

# 74HC74-Q100; 74HCT74-Q100

Dual D-type flip-flop with set and reset; positive edge-trigger

Rev. 3 — 4 December 2015

Product data sheet

## 1. General description

The 74HC74-Q100; 74HCT74-Q100 are dual positive edge triggered D-type flip-flop with individual data ( $nD$ ), clock ( $nCP$ ), set ( $n\overline{SD}$ ) and reset ( $n\overline{RD}$ ) inputs, and complementary  $nQ$  and  $n\overline{Q}$  outputs. Data at the  $nD$ -input, that meets the set-up and hold time requirements on the LOW-to-HIGH clock transition, will be stored in the flip-flop and appear at the  $nQ$  output. The Schmitt-trigger action in the clock input, makes the circuit highly tolerant to slower clock rise and fall times. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

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  $+125\text{ }^{\circ}\text{C}$
- Input levels:
  - ◆ For 74HC74-Q100: CMOS level
  - ◆ For 74HCT74-Q100: TTL level
- Symmetrical output impedance
- Low power dissipation
- High noise immunity
- Balanced propagation delays
- Specified in compliance with JEDEC standard no. 7A
- 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  |
| 74HC74D-Q100   | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads; body width 3.9 mm                                                                   | SOT108-1 |
| 74HCT74D-Q100  |                   |          |                                                                                                                              |          |
| 74HC74PW-Q100  | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads; body width 4.4 mm                                                       | SOT402-1 |
| 74HCT74PW-Q100 |                   |          |                                                                                                                              |          |
| 74HC74BQ-Q100  | -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 |
| 74HCT74BQ-Q100 |                   |          |                                                                                                                              |          |

4. Functional diagram

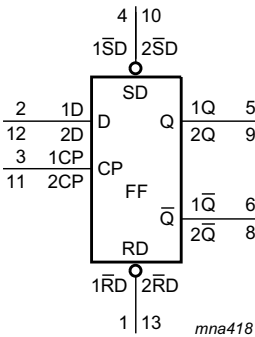


Fig 1. Logic symbol

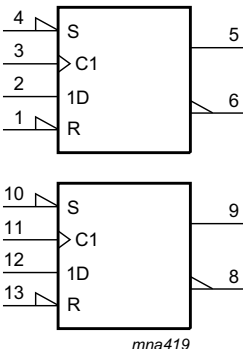


Fig 2. IEC logic symbol

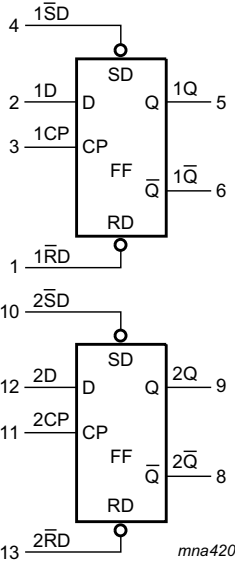


Fig 3. Functional diagram

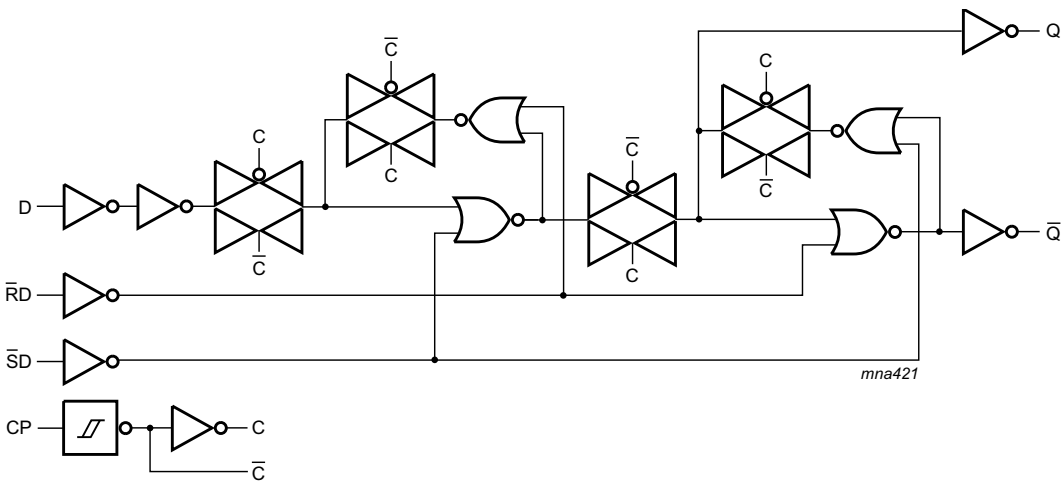


Fig 4. Logic diagram for one flip-flop

5. Pinning information

5.1 Pinning

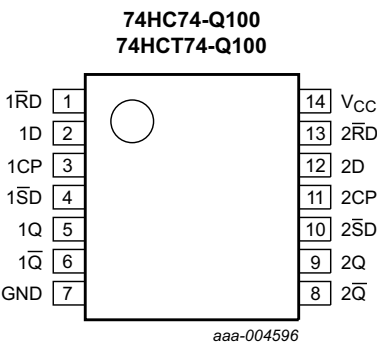
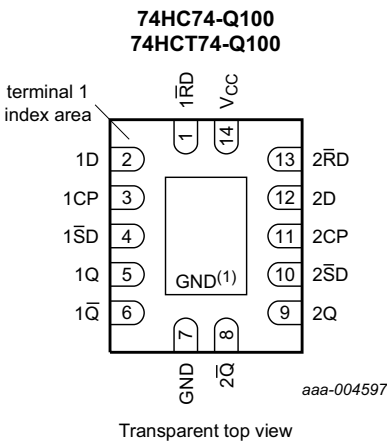


