

# 74HC164; 74HCT164

8-bit serial-in, parallel-out shift register

Rev. 04 — 2 February 2010

Product data sheet

## 1. General description

The 74HC164; 74HCT164 are high-speed Si-gate CMOS devices and are pin compatible with Low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC164; 74HCT164 are 8-bit edge-triggered shift registers with serial data entry and an output from each of the eight stages. Data is entered serially through one of two inputs (DSA or DSB); either input can be used as an active HIGH enable for data entry through the other input. Both inputs must be connected together or an unused input must be tied HIGH.

Data shifts one place to the right on each LOW-to-HIGH transition of the clock (CP) input and enters into Q0, which is the logical AND of the two data inputs (DSA and DSB) that existed one set-up time prior to the rising clock edge.

A LOW level on the master reset ( $\overline{\text{MR}}$ ) input overrides all other inputs and clears the register asynchronously, forcing all outputs LOW.

## 2. Features

- Input levels:
  - ◆ For 74HC164: CMOS level
  - ◆ For 74HCT164: TTL level
- Gated serial data inputs
- Asynchronous master reset
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V.
- Multiple package options
- 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  |
| 74HC164N    | −40 °C to +125 °C | DIP14    | plastic dual in-line package; 14 leads (300 mil)                                                                             | SOT27-1  |
| 74HCT164N   |                   |          |                                                                                                                              |          |
| 74HC164D    | −40 °C to +125 °C | SO14     | plastic small outline package; 14 leads; body width 3.9 mm                                                                   | SOT108-1 |
| 74HCT164D   |                   |          |                                                                                                                              |          |
| 74HC164DB   | −40 °C to +125 °C | SSOP14   | plastic shrink small outline package; 14 leads; body width 5.3 mm                                                            | SOT337-1 |
| 74HCT164DB  |                   |          |                                                                                                                              |          |
| 74HC164PW   | −40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads; body width 4.4 mm                                                       | SOT402-1 |
| 74HCT164PW  |                   |          |                                                                                                                              |          |
| 74HC164BQ   | −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 |
| 74HCT164BQ  |                   |          |                                                                                                                              |          |

4. Functional diagram

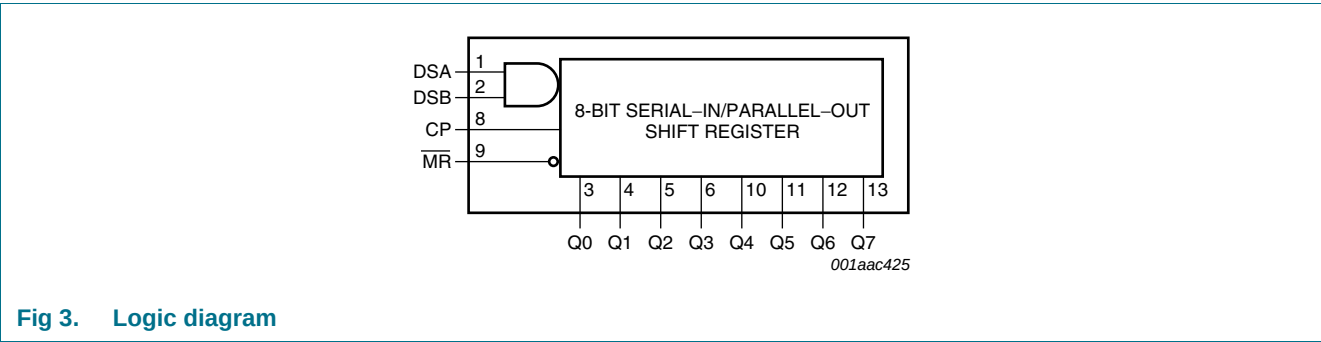
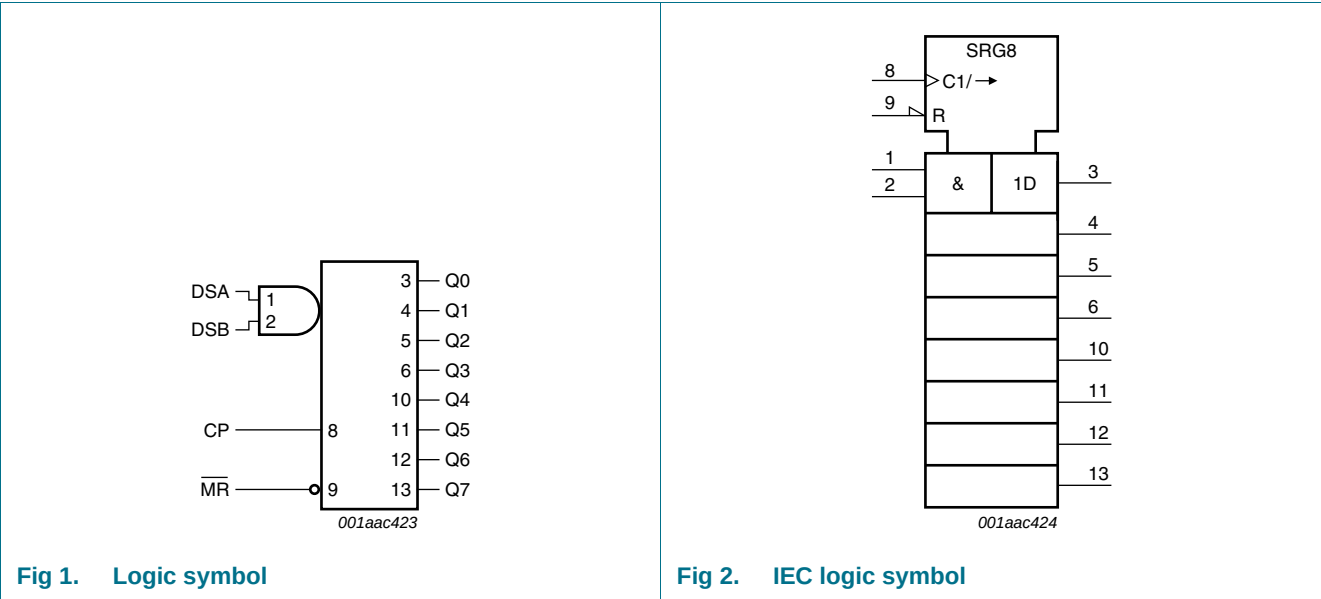


