

# 74HC165-Q100; 74HCT165-Q100

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

Rev. 3 — 23 April 2020

Product data sheet

### 1. General description

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The 74HC165-Q100; 74HCT165-Q100 are 8-bit serial or parallel-in/serial-out shift registers. The device features a serial data input (DS), eight parallel data inputs (D0 to D7) and two complementary serial outputs (Q7 and  $\overline{Q7}$ ). When the parallel load input (PL) is LOW the data from D0 to D7 is loaded into the shift register asynchronously. When PL is HIGH data enters the register serially at DS. When the clock enable input ( $\overline{CE}$ ) is LOW data is shifted on the LOW-to-HIGH transitions of the CP input. A HIGH on  $\overline{CE}$  will disable the CP input. Inputs are overvoltage tolerant to 15 V. This enables the device to be used in HIGH-to-LOW level shifting applications.

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

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- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Asynchronous 8-bit parallel load
- Synchronous serial input
- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC165-Q100: CMOS level
  - For 74HCT165-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 pF, R = 0  $\Omega$ )
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

### 3. Applications

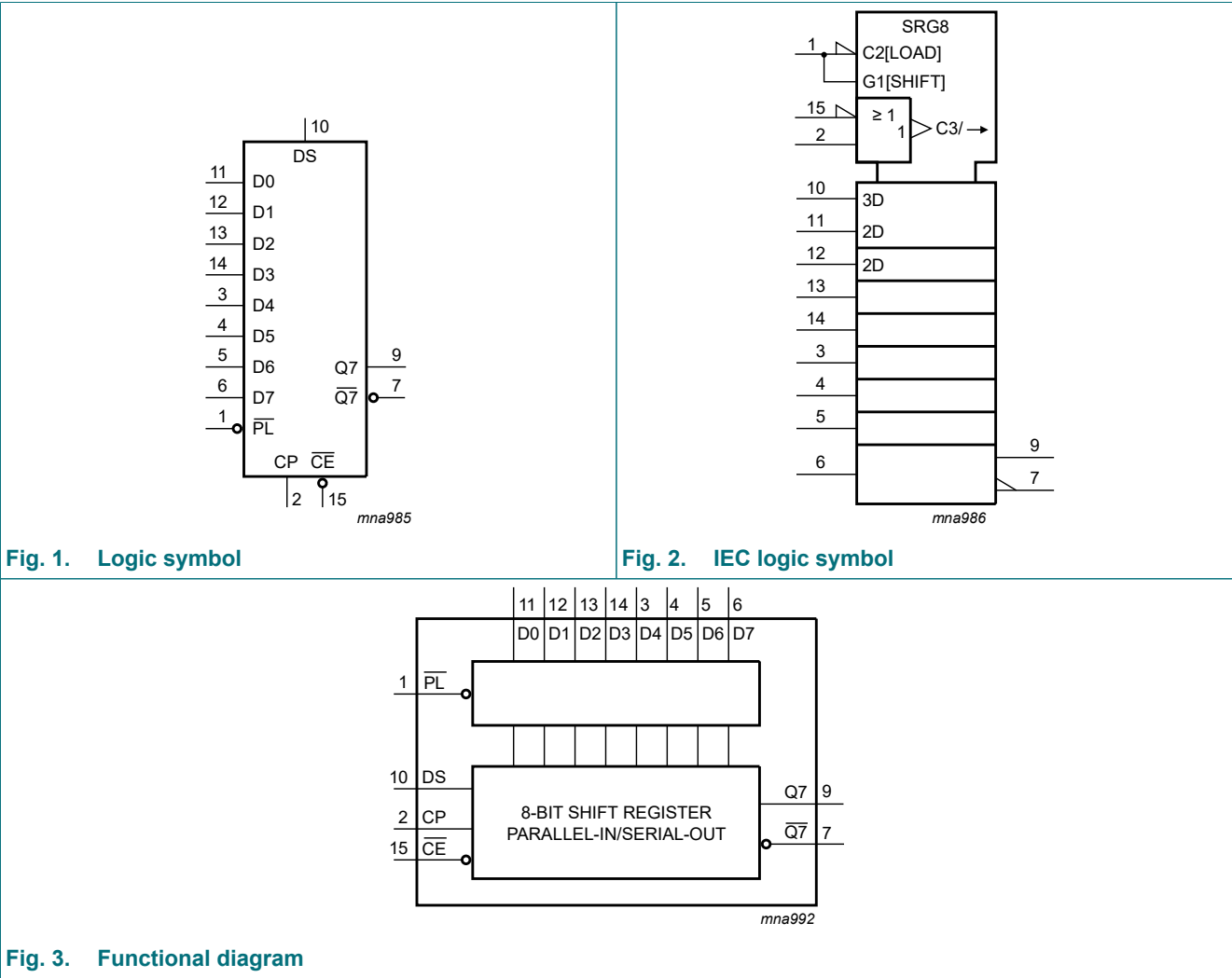
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- Parallel-to-serial data conversion

