

# 74HC7014

Hex non-inverting precision Schmitt-trigger

Rev. 3 — 30 April 2014

Product data sheet

## 1. General description

The 74HC7014 is a hex buffer with precision Schmitt-trigger inputs. The precisely defined trigger levels are lying in a window between  $0.55 \times V_{CC}$  and  $0.65 \times V_{CC}$ . It makes the circuit suitable to operate in a highly noisy environment. Input shorts are allowed to  $-1.5$  V and  $+16$  V without disturbing other channels. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

## 2. Features and benefits

- Operating voltage 3.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115A exceeds 200 V
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

## 3. Applications

- Wave and pulse shapers for highly noisy environments

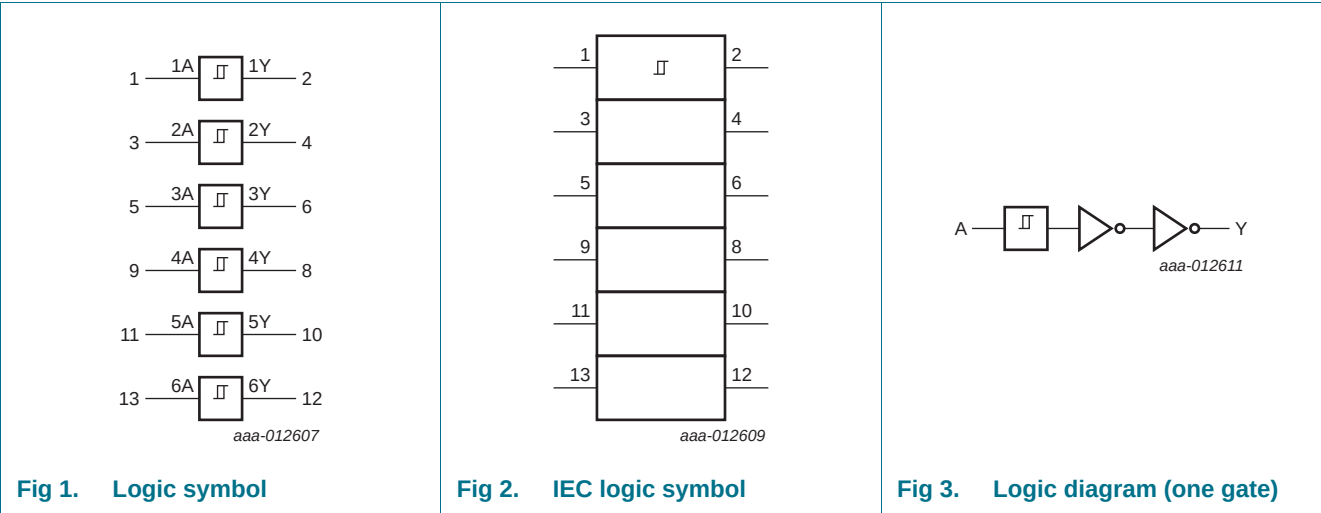
## 4. Ordering information

Table 1. Ordering information

| Type number | Package               |       |                                                            |          |
|-------------|-----------------------|-------|------------------------------------------------------------|----------|
|             | Temperature range     | Name  | Description                                                | Version  |
| 74HC7014N   | $-40$ °C to $+125$ °C | DIP14 | plastic dual in-line package; 14 leads (300 mil)           | SOT27-1  |
| 74HC7014D   | $-40$ °C to $+125$ °C | SO14  | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |

