

# 74HC165; 74HCT165

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

Rev. 4 — 28 December 2015

Product data sheet

### 1. General description

The 74HC165; 74HCT165 is an 8-bit serial or parallel-in/serial-out shift register. 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 ( $\overline{PL}$ ) is LOW the data from D0 to D7 is loaded into the shift register asynchronously. When  $\overline{PL}$  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 include clamp diodes, this enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

### 2. Features and benefits

- Asynchronous 8-bit parallel load
- Synchronous serial input
- Complies with JEDEC standard no. 7A
- Input levels:
  - ◆ For 74HC165: CMOS level
  - ◆ For 74HCT165: TTL level
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

### 3. Applications

- Parallel-to-serial data conversion

### 4. Ordering information

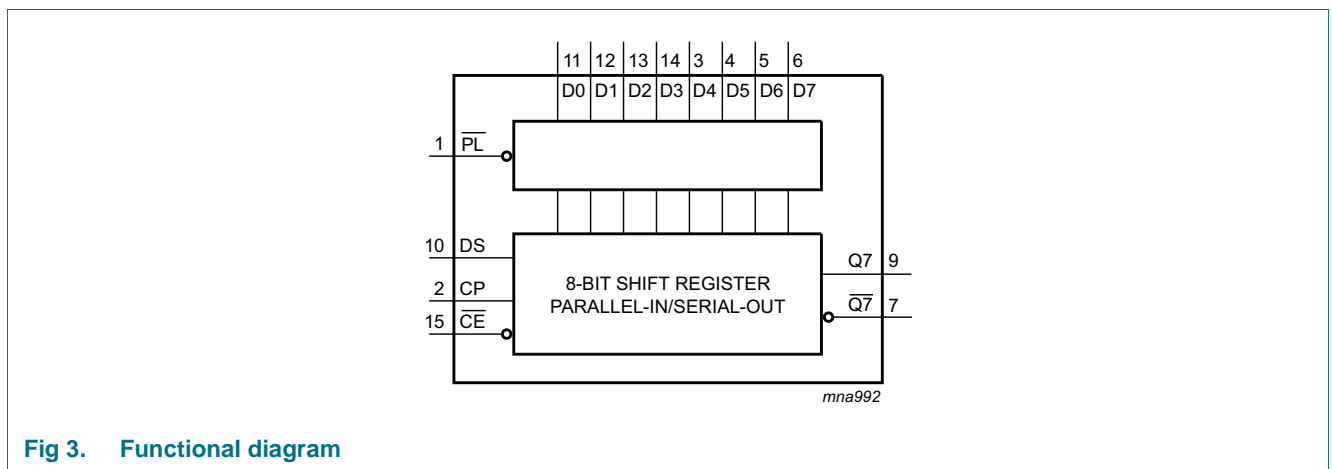
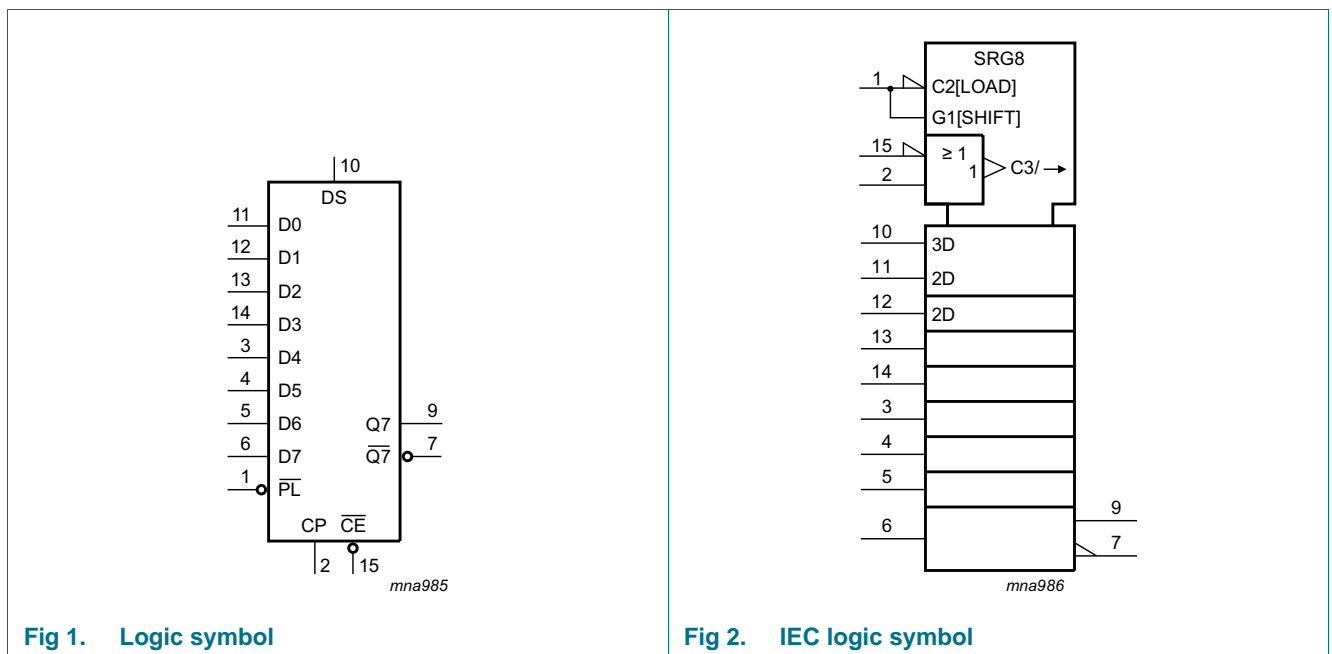
Table 1. Ordering information