4. Ordering information

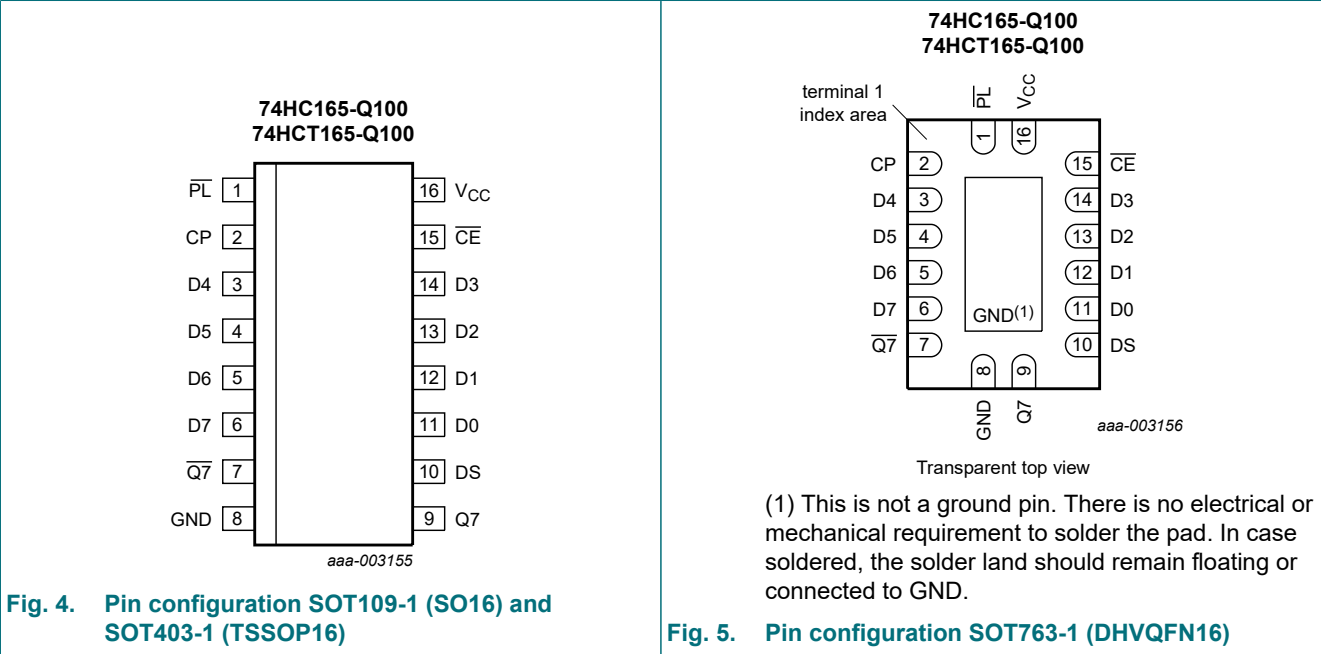
| Table 1. Ordering information |                   |          |                                                                                                                                      |          |
|-------------------------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
| Type number                   | Package           |          |                                                                                                                                      |          |
|                               | Temperature range | Name     | Description                                                                                                                          | Version  |
| 74HC165D-Q100                 | -40 °C to +125 °C | SO16     | plastic small outline package; 16 leads;<br>body width 3.9 mm                                                                        | SOT109-1 |
| 74HCT165D-Q100                |                   |          |                                                                                                                                      |          |
| 74HC165PW-Q100                | -40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm                                                            | SOT403-1 |
| 74HCT165PW-Q100               |                   |          |                                                                                                                                      |          |
| 74HC165BQ-Q100                | -40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads; 16 terminals;<br>body 2.5 × 3.5 × 0.85 mm | SOT763-1 |
| 74HCT165BQ-Q100               |                   |          |                                                                                                                                      |          |

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 2. Pin description

| Symbol          | Pin                        | Description                                   |
|-----------------|----------------------------|-----------------------------------------------|
| $\overline{PL}$ | 1                          | asynchronous parallel load input (active LOW) |
| CP              | 2                          | clock input (LOW-to-HIGH edge-triggered)      |
| $\overline{Q7}$ | 7                          | complementary output from the last stage      |
| GND             | 8                          | ground (0 V)                                  |
| Q7              | 9                          | serial output from the last stage             |
| DS              | 10                         | serial data input                             |
| D0 to D7        | 11, 12, 13, 14, 3, 4, 5, 6 | parallel data inputs (also referred to as Dn) |
| $\overline{CE}$ | 15                         | clock enable input (active LOW)               |
| $V_{CC}$        | 16                         | positive supply voltage                       |

7. 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 = state of the referenced output one set-up time prior to the LOW-to-HIGH clock transition;*  
*X = don't care; ↑ = LOW-to-HIGH clock transition.*

| Operating modes   | Inputs |    |    |    |          | Qn registers |          | Outputs |    |
|-------------------|--------|----|----|----|----------|--------------|----------|---------|----|
|                   | PL     | CE | CP | DS | D0 to D7 | Q0           | Q1 to Q6 | Q7      | Q7 |
| parallel load     | L      | X  | X  | X  | L        | L            | L to L   | L       | H  |
|                   | L      | X  | X  | X  | H        | H            | H to H   | H       | L  |
| serial shift      | H      | L  | ↑  | l  | X        | L            | q0 to q5 | q6      | q6 |
|                   | H      | L  | ↑  | h  | X        | H            | q0 to q5 | q6      | q6 |
|                   | H      | ↑  | L  | l  | X        | L            | q0 to q5 | q6      | q6 |
|                   | H      | ↑  | L  | h  | X        | H            | q0 to q5 | q6      | q6 |
| hold "do nothing" | H      | H  | X  | X  | X        | q0           | q1 to q6 | q7      | q7 |
|                   | H      | X  | H  | X  | X        | q0           | q1 to q6 | q7      | q7 |

