

# 74HC164; 74HCT164

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

Rev. 9 — 11 June 2020

Product data sheet

### 1. General description

The 74HC164; 74HCT164 is an 8-bit serial-in/parallel-out shift register. The device features two serial data inputs (DSA and DSB), eight parallel data outputs (Q0 to Q7). Data is entered serially through DSA or DSB and either input can be used as an active HIGH enable for data entry through the other input. Data is shifted on the LOW-to-HIGH transitions of the clock (CP) input. A LOW on the master reset input ( $\overline{MR}$ ) clears the register and forces all outputs LOW, independently of other inputs. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

### 2. Features and benefits

- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Input levels:
  - For 74HC164: CMOS level
  - For 74HCT164: TTL level
- Gated serial data inputs
- Asynchronous master reset
- Complies with JEDEC standards
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C.

### 3. Ordering information

Table 1. Ordering information

| Type number | Package           |          |  | Version  |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  |          |
| 74HC164D    | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm  | SOT108-1 |
| 74HCT164D   |                   |          |  |          |
| 74HC164DB   | -40 °C to +125 °C | SSOP14   | plastic shrink small outline package; 14 leads;<br>body width 5.3 mm   | SOT337-1 |
| 74HCT164DB  |                   |          |  |          |
| 74HC164PW   | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads;<br>body width 4.4 mm  | SOT402-1 |
| 74HCT164PW  |                   |          |  |          |
| 74HC164BQ   | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads; 14 terminals;<br>body 2.5 × 3 × 0.85 mm | SOT762-1 |
| 74HCT164BQ  |                   |          |  |          |