Fig 5. Pin configuration for SO14 and TSSOP14



- (1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 6. Pin configuration for DHVQFN14

## 5.2 Pin description

Table 2. Pin description

| Symbol           | Pin | Description                                  |
|------------------|-----|----------------------------------------------|
| $1\overline{RD}$ | 1   | asynchronous reset-direct input (active LOW) |
| 1D               | 2   | data input                                   |
| 1CP              | 3   | clock input (LOW-to-HIGH, edge-triggered)    |
| $1\overline{SD}$ | 4   | asynchronous set-direct input (active LOW)   |
| 1Q               | 5   | output                                       |
| $1\overline{Q}$  | 6   | complement output                            |
| GND              | 7   | ground (0 V)                                 |
| $2\overline{Q}$  | 8   | complement output                            |
| 2Q               | 9   | output                                       |
| $2\overline{SD}$ | 10  | asynchronous set-direct input (active LOW)   |
| 2CP              | 11  | clock input (LOW-to-HIGH, edge-triggered)    |
| 2D               | 12  | data input                                   |
| $2\overline{RD}$ | 13  | asynchronous reset-direct input (active LOW) |
| V <sub>CC</sub>  | 14  | supply voltage                               |

## 6. Functional description

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

| Input            |                  |     |    | Output |                 |
|------------------|------------------|-----|----|--------|-----------------|
| $\overline{nSD}$ | $\overline{nRD}$ | nCP | nD | nQ     | $\overline{nQ}$ |
| L                | H                | X   | X  | H      | L               |
| H                | L                | X   | X  | L      | H               |
| L                | L                | X   | X  | H      | H               |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

Table 4. Function table<sup>[1]</sup>

| Input            |                  |     |    | Output     |                       |
|------------------|------------------|-----|----|------------|-----------------------|
| $\overline{nSD}$ | $\overline{nRD}$ | nCP | nD | $nQ_{n+1}$ | $\overline{nQ}_{n+1}$ |
| H                | H                | ↑   | L  | L          | H                     |
| H                | H                | ↑   | H  | H          | L                     |

[1] H = HIGH voltage level; L = LOW voltage level; ↑ = LOW-to-HIGH transition;  $Q_{n+1}$  = state after the next LOW-to-HIGH CP transition; X = don't care.

## 7. Limiting values

**Table 5. 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 $V_I > V_{CC} + 0.5\text{ V}$  | -    | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$  | -    | $\pm 20$ | mA   |
| $I_O$     | output current          | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$      | -    | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |                                                         | -    | +100     | mA   |
| $I_{GND}$ | ground current          |                                                         | -100 | -        | mA   |
| $T_{stg}$ | storage temperature     |                                                         | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation | DIP14 package <a href="#">[1]</a>                       | -    | 750      | mW   |
|           |                         | SO14, TSSOP14 and DHVQFN14 packages <a href="#">[1]</a> | -    | 500      | mW   |

- [1] For DIP14 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.  
 For SO14 packages:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
 For TSSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.  
 For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol              | Parameter                           | Conditions              | 74HC74-Q100 |      |          | 74HCT74-Q100 |      |          | 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 7. Static characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol          | Parameter                | Conditions              | T <sub>amb</sub> = −40 °C to +85 °C |                    |     | T <sub>amb</sub> = −40 °C to +125 °C |     | Unit |
|-----------------|--------------------------|-------------------------|-------------------------------------|--------------------|-----|--------------------------------------|-----|------|
|                 |                          |                         | Min                                 | Typ <sup>[1]</sup> | Max | Min                                  | Max |      |
| 74HC74-Q100     |                          |                         |                                     |                    |     |                                      |     |      |
| V <sub>IH</sub> | HIGH-level input voltage | V <sub>CC</sub> = 2.0 V | 1.5                                 | 1.2                | -   | 1.5                                  | -   | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | 3.15                                | 2.4                | -   | 3.15                                 | -   | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | 4.2                                 | 3.2                | -   | 4.2                                  | -   | V    |