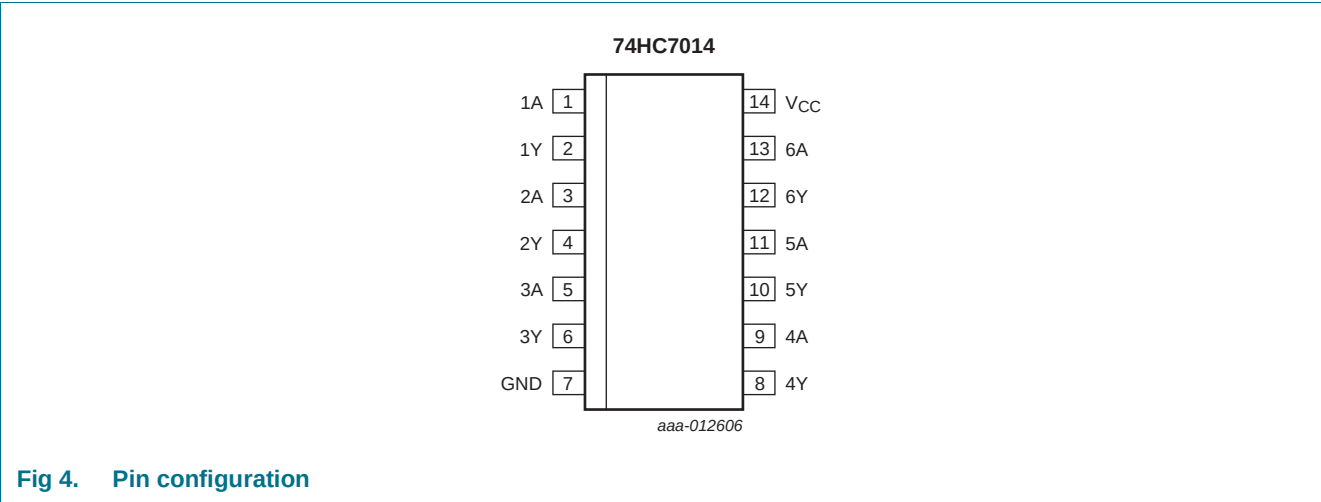


5. Functional diagram



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

| Symbol          | Pin                | Description    |
|-----------------|--------------------|----------------|
| 1A to 6A        | 1, 3, 5, 9, 11, 13 | data input     |
| 1Y to 6Y        | 2, 4, 6, 8, 10, 12 | data output    |
| GND             | 7                  | ground (0 V)   |
| V <sub>CC</sub> | 14                 | supply voltage |

## 7. Functional description

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

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

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

## 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 | +7   | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup> | -    | ±20  | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup> | -    | ±20  | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$                         | -    | 25   | mA   |
| $I_{CC}$  | supply current          |                                                                       | -    | 50   | mA   |
| $I_{GND}$ | ground current          |                                                                       | -50  | -    | mA   |
| $T_{stg}$ | storage temperature     |                                                                       | -65  | +150 | °C   |
| $P_{tot}$ | total power dissipation | DIP14 <sup>[2]</sup>                                                  | -    | 750  | mW   |
|           |                         | SO14 <sup>[2]</sup>                                                   | -    | 500  | mW   |

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

[2] For DIP14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
For SO14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