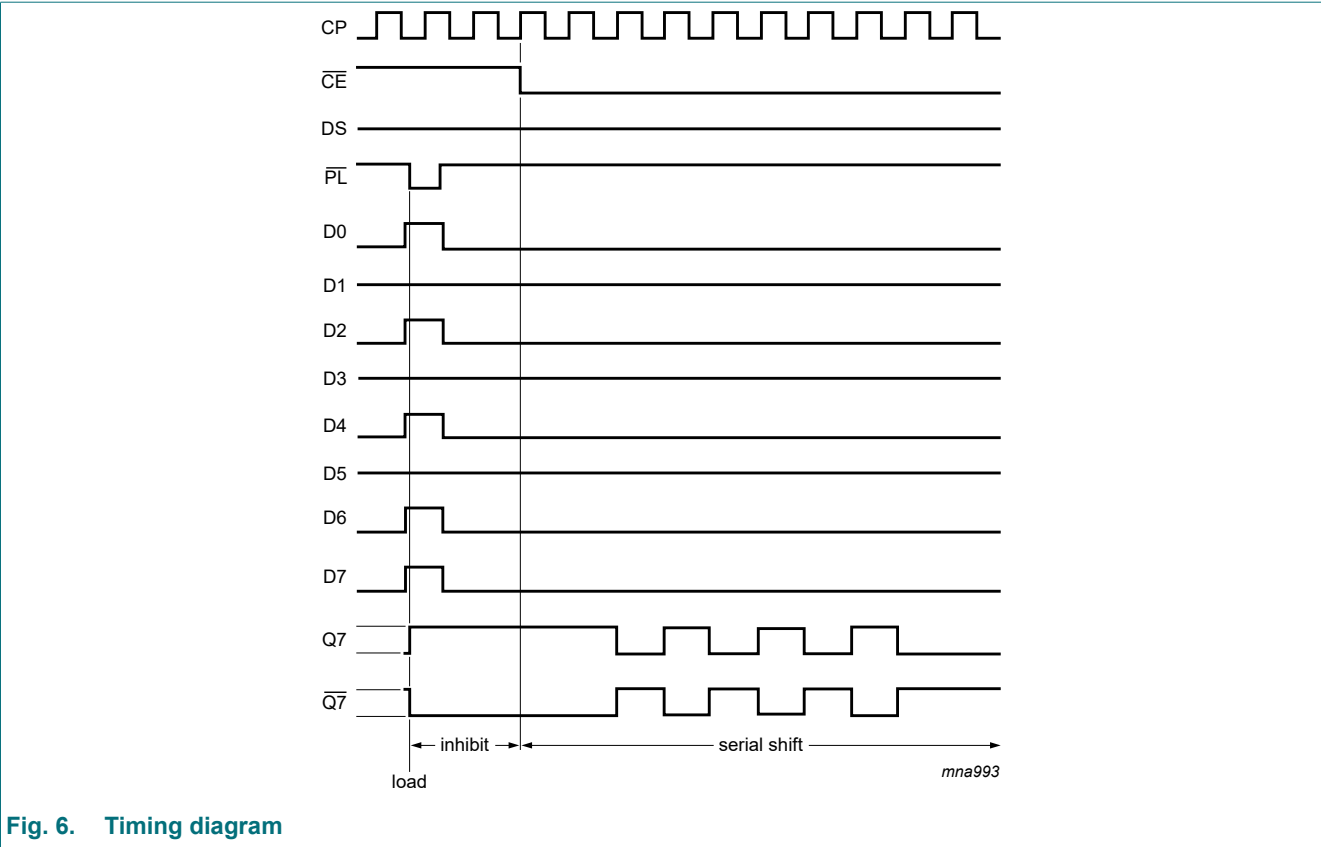


Fig. 6. Timing diagram

## 8. Limiting values

**Table 4. Limiting values**

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

| Symbol    | Parameter               | Conditions                                                 | Min  | Max      | Unit |
|-----------|-------------------------|------------------------------------------------------------|------|----------|------|
| $V_{CC}$  | supply voltage          |                                                            | -0.5 | +7       | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1] | -    | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | -    | $\pm 20$ | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$              | -    | $\pm 25$ | 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 | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [2]          | -    | 500      | mW   |

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

[2] For SOT109-1 (SO16) package:  $P_{tot}$  derates linearly with 12.4 mW/K above 110 °C.

For SOT403-1 (TSSOP16) package:  $P_{tot}$  derates linearly with 8.5 mW/K above 91 °C.

For SOT763-1 (DHVQFN16) package:  $P_{tot}$  derates linearly with 11.2 mW/K above 106 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol              | Parameter                           | Conditions              | 74HC165-Q100 |      |          | 74HCT165-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          | -    | +125     | -40           | -    | +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 |

## 10. 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  |      |
| 74HC165-Q100    |                          |                         |       |     |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage | V <sub>CC</sub> = 2.0 V | 1.5   | 1.2 | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | 3.15  | 2.4 | -    | 3.15             | -    | 3.15              | -    | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | 4.2   | 3.2 | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage  | V <sub>CC</sub> = 2.0 V | -     | 0.8 | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | -     | 2.1 | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | -     | 2.8 | 1.8  | -                | 1.8  | -                 | 1.8  | V    |

| Symbol               | Parameter                 | Conditions                                                                                                                        | 25 °C |      |      | -40 °C to +85 °C |       | -40 °C to +125 °C |       | Unit |
|----------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|-------|-------------------|-------|------|
|                      |                           |                                                                                                                                   | Min   | Typ  | Max  | Min              | Max   | Min               | Max   |      |
| V <sub>OH</sub>      | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                               |       |      |      |                  |       |                   |       |      |
|                      |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                                                                  | 1.9   | 2.0  | -    | 1.9              | -     | 1.9               | -     | V    |
|                      |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                                                                  | 4.4   | 4.5  | -    | 4.4              | -     | 4.4               | -     | V    |
|                      |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                                                                  | 5.9   | 6.0  | -    | 5.9              | -     | 5.9               | -     | V    |
|                      |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                 | 3.98  | 4.32 | -    | 3.84             | -     | 3.7               | -     | V    |
|                      |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                 | 5.48  | 5.81 | -    | 5.34             | -     | 5.2               | -     | V    |
| V <sub>OL</sub>      | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                               |       |      |      |                  |       |                   |       |      |
|                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V                                                                                   | -     | 0    | 0.1  | -                | 0.1   | -                 | 0.1   | V    |
|                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                                   | -     | 0    | 0.1  | -                | 0.1   | -                 | 0.1   | V    |
|                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                                                                   | -     | 0    | 0.1  | -                | 0.1   | -                 | 0.1   | V    |
|                      |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                  | -     | 0.15 | 0.26 | -                | 0.33  | -                 | 0.4   | V    |
|                      |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                  | -     | 0.16 | 0.26 | -                | 0.33  | -                 | 0.4   | V    |
| I <sub>I</sub>       | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; 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                                            | -     | -    | 8.0  | -                | 80    | -                 | 160   | µA   |
| C <sub>I</sub>       | input capacitance         |                                                                                                                                   | -     | 3.5  | -    | -                | -     | -                 | -     | pF   |
| <b>74HCT165-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              | -     | 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>                                                                               |       |      |      |                  |       |                   |       |      |
|                      |                           | 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                                                                                  | -     | 0.16 | 0.26 | -                | 0.33  | -                 | 0.4   | V    |
| I <sub>I</sub>       | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; 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                                            | -     | -    | 8.0  | -                | 80    | -                 | 160   | µA   |
| ΔI <sub>CC</sub>     | additional supply current | per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V |       |      |      |                  |       |                   |       |      |
|                      |                           | Dn and DS inputs                                                                                                                  | -     | 35   | 126  | -                | 157.5 | -                 | 171.5 | µA   |
|                      |                           | CP, $\overline{\text{CE}}$ , and $\overline{\text{PE}}$ inputs                                                                    | -     | 65   | 234  | -                | 292.5 | -                 | 318.5 | µA   |
| C <sub>I</sub>       | input capacitance         |                                                                                                                                   | -     | 3.5  | -    | -                | -     | -                 | -     | pF   |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

