

# 74AHC164-Q100; 74AHCT164-Q100

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

Rev. 1 — 5 July 2013

Product data sheet

## 1. General description

The 74AHC164-Q100; 74AHCT164-Q100 shift register is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7A.

The 74AHC164-Q100; 74AHCT164-Q100 input signals are 8-bit serial 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 input (CP). It enters into output Q0, which is a logical AND of the two data inputs (DSA and DSB). These data inputs 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.

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

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than  $V_{\text{CC}}$
- Input levels:
  - ◆ For 74AHC164-Q100: CMOS level
  - ◆ For 74AHCT164-Q100: TTL level
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

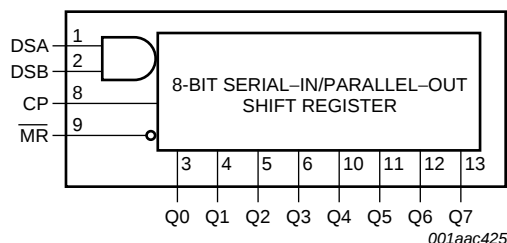


### 3. Ordering information

**Table 1.** Ordering information

| Type number           | Package           |          |                                                                                                                                    |          |
|-----------------------|-------------------|----------|------------------------------------------------------------------------------------------------------------------------------------|----------|
|                       | Temperature range | Name     | Description                                                                                                                        | Version  |
| <b>74AHC164-Q100</b>  |                   |          |                                                                                                                                    |          |
| 74AHC164D-Q100        | –40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm                                                                      | SOT108-1 |
| 74AHC164PW-Q100       | –40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package;<br>14 leads; body width 4.4 mm                                                          | SOT402-1 |
| 74AHC164BQ-Q100       | –40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads;<br>14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |
| <b>74AHCT164-Q100</b> |                   |          |                                                                                                                                    |          |
| 74AHCT164D-Q100       | –40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm                                                                      | SOT108-1 |
| 74AHCT164PW-Q100      | –40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package;<br>14 leads; body width 4.4 mm                                                          | SOT402-1 |
| 74AHCT164BQ-Q100      | –40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads;<br>14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |

### 4. Functional diagram



**Fig 1.** Functional diagram

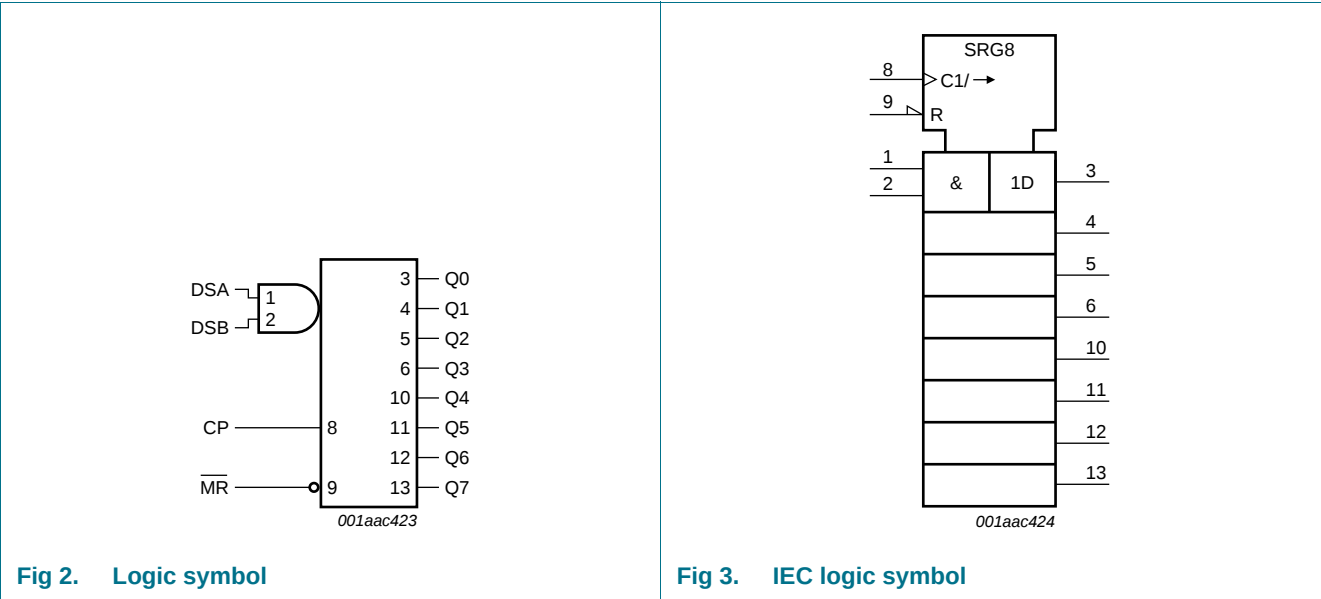


Fig 2. Logic symbol

Fig 3. IEC logic symbol

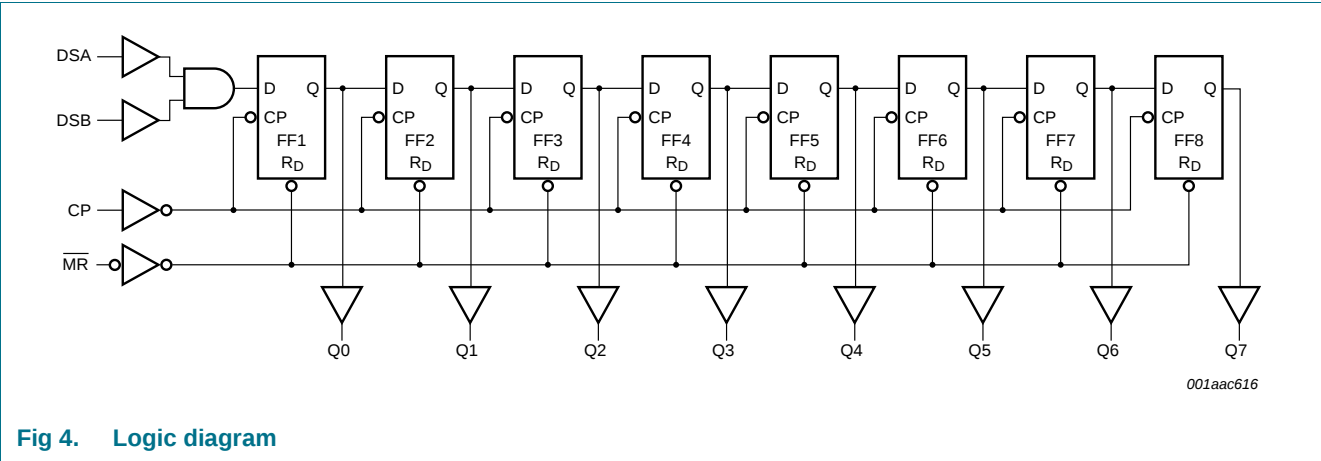
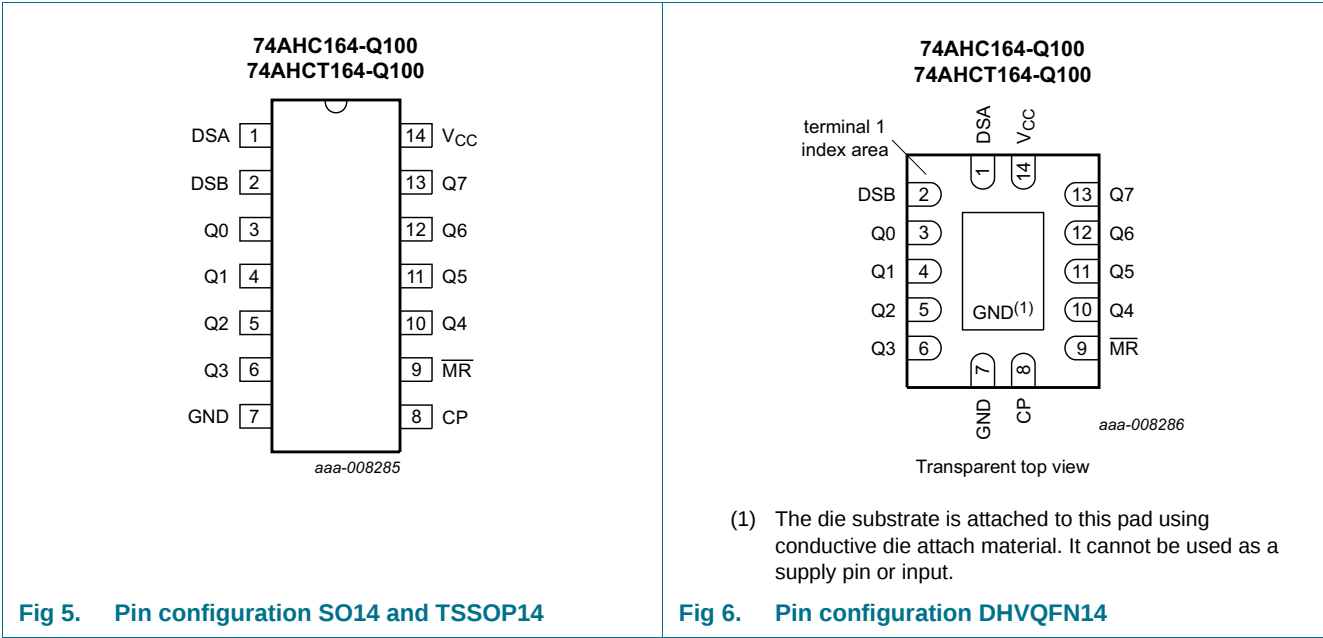


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

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

## 6. Functional description

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

| Operating mode | Control |    | 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 |
|                |         |    | l     | h   | L      | q0 to q6 |
|                |         |    | h     | l   | L      | q0 to q6 |
|                |         |    | 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;  
 ↑ = LOW-to-HIGH transition;  
 X = don't care;  
 q = lower case letter indicates the state of the referenced input one set-up time prior to the LOW-to-HIGH 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               | +7.0 | V    |
| V <sub>I</sub>   | input voltage           |                                                                     | -0.5               | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</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 | +20  | mA   |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = -0.5 V to (V <sub>CC</sub> + 0.5 V)                | -25                | +25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                     | -                  | +75  | mA   |
| I <sub>GND</sub> | ground current          |                                                                     | -75                | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                     | -65                | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C                                | <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 SO14 packages: above 70 °C the value of P<sub>tot</sub> derates linearly at 8 mW/K.  
 For TSSOP14 packages: above 60 °C the value of P<sub>tot</sub> derates linearly at 5.5 mW/K.  
 For DHVQFN14 packages: above 60 °C the value of P<sub>tot</sub> derates linearly at 4.5 mW/K.