## 9. 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      |            | 2.0 | 5.0 | 6.0      | V    |
| $V_I$     | input voltage       |            | 0   | -   | $V_{CC}$ | 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                                                           | T <sub>amb</sub> = 25 °C |      |      | T <sub>amb</sub> = −40 °C to +85 °C |      | T <sub>amb</sub> = −40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|----------------------------------------------------------------------|--------------------------|------|------|-------------------------------------|------|--------------------------------------|------|------|
|                 |                           |                                                                      | Min                      | Typ  | Max  | Min                                 | Max  | Min                                  | Max  |      |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                  |                          |      |      |                                     |      |                                      |      |      |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 2.0 V                     | 1.9                      | 2.0  | -    | 1.9                                 | -    | 1.9                                  | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 4.5 V                     | 4.4                      | 4.5  | -    | 4.4                                 | -    | 4.4                                  | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 6.0 V                     | 5.9                      | 6.0  | -    | 5.9                                 | -    | 5.9                                  | -    | V    |
|                 |                           | I <sub>O</sub> = −4.0 mA; V <sub>CC</sub> = 4.5 V                    | 3.98                     | 4.32 | -    | 3.84                                | -    | 3.7                                  | -    | V    |
|                 |                           | I <sub>O</sub> = −5.2 mA; V <sub>CC</sub> = 6.0 V                    | 5.48                     | 5.81 | -    | 5.34                                | -    | 5.2                                  | -    | 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> = 20 μA; V <sub>CC</sub> = 2.0 V                      | -                        | 0    | 0.1  | -                                   | 0.1  | -                                    | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V                      | -                        | 0    | 0.1  | -                                   | 0.1  | -                                    | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V                      | -                        | 0    | 0.1  | -                                   | 0.1  | -                                    | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                     | -                        | 0.15 | 0.26 | -                                   | 0.33 | -                                    | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                     | -                        | 0.16 | 0.26 | -                                   | 0.33 | -                                    | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>CC</sub> = 6.00 V;<br>V <sub>I</sub> = V <sub>CC</sub> or GND | -                        | -    | 0.1  | 1.0                                 | -    | 1.0                                  | -    | μA   |
|                 |                           | V <sub>CC</sub> = 3.00 V to 6.00 V;<br>V <sub>I</sub> = 16 V or GND  | -                        | -    | 0.5  | 5.0                                 | -    | 5.0                                  | -    | μA   |
| I <sub>CC</sub> | DC supply current         | V <sub>CC</sub> = 3.00 V                                             | -                        | 0.7  | 1.4  | -                                   | 1.8  | -                                    | 2.1  | mA   |
|                 |                           | V <sub>CC</sub> = 5.25 V                                             | -                        | 3.0  | 6.0  | -                                   | 7.5  | -                                    | 7.5  | mA   |
|                 |                           | V <sub>CC</sub> = 6.00 V                                             | -                        | 3.7  | 7.4  | -                                   | 10.0 | -                                    | 13.0 | mA   |
| C <sub>I</sub>  | input capacitance         |                                                                      | -                        | 3.5  | -    | -                                   | -    | -                                    | -    | pF   |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

GND = 0 V; for test circuit, see [Figure 6](#).

| Symbol           | Parameter                     | Conditions                                                            | T <sub>amb</sub> = 25 °C |     |     | T <sub>amb</sub> = −40 °C to +125 °C |              | Unit |
|------------------|-------------------------------|-----------------------------------------------------------------------|--------------------------|-----|-----|--------------------------------------|--------------|------|
|                  |                               |                                                                       | Min                      | Typ | Max | Max (85 °C)                          | Max (125 °C) |      |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | nA to nY; see <a href="#">Figure 5</a>                                |                          |     |     |                                      |              |      |
|                  |                               | V <sub>CC</sub> = 3.00 V                                              | -                        | 95  | 475 |                                      | 715          | ns   |
|                  |                               | V <sub>CC</sub> = 4.75 V                                              | -                        | 38  | 115 | -                                    | 175          | ns   |
|                  |                               | V <sub>CC</sub> = 6.00 V                                              | -                        | 27  | 73  | 93                                   | 112          | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | nA to nY; see <a href="#">Figure 5</a>                                |                          |     |     |                                      |              |      |
|                  |                               | V <sub>CC</sub> = 3.00 V                                              | -                        | 47  | 175 | 220                                  | 260          | ns   |
|                  |                               | V <sub>CC</sub> = 4.75 V                                              | -                        | 23  | 52  | 65                                   | 78           | ns   |
|                  |                               | V <sub>CC</sub> = 6.00 V                                              | -                        | 18  | 46  | 58                                   | 70           | ns   |
| t <sub>t</sub>   | transition time               | see <a href="#">Figure 5</a> <a href="#">[1]</a>                      |                          |     |     |                                      |              |      |
|                  |                               | V <sub>CC</sub> = 3.00 V                                              | -                        | 12  | 20  | 25                                   | 30           | ns   |
|                  |                               | V <sub>CC</sub> = 4.75 V                                              | -                        | 7   | 15  | 19                                   | 22           | ns   |
|                  |                               | V <sub>CC</sub> = 6.00 V                                              | -                        | 6   | 13  | 16                                   | 19           | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | per gate; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[2]</a> | -                        | 9   | -   | -                                    | -            | pF   |