| Type number | Package   |        |   |          |
|-------------|---|--------|---|----------|
|             | Temperature range   | Name   | Description   | Version  |
| 74HC165D    | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO16   | plastic small outline package; 16 leads; body width 3.9 mm        | SOT109-1 |
| 74HCT165D   |   |        |   |          |
| 74HC165DB   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HCT165DB  |   |        |   |          |

**Table 1. Ordering information ...continued**

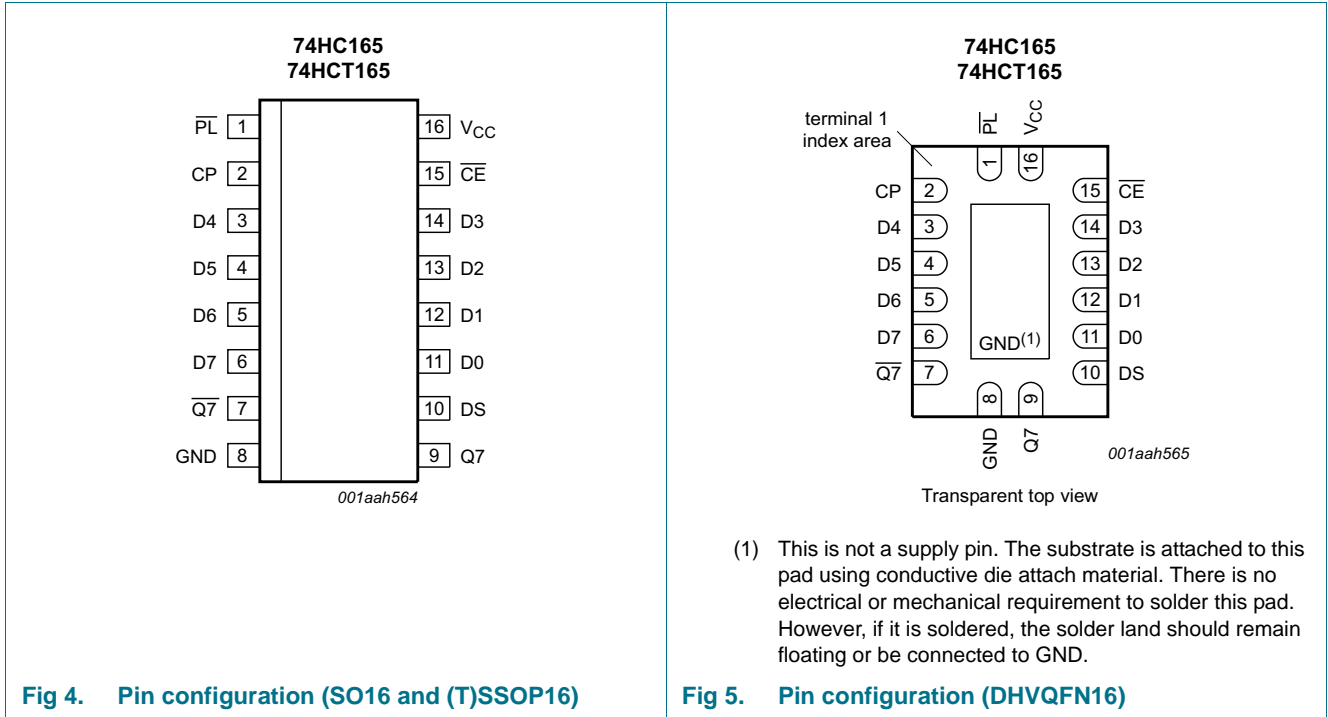
| Type number | Package           |          |  | Version  |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  |          |
| 74HC165PW   | -40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads; body width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