4. Functional diagram

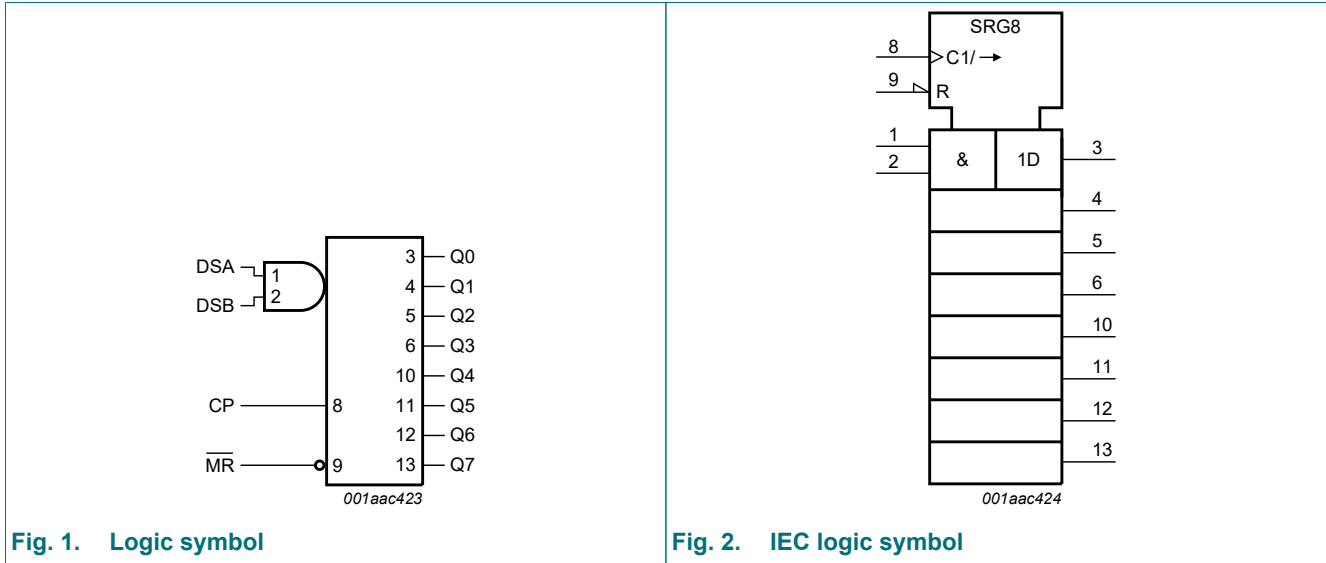


Fig. 1. Logic symbol

Fig. 2. IEC logic symbol

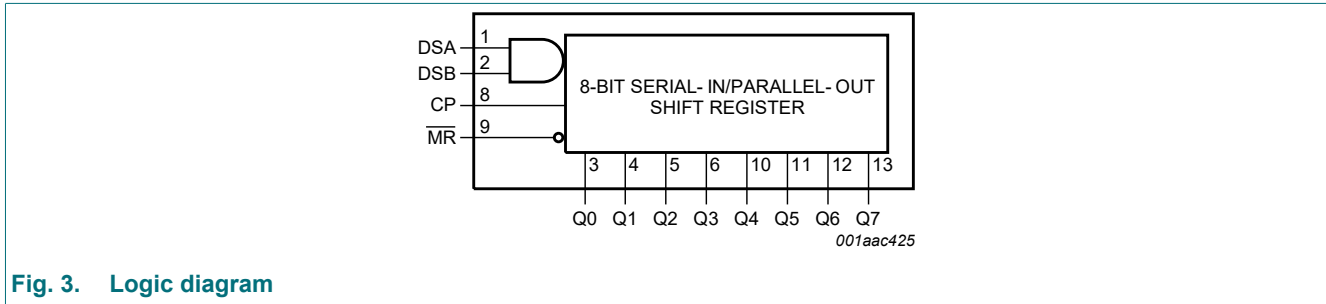


Fig. 3. Logic diagram

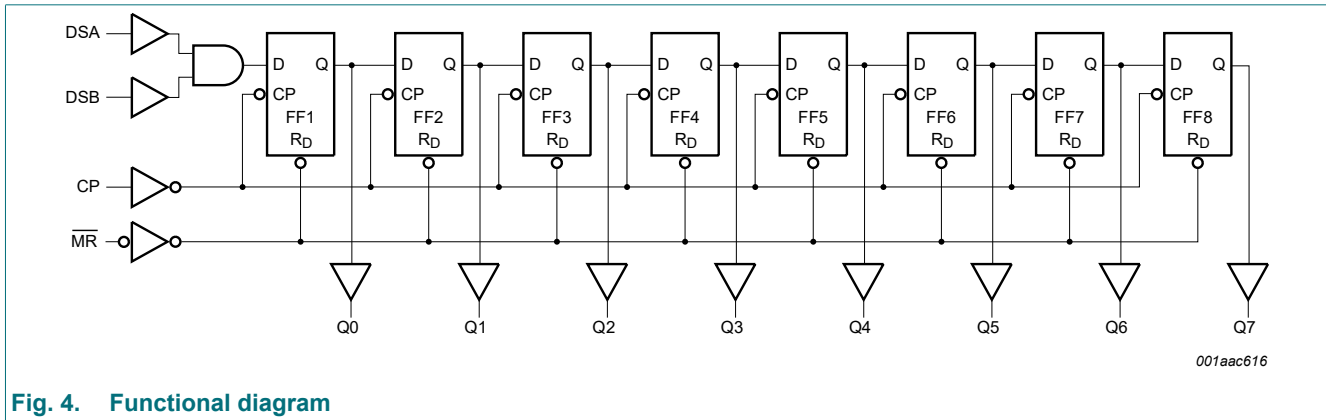
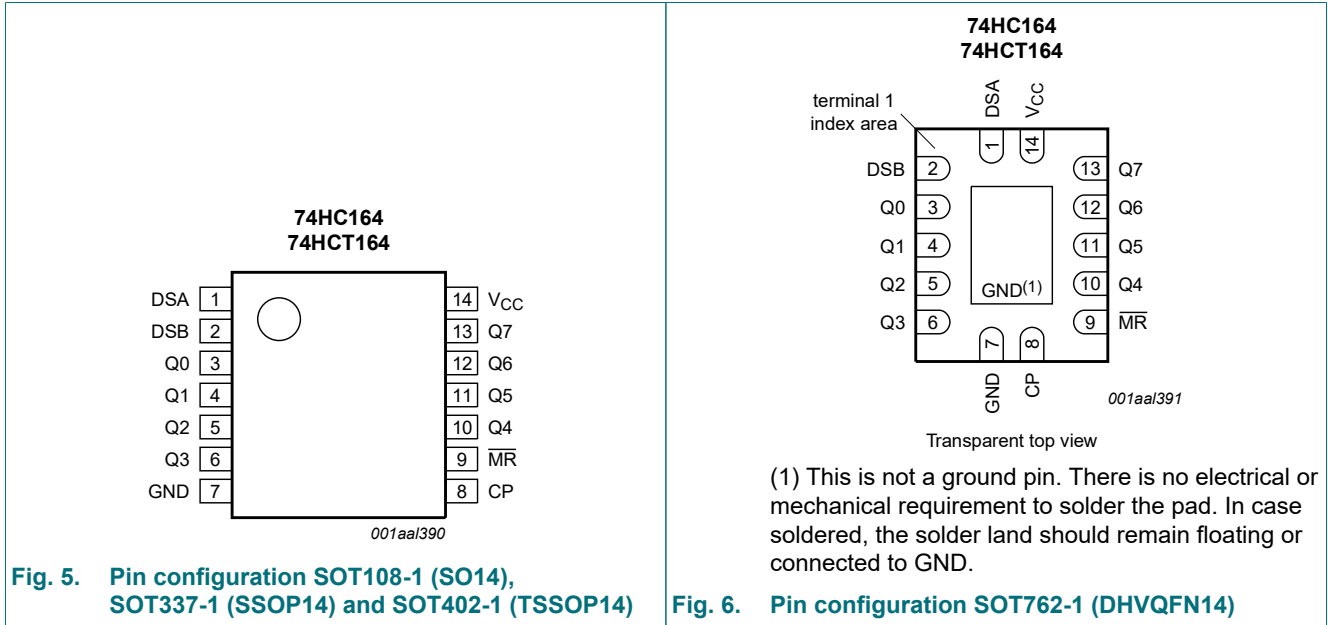


Fig. 4. Functional diagram

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol                         | Pin                        | Description                               |
|--------------------------------|----------------------------|---|
| DSA                            | 1                          | data input                                |
| DSB                            | 2                          | data input                                |
| Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7 | 3, 4, 5, 6, 10, 11, 12, 13 | output                                    |
| GND                            | 7                          | ground (0 V)                              |
| CP                             | 8                          | clock input (LOW-to-HIGH, edge-triggered) |
| MR                             | 9                          | master reset input (active LOW)           |
| V <sub>CC</sub>                | 14                         | positive supply voltage                   |

## 6. Functional description

**Table 3. Function table**

*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; X = don't care*

| Operating modes | Input |    |     |     | Output |          |
|-----------------|-------|----|-----|-----|--------|----------|
|                 | 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 |

## 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   | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1] | -    | ±20  | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | -    | ±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 | [2]  | -    | 500  | mW   |

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

[2] For SOT108-1 (SO14) package:  $P_{tot}$  derates linearly with 10.1 mW/K above 100 °C.