$C_L = 50$  pF unless otherwise specified; for test circuit, see [Fig. 12](#)

| Symbol           | Parameter         | Conditions                                                                    | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------|-------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                   |                                                                               | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC165-Q100     |                   |                                                                               |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay | CP or $\overline{CE}$ to Q7, $\overline{Q7}$ ; see <a href="#">Fig. 7</a> [1] |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | -     | 52  | 165 | -                | 205 | -                 | 250 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | -     | 19  | 33  | -                | 41  | -                 | 50  | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | -     | 15  | 28  | -                | 35  | -                 | 43  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                               | -     | 16  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | $\overline{PL}$ to Q7, $\overline{Q7}$ ; see <a href="#">Fig. 8</a>           |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | -     | 50  | 165 | -                | 205 | -                 | 250 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | -     | 18  | 33  | -                | 41  | -                 | 50  | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | -     | 14  | 28  | -                | 35  | -                 | 43  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                               | -     | 15  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | D7 to Q7, $\overline{Q7}$ ; see <a href="#">Fig. 9</a>                        |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | -     | 36  | 120 | -                | 150 | -                 | 180 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | -     | 13  | 24  | -                | 30  | -                 | 36  | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | -     | 10  | 20  | -                | 26  | -                 | 31  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                               | -     | 11  | -   | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>   | transition time   | Q7, $\overline{Q7}$ output; see <a href="#">Fig. 7</a> [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   |
| t <sub>w</sub>   | pulse width       | CP input HIGH or LOW; see <a href="#">Fig. 7</a>                              |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|                  |                   | $\overline{PL}$ input LOW; see <a href="#">Fig. 8</a>                         |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | 80    | 14  | -   | 100              | -   | 120               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | 16    | 5   | -   | 20               | -   | 24                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | 14    | 4   | -   | 17               | -   | 20                | -   | ns   |
| t <sub>rec</sub> | recovery time     | $\overline{PL}$ to CP, $\overline{CE}$ ; see <a href="#">Fig. 8</a>           |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                       | 100   | 22  | -   | 125              | -   | 150               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                       | 20    | 8   | -   | 25               | -   | 30                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                       | 17    | 6   | -   | 21               | -   | 26                | -   | ns   |

| Symbol               | Parameter                     | Conditions                                                        | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|----------------------|-------------------------------|-------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                      |                               |                                                                   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_{su}$             | set-up time                   | DS to CP, $\overline{CE}$ ; see Fig. 10                           |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 80    | 11  | -   | 100              | -   | 120               | -   | ns   |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 16    | 4   | -   | 20               | -   | 24                | -   | ns   |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 14    | 3   | -   | 17               | -   | 20                | -   | ns   |
|                      |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see Fig. 10     |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|                      |                               | Dn to $\overline{PL}$ ; see Fig. 11                               |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 80    | 22  | -   | 100              | -   | 120               | -   | ns   |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 16    | 8   | -   | 20               | -   | 24                | -   | ns   |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 14    | 6   | -   | 17               | -   | 20                | -   | ns   |
| $t_h$                | hold time                     | DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ; see Fig. 10 |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 5     | 2   | -   | 5                | -   | 5                 | -   | ns   |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 5     | 2   | -   | 5                | -   | 5                 | -   | ns   |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 5     | 2   | -   | 5                | -   | 5                 | -   | ns   |
|                      |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see Fig. 10     |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 5     | -17 | -   | 5                | -   | 5                 | -   | ns   |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 5     | -6  | -   | 5                | -   | 5                 | -   | ns   |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 5     | -5  | -   | 5                | -   | 5                 | -   | ns   |
| $f_{max}$            | maximum frequency             | CP input; see Fig. 7                                              |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 2.0\text{ V}$                                           | 6     | 17  | -   | 5                | -   | 4                 | -   | MHz  |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | 30    | 51  | -   | 24               | -   | 20                | -   | MHz  |
|                      |                               | $V_{CC} = 6.0\text{ V}$                                           | 35    | 61  | -   | 28               | -   | 24                | -   | MHz  |
|                      |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$                    | -     | 56  | -   | -                | -   | -                 | -   | MHz  |
| $C_{PD}$             | power dissipation capacitance | per package; $V_I = \text{GND to } V_{CC}$ [3]                    | -     | 35  | -   | -                | -   | -                 | -   | pF   |
| <b>74HCT165-Q100</b> |                               |                                                                   |       |     |     |                  |     |                   |     |      |
| $t_{pd}$             | propagation delay             | $\overline{CE}$ , CP to Q7, $\overline{Q7}$ ; see Fig. 7 [1]      |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | -     | 17  | 34  | -                | 43  | -                 | 51  | ns   |
|                      |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$                    | -     | 14  | -   | -                | -   | -                 | -   | ns   |
|                      |                               | $\overline{PL}$ to Q7, $\overline{Q7}$ ; see Fig. 8               |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | -     | 20  | 40  | -                | 50  | -                 | 60  | ns   |
|                      |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$                    | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                      |                               | D7 to Q7, $\overline{Q7}$ ; see Fig. 9                            |       |     |     |                  |     |                   |     |      |
|                      |                               | $V_{CC} = 4.5\text{ V}$                                           | -     | 14  | 28  | -                | 35  | -                 | 42  | ns   |
|                      |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$                    | -     | 11  | -   | -                | -   | -                 | -   | ns   |