**Table 7.** Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol              | Parameter                 | Conditions                                                                                                                                        | T <sub>amb</sub> = –40 °C to +85 °C |                    |      | T <sub>amb</sub> = –40 °C to +125 °C |      | Unit |
|---------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------|------|--------------------------------------|------|------|
|                     |                           |                                                                                                                                                   | Min                                 | Typ <sup>[1]</sup> | Max  | Min                                  | Max  |      |
| V <sub>IL</sub>     | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                                                                           | -                                   | 0.8                | 0.5  | -                                    | 0.5  | V    |
|                     |                           | V <sub>CC</sub> = 4.5 V                                                                                                                           | -                                   | 2.1                | 1.35 | -                                    | 1.35 | V    |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                                                                           | -                                   | 2.8                | 1.8  | -                                    | 1.8  | 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> = –4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                 | 3.84                                | 4.32               | -    | 3.7                                  | -    | V    |
|                     |                           | I <sub>O</sub> = –5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                                 | 5.34                                | 5.81               | -    | 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> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                  | -                                   | 0.15               | 0.33 | -                                    | 0.4  | V    |
|                     |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                                  | -                                   | 0.16               | 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                                                                               | -                                   | -                  | ±1.0 | -                                    | ±1.0 | 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                                                         | -                                   | -                  | 40   | -                                    | 80   | µA   |
| C <sub>I</sub>      | input capacitance         |                                                                                                                                                   | -                                   | 3.5                | -    | -                                    | -    | pF   |
| <b>74HCT74-Q100</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                                  | -    | 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  | 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> = –4 mA                                                                                                                            | 3.84                                | 4.32               | -    | 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> = 4.0 mA                                                                                                                           | -                                   | 0.15               | 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> = 5.5 V                                                                               | -                                   | -                  | ±1.0 | -                                    | ±1.0 | 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> = 5.5 V                                                         | -                                   | -                  | 40   | -                                    | 80   | µA   |
| ΔI <sub>CC</sub>    | additional supply current | V <sub>I</sub> = V <sub>CC</sub> – 2.1 V;<br>other inputs at V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 4.5 V to 5.5 V;<br>I <sub>O</sub> = 0 A |                                     |                    |      |                                      |      |      |
|                     |                           | per input pin; nD, nRD inputs                                                                                                                     | -                                   | 70                 | 315  | -                                    | 343  | µA   |
|                     |                           | per input pin; nSD, nCP input                                                                                                                     | -                                   | 80                 | 360  | -                                    | 392  | µA   |
| C <sub>I</sub>      | input capacitance         |                                                                                                                                                   | -                                   | 3.5                | -    | -                                    | -    | pF   |

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

| Symbol                  | Parameter         | Conditions                                                   | T <sub>amb</sub> = −40 °C to +85 °C |                    |     | T <sub>amb</sub> = −40 °C to +125 °C |     | Unit |
|-------------------------|-------------------|--------------------------------------------------------------|-------------------------------------|--------------------|-----|--------------------------------------|-----|------|
|                         |                   |                                                              | Min                                 | Typ <sup>[1]</sup> | Max | Min                                  | Max |      |
| 74HC74-Q100             |                   |                                                              |                                     |                    |     |                                      |     |      |
| t <sub>pd</sub>         | propagation delay | nCP to nQ, nQ̄; see <a href="#">Figure 7</a> <sup>[2]</sup>  |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | -                                   | 47                 | 220 | -                                    | 265 | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | -                                   | 17                 | 44  | -                                    | 53  | ns   |
|                         |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                | -                                   | 14                 | -   | -                                    | -   | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | -                                   | 14                 | 37  | -                                    | 45  | ns   |
|                         |                   | nSD̄ to nQ, nQ̄; see <a href="#">Figure 8</a> <sup>[2]</sup> |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | -                                   | 50                 | 250 | -                                    | 300 | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | -                                   | 18                 | 50  | -                                    | 60  | ns   |
|                         |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                | -                                   | 15                 | -   | -                                    | -   | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | -                                   | 14                 | 43  | -                                    | 51  | ns   |
|                         |                   | nRD̄ to nQ, nQ̄; see <a href="#">Figure 8</a> <sup>[2]</sup> |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | -                                   | 52                 | 250 | -                                    | 300 | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | -                                   | 19                 | 50  | -                                    | 60  | ns   |
|                         |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                | -                                   | 16                 | -   | -                                    | -   | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | -                                   | 15                 | 43  | -                                    | 51  | ns   |
| t <sub>t</sub>          | transition time   | nQ, nQ̄; see <a href="#">Figure 7</a> <sup>[3]</sup>         |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | -                                   | 19                 | 95  | -                                    | 110 | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | -                                   | 7                  | 19  | -                                    | 22  | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | -                                   | 6                  | 16  | -                                    | 19  | ns   |
| t <sub>w</sub>          | pulse width       | nCP HIGH or LOW; see <a href="#">Figure 7</a>                |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | 100                                 | 19                 | -   | 120                                  | -   | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | 20                                  | 7                  | -   | 24                                   | -   | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | 17                                  | 6                  | -   | 20                                   | -   | ns   |
|                         |                   | nSD̄, nRD̄ LOW; see <a href="#">Figure 8</a>                 |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | 100                                 | 19                 | -   | 120                                  | -   | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | 20                                  | 7                  | -   | 24                                   | -   | ns   |
| V <sub>CC</sub> = 6.0 V | 17                | 6                                                            | -                                   | 20                 | -   | ns                                   |     |      |
| t <sub>rec</sub>        | recovery time     | nSD̄, nRD̄; see <a href="#">Figure 8</a>                     |                                     |                    |     |                                      |     |      |
|                         |                   | V <sub>CC</sub> = 2.0 V                                      | 40                                  | 3                  | -   | 45                                   | -   | ns   |
|                         |                   | V <sub>CC</sub> = 4.5 V                                      | 8                                   | 1                  | -   | 9                                    | -   | ns   |
|                         |                   | V <sub>CC</sub> = 6.0 V                                      | 7                                   | 1                  | -   | 8                                    | -   | ns   |