## 8. Recommended operating conditions

Table 5. Operating conditions

| Symbol                | Parameter                           | Conditions                              | Min | Typ | Max      | Unit |
|-----------------------|-------------------------------------|-----------------------------------------|-----|-----|----------|------|
| <b>74AHC164-Q100</b>  |                                     |                                         |     |     |          |      |
| $V_{CC}$              | supply voltage                      |                                         | 2.0 | 5.0 | 5.5      | V    |
| $V_I$                 | input voltage                       |                                         | 0   | -   | 5.5      | V    |
| $V_O$                 | output voltage                      |                                         | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$             | ambient temperature                 |                                         | -40 | +25 | +125     | °C   |
| $\Delta t/\Delta V$   | input transition rise and fall rate | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | -   | -   | 100      | ns/V |
|                       |                                     | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | -   | -   | 20       | ns/V |
| <b>74AHCT164-Q100</b> |                                     |                                         |     |     |          |      |
| $V_{CC}$              | supply voltage                      |                                         | 4.5 | 5.0 | 5.5      | V    |
| $V_I$                 | input voltage                       |                                         | 0   | -   | 5.5      | V    |
| $V_O$                 | output voltage                      |                                         | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$             | ambient temperature                 |                                         | -40 | +25 | +125     | °C   |
| $\Delta t/\Delta V$   | input transition rise and fall rate | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | -   | -   | 20       | 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  |      |
| 74AHC164-Q100   |                           |                                                     |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                             | 1.5   | -   | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V                             | 2.1   | -   | -    | 2.1              | -    | 2.1               | -    | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V                             | 3.85  | -   | -    | 3.85             | -    | 3.85              | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                             | -     | -   | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V                             | -     | -   | 0.9  | -                | 0.9  | -                 | 0.9  | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V                             | -     | -   | 1.65 | -                | 1.65 | -                 | 1.65 | V    |
| 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> = −50 μA; V <sub>CC</sub> = 2.0 V    | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −50 μA; V <sub>CC</sub> = 3.0 V    | 2.9   | 3.0 | -    | 2.9              | -    | 2.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −50 μA; V <sub>CC</sub> = 4.5 V    | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = −4.0 mA; V <sub>CC</sub> = 3.0 V   | 2.58  | -   | -    | 2.48             | -    | 2.40              | -    | V    |
|                 |                           | I <sub>O</sub> = −8.0 mA; V <sub>CC</sub> = 4.5 V   | 3.94  | -   | -    | 3.80             | -    | 3.70              | -    | 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> = 50 μA; V <sub>CC</sub> = 2.0 V     | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V     | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V     | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V    | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
|                 |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V    | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | 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  |               |
| $I_I$                 | input leakage current     | $V_I = 5.5 \text{ V}$ or GND;<br>$V_{CC} = 0 \text{ V}$ to $5.5 \text{ V}$                                                                                | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | $\mu\text{A}$ |
| $I_{CC}$              | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ;<br>$V_{CC} = 5.5 \text{ V}$                                                                                  | -     | -   | 4.0  | -                | 40   | -                 | 80   | $\mu\text{A}$ |
| $C_I$                 | input capacitance         |                                                                                                                                                           | -     | 3   | 10   | -                | -    | -                 | -    | pF            |
| <b>74AHCT164-Q100</b> |                           |                                                                                                                                                           |       |     |      |                  |      |                   |      |               |
| $V_{IH}$              | HIGH-level input voltage  | $V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$                                                                                                               | 2.0   | -   | -    | 2.0              | -    | 2.0               | -    | V             |
| $V_{IL}$              | LOW-level input voltage   | $V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$                                                                                                               | -     | -   | 0.8  | -                | 0.8  | -                 | 0.8  | V             |
| $V_{OH}$              | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$                                                                                                     |       |     |      |                  |      |                   |      |               |
|                       |                           | $I_O = -50 \mu\text{A}$                                                                                                                                   | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V             |
|                       |                           | $I_O = -8.0 \text{ mA}$                                                                                                                                   | 3.94  | -   | -    | 3.80             | -    | 3.70              | -    | V             |
| $V_{OL}$              | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$                                                                                                     |       |     |      |                  |      |                   |      |               |
|                       |                           | $I_O = 50 \mu\text{A}$                                                                                                                                    | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V             |
|                       |                           | $I_O = 8.0 \text{ mA}$                                                                                                                                    | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V             |
| $I_I$                 | input leakage current     | $V_I = 5.5 \text{ V}$ or GND;<br>$V_{CC} = 0 \text{ V}$ to $5.5 \text{ V}$                                                                                | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | $\mu\text{A}$ |
| $I_{CC}$              | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ;<br>$V_{CC} = 5.5 \text{ V}$                                                                                  | -     | -   | 4.0  | -                | 40   | -                 | 80   | $\mu\text{A}$ |
| $\Delta I_{CC}$       | additional supply current | per input pin;<br>$V_I = V_{CC} - 2.1 \text{ V}$ ; $I_O = 0 \text{ A}$ ;<br>other pins at $V_{CC}$ or GND;<br>$V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$ | -     | -   | 1.35 | -                | 1.5  | -                 | 1.5  | mA            |
| $C_I$                 | input capacitance         |                                                                                                                                                           | -     | 3   | 10   | -                | -    | -                 | -    | pF            |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 10](#).