| Symbol    | Parameter                     | Conditions                                                        | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|-------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                               |                                                                   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_t$     | transition time               | Q7, $\overline{Q7}$ output; see Fig. 7 [2]                        |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_W$     | pulse width                   | CP input; see Fig. 7                                              |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|           |                               | $\overline{PL}$ input; see Fig. 8                                 |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 20    | 9   | -   | 25               | -   | 30                | -   | ns   |
| $t_{rec}$ | recovery time                 | $\overline{PL}$ to CP, $\overline{CE}$ ; see Fig. 8               |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 20    | 8   | -   | 25               | -   | 30                | -   | ns   |
| $t_{su}$  | set-up time                   | DS to CP, $\overline{CE}$ ; see Fig. 10                           |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 20    | 2   | -   | 25               | -   | 30                | -   | ns   |
|           |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see Fig. 10     |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 20    | 7   | -   | 25               | -   | 30                | -   | ns   |
|           |                               | Dn to $\overline{PL}$ ; see Fig. 11                               |       |     |     |                  |     |                   |     |      |
| $t_h$     | hold time                     | $V_{CC} = 4.5\text{ V}$                                           | 20    | 10  | -   | 25               | -   | 30                | -   | ns   |
|           |                               | DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ; see Fig. 10 |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 7     | -1  | -   | 9                | -   | 11                | -   | ns   |
|           |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see Fig. 10     |       |     |     |                  |     |                   |     |      |
| $f_{max}$ | maximum frequency             | $V_{CC} = 4.5\text{ V}$                                           | 0     | -7  | -   | 0                | -   | 0                 | -   | ns   |
|           |                               | CP input; see Fig. 7                                              |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$                                           | 26    | 44  | -   | 21               | -   | 17                | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$                    | -     | 48  | -   | -                | -   | -                 | -   | MHz  |
|           |                               | per package; $V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ [3]     | -     | 35  | -   | -                | -   | -                 | -   | pF   |

[1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .

[2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

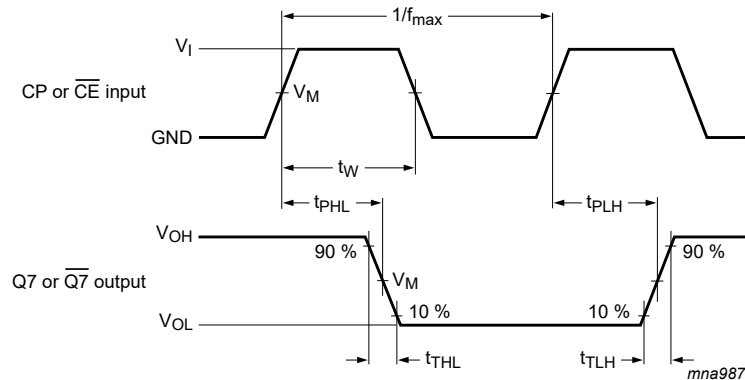
$f_o$  = output frequency in MHz;

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

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V.

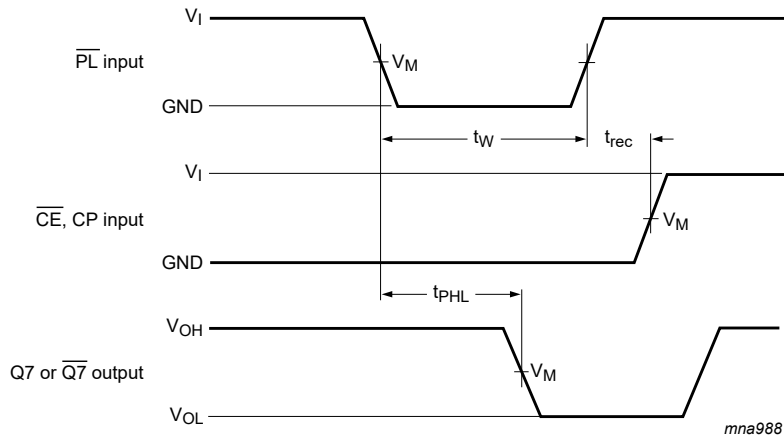
### 11.1. Waveforms and test circuit



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

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

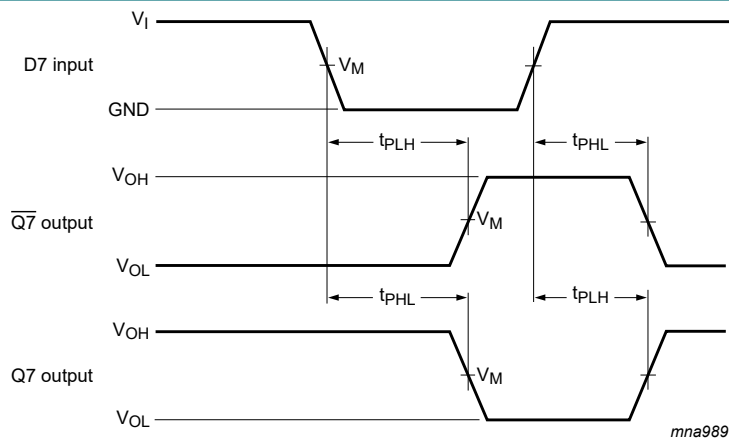
**Fig. 7. The clock (CP) or clock enable ( $\overline{CE}$ ) to output (Q7 or  $\overline{Q7}$ ) propagation delays, the clock pulse width, the maximum clock frequency and the output transition times**



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

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

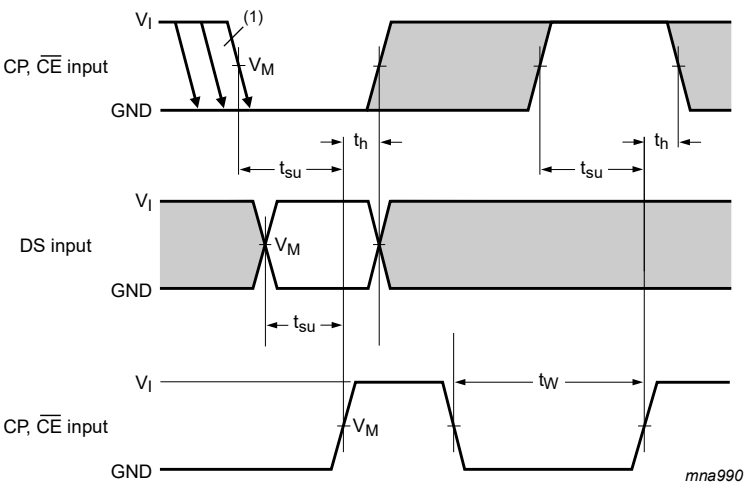
**Fig. 8. The parallel load ( $\overline{PL}$ ) pulse width, the parallel load to output (Q7 or  $\overline{Q7}$ ) propagation delays, the parallel load to clock (CP) and clock enable ( $\overline{CE}$ ) recovery time**