**Table 8.** Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

| Symbol    | Parameter                     | Conditions                                                                               | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ |                    |     | $T_{amb} = -40\text{ °C to }+125\text{ °C}$ |     | Unit |
|-----------|-------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------|--------------------|-----|---------------------------------------------|-----|------|
|           |                               |                                                                                          | Min                                        | Typ <sup>[1]</sup> | Max | Min                                         | Max |      |
| $t_{su}$  | set-up time                   | nD to nCP; see <a href="#">Figure 7</a>                                                  |                                            |                    |     |                                             |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$                                                                  | 75                                         | 6                  | -   | 90                                          | -   | ns   |
|           |                               | $V_{CC} = 4.5\text{ V}$                                                                  | 15                                         | 2                  | -   | 18                                          | -   | ns   |
|           |                               | $V_{CC} = 6.0\text{ V}$                                                                  | 13                                         | 2                  | -   | 15                                          | -   | ns   |
| $t_h$     | hold time                     | nD to nCP; see <a href="#">Figure 7</a>                                                  |                                            |                    |     |                                             |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$                                                                  | 3                                          | -6                 | -   | 3                                           | -   | ns   |
|           |                               | $V_{CC} = 4.5\text{ V}$                                                                  | 3                                          | -2                 | -   | 3                                           | -   | ns   |
|           |                               | $V_{CC} = 6.0\text{ V}$                                                                  | 3                                          | -2                 | -   | 3                                           | -   | ns   |
| $f_{max}$ | maximum frequency             | nCP; see <a href="#">Figure 7</a>                                                        |                                            |                    |     |                                             |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$                                                                  | 4.8                                        | 23                 | -   | 4.0                                         | -   | MHz  |
|           |                               | $V_{CC} = 4.5\text{ V}$                                                                  | 24                                         | 69                 | -   | 20                                          | -   | MHz  |
|           |                               | $V_{CC} = 5\text{ V}$ ; $C_L = 15\text{ pF}$                                             | -                                          | 76                 | -   | -                                           | -   | MHz  |
|           |                               | $V_{CC} = 6.0\text{ V}$                                                                  | 28                                         | 82                 | -   | 24                                          | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $C_L = 50\text{ pF}$ ; $f = 1\text{ MHz}$ ; $V_I = \text{GND to } V_{CC}$ <sup>[4]</sup> | -                                          | 24                 | -   | -                                           | -   | pF   |

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|           |                   |                                                                                       |    |    |    |    |    |    |
|-----------|-------------------|---------------------------------------------------------------------------------------|----|----|----|----|----|----|
| $t_{pd}$  | propagation delay | nCP to nQ, $\overline{nQ}$ ; see <a href="#">Figure 7</a> <sup>[2]</sup>              |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | -  | 18 | 44 | -  | 53 | ns |
|           |                   | $V_{CC} = 5\text{ V}$ ; $C_L = 15\text{ pF}$                                          | -  | 15 | -  | -  | -  | ns |
|           |                   | $\overline{nSD}$ to nQ, $\overline{nQ}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup> |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | -  | 23 | 50 | -  | 60 | ns |
|           |                   | $V_{CC} = 5\text{ V}$ ; $C_L = 15\text{ pF}$                                          | -  | 18 | -  | -  | -  | ns |
|           |                   | $\overline{nRD}$ to nQ, $\overline{nQ}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup> |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | -  | 24 | 50 | -  | 60 | ns |
|           |                   | $V_{CC} = 5\text{ V}$ ; $C_L = 15\text{ pF}$                                          | -  | 18 | -  | -  | -  | ns |
| $t_t$     | transition time   | nQ, $\overline{nQ}$ ; see <a href="#">Figure 7</a> <sup>[3]</sup>                     |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | -  | 7  | 19 | -  | 22 | ns |
| $t_w$     | pulse width       | nCP HIGH or LOW; see <a href="#">Figure 7</a>                                         |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | 23 | 9  | -  | 27 | -  | ns |
|           |                   | $\overline{nSD}$ , $\overline{nRD}$ LOW; see <a href="#">Figure 8</a>                 |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | 20 | 9  | -  | 24 | -  | ns |
| $t_{rec}$ | recovery time     | $\overline{nSD}$ , $\overline{nRD}$ ; see <a href="#">Figure 8</a>                    |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | 8  | 1  | -  | 9  | -  | ns |
| $t_{su}$  | set-up time       | nD to nCP; see <a href="#">Figure 7</a>                                               |    |    |    |    |    |    |
|           |                   | $V_{CC} = 4.5\text{ V}$                                                               | 15 | 5  | -  | 18 | -  | ns |