Fig 3. Logic diagram

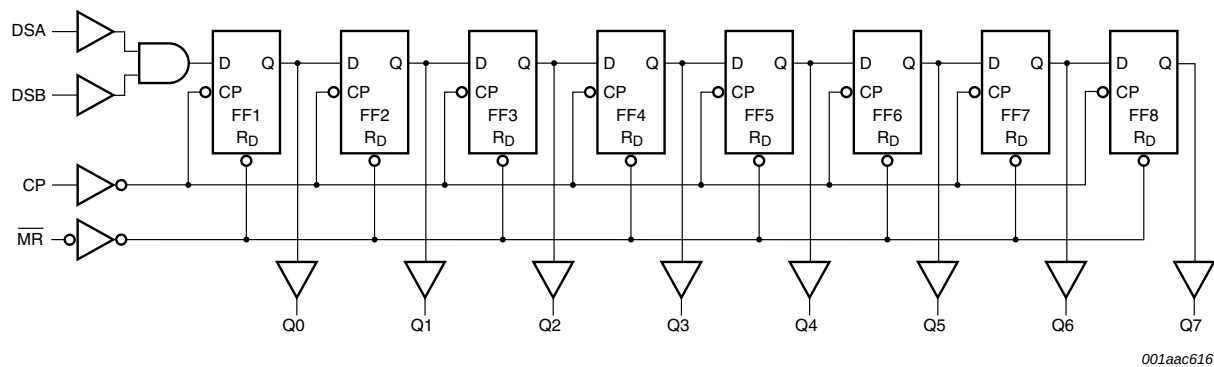


Fig 4. Functional diagram

5. Pinning information

5.1 Pinning

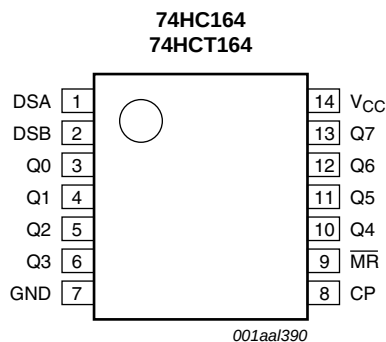
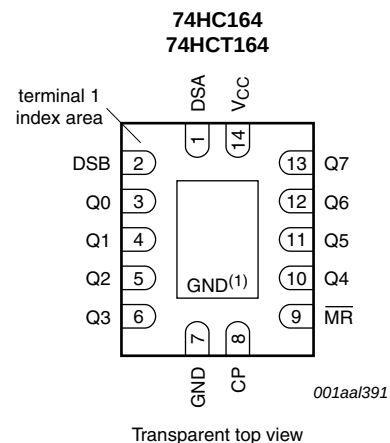


Fig 5. Pin configuration DIP14, SO14, (T)SSOP14



- (1) The substrate is attached to this pad using conductive die attach material. It can not be used as supply pin or input. It is recommended that no connection is made at all.

Fig 6. Pin configuration DHVQFN14

## 5.2 Pin description

**Table 2.** Pin description

| Symbol                 | Pin                        | Description                               |
|------------------------|----------------------------|-------------------------------------------|
| DSA                    | 1                          | data input                                |
| DSB                    | 2                          | data input                                |
| Q0 to Q7               | 3, 4, 5, 6, 10, 11, 12, 13 | output                                    |
| GND                    | 7                          | ground (0 V)                              |
| CP                     | 8                          | clock input (LOW-to-HIGH, edge-triggered) |
| $\overline{\text{MR}}$ | 9                          | master reset input (active LOW)           |
| V <sub>CC</sub>        | 14                         | positive supply voltage                   |

## 6. Functional description

**Table 3.** Function table<sup>[1]</sup>

| Operating modes | Input                  |    |     |     | Output |          |
|-----------------|------------------------|----|-----|-----|--------|----------|
|                 | $\overline{\text{MR}}$ | CP | DSA | DSB | Q0     | Q1 to Q7 |
| Reset (clear)   | L                      | X  | X   | X   | L      | L to L   |
| Shift           | H                      | ↑  | l   | l   | L      | q0 to q6 |
|                 | H                      | ↑  | l   | h   | L      | q0 to q6 |
|                 | H                      | ↑  | h   | l   | L      | q0 to q6 |
|                 | H                      | ↑  | h   | h   | H      | q0 to q6 |

[1] H = HIGH voltage level

h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition

L = LOW voltage level

l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition

q = lower case letters indicate the state of the referenced input one set-up time prior to the LOW-to-HIGH clock transition

↑ = LOW-to-HIGH clock transition

## 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             | +7   | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>O</sub>   | output current          | -0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V                   | -                | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                     | -                | 50   | mA   |
| I <sub>GND</sub> | ground current          |                                                                     | -50              | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                     | -65              | +150 | °C   |

**Table 4.** Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol           | Parameter                             | Conditions | Min | Max | Unit |
|------------------|---------------------------------------|------------|-----|-----|------|
| P <sub>tot</sub> | total power dissipation               |            | [2] |     |      |
|                  | DIP14 package                         |            | -   | 750 | mW   |
|                  | SO14, (T)SSOP14 and DHVQFN14 packages |            | -   | 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<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