## 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 <sub>CC</sub> | 16                         | positive supply voltage                       |

## 7. Functional description

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

| Operating modes   | Inputs                 |                        |    |    |          | Qn registers |          | Outputs |                        |
|-------------------|------------------------|------------------------|----|----|----------|--------------|----------|---------|------------------------|
|                   | $\overline{\text{PL}}$ | $\overline{\text{CE}}$ | CP | DS | D0 to D7 | Q0           | Q1 to Q6 | Q7      | $\overline{\text{Q7}}$ |
| 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      | $\overline{\text{q6}}$ |
|                   | H                      | L                      | ↑  | h  | X        | H            | q0 to q5 | q6      | $\overline{\text{q6}}$ |
|                   | H                      | ↑                      | L  | l  | X        | L            | q0 to q5 | q6      | $\overline{\text{q6}}$ |
|                   | H                      | ↑                      | L  | h  | X        | H            | q0 to q5 | q6      | $\overline{\text{q6}}$ |
| hold "do nothing" | H                      | H                      | X  | X  | X        | q0           | q1 to q6 | q7      | $\overline{\text{q7}}$ |
|                   | H                      | X                      | H  | X  | X        | q0           | q1 to q6 | q7      | $\overline{\text{q7}}$ |

- [1] H = HIGH voltage level;  
 h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition;  
 L = LOW voltage level;  
 l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition;  
 q = 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.