[1] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[2] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

12. Waveforms

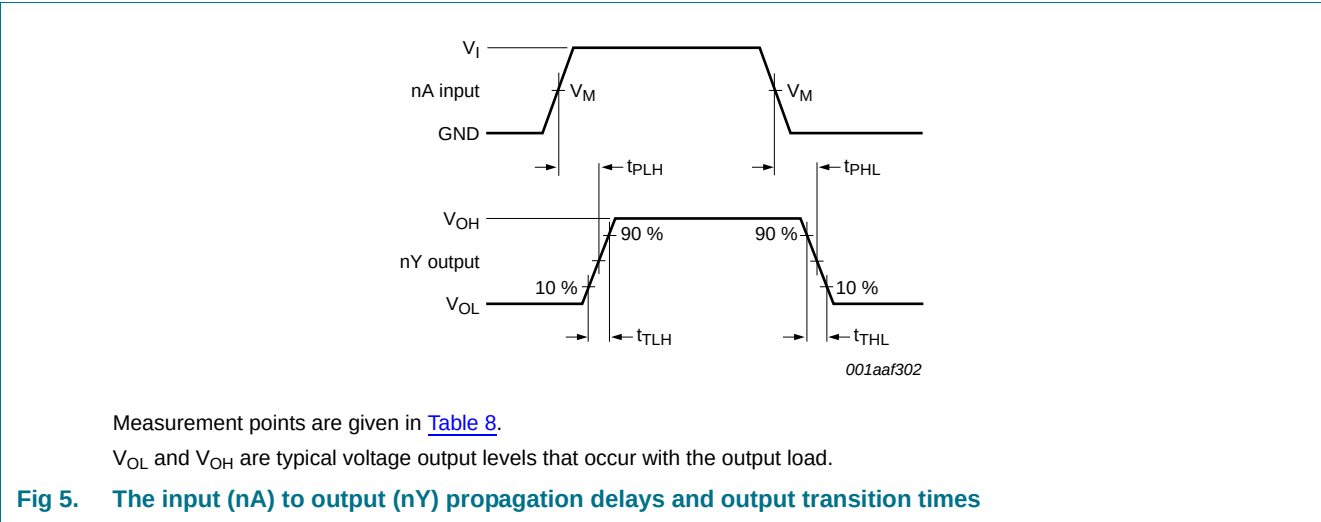


Table 8. Measurement points

| Type     | Input       | Output      |
|----------|-------------|-------------|
|          | $V_M$       | $V_M$       |
| 74HC7014 | $0.5V_{CC}$ | $0.5V_{CC}$ |