| Symbol           | Parameter         | Conditions                                   | 25 °C               |                    |      | −40 °C to +85 °C |      | −40 °C to +125 °C |      | Unit |
|------------------|-------------------|----------------------------------------------|---------------------|--------------------|------|------------------|------|-------------------|------|------|
|                  |                   |                                              | Min                 | Typ <sup>[1]</sup> | Max  | Min              | Max  | Min               | Max  |      |
| 74AHC164-Q100    |                   |                                              |                     |                    |      |                  |      |                   |      |      |
| t <sub>pd</sub>  | propagation delay | CP to Qn; see <a href="#">Figure 7</a>       | <a href="#">[2]</a> |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | -                   | 6.5                | 12.8 | 1.0              | 15.0 | 1.0               | 16.0 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF                       | -                   | 9.3                | 16.3 | 1.0              | 18.5 | 1.0               | 20.5 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | -                   | 4.5                | 9.0  | 1.0              | 10.5 | 1.0               | 11.5 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF                       | -                   | 6.4                | 11.0 | 1.0              | 12.5 | 1.0               | 14.0 | ns   |
|                  |                   | MR to Qn; see <a href="#">Figure 8</a>       | <a href="#">[3]</a> |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | -                   | 5.3                | 12.8 | 1.0              | 15.0 | 1.0               | 16.0 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF                       | -                   | 7.6                | 16.3 | 1.0              | 18.5 | 1.0               | 20.5 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | -                   | 4.0                | 8.6  | 1.0              | 10.0 | 1.0               | 11.0 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF                       | -                   | 5.8                | 10.6 | 1.0              | 12.0 | 1.0               | 13.5 | ns   |
| f <sub>max</sub> | maximum frequency | see <a href="#">Figure 7</a>                 |                     |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | 80                  | 125                | -    | 65               | -    | 50                | -    | MHz  |
|                  |                   | C <sub>L</sub> = 50 pF                       | 50                  | 75                 | -    | 45               | -    | 35                | -    | MHz  |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF                       | 125                 | 175                | -    | 105              | -    | 85                | -    | MHz  |
|                  |                   | C <sub>L</sub> = 50 pF                       | 85                  | 115                | -    | 75               | -    | 65                | -    | MHz  |
| t <sub>w</sub>   | pulse width       | CP HIGH or LOW; see <a href="#">Figure 7</a> |                     |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             | 5.0                 | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             | 5.0                 | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>WL</sub>  | pulse width LOW   | MR; see <a href="#">Figure 8</a>             |                     |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             | 5.0                 | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             | 5.0                 | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>su</sub>  | set-up time       | DSA, DSB to CP; see <a href="#">Figure 9</a> |                     |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             | 5.0                 | -                  | -    | 6.0              | -    | 6.0               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             | 4.5                 | -                  | -    | 4.5              | -    | 4.5               | -    | ns   |
| t <sub>h</sub>   | hold time         | DSA, DSB to CP; see <a href="#">Figure 9</a> |                     |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V             | 1.5                 | -                  | -    | 1.5              | -    | 1.5               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V             | 2.0                 | -                  | -    | 2.0              | -    | 2.0               | -    | ns   |

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 10](#).