For SOT337-1 (SSOP14) package:  $P_{tot}$  derates linearly with 7.3 mW/K above 81 °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.

## 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      |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0     | 5.0  | 6.0      | 4.5      | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0       | -    | $V_{CC}$ | 0        | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0       | -    | $V_{CC}$ | 0        | -    | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |                         | -40     | +25  | +125     | -40      | +25  | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -       | -    | 625      | -        | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -       | 1.67 | 139      | -        | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -       | -    | 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     |               |
| <b>74HC164</b> |                           |   |       |      |           |                  |         |                   |         |               |
| $V_{IH}$       | HIGH-level input voltage  | $V_{CC} = 2.0\text{ V}$   | 1.5   | 1.2  | -         | 1.5              | -       | 1.5               | -       | V             |
|                |                           | $V_{CC} = 4.5\text{ V}$   | 3.15  | 2.4  | -         | 3.15             | -       | 3.15              | -       | V             |
|                |                           | $V_{CC} = 6.0\text{ V}$   | 4.2   | 3.2  | -         | 4.2              | -       | 4.2               | -       | V             |
| $V_{IL}$       | LOW-level input voltage   | $V_{CC} = 2.0\text{ V}$   | -     | 0.8  | 0.5       | -                | 0.5     | -                 | 0.5     | V             |
|                |                           | $V_{CC} = 4.5\text{ V}$   | -     | 2.1  | 1.35      | -                | 1.35    | -                 | 1.35    | V             |
|                |                           | $V_{CC} = 6.0\text{ V}$   | -     | 2.8  | 1.8       | -                | 1.8     | -                 | 1.8     | V             |
| $V_{OH}$       | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$  |       |      |           |                  |         |                   |         |               |
|                |                           | $I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$            | 1.9   | 2.0  | -         | 1.9              | -       | 1.9               | -       | V             |
|                |                           | $I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$            | 4.4   | 4.5  | -         | 4.4              | -       | 4.4               | -       | V             |
|                |                           | $I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$            | 5.9   | 6.0  | -         | 5.9              | -       | 5.9               | -       | V             |
|                |                           | $I_O = -4.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$                    | 3.98  | 4.32 | -         | 3.84             | -       | 3.7               | -       | V             |
|                |                           | $I_O = -5.2\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$                    | 5.48  | 5.81 | -         | 5.34             | -       | 5.2               | -       | V             |
| $V_{OL}$       | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$  |       |      |           |                  |         |                   |         |               |
|                |                           | $I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$             | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V             |
|                |                           | $I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$             | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V             |
|                |                           | $I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$             | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1     | V             |
|                |                           | $I_O = 4.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$                     | -     | 0.15 | 0.26      | -                | 0.33    | -                 | 0.4     | V             |
|                |                           | $I_O = 5.2\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$                     | -     | 0.16 | 0.26      | -                | 0.33    | -                 | 0.4     | V             |
| $I_I$          | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$                      | -     | -    | $\pm 0.1$ | -                | $\pm 1$ | -                 | $\pm 1$ | $\mu\text{A}$ |
| $I_{CC}$       | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$ | -     | -    | 8.0       | -                | 80      | -                 | 160     | $\mu\text{A}$ |
| $C_I$          | input capacitance         |   | -     | 3.5  | -         | -                | -       | -                 | -       | pF            |

| Symbol           | Parameter                 | Conditions  | 25 °C |      |      | -40 °C to +85 °C |      | -40 °C to +125 °C |     | Unit |
|------------------|---------------------------|---|-------|------|------|------------------|------|-------------------|-----|------|
|                  |                           |   | Min   | Typ  | Max  | Min              | Max  | Min               | Max |      |
| <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; 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; V <sub>CC</sub> = 6.0 V  | -     | -    | 8    | -                | 80   | -                 | 160 | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A; other inputs at V <sub>CC</sub> or GND; 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 V; t<sub>r</sub> = t<sub>f</sub> = 6 ns; C<sub>L</sub> = 50 pF; test circuit see Fig. 10; unless otherwise specified