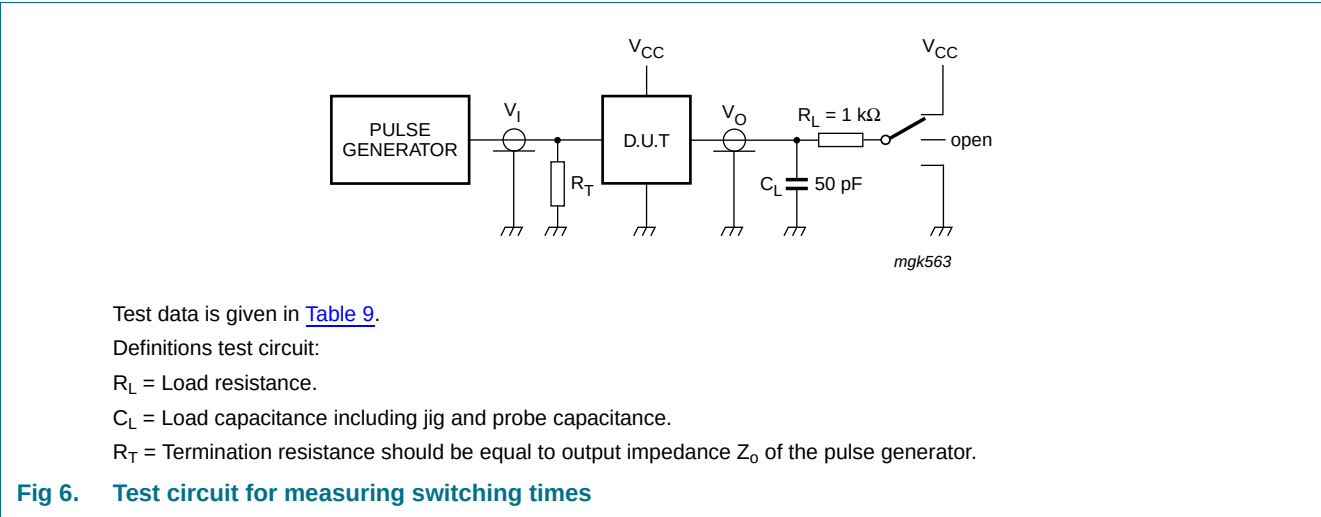


Table 9. Test data

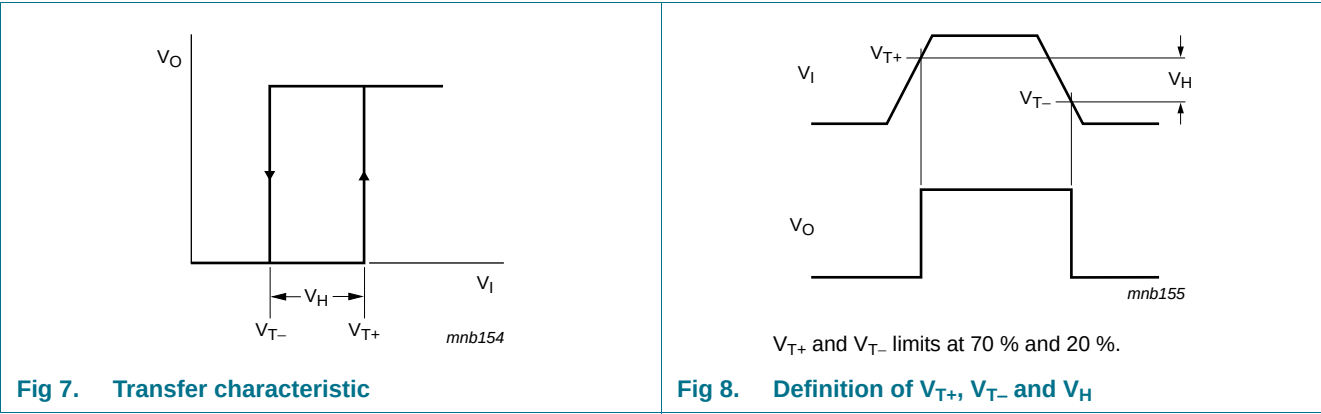
| Type     | Input           |            | Test               |
|----------|-----------------|------------|--------------------|
|          | $V_I$           | $t_r, t_f$ | $t_{PHL}, t_{PLH}$ |
| 74HC7014 | GND to $V_{CC}$ | 6 ns       | open               |

13. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Figure 7 and Figure 8.