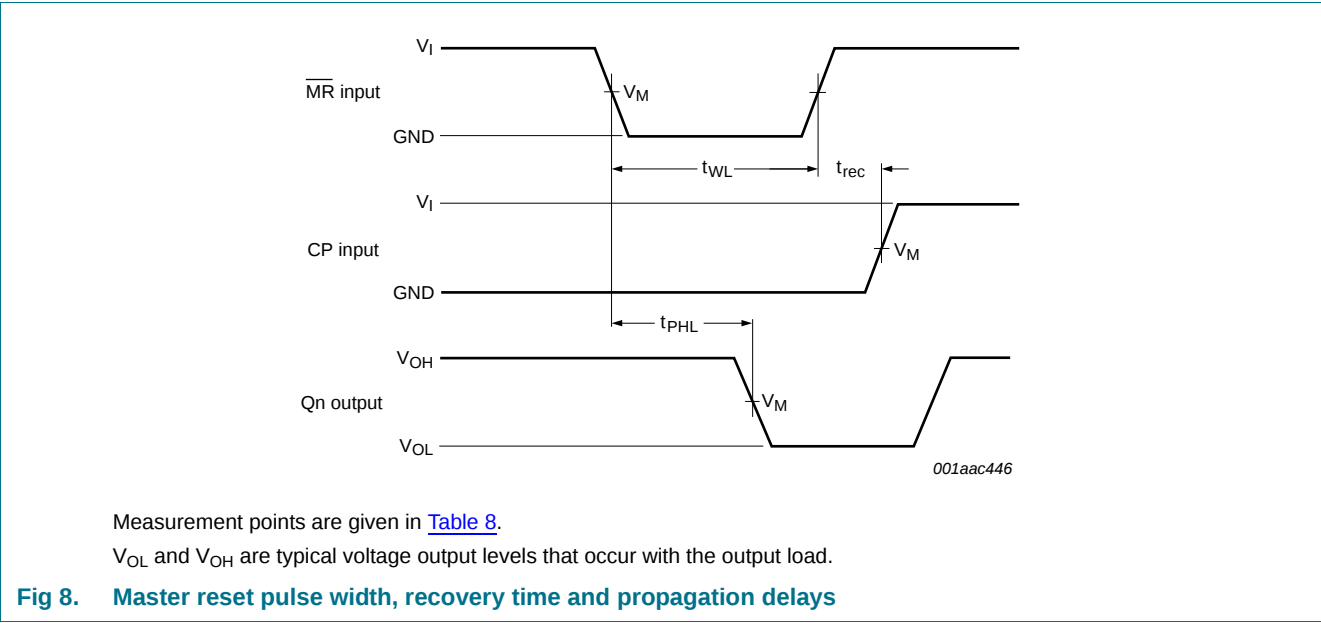
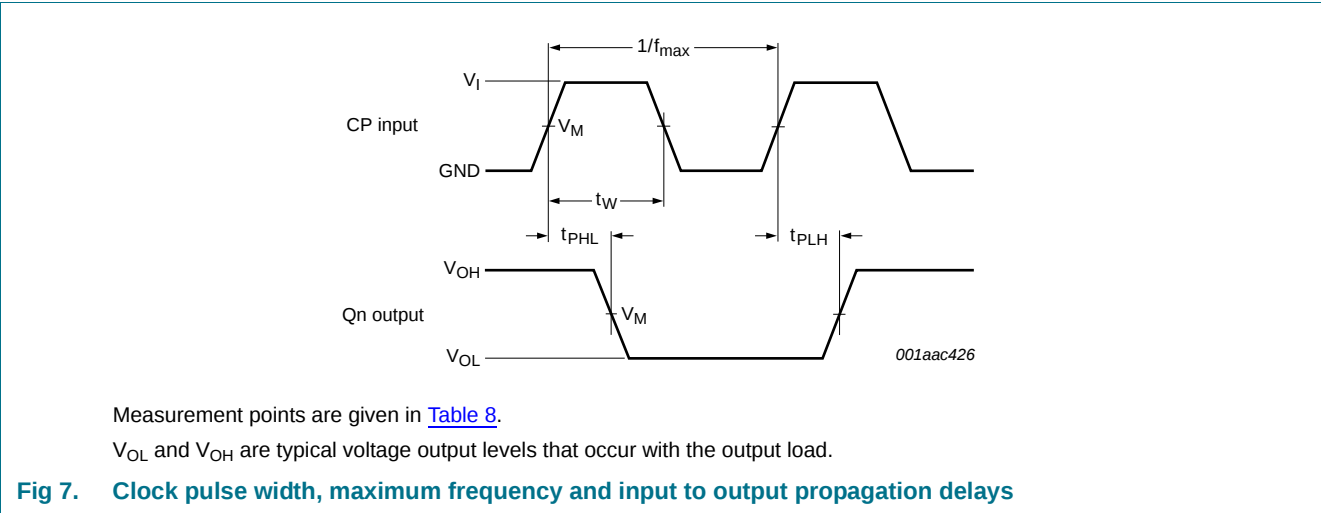
| Symbol                                                 | Parameter                     | Conditions                                                                          | 25 °C |                    |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|--------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|-------|--------------------|------|------------------|------|-------------------|------|------|
|                                                        |                               |                                                                                     | Min   | Typ <sup>[1]</sup> | Max  | Min              | Max  | Min               | Max  |      |
| t <sub>rec</sub>                                       | recovery time                 | MR to CP; see <a href="#">Figure 8</a>                                              |       |                    |      |                  |      |                   |      |      |
|                                                        |                               | V <sub>CC</sub> = 3.0 V to 3.6 V                                                    | 2.5   | -                  | -    | 2.5              | -    | 2.5               | -    | ns   |
|                                                        |                               | V <sub>CC</sub> = 4.5 V to 5.5 V                                                    | 2.5   | -                  | -    | 2.5              | -    | 2.5               | -    | ns   |
| C <sub>PD</sub>                                        | power dissipation capacitance | f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[4]</a> | -     | 48                 | -    | -                | -    | -                 | -    | pF   |
| <b>74AHCT164-Q100; V<sub>CC</sub> = 4.5 V to 5.5 V</b> |                               |                                                                                     |       |                    |      |                  |      |                   |      |      |
| t <sub>pd</sub>                                        | propagation delay             | CP to Q <sub>n</sub> ; see <a href="#">Figure 7</a> <a href="#">[2]</a>             |       |                    |      |                  |      |                   |      |      |
|                                                        |                               | C <sub>L</sub> = 15 pF                                                              | -     | 3.4                | 9.0  | 1.0              | 10.5 | 1.0               | 11.5 | ns   |
|                                                        |                               | C <sub>L</sub> = 50 pF                                                              | -     | 4.9                | 11.0 | 1.0              | 12.5 | 1.0               | 14.0 | ns   |
|                                                        |                               | MR to Q <sub>n</sub> ; see <a href="#">Figure 8</a> <a href="#">[3]</a>             |       |                    |      |                  |      |                   |      |      |
|                                                        |                               | C <sub>L</sub> = 15 pF                                                              | -     | 3.5                | 8.6  | 1.0              | 10.0 | 1.0               | 11.0 | ns   |
| f <sub>max</sub>                                       | maximum frequency             | see <a href="#">Figure 7</a>                                                        |       |                    |      |                  |      |                   |      |      |
|                                                        |                               | C <sub>L</sub> = 15 pF                                                              | 125   | 175                | -    | 105              | -    | 85                | -    | MHz  |
|                                                        |                               | C <sub>L</sub> = 50 pF                                                              | 85    | 115                | -    | 75               | -    | 65                | -    | MHz  |
| t <sub>W</sub>                                         | pulse width                   | CP HIGH or LOW; see <a href="#">Figure 7</a>                                        | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>WL</sub>                                        | pulse width LOW               | MR; see <a href="#">Figure 8</a>                                                    | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>su</sub>                                        | set-up time                   | DSA, DSB to CP; see <a href="#">Figure 9</a>                                        | 4.5   | -                  | -    | 4.5              | -    | 4.5               | -    | ns   |
| t <sub>h</sub>                                         | hold time                     | DSA, DSB to CP; see <a href="#">Figure 9</a>                                        | 2.0   | -                  | -    | 2.0              | -    | 2.0               | -    | ns   |
| t <sub>rec</sub>                                       | recovery time                 | MR to CP; see <a href="#">Figure 8</a>                                              | 2.5   | -                  | -    | 2.5              | -    | 2.5               | -    | ns   |
| C <sub>PD</sub>                                        | power dissipation capacitance | f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[4]</a> | -     | 51                 | -    | -                | -    | -                 | -    | pF   |