For SO14 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

For (T)SSOP14 packages: P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

For DHVQFN14 packages: P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5.** Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC164 |      |                 | 74HCT164 |      |                 | Unit |
|------------------|-------------------------------------|-------------------------|---------|------|-----------------|----------|------|-----------------|------|
|                  |                                     |                         | Min     | Typ  | Max             | Min      | Typ  | Max             |      |
| V <sub>CC</sub>  | supply voltage                      |                         | 2.0     | 5.0  | 6.0             | 4.5      | 5.0  | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                         | 0       | -    | V <sub>CC</sub> | 0        | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                         | 0       | -    | V <sub>CC</sub> | 0        | -    | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                         | -40     | +25  | +125            | -40      | +25  | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V | -       | -    | 625             | -        | -    | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 4.5 V | -       | 1.67 | 139             | -        | 1.67 | 139             | ns/V |
|                  |                                     | V <sub>CC</sub> = 6.0 V | -       | -    | 83              | -        | -    | -               | ns/V |

## 9. Static characteristics

**Table 6.** Static characteristics

At recommended operating conditions; 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  |      |
| 74HC164         |                          |                         |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage | V <sub>CC</sub> = 2.0 V | 1.5   | 1.2 | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | 3.15  | 2.4 | -    | 3.15             | -    | 3.15              | -    | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | 4.2   | 3.2 | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage  | V <sub>CC</sub> = 2.0 V | -     | 0.8 | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | -     | 2.1 | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | -     | 2.8 | 1.8  | -                | 1.8  | -                 | 1.8  | V    |

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

At recommended operating conditions; 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 <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>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V                                                                                              | -     | -    | ±0.1 | -                | ±1   | -                 | ±1  | µA   |
| 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> = 6.0 V                                                                        | -     | -    | 8.0  | -                | 80   | -                 | 160 | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                                  | -     | 3.5  | -    | -                | -    | -                 | -   | pF   |
| <b>74HCT164</b>  |                           |                                                                                                                                                                  |       |      |      |                  |      |                   |     |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                                 | 2.0   | 1.6  | -    | 2.0              | -    | 2.0               | -   | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                                 | -     | 1.2  | 0.8  | -                | 0.8  | -                 | 0.8 | V    |
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V                                                                                    |       |      |      |                  |      |                   |     |      |
|                  |                           | I <sub>O</sub> = –20 µA                                                                                                                                          | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -   | V    |
|                  |                           | I <sub>O</sub> = –4.0 mA                                                                                                                                         | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -   | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 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> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                                                 | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4 | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V                                                                                              | -     | -    | ±0.1 | -                | ±1   | -                 | ±1  | µA   |
| 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> = 6.0 V                                                                        | -     | -    | 8    | -                | 80   | -                 | 160 | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>V <sub>I</sub> = V <sub>CC</sub> – 2.1 V; I <sub>O</sub> = 0 A;<br>other inputs at V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 4.5 V to 5.5 V | -     | 100  | 360  | -                | 450  | -                 | 490 | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                                  | -     | 3.5  | -    | -                | -    | -                 | -   | pF   |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; test circuit see [Figure 10](#); unless otherwise specified

| Symbol           | Parameter                     | Conditions                                            | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                       | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC164          |                               |                                                       |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | CP to Qn; see <a href="#">Figure 7</a> <sup>[1]</sup> |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | -     | 41  | 170 | -                | 215 | -                 | 255 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | -     | 15  | 34  | -                | 43  | -                 | 51  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF       | -     | 12  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | -     | 12  | 29  | -                | 37  | -                 | 43  | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | MR to Qn; see <a href="#">Figure 8</a>                |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | -     | 39  | 140 | -                | 175 | -                 | 210 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | -     | 14  | 28  | -                | 35  | -                 | 42  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF       | -     | 11  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | -     | 11  | 24  | -                | 30  | -                 | 36  | ns   |
| t <sub>t</sub>   | transition time               | see <a href="#">Figure 7</a> <sup>[2]</sup>           |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| t <sub>w</sub>   | pulse width                   | CP HIGH or LOW; see <a href="#">Figure 7</a>          |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | 80    | 14  | -   | 100              | -   | 120               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | 16    | 5   | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | 14    | 4   | -   | 17               | -   | 20                | -   | ns   |
|                  |                               | MR LOW; see <a href="#">Figure 8</a>                  |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | 60    | 17  | -   | 75               | -   | 90                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | 12    | 6   | -   | 15               | -   | 18                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | 10    | 5   | -   | 13               | -   | 15                | -   | ns   |
| t <sub>rec</sub> | recovery time                 | MR to CP; see <a href="#">Figure 8</a>                |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | 60    | 17  | -   | 75               | -   | 90                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | 12    | 6   | -   | 15               | -   | 18                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | 10    | 5   | -   | 13               | -   | 15                | -   | ns   |
| t <sub>su</sub>  | set-up time                   | DSA, and DSB to CP; see <a href="#">Figure 9</a>      |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | 60    | 8   | -   | 75               | -   | 90                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | 12    | 3   | -   | 15               | -   | 18                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | 10    | 2   | -   | 13               | -   | 15                | -   | ns   |
| t <sub>h</sub>   | hold time                     | DSA, and DSB to CP; see <a href="#">Figure 9</a>      |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                               | +4    | –6  | -   | 4                | -   | 4                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                               | +4    | –2  | -   | 4                | -   | 4                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                               | +4    | –2  | -   | 4                | -   | 4                 | -   | ns   |

**Table 7. Dynamic characteristics**GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF; test circuit see [Figure 10](#); unless otherwise specified