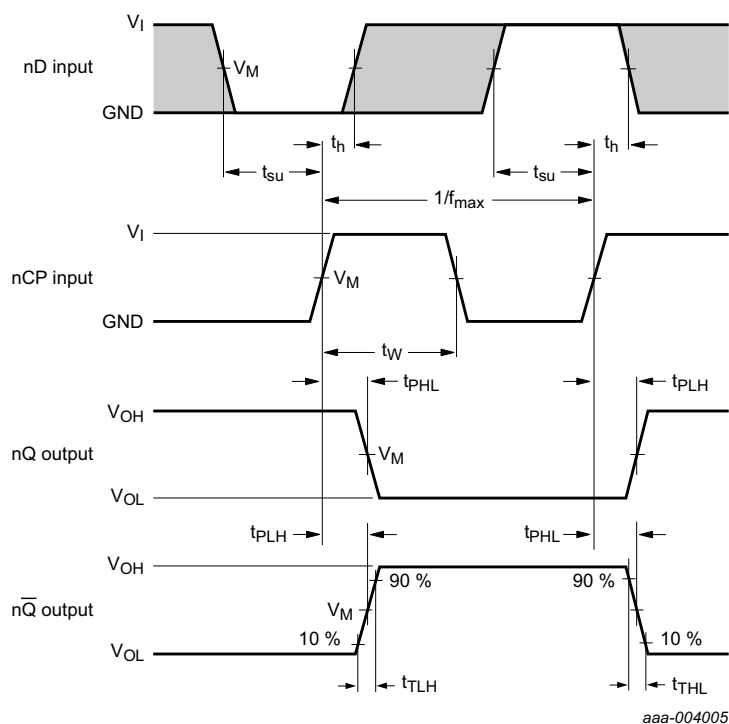
**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

| Symbol    | Parameter                     | Conditions                                                                                              | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ |                    |     | $T_{amb} = -40\text{ °C to }+125\text{ °C}$ |     | Unit |
|-----------|-------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------|-----|---------------------------------------------|-----|------|
|           |                               |                                                                                                         | Min                                        | Typ <sup>[1]</sup> | Max | Min                                         | Max |      |
| $t_h$     | hold time                     | nD to nCP; see <a href="#">Figure 7</a>                                                                 |                                            |                    |     |                                             |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                                                                 | 3                                          | -3                 | -   | 3                                           | -   | ns   |