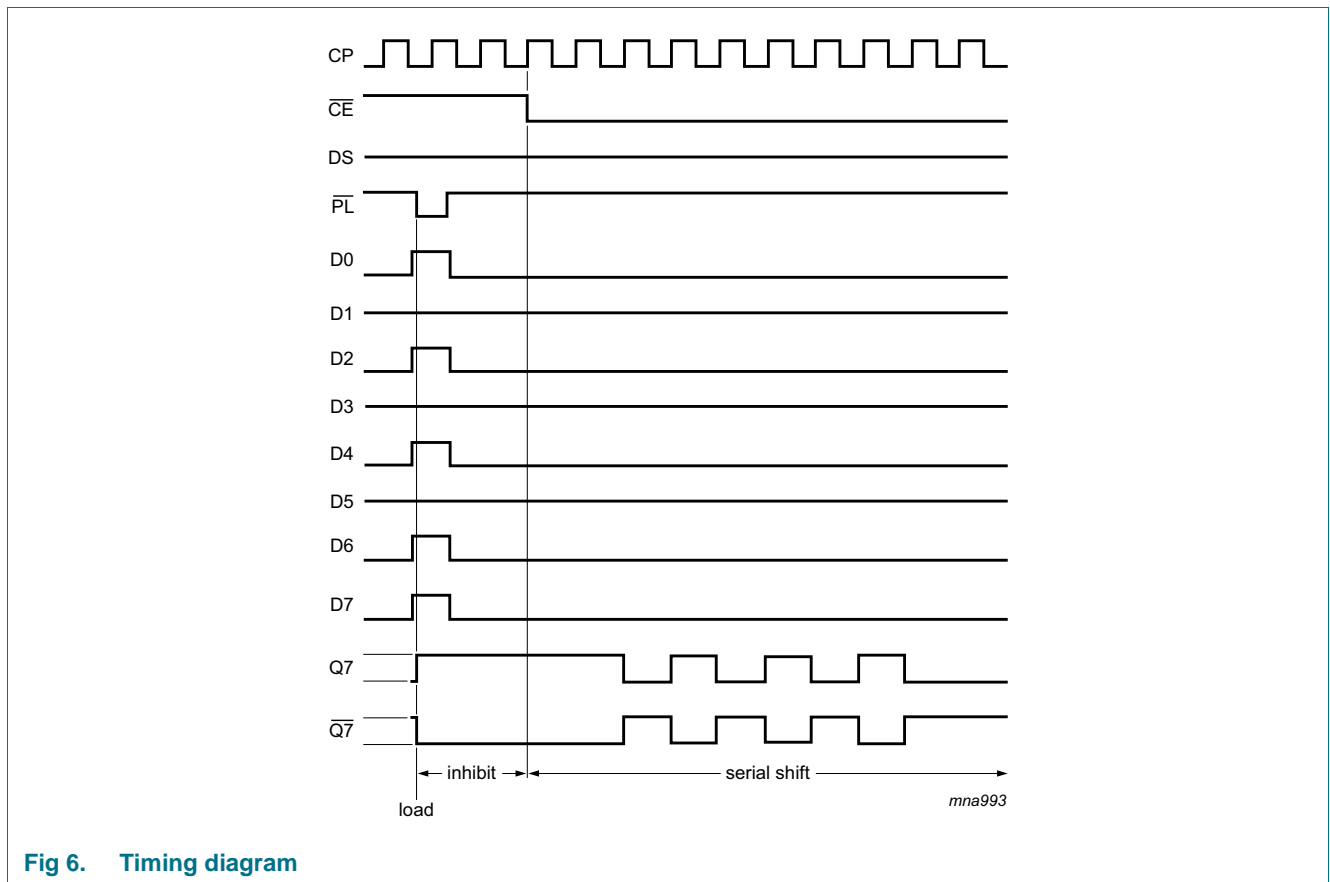


Fig 6. Timing diagram

## 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 $+125\text{ °C}$              |      |          |      |
|           |                         | SO16 package [2]   | -    | 500      | mW   |
|           |                         | (T)SSOP16 package [3]                                      | -    | 500      | mW   |
|           |                         | DHVQFN16 package [4]                                       | -    | 500      | mW   |

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

[2]  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[3]  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

[4]  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol              | Parameter                           | Conditions              | 74HC165 |      |          | 74HCT165 |      |          | 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  |      |
| <b>74HC165</b>  |                           |   |                |   |      |                  |      |                   |      |      |
| 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    |
| 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    |
| 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>I</sub>  | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V           | -              | -   | ±0.1 | -                | ±1   | -                 | ±1   | μA   |
|                 |                           | I <sub>CC</sub>   | supply current | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 6.0 V | -    | -                | 8.0  | -                 | 80   | -    |
| C <sub>I</sub>  | input capacitance         |   | -              | 3.5   | -    | -                | -    | -                 | -    | pF   |
| <b>74HCT165</b> |                           |   |                |   |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V  | 2.0            | 1.6   | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V  | -              | 1.2   | 0.8  | -                | 0.8  | -                 | 0.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V |                |   |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 μA   | 4.4            | 4.5   | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -4.0 mA  | 3.98           | 4.32  | -    | 3.84             | -    | 3.7               | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V |                |   |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V                               | -              | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                              | -              | 0.16  | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V           | -              | -   | ±0.1 | -                | ±1   | -                 | ±1   | μA   |