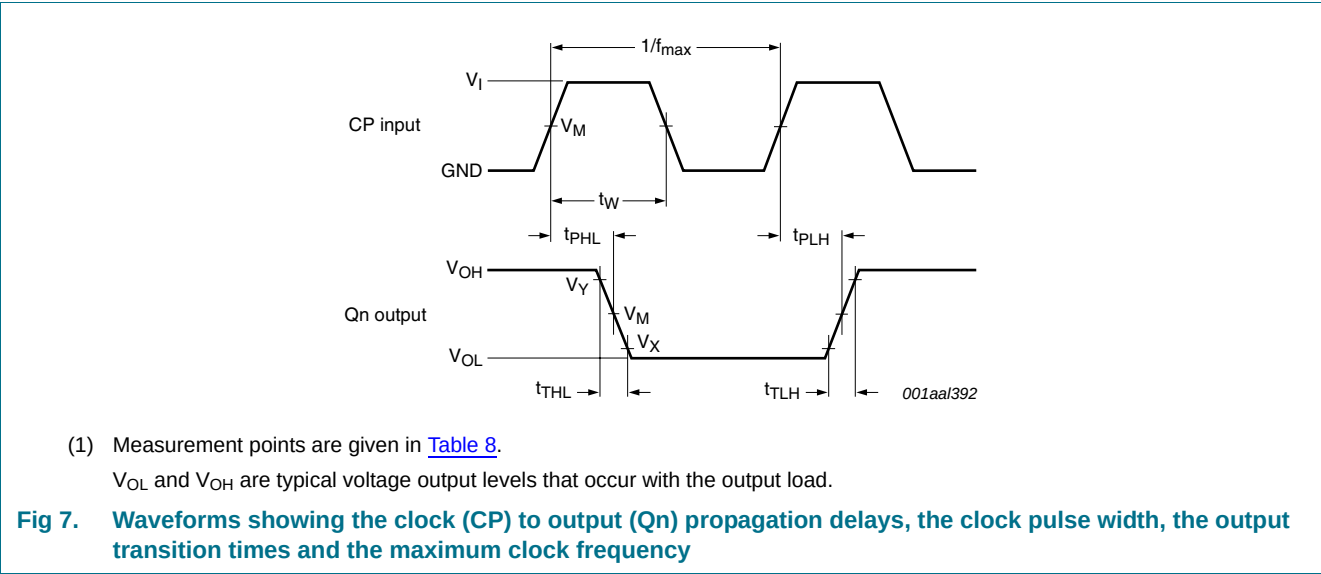
| Symbol          | Parameter                     | Conditions                                                     | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                                | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $f_{\max}$      | maximum frequency             | for $C_p$ , see <a href="#">Figure 7</a>                       |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V                                               | 6     | 23  | -   | 5                | -   | 4                 | -   | MHz  |
|                 |                               | $V_{CC} = 4.5$ V                                               | 30    | 71  | -   | 24               | -   | 20                | -   | MHz  |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                                | -     | 78  | -   | -                | -   | -                 | -   | MHz  |
|                 |                               | $V_{CC} = 6.0$ V                                               | 35    | 85  | -   | 28               | -   | 24                | -   | MHz  |
| $C_{PD}$        | power dissipation capacitance | per package; $V_I = \text{GND to } V_{CC}$ <a href="#">[3]</a> | -     | 40  | -   | -                | -   | -                 | -   | pF   |
| <b>74HCT164</b> |                               |                                                                |       |     |     |                  |     |                   |     |      |
| $t_{pd}$        | propagation delay             | CP to Qn; see <a href="#">Figure 7</a> <a href="#">[1]</a>     |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | -     | 17  | 36  | -                | 45  | -                 | 54  | ns   |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                                | -     | 14  | -   | -                | -   | -                 | -   | ns   |
| $t_{PHL}$       | HIGH to LOW propagation delay | $\overline{\text{MR}}$ to Qn; see <a href="#">Figure 8</a>     |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | -     | 19  | 38  | -                | 48  | -                 | 57  | ns   |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                                | -     | 16  | -   | -                | -   | -                 | -   | ns   |
| $t_t$           | transition time               | see <a href="#">Figure 7</a> <a href="#">[2]</a>               |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_W$           | pulse width                   | CP HIGH or LOW; see <a href="#">Figure 7</a>                   |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | 18    | 7   | -   | 23               | -   | 27                | -   | ns   |
|                 |                               | $\overline{\text{MR}}$ LOW; see <a href="#">Figure 8</a>       |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | 18    | 10  | -   | 23               | -   | 27                | -   | ns   |
| $t_{rec}$       | recovery time                 | $\overline{\text{MR}}$ to CP; see <a href="#">Figure 8</a>     |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |
| $t_{su}$        | set-up time                   | DSA, and DSB to CP; see <a href="#">Figure 9</a>               |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | 12    | 6   | -   | 15               | -   | 18                | -   | ns   |
| $t_h$           | hold time                     | DSA, and DSB to CP; see <a href="#">Figure 9</a>               |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | +4    | -2  | -   | 4                | -   | 4                 | -   | ns   |
| $f_{\max}$      | maximum frequency             | for $C_p$ , see <a href="#">Figure 7</a>                       |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V                                               | 27    | 55  | -   | 22               | -   | 18                | -   | MHz  |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                                | -     | 61  | -   | -                | -   | -                 | -   | MHz  |



**Table 7. Dynamic characteristics**  
*GND = 0 V;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; test circuit see [Figure 10](#); unless otherwise specified*

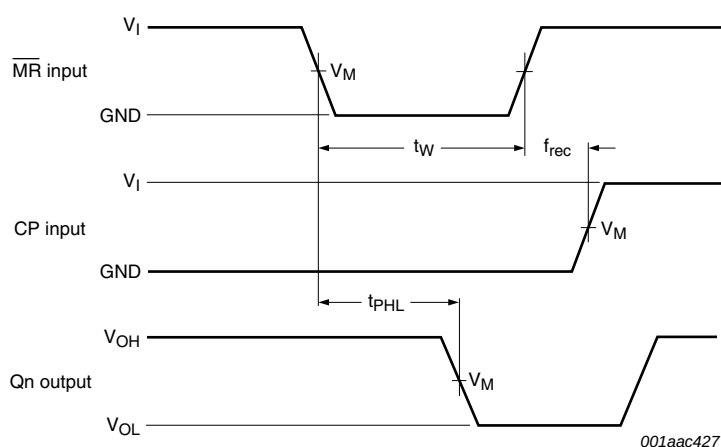
| Symbol   | Parameter                     | Conditions                                                   | 25 °C |     |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|----------|-------------------------------|--------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|          |                               |                                                              | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $C_{PD}$ | power dissipation capacitance | per package;<br>$V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ | -     | 40  | -   | -                | -   | -                 | -   | pF   |

- [1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$  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 V;  
 $N$  = number of inputs switching;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.