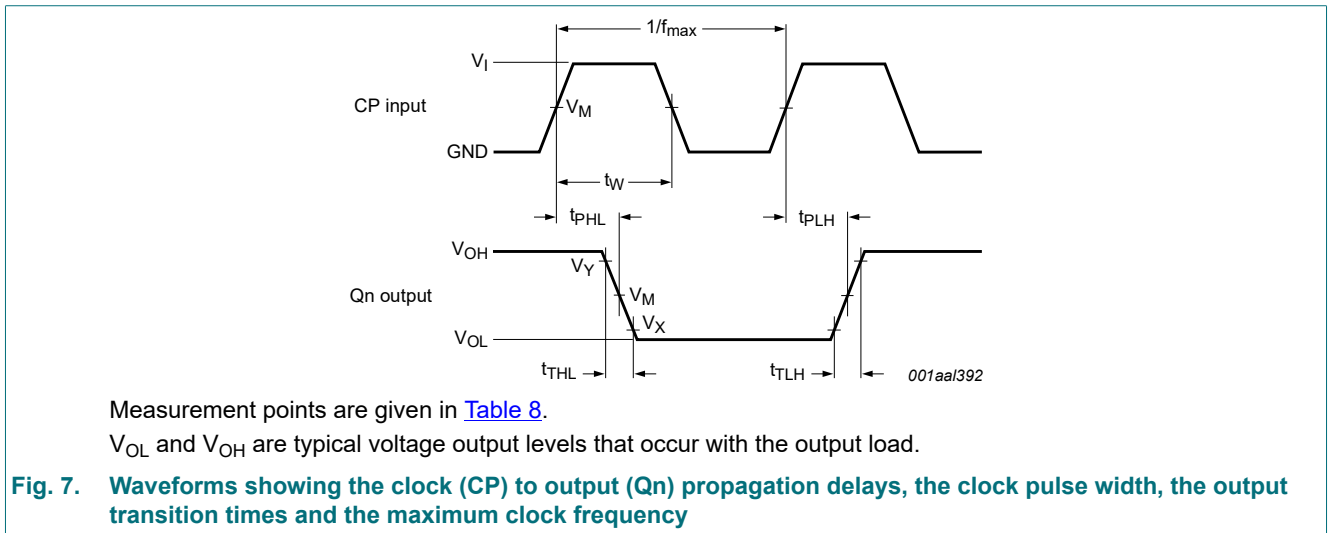
| Symbol           | Parameter                     | Conditions                                      | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| <b>74HC164</b>   |                               |   |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | CP to Q <sub>n</sub> ; see Fig. 7 [1]           |       |     |     |                  |     |                   |     |      |
|                  |                               | 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 Q <sub>n</sub> ; see Fig. 8               |       |     |     |                  |     |                   |     |      |
|                  |                               | 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 Fig. 7 [2]                                  |       |     |     |                  |     |                   |     |      |
|                  |                               | 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   |

| Symbol                  | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-------------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                         |                               |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| t <sub>W</sub>          | pulse width                   | CP HIGH or LOW; see Fig. 7                               |       |     |     |                  |     |                   |     |      |
|                         |                               | 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 Fig. 8                                       |       |     |     |                  |     |                   |     |      |
|                         |                               | 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 Fig. 8                                     |       |     |     |                  |     |                   |     |      |
|                         |                               | 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 Fig. 9                           |       |     |     |                  |     |                   |     |      |
|                         |                               | 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 Fig. 9                           |       |     |     |                  |     |                   |     |      |
|                         |                               | 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   |
| f <sub>max</sub>        | maximum frequency             | for Cp, see Fig. 7                                       |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                  | 6     | 23  | -   | 5                | -   | 4                 | -   | MHz  |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | 30    | 71  | -   | 24               | -   | 20                | -   | MHz  |
|                         |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF          | -     | 78  | -   | -                | -   | -                 | -   | MHz  |
|                         |                               | V <sub>CC</sub> = 6.0 V                                  | 35    | 85  | -   | 28               | -   | 24                | -   | MHz  |
| C <sub>PD</sub>         | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> [3] | -     | 40  | -   | -                | -   | -                 | -   | pF   |
| <b>74HCT164</b>         |                               |  |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>         | propagation delay             | CP to Q <sub>n</sub> ; see Fig. 7 [1]                    |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | -     | 17  | 36  | -                | 45  | -                 | 54  | ns   |
|                         |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF          | -     | 14  | -   | -                | -   | -                 | -   | ns   |
| t <sub>PHL</sub>        | HIGH to LOW propagation delay | MR to Q <sub>n</sub> ; see Fig. 8                        |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | -     | 19  | 38  | -                | 48  | -                 | 57  | ns   |
|                         |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF          | -     | 16  | -   | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>          | transition time               | see Fig. 7 [2]   |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| t <sub>W</sub>          | pulse width                   | CP HIGH or LOW; see Fig. 7                               |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | 18    | 7   | -   | 23               | -   | 27                | -   | ns   |
|                         |                               | MR LOW; see Fig. 8                                       |       |     |     |                  |     |                   |     |      |
| t <sub>rec</sub>        | recovery time                 | V <sub>CC</sub> = 4.5 V                                  | 18    | 10  | -   | 23               | -   | 27                | -   | ns   |
|                         |                               | MR to CP; see Fig. 8                                     |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 4.5 V                                  | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |

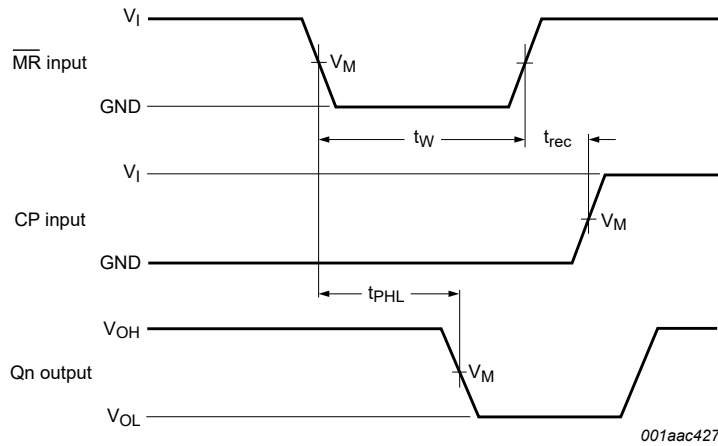
| Symbol           | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| t <sub>su</sub>  | set-up time                   | DSA, and DSB to CP; see Fig. 9                                   |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V  | 12    | 6   | -   | 15               | -   | 18                | -   | ns   |
| t <sub>h</sub>   | hold time                     | DSA, and DSB to CP; see Fig. 9                                   |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V  | +4    | -2  | -   | 4                | -   | 4                 | -   | ns   |
| f <sub>max</sub> | maximum frequency             | for Cp, see Fig. 7   |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V  | 27    | 55  | -   | 22               | -   | 18                | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                  | -     | 61  | -   | -                | -   | -                 | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [3] | -     | 40  | -   | -                | -   | -                 | -   | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$  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;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

### 10.1. Waveforms and test circuit



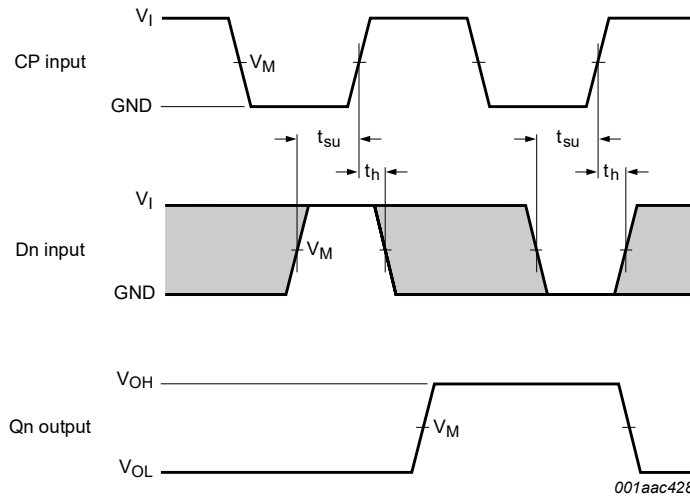




Measurement points are given in [Table 8](#).

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

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



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

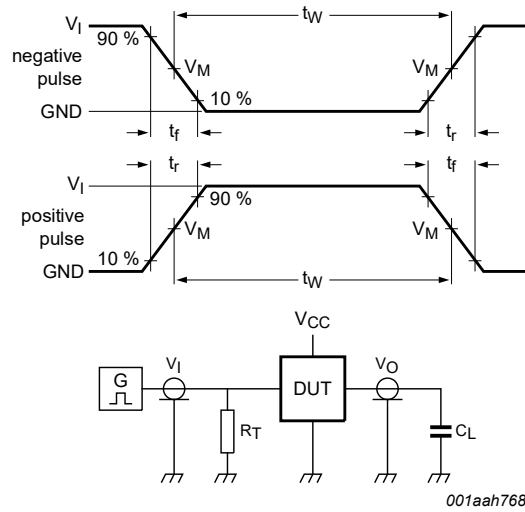
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