| $f_{max}$ | maximum frequency             | nCP; see <a href="#">Figure 7</a>                                                                       |                                            |                    |     |                                             |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                                                                 | 22                                         | 54                 | -   | 18                                          | -   | MHz  |
|           |                               | $V_{CC} = 5\text{ V}$ ; $C_L = 15\text{ pF}$                                                            | -                                          | 59                 | -   | -                                           | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $C_L = 50\text{ pF}$ ; $f = 1\text{ MHz}$ ; $V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ <sup>[4]</sup> | -                                          | 29                 | -   | -                                           | -   | pF   |

- [1] All typical values are measured at  $T_{amb} = 25\text{ °C}$ .
- [2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [3]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  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;  
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## 11. Waveforms



Measurement points are given in [Table 9](#).

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

**Fig 7. Propagation delay input (CP) to output (Qn), output transition time, clock input (CP) pulse width and the maximum frequency (CP)**

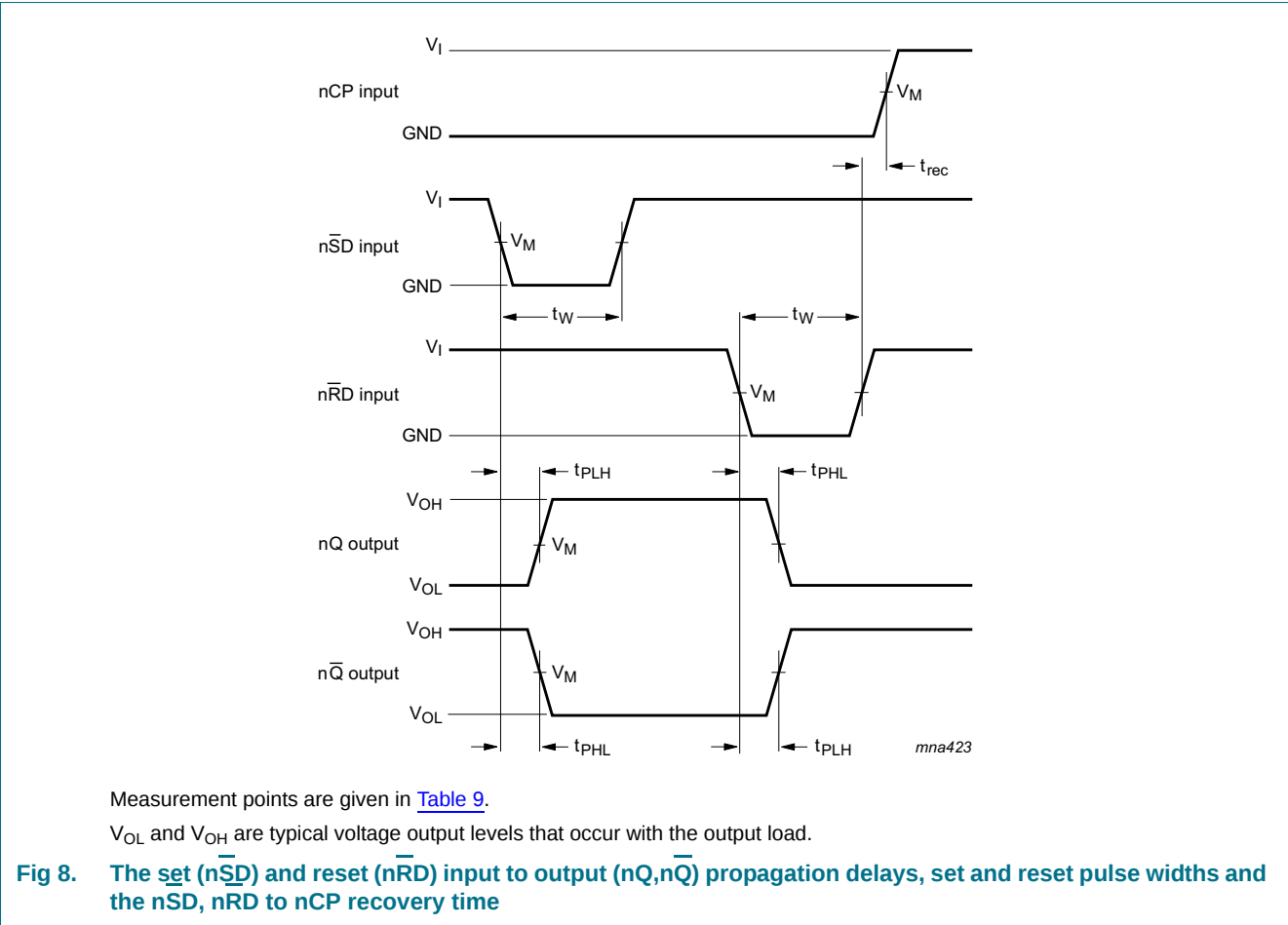
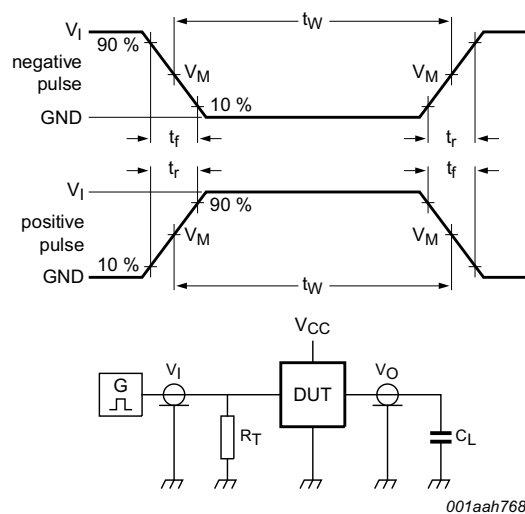


