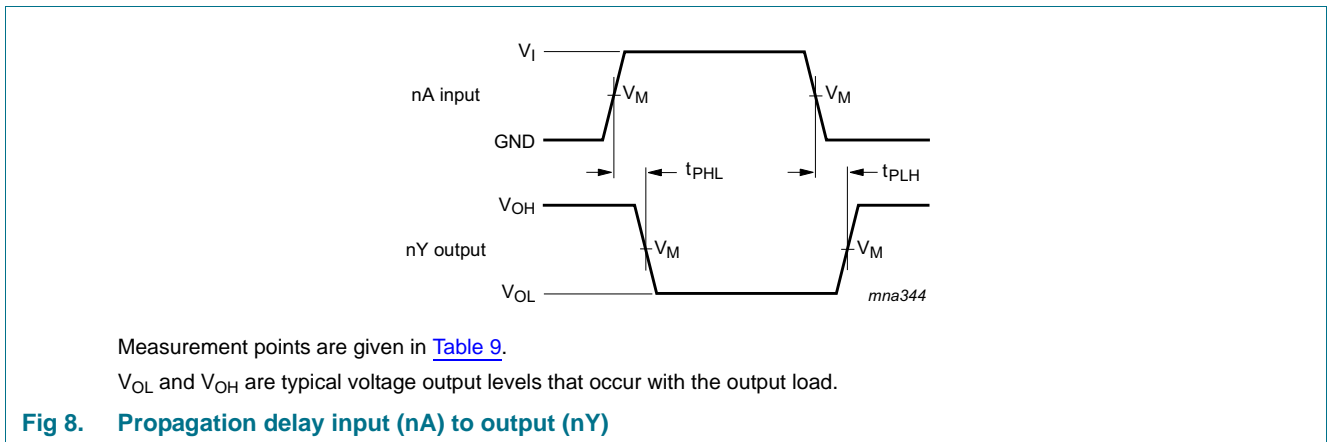
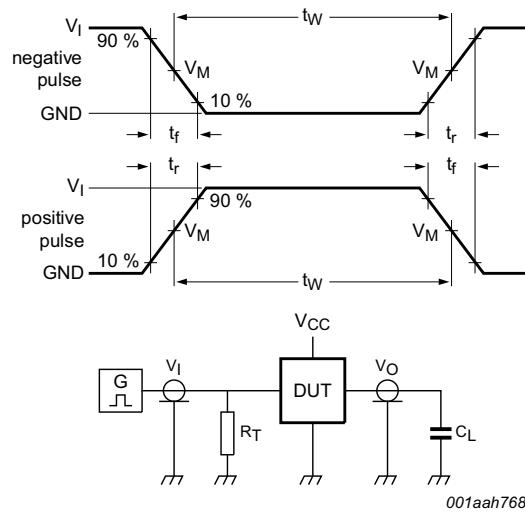


Table 9. Measurement points

| Input | Output |
|--------------------|--------------------|
| V _M | V _M |
| 0.5V _{CC} | 0.5V _{CC} |



Test data is given in [Table 10](#).

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

S1 = Test selection switch

Fig 9. Test circuit for measuring switching times

Table 10. Test data

| Input | | Load | Test |
|-----------------|------------|--------------|--------------------|
| V_I | t_r, t_f | C_L | |
| GND to V_{CC} | 3.0 ns | 15 pF, 50 pF | t_{PLH}, t_{PHL} |