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  $D_n$  inputs**

**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       | $0.1V_{CC}$ | $0.9V_{CC}$ |



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

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

SOT108-1

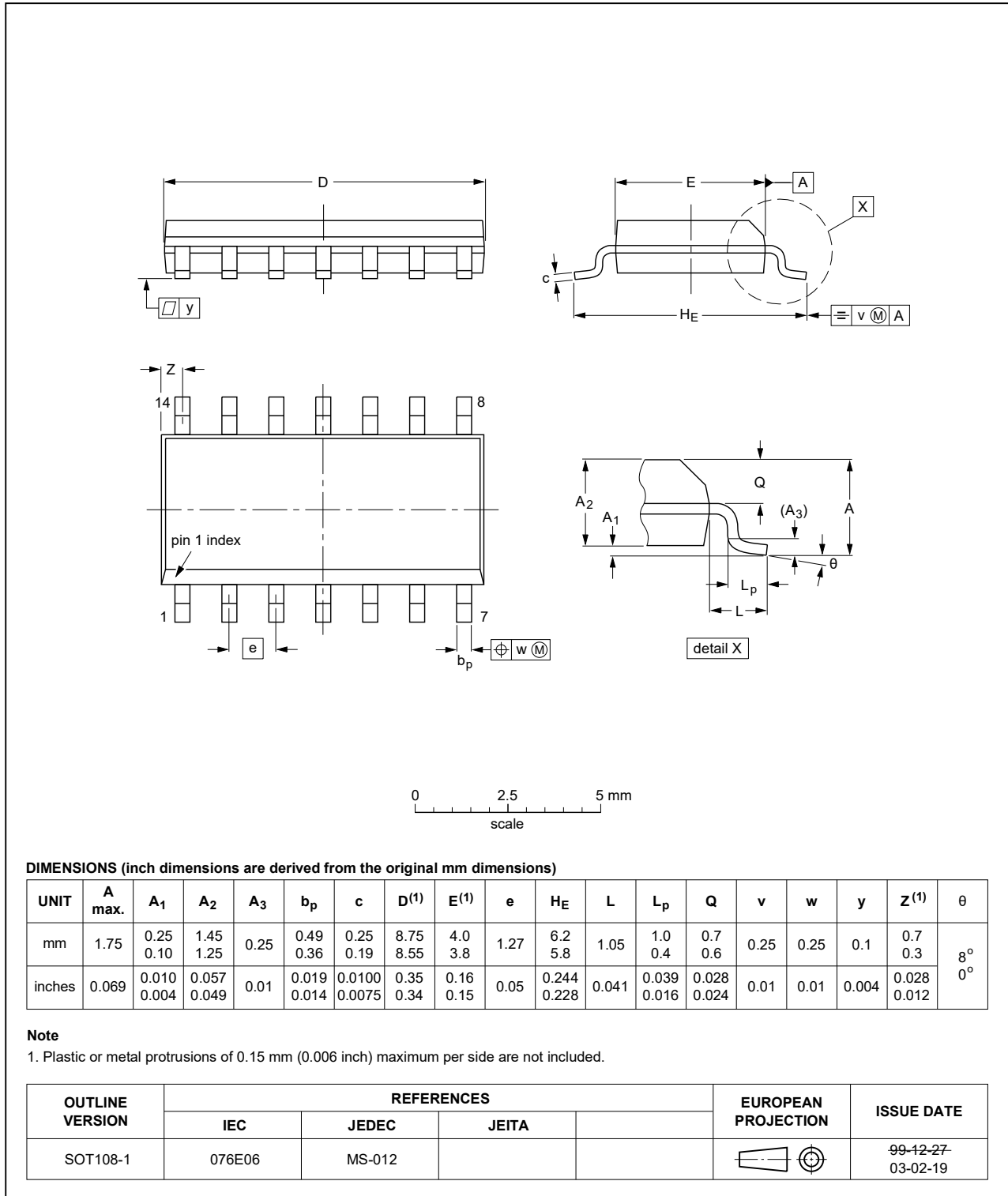


Fig. 11. Package outline SOT108-1 (SO14)