| Symbol          | Parameter                        | Conditions               | T <sub>amb</sub> = 25 °C |      |      | T <sub>amb</sub> = –40 °C to +85 °C |      | T <sub>amb</sub> = –40 °C to +125 °C |      | Unit |
|-----------------|----------------------------------|--------------------------|--------------------------|------|------|-------------------------------------|------|--------------------------------------|------|------|
|                 |                                  |                          | Min                      | Typ  | Max  | Min                                 | Max  | Min                                  | Max  |      |
| V <sub>T+</sub> | positive-going threshold voltage | V <sub>CC</sub> = 3.00 V | -                        | 1.86 | 1.95 | -                                   | 1.95 | -                                    | 1.95 | V    |
|                 |                                  | V <sub>CC</sub> = 4.75 V | -                        | 2.94 | 3.08 | -                                   | 3.08 | -                                    | 3.08 | V    |
|                 |                                  | V <sub>CC</sub> = 5.00 V | -                        | 3.10 | 3.25 | -                                   | 3.25 | -                                    | 3.25 | V    |
|                 |                                  | V <sub>CC</sub> = 5.25 V | -                        | 3.25 | 3.41 | -                                   | 3.41 | -                                    | 3.41 | V    |
|                 |                                  | V <sub>CC</sub> = 6.00 V | -                        | 3.72 | 3.90 | -                                   | 3.90 | -                                    | 3.90 | V    |
| V <sub>T–</sub> | negative-going threshold voltage | V <sub>CC</sub> = 3.00 V | 1.65                     | 1.74 | -    | 1.65                                | -    | 1.65                                 | -    | V    |
|                 |                                  | V <sub>CC</sub> = 4.75 V | 2.62                     | 2.76 | -    | 2.62                                | -    | 2.62                                 | -    | V    |
|                 |                                  | V <sub>CC</sub> = 5.00 V | 2.75                     | 2.90 | -    | 2.75                                | -    | 2.75                                 | -    | V    |
|                 |                                  | V <sub>CC</sub> = 5.25 V | 2.89                     | 3.05 | -    | 2.89                                | -    | 2.89                                 | -    | V    |
|                 |                                  | V <sub>CC</sub> = 6.00 V | 3.30                     | 3.48 | -    | 3.30                                | -    | 3.30                                 | -    | V    |
| V <sub>H</sub>  | hysteresis voltage               | V <sub>CC</sub> = 3.00 V | 50                       | 120  | -    | 50                                  | -    | 50                                   | -    | V    |
|                 |                                  | V <sub>CC</sub> = 4.75 V | 100                      | 180  | -    | 100                                 | -    | 100                                  | -    | V    |
|                 |                                  | V <sub>CC</sub> = 5.00 V | 120                      | 200  | -    | 120                                 | -    | 120                                  | -    | V    |
|                 |                                  | V <sub>CC</sub> = 5.25 V | 130                      | 210  | -    | 130                                 | -    | 130                                  | -    | V    |
|                 |                                  | V <sub>CC</sub> = 6.00 V | 160                      | 240  | -    | 160                                 | -    | 160                                  | -    | V    |



14. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

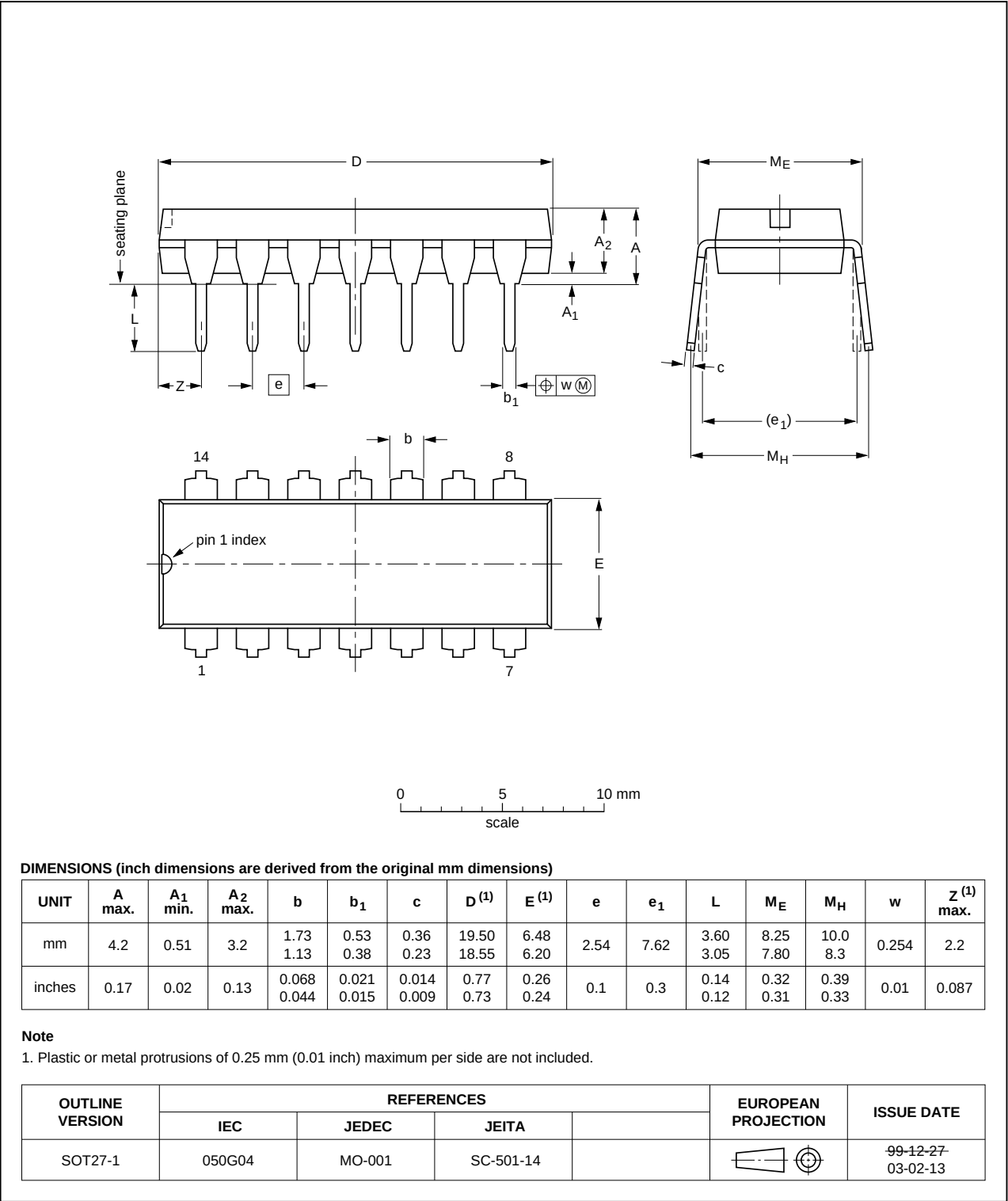


Fig 9. Package outline SOT27-1 (DIP14)