**Table 8. Measurement points**

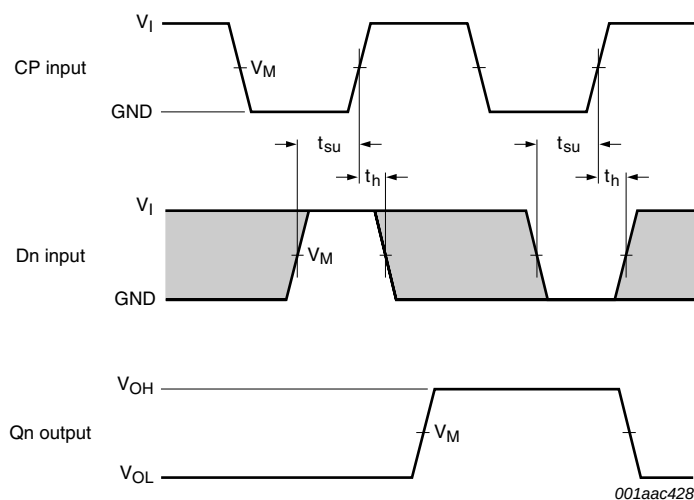
| Type     | Input       | Output      |             |             |
|----------|-------------|-------------|-------------|-------------|
|          | $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| 74HC164  | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT164 | 1.3 V       | 1.3 V       | $0.1V_{CC}$ | $0.9V_{CC}$ |



- (1) Measurement points are given in [Table 8](#).

$V_{\text{OL}}$  and  $V_{\text{OH}}$  are typical voltage output levels that occur with the output load.

**Fig 8. Waveforms showing the master reset ( $\overline{\text{MR}}$ ) pulse width, the master reset to output (Qn) propagation delays and the master reset to clock (CP) removal time**

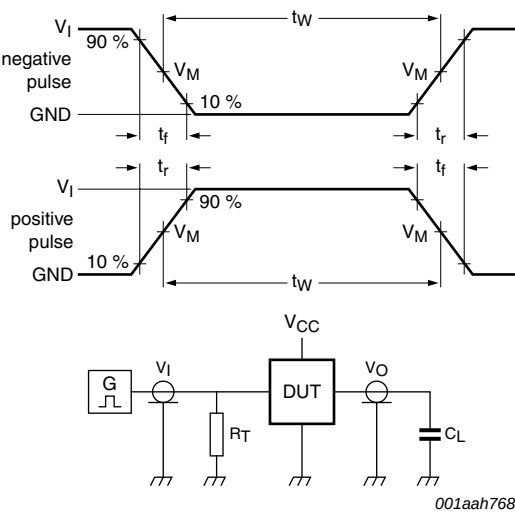


- (1) Measurement points are given in [Table 8](#).

$V_{\text{OL}}$  and  $V_{\text{OH}}$  are typical voltage output levels that occur with the output load.

The shaded areas indicate when the input is permitted to change for predictable output performance.

**Fig 9. Waveforms showing the data set-up and hold times for Dn inputs**



Test data is given in [Table 9](#).  
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.

Fig 10. Test circuit for measuring switching times

Table 9. Test data

| Type     | Input    |            | Load         | Test               |
|----------|----------|------------|--------------|--------------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC164  | $V_{CC}$ | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT164 | 3.0 V    | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