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

SOT337-1

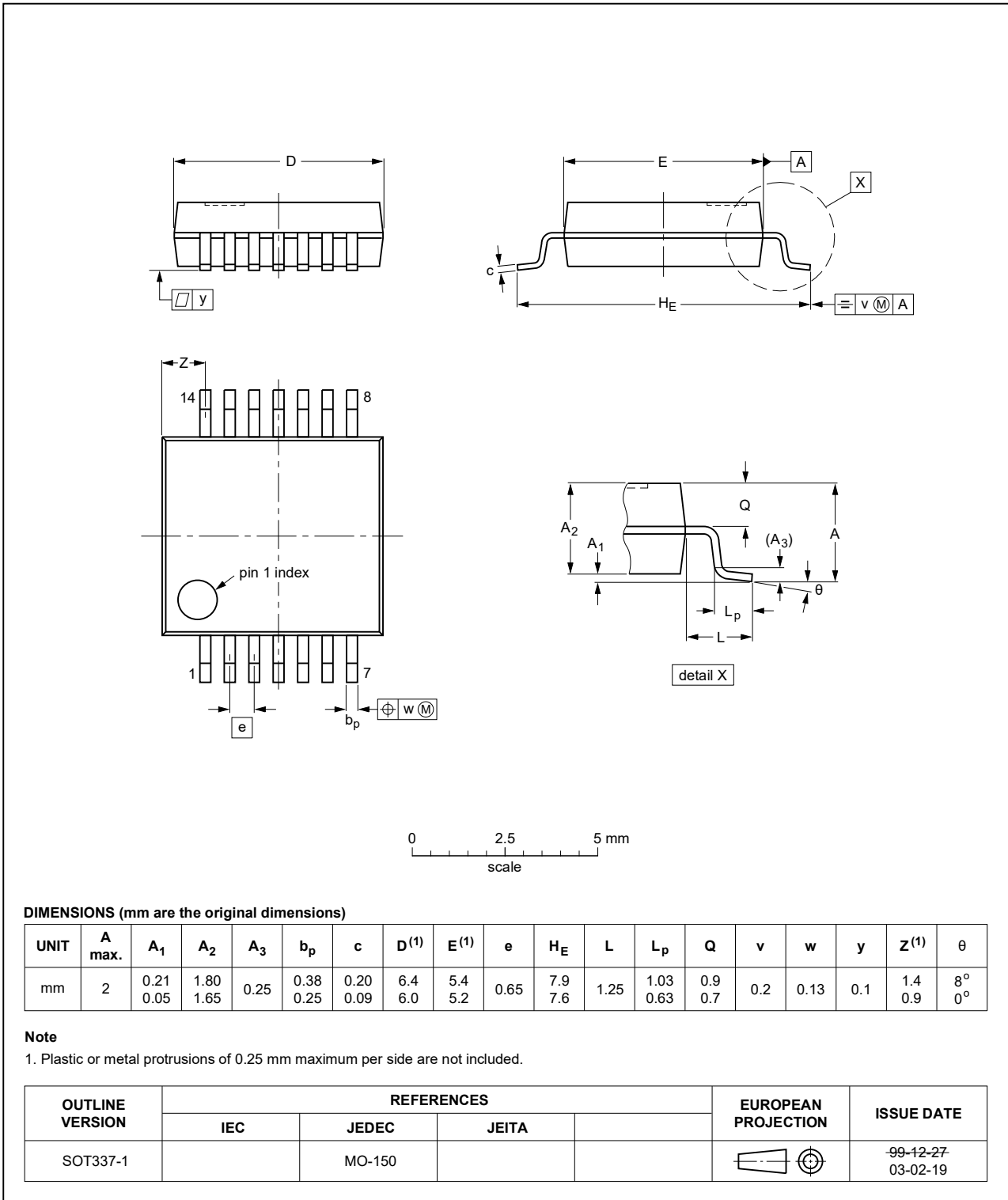


Fig. 12. Package outline SOT337-1 (SSOP14)

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

SOT402-1

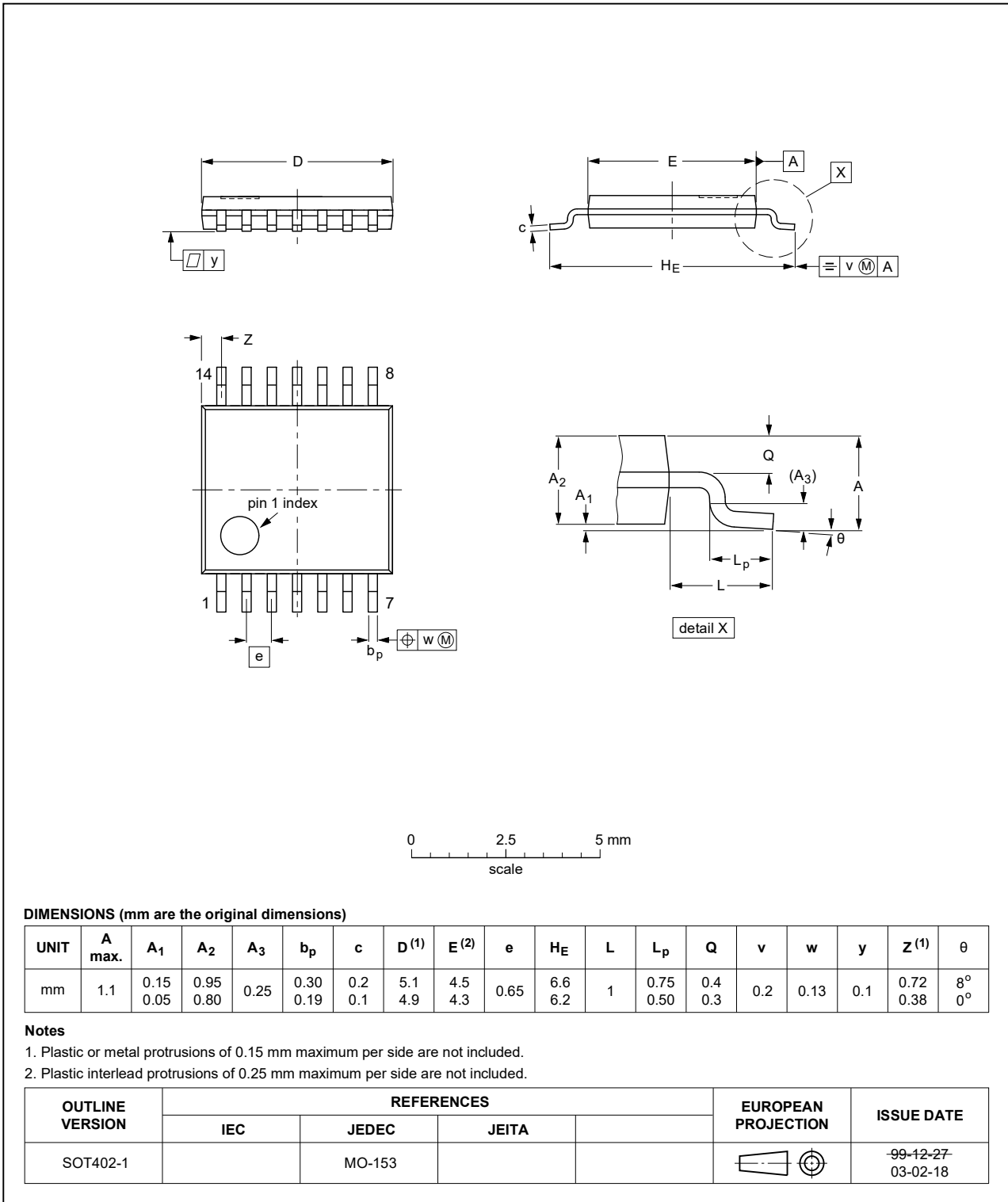


Fig. 13. Package outline SOT402-1 (TSSOP14)