Table 9. Measurement points

| Type         | Input       | Output      |
|--------------|-------------|-------------|
|              | $V_M$       | $V_M$       |
| 74HC74-Q100  | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT74-Q100 | 1.3 V       | 1.3 V       |



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

Definitions test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_L$  = Load resistance.

S1 = Test selection switch.

Fig 9. Test circuit for measuring switching times

Table 10. Test data

| Type         | Input    |            | Load         |              | Test               |
|--------------|----------|------------|--------------|--------------|--------------------|
|              | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        |                    |
| 74HC74-Q100  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | $t_{PLH}, t_{PHL}$ |
| 74HCT74-Q100 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | $t_{PLH}, t_{PHL}$ |

12. Package outline

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

SOT108-1

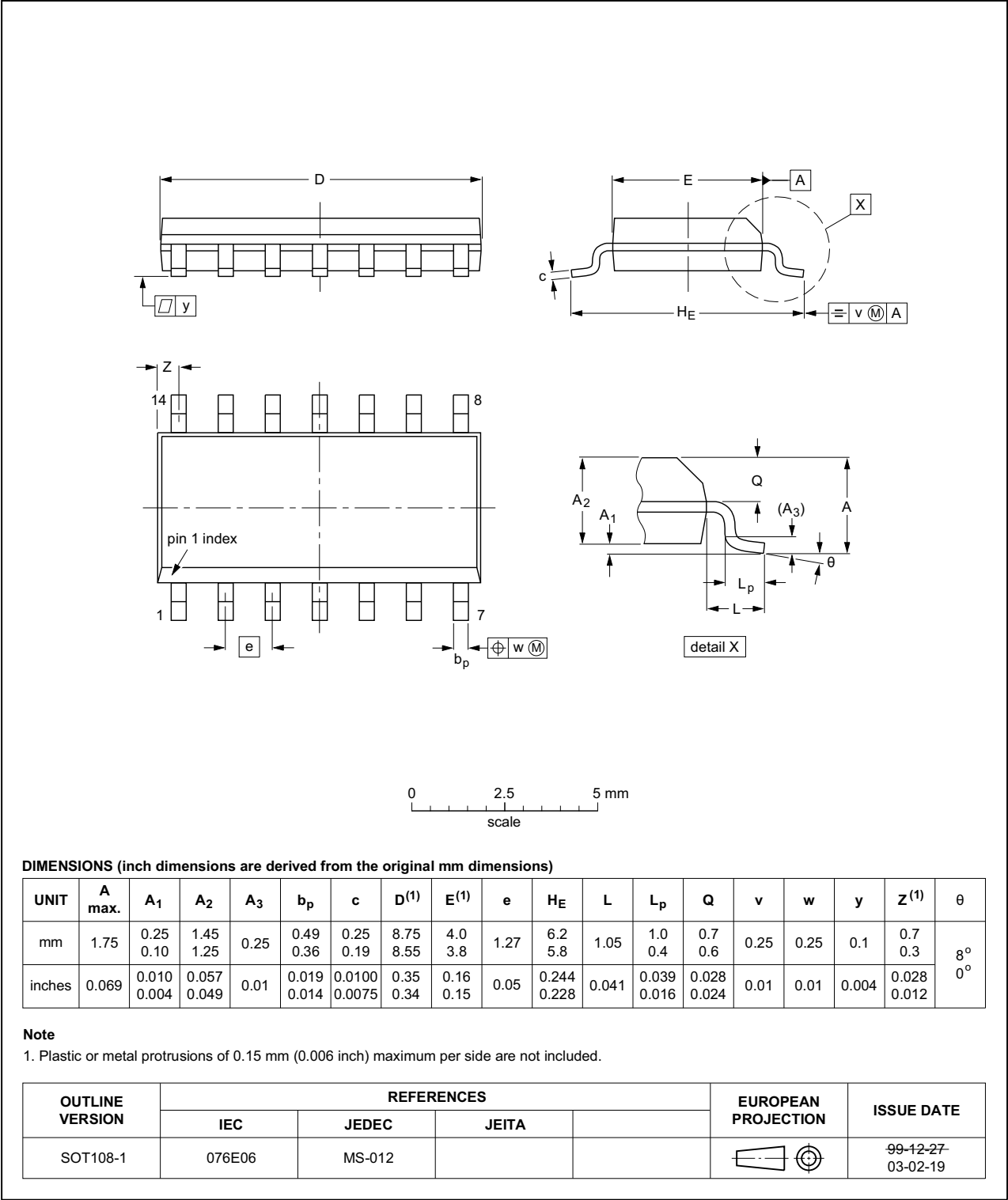
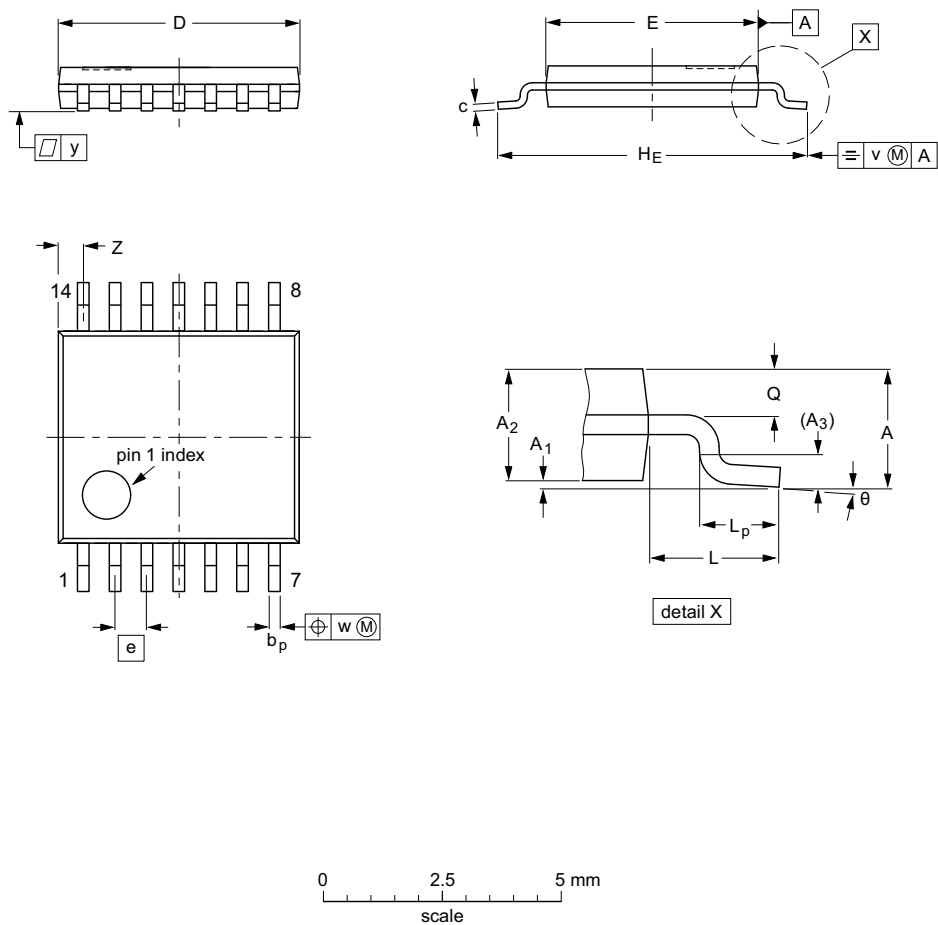


Fig 10. Package outline SOT108-1 (SO14)

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

SOT402-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | Z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 5.1<br>4.9       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38     | 8°<br>0° |