11. Package outline

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

SOT27-1

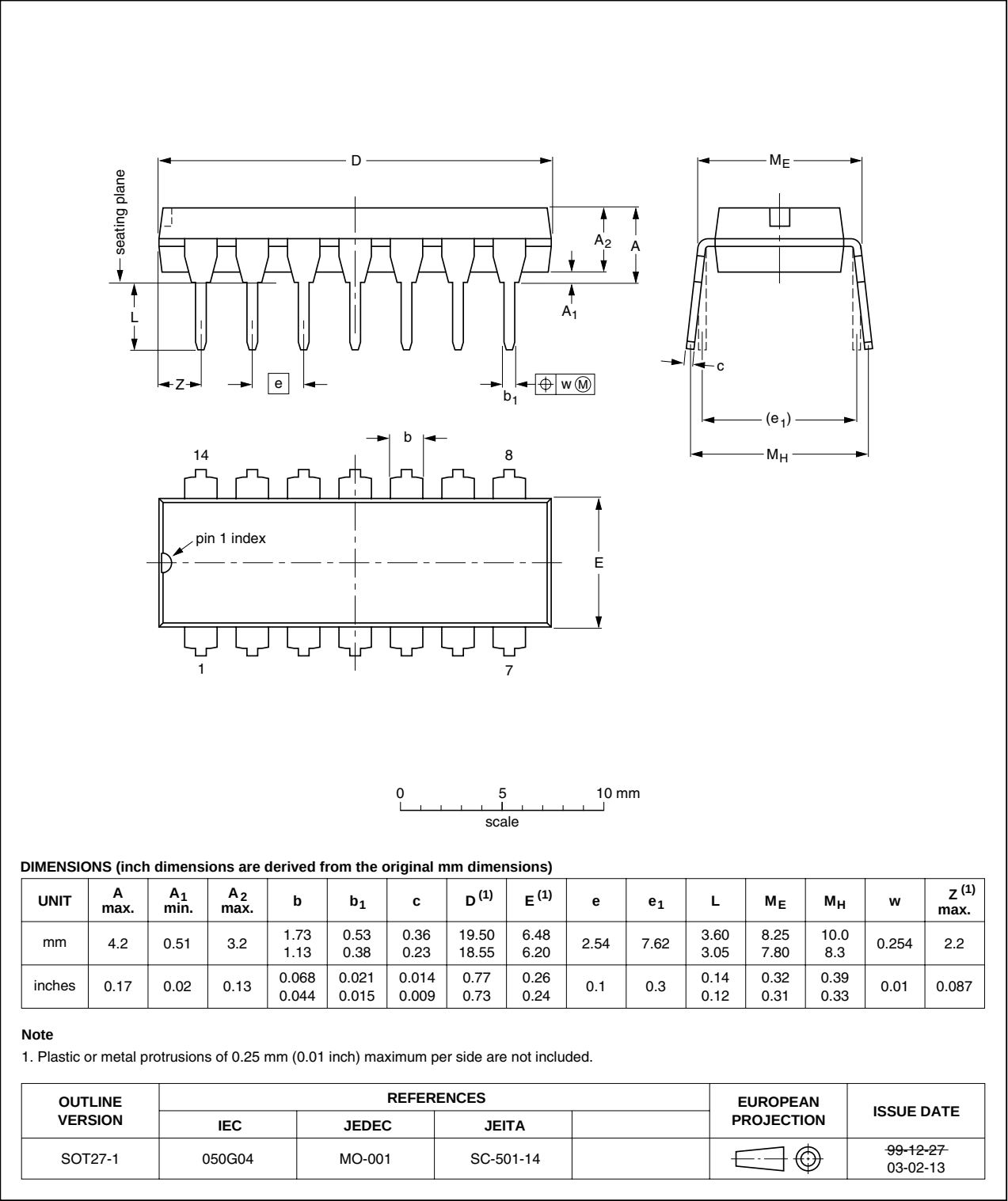


Fig 11. Package outline SOT27-1 (DIP14)

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

SOT108-1

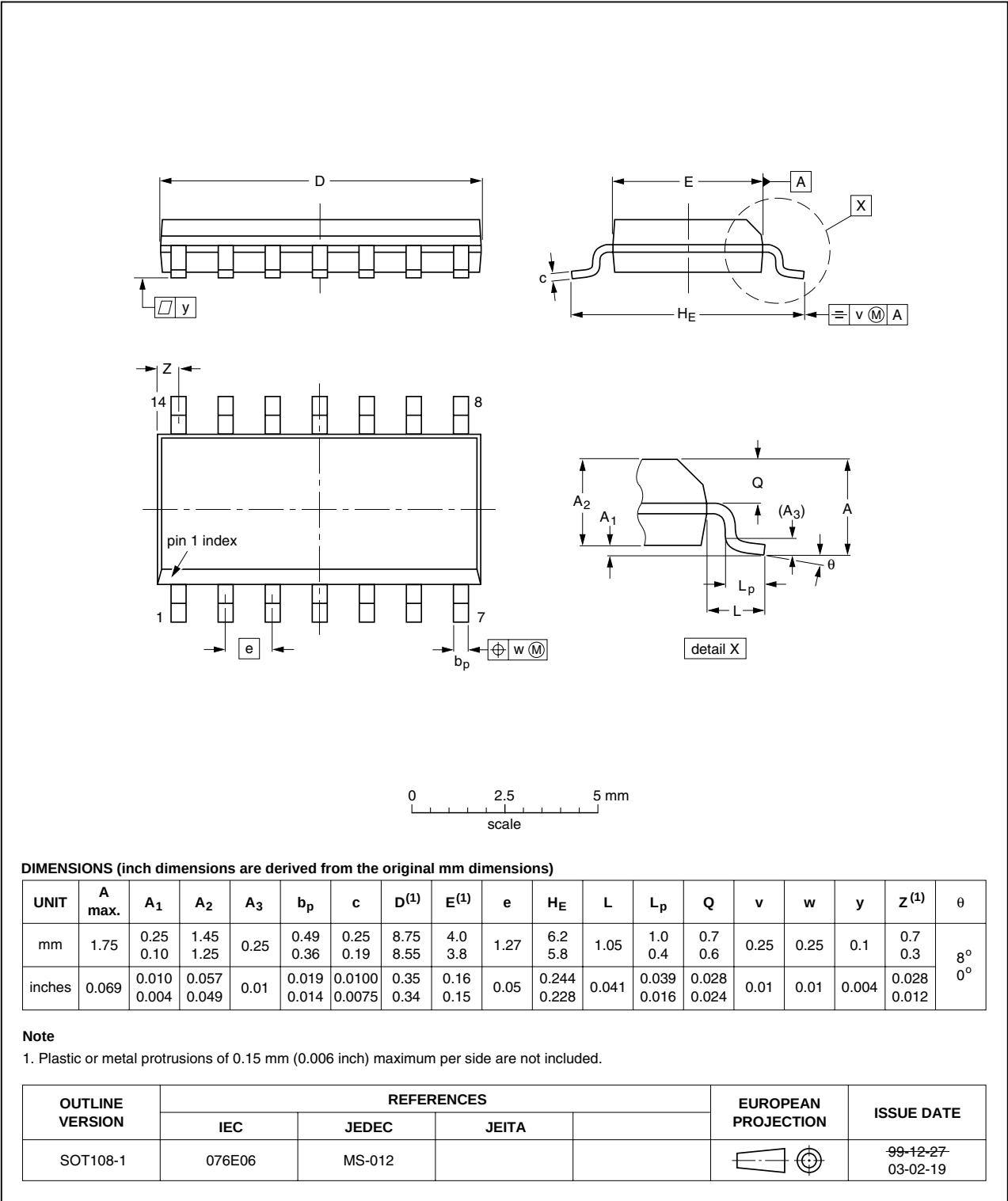


Fig 12. Package outline SOT108-1 (SO14)