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

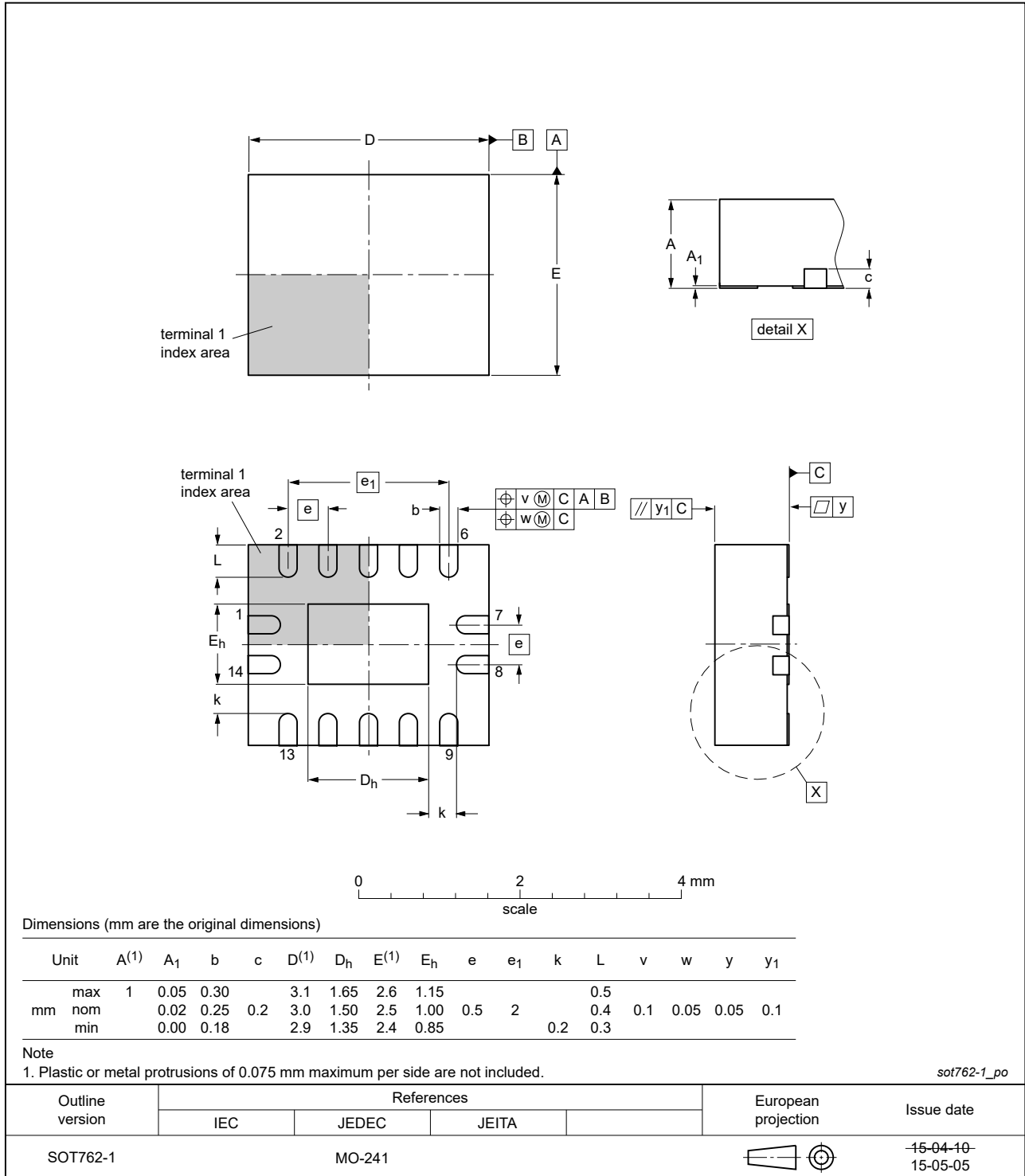


Fig. 14. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 10. Abbreviations

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| 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 v.9     | 20200611  | Product data sheet    | -             | 74HC_HCT164 v.8     |
| Modifications:      | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul> |                       |               |                     |
| 74HC_HCT164 v.8     | 20151119  | Product data sheet    | -             | 74HC_HCT164 v.7     |
| Modifications:      | <ul style="list-style-type: none"> <li>Type numbers 74HC164N and 74HCT164N (SOT27-1) removed.</li> </ul>  |                       |               |                     |
| 74HC_HCT164 v.7     | 20130613  | Product data sheet    | -             | 74HC_HCT164 v.6     |
| Modifications:      | <ul style="list-style-type: none"> <li>General description updated.</li> </ul>  |                       |               |                     |
| 74HC_HCT164 v.6     | 20111212  | Product data sheet    | -             | 74HC_HCT164 v.5     |
| Modifications:      | <ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>  |                       |               |                     |
| 74HC_HCT164 v.5     | 20101125  | Product data sheet    | -             | 74HC_HCT164 v.4     |
| 74HC_HCT164 v.4     | 20100202  | Product data sheet    | -             | 74HC_HCT164 v.3     |
| 74HC_HCT164 v.3     | 20050404  | Product data sheet    | -             | 74HC_HCT164_CNV v.2 |
| 74HC_HCT164_CNV v.2 | 19901201  | Product specification | -             | -                   |

## 14. 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.                                     |

- [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 <https://www.nexperia.com>.

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