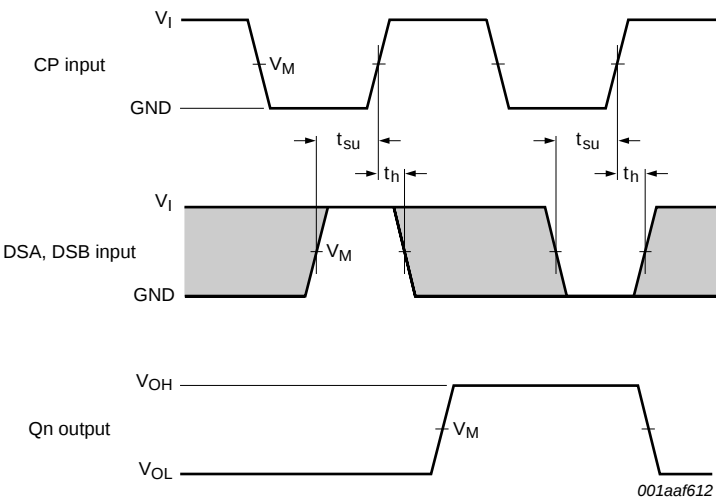
[1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.[3] t<sub>pd</sub> is the same as t<sub>PHL</sub> only.[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).
$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$
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;

Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

11. Waveforms



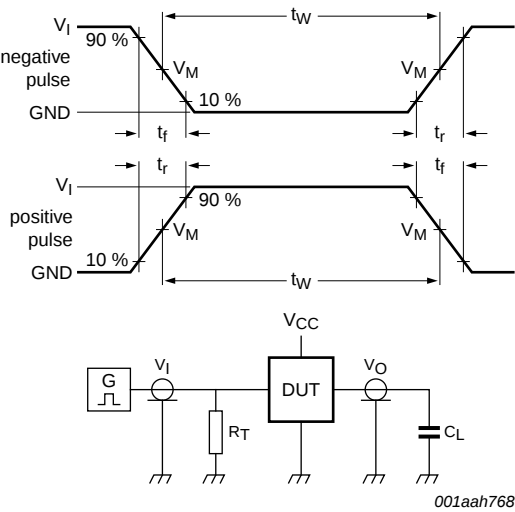


Measurement points are given in [Table 8](#).  
The shaded areas indicate when the input is permitted to change for predictable output performance.  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 9. Data set-up and hold times

Table 8. Measurement points

| Type           | Input               | Output              |
|----------------|---------------------|---------------------|
|                | $V_M$               | $V_M$               |
| 74AHC164-Q100  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74AHCT164-Q100 | 1.5 V               | $0.5 \times V_{CC}$ |



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. Load circuitry for measuring switching times

Table 9. Test data

| Type           | Input    |                       | Load         | Test               |
|----------------|----------|-----------------------|--------------|--------------------|
|                | $V_I$    | $t_r, t_f$            | $C_L$        |                    |
| 74AHC164-Q100  | $V_{CC}$ | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74AHCT164-Q100 | 3.0 V    | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