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

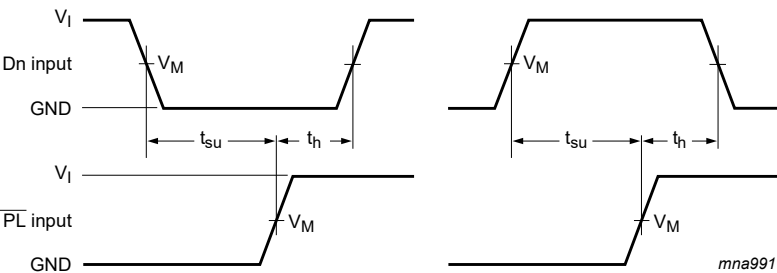
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig. 9. The data input (D7) to output (Q7 or  $\overline{Q7}$ ) propagation delays when  $\overline{PL}$  is LOW**



(1)  $\overline{CE}$  may change only from HIGH-to-LOW while CP is LOW.  
The shaded areas indicate when the input is permitted to change for predictable output performance  
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig. 10. The set-up and hold times from the serial data input (DS) to the clock (CP) and clock enable ( $\overline{CE}$ ) inputs, from the clock enable input ( $\overline{CE}$ ) to the clock input (CP) and from the clock input (CP) to the clock enable input ( $\overline{CE}$ )**



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig. 11. The set-up and hold times from the data inputs (Dn) to the parallel load input ( $\overline{PL}$ )**

**Table 8. Measurement points**

| Type          | Input    |             | Output      |
|---------------|----------|-------------|-------------|
|               | $V_I$    | $V_M$       | $V_M$       |
| 74HC165-Q100  | $V_{CC}$ | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT165-Q100 | 3 V      | 1.3 V       | 1.3 V       |

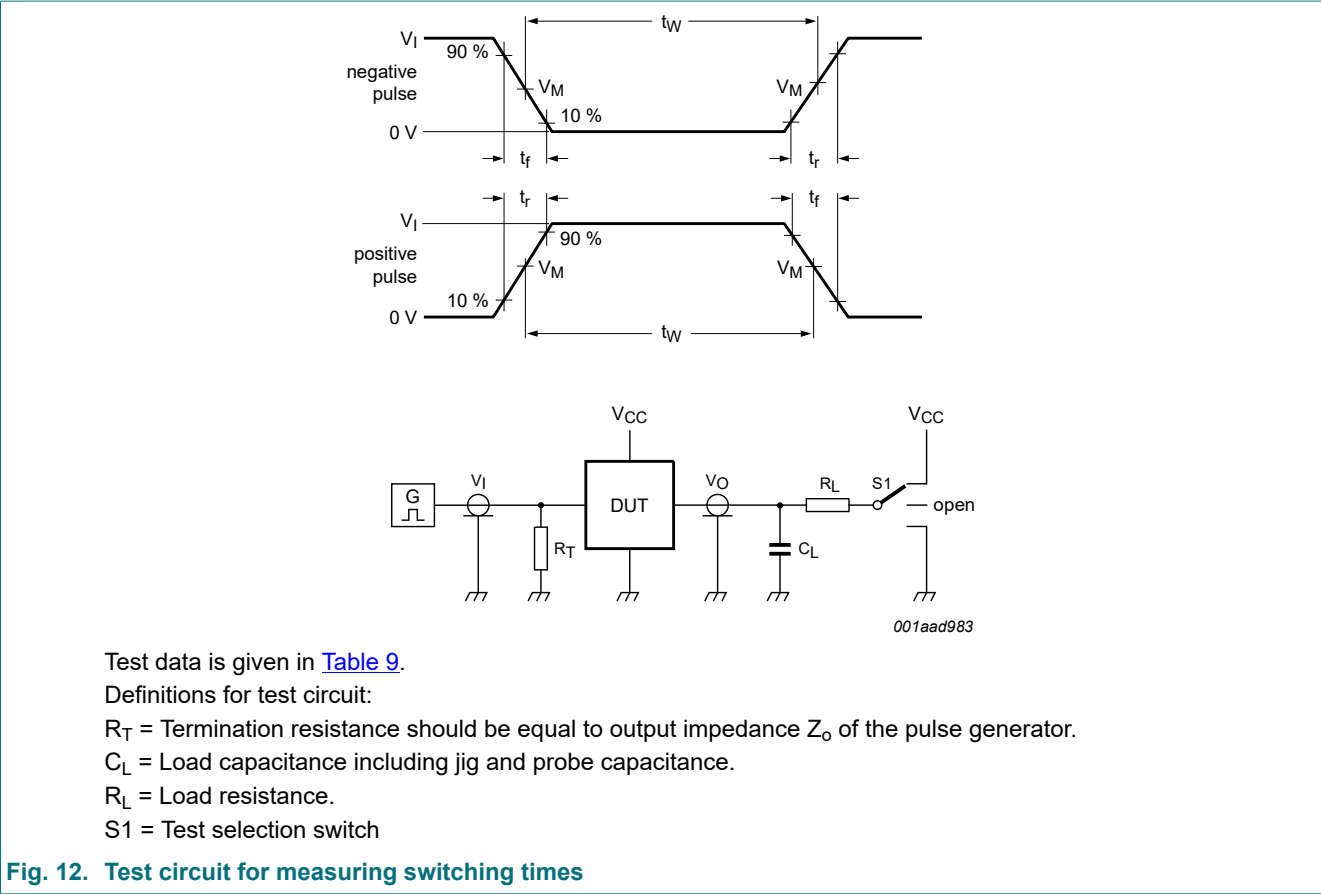


Fig. 12. Test circuit for measuring switching times

Table 9. Test data

| Type          | Input    |            | Load         |              | S1 position |
|---------------|----------|------------|--------------|--------------|-------------|
|               | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        |             |
| 74HC165-Q100  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open        |
| 74HCT165-Q100 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open        |