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

SOT108-1

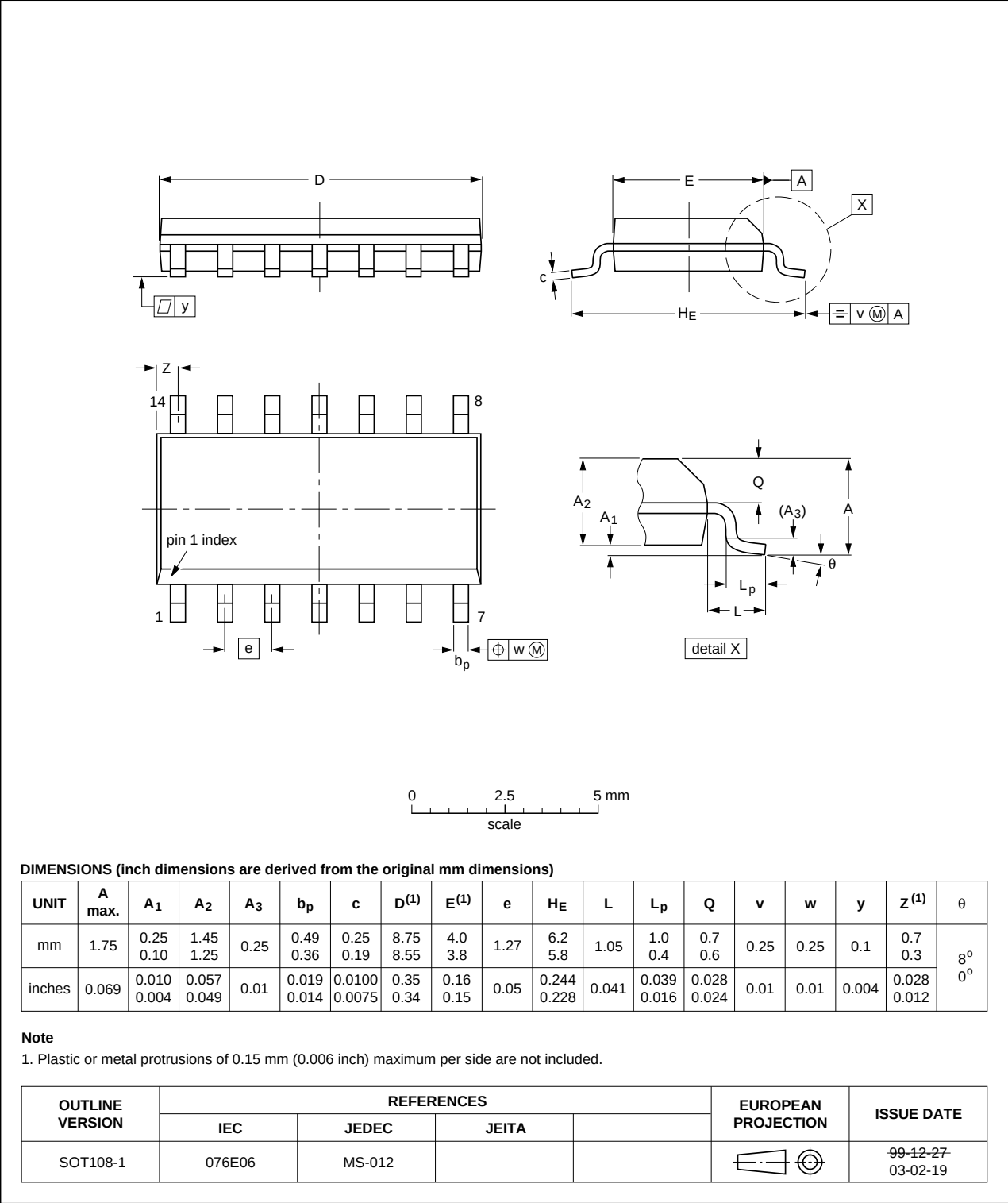


Fig 10. Package outline SOT108-1 (SO14)

## 15. Abbreviations

Table 11. Abbreviations

| Acronym | Description             |
|---------|-------------------------|
| DUT     | Device Under Test       |
| ESD     | ElectroStatic Discharge |
| HBM     | Human Body Model        |
| MM      | Machine Model           |

## 16. Revision history

Table 12. Revision history

| Document ID      | Release date                                                                                                                                                                                                                                         | Data sheet status     | Change notice | Supersedes       |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------------------|
| 74HC7014 v.3     | 20140430                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC7014_CVN v.2 |
| 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></ul> |                       |               |                  |
| 74HC7014_CVN v.2 | 19980708                                                                                                                                                                                                                                             | Product specification | -             | 74HC7014 v.1     |
| 74HC7014 v.1     | 19930901                                                                                                                                                                                                                                             | Product specification | -             | -                |

## 17. Legal information

### 17.1 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".

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