12. Package outline

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

SOT108-1

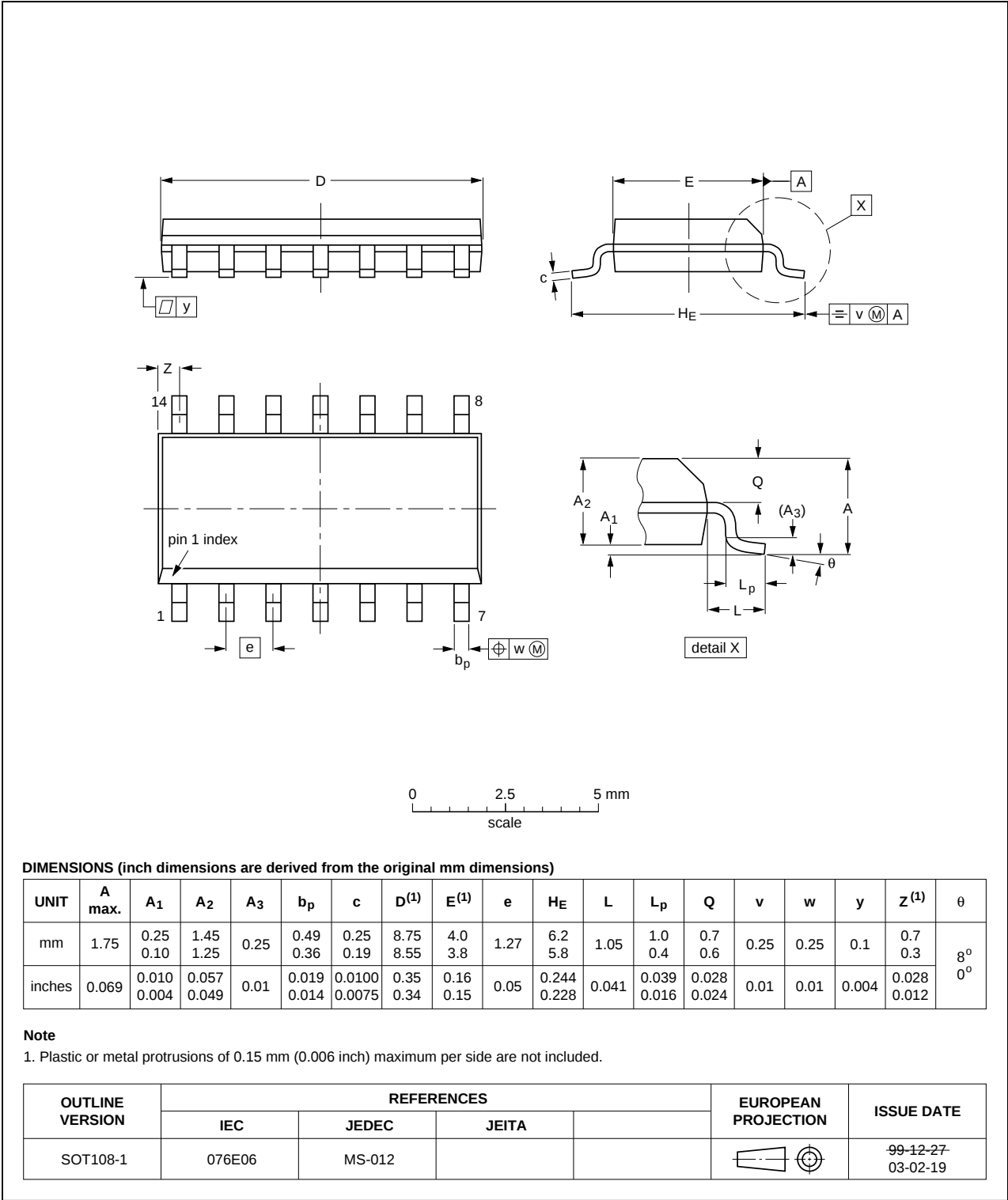


Fig 11. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm
SOT402-1

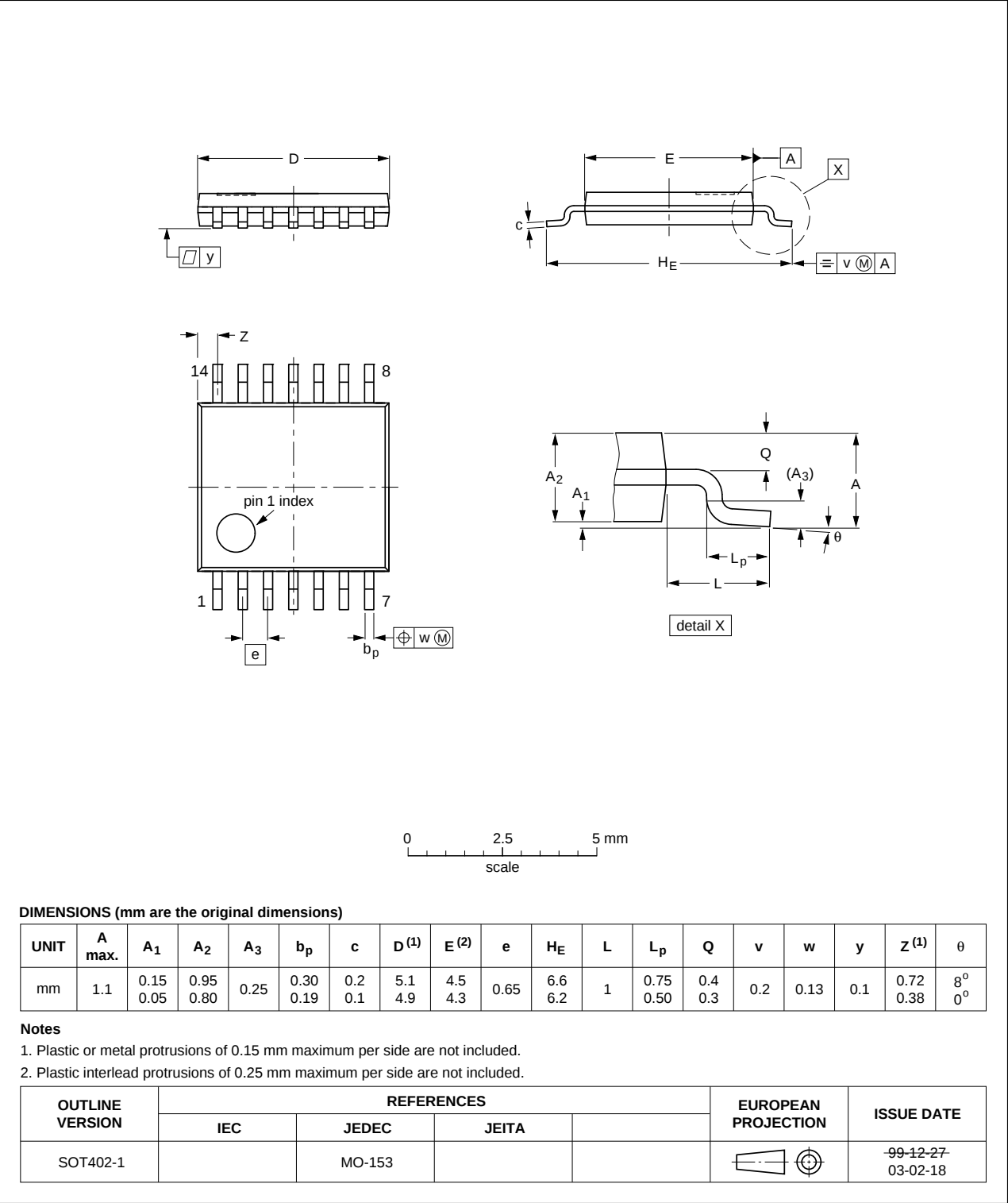


Fig 12. Package outline SOT402-1 (TSSOP14)

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

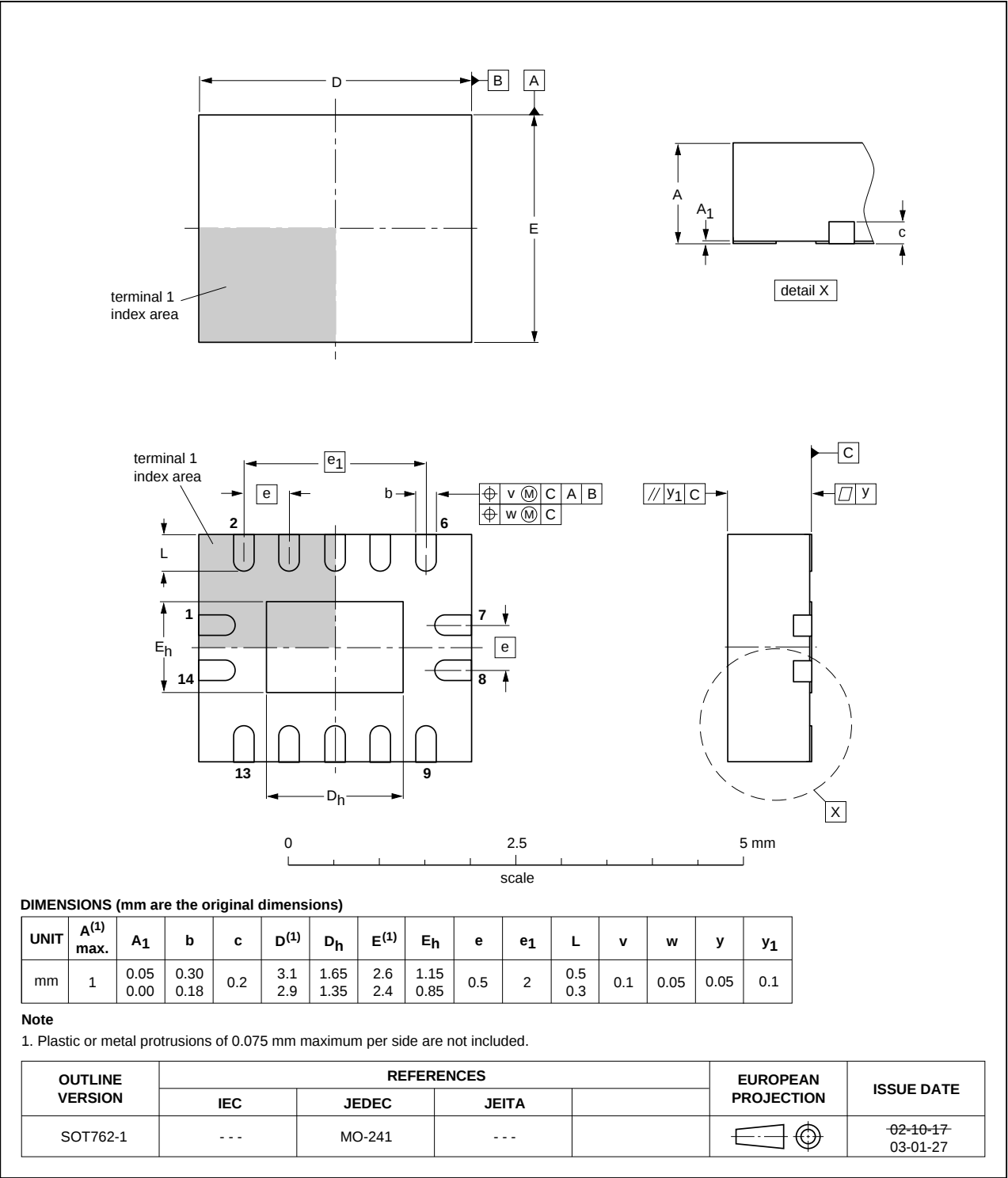


Fig 13. Package outline SOT762-1 (DHVQFN14)

## 13. Abbreviations

Table 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

| Document ID            | Release date | Data sheet status  | Change notice | Supersedes |
|------------------------|--------------|--------------------|---------------|------------|
| 74AHC_AHCT164_Q100 v.1 | 20130705     | Product data sheet | -             | -          |

## 15. Legal information

### 15.1 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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