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

SOT337-1

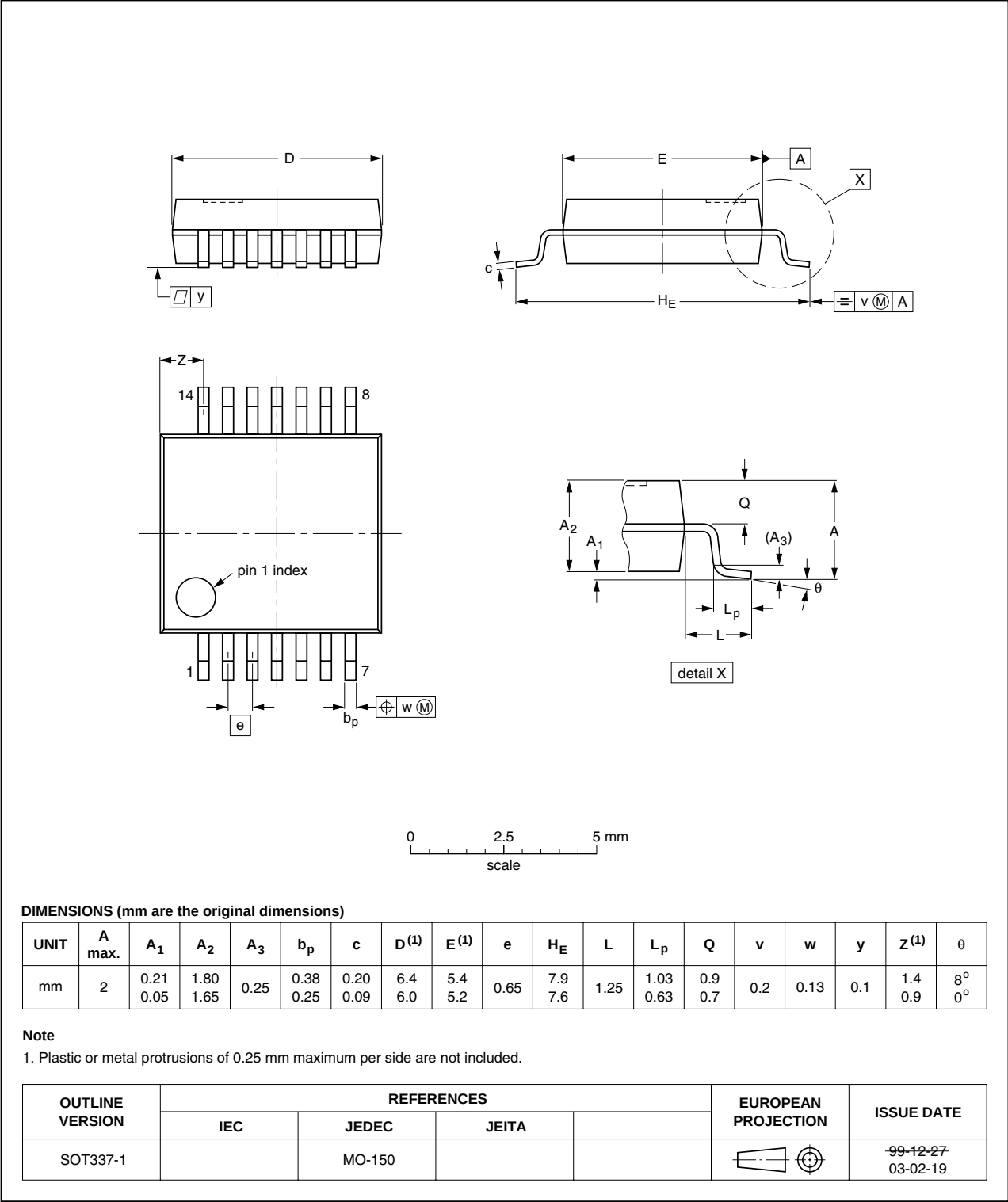


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

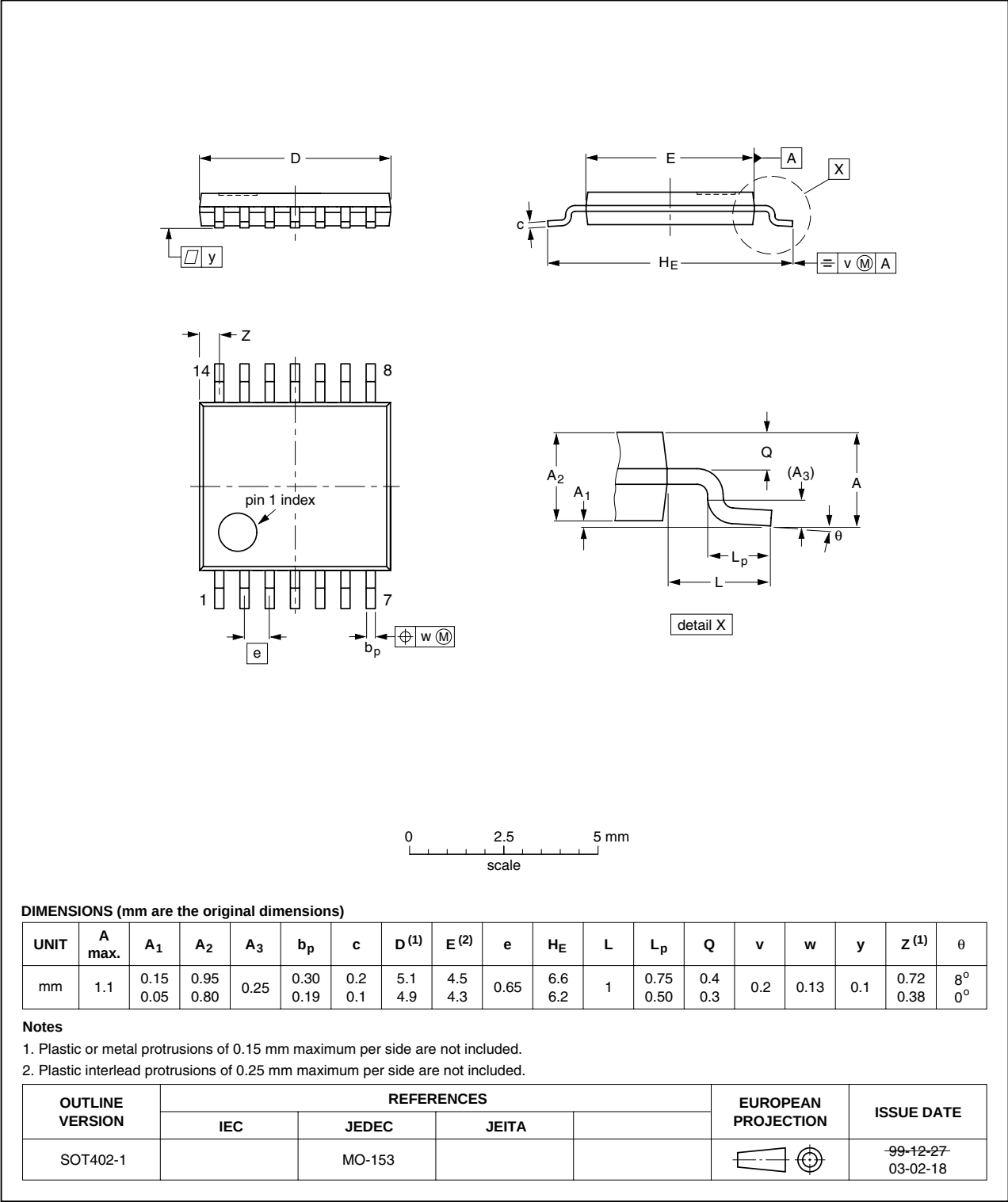


Fig 14. Package outline SOT402-1 (TSSOP14)

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

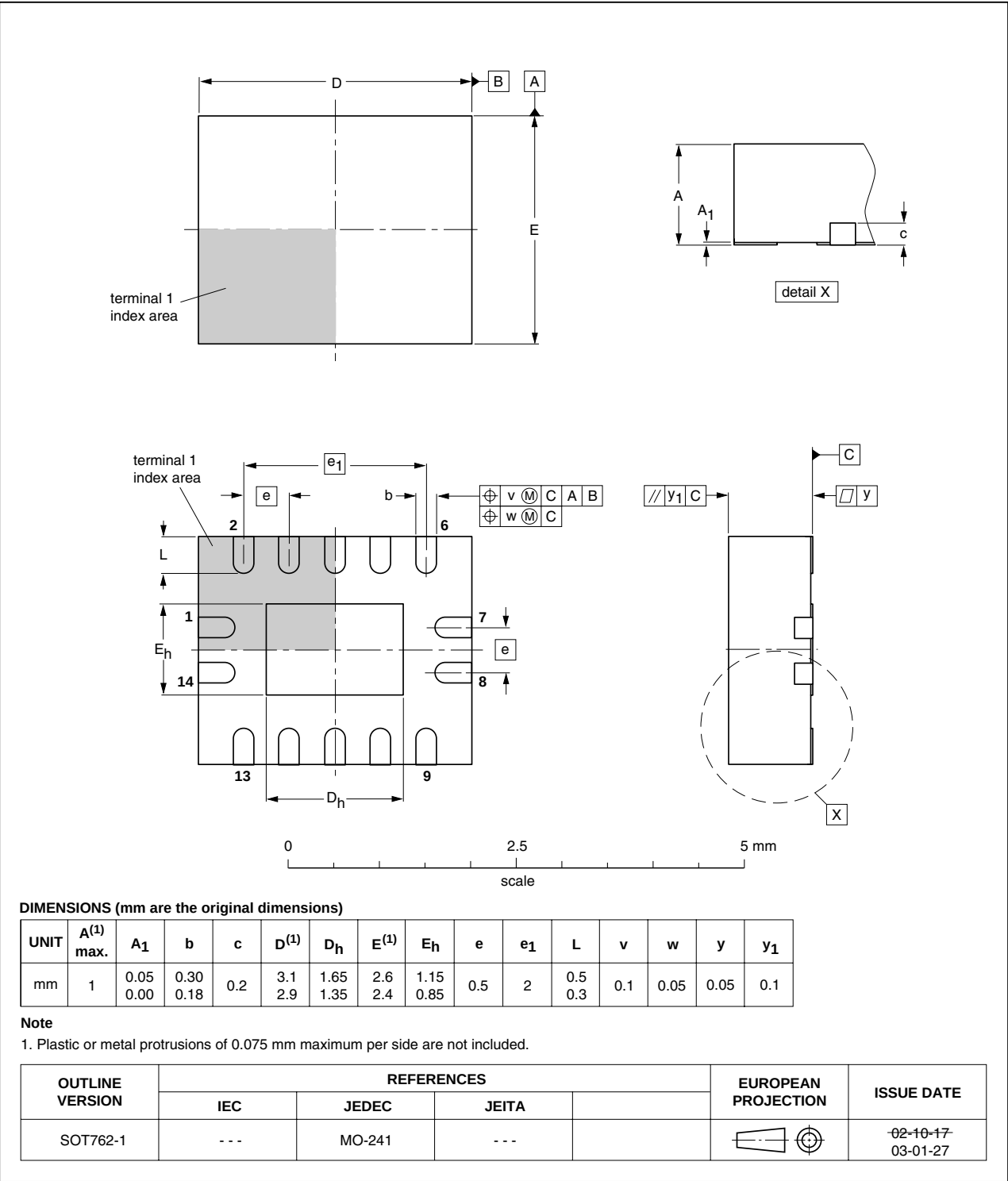


Fig 15. Package outline SOT762-1 (DHVQFN14)



## 12. Abbreviations

Table 10. Abbreviations

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

## 13. Revision history

Table 11. Revision history

| Document ID       | Release date                                                                                                                                                                                                                                                                                                                                                                                                              | Data sheet status     | Change notice | Supersedes        |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|-------------------|
| 74HC_HCT164_4     | 20100202                                                                                                                                                                                                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT164_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>• Added type number 74HC164BQ (DHVQFN14 / SOT762-1 package).</li><li>• For type numbers 74HC164D and 74HCT164D: sot number SOT108-2 changed to SOT108-1.</li></ul> |                       |               |                   |
| 74HC_HCT164_3     | 20050404                                                                                                                                                                                                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT164_CNV_2 |
| 74HC_HCT164_CNV_2 | 19901201                                                                                                                                                                                                                                                                                                                                                                                                                  | Product specification | -             | -                 |

## 14. Legal information

### 14.1 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.nxp.com>.

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