12. Package outline

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

SOT402-1

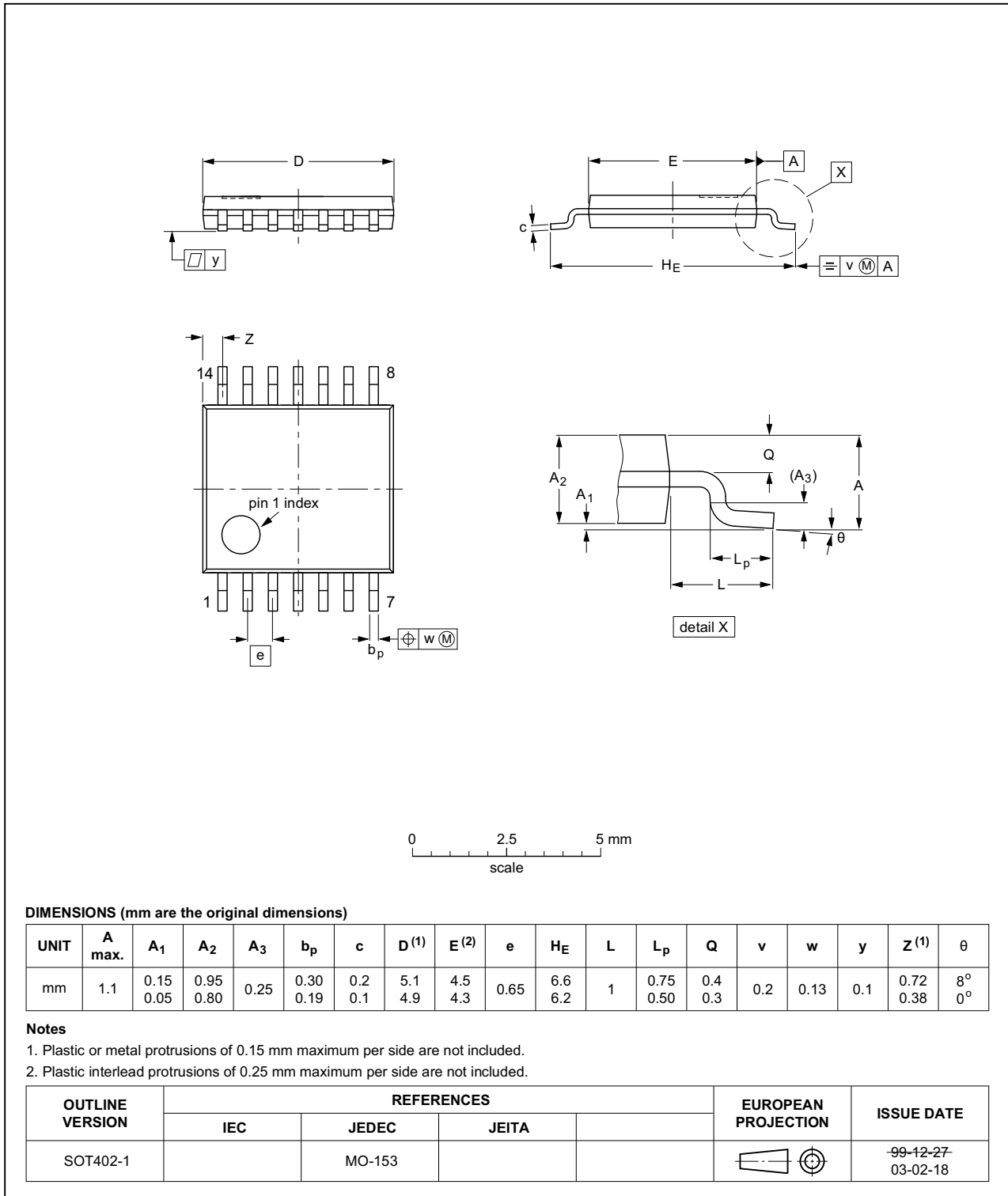


Fig 10. Package outline SOT402-1 (TSSOP14)

13. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|-----------------------------|
| CDM | Charge Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|---------------|
| 74AHCV14A v.3 | 20161117 | Product data sheet | - | 74AHCV14A v.2 |
| Modifications: | <ul style="list-style-type: none"> Section 1: Errata fixed. | | | |
| 74AHCV14A v.2 | 20161102 | Product data sheet | - | 74AHCV14A v.1 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74AHCV14AD and 74AHCV14ABQ removed. | | | |
| 74AHCV14A v.1 | 20160614 | Product data sheet | - | - |

15. Legal information

15.1 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".

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