Notes

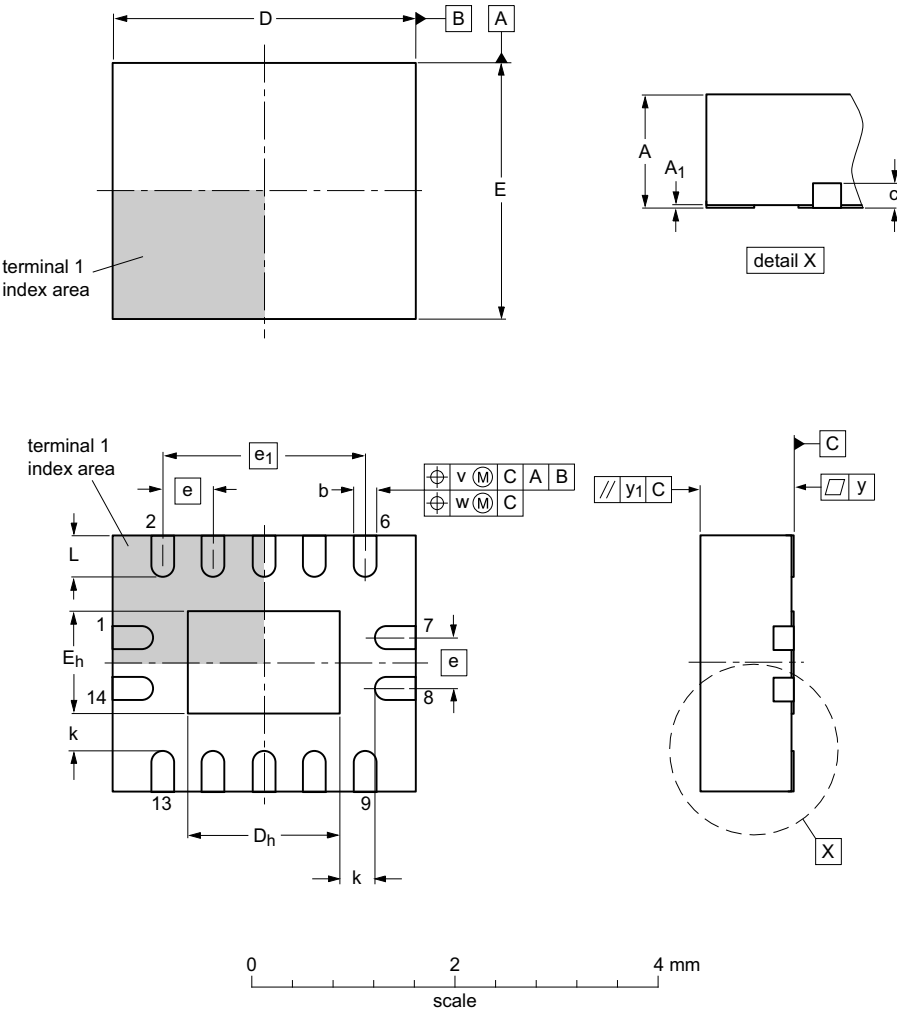
- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                       |
| SOT402-1           |            | MO-153 |       |  |                        | -99-12-27<br>03-02-18 |

Fig 11. 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



Dimensions (mm are the original dimensions)

| Unit | A <sup>(1)</sup> | A <sub>1</sub> | b    | c   | D <sup>(1)</sup> | D <sub>h</sub> | E <sup>(1)</sup> | E <sub>h</sub> | e   | e <sub>1</sub> | k   | L   | v   | w    | y    | y <sub>1</sub> |
|------|------------------|----------------|------|-----|------------------|----------------|------------------|----------------|-----|----------------|-----|-----|-----|------|------|----------------|
| max  | 1                | 0.05           | 0.30 |     | 3.1              | 1.65           | 2.6              | 1.15           |     |                |     | 0.5 |     |      |      |                |
| mm   | nom              | 0.02           | 0.25 | 0.2 | 3.0              | 1.50           | 2.5              | 1.00           | 0.5 | 2              |     | 0.4 | 0.1 | 0.05 | 0.05 | 0.1            |
|      | min              | 0.00           | 0.18 |     | 2.9              | 1.35           | 2.4              | 0.85           |     |                | 0.2 | 0.3 |     |      |      |                |

Note  
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot762-1\_po

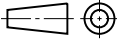
| Outline version | References |        |       |  | European projection                                                                   | Issue date            |
|-----------------|------------|--------|-------|--|---------------------------------------------------------------------------------------|-----------------------|
|                 | IEC        | JEDEC  | JEITA |  |                                                                                       |                       |
| SOT762-1        |            | MO-241 |       |  |  | 15-04-10-<br>15-05-05 |

Fig 12. Package outline SOT762-1 (DHVQFN14)

## 13. Abbreviations

Table 11. Abbreviations

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

## 14. Revision history

Table 12. Revision history

| Document ID         | Release date                                  | Data sheet status  | Change notice | Supersedes          |
|---------------------|-----------------------------------------------|--------------------|---------------|---------------------|
| 74HC_HCT74_Q100 v.3 | 20151204                                      | Product data sheet | -             | 74HC_HCT74_Q100 v.2 |
| Modifications:      | • Type number 74HC74N-Q100 (SOT27-1) removed. |                    |               |                     |
| 74HC_HCT74_Q100 v.2 | 20130906                                      | Product data sheet | -             | 74HC_HCT74_Q100 v.1 |
| Modifications:      | • 74HC74N-Q100 (DIP14) added.                 |                    |               |                     |
| 74HC_HCT74_Q100 v.1 | 20120807                                      | 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".

[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.nexperia.com>.

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