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

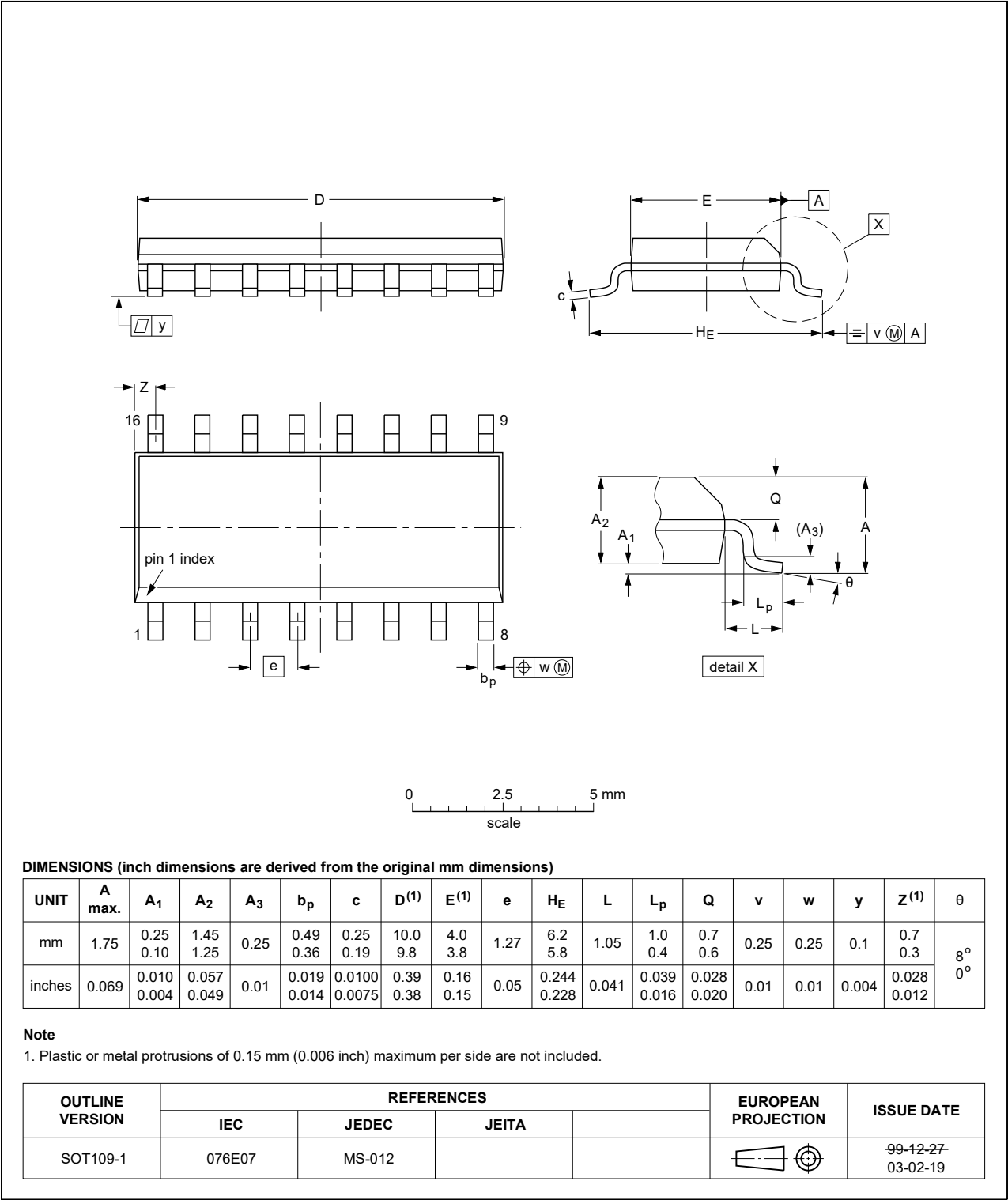


Fig. 13. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

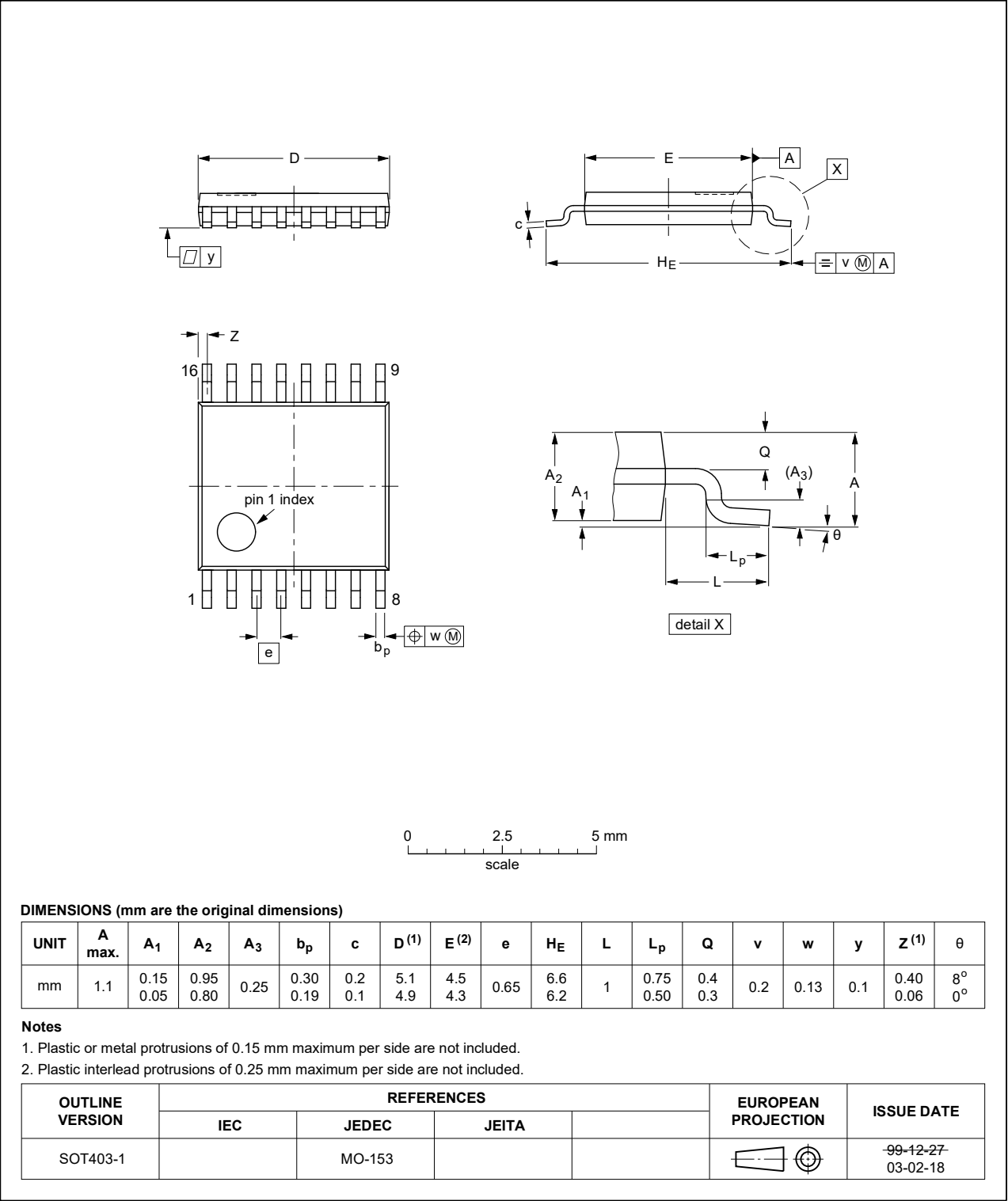


Fig. 14. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;  
16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

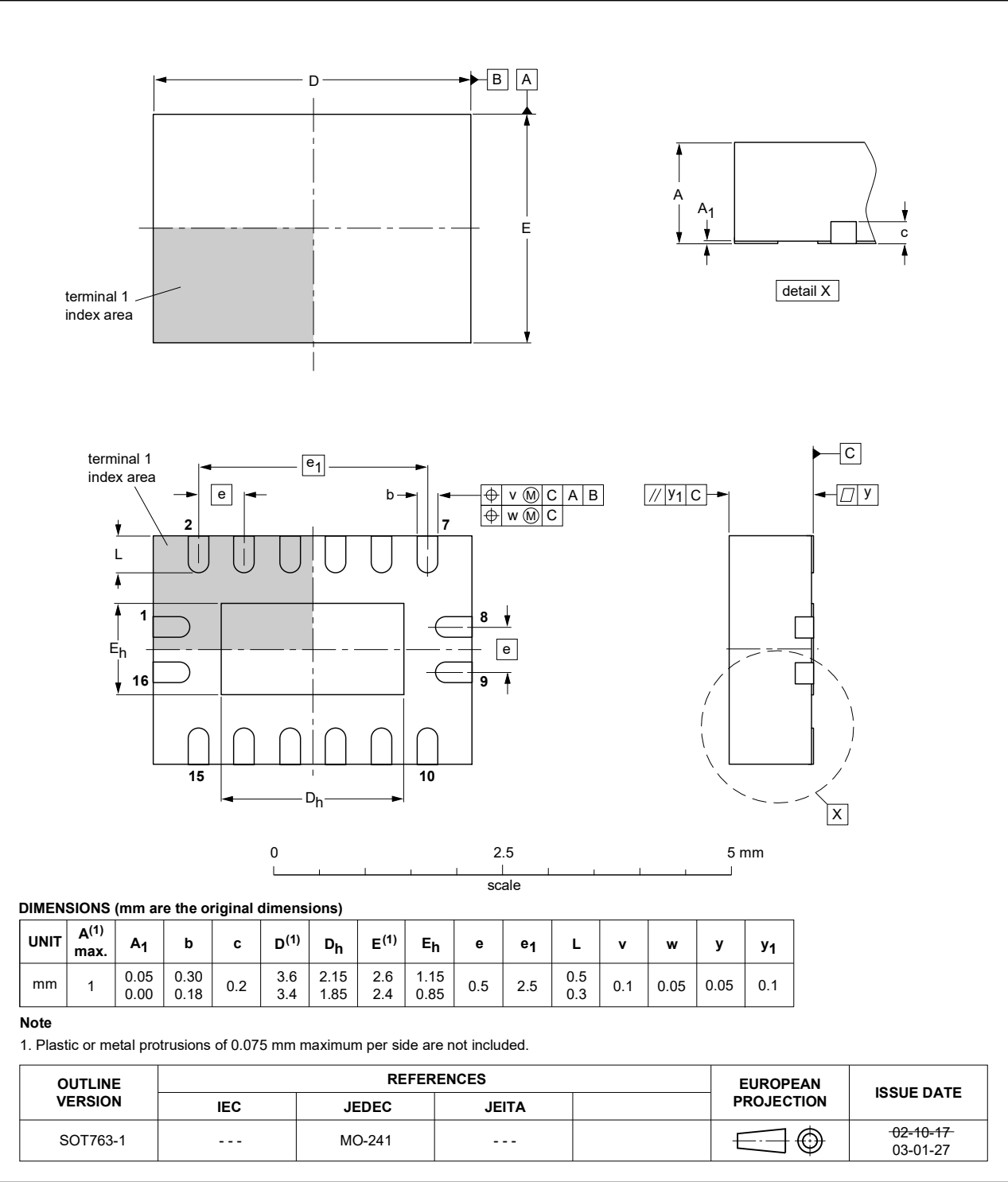


Fig. 15. Package outline SOT763-1 (DHVQFN16)

## 13. Abbreviations

Table 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

| Document ID          | Release date                                                                                                                                                                                                                                                                                                                                                       | Data sheet status  | Change notice | Supersedes           |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|----------------------|
| 74HC_HCT165_Q100 v.3 | 20200423                                                                                                                                                                                                                                                                                                                                                           | Product data sheet | -             | 74HC_HCT165_Q100 v.2 |
| Modifications:       | <ul style="list-style-type: none"><li>• <a href="#">Section 2</a> updated.</li><li>• <a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li></ul>                                                                                                                                                                  |                    |               |                      |
| 74HC_HCT165_Q100 v.2 | 20170821                                                                                                                                                                                                                                                                                                                                                           | Product data sheet | -             | 74HC_HCT165_Q100 v.1 |
| Modifications:       | <ul style="list-style-type: none"><li>• <a href="#">Section 1</a> updated.</li><li>• <a href="#">Table 7</a>: Hold time for 74HC165 has been updated.</li><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></ul> |                    |               |                      |
| 74HC_HCT165_Q100 v.1 | 20120717                                                                                                                                                                                                                                                                                                                                                           | Product data sheet | -             | -                    |

## 15. Legal information

### Data sheet status

| Document status<br>[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".
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