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

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

| Symbol           | Parameter                 | Conditions   | 25 °C |     |     | -40 °C to +85 °C |       | -40 °C to +125 °C |       | Unit |
|------------------|---------------------------|--|-------|-----|-----|------------------|-------|-------------------|-------|------|
|                  |                           |  | Min   | Typ | Max | Min              | Max   | Min               | Max   |      |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 6.0 V  | -     | -   | 8.0 | -                | 80    | -                 | 160   | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>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 |       |     |     |                  |       |                   |       |      |
|                  |                           | Dn and DS inputs   | -     | 35  | 126 | -                | 157.5 | -                 | 171.5 | μA   |
|                  |                           | CP $\overline{CE}$ , and $\overline{PL}$ inputs  | -     | 65  | 234 | -                | 292.5 | -                 | 318.5 | μA   |
| C <sub>I</sub>   | input capacitance         |  | -     | 3.5 | -   | -                | -     | -                 | -     | pF   |

## 11. Dynamic characteristics

**Table 7.** Dynamic characteristicsGND (ground = 0 V); C<sub>L</sub> = 50 pF unless otherwise specified; for test circuit, see [Figure 12](#)

| Symbol  | Parameter         | Conditions  | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|---|-------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
|   |                   |   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| <b>74HC165</b>                                  |                   |   |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>                                 | propagation delay | CP or $\overline{CE}$ to Q7, $\overline{Q7}$ ;<br>see <a href="#">Figure 7</a> <sup>[1]</sup> |       |     |     |                  |     |                   |     |      |
|   |                   | 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="#">Figure 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="#">Figure 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="#">Figure 7</a> <sup>[2]</sup>                       |       |     |     |                  |     |                   |     |      |
|   |                   | V <sub>CC</sub> = 2.0 V   | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|   |                   | V <sub>CC</sub> = 4.5 V   | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|   |                   | V <sub>CC</sub> = 6.0 V   | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |

**Table 7. Dynamic characteristics ...continued**GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 12](#)

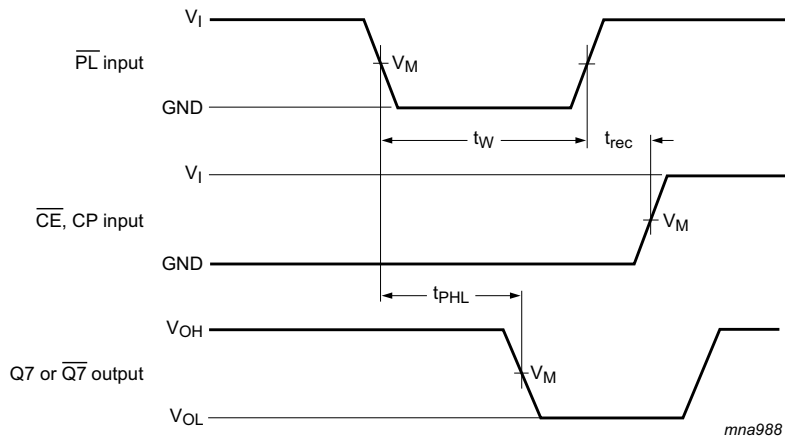
| Symbol    | Parameter        | Conditions   | 25 °C |     |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|-----------|------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                  |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_w$     | pulse width      | CP input HIGH or LOW;<br>see <a href="#">Figure 7</a>                                  |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|           |                  | $\overline{PL}$ input LOW; see <a href="#">Figure 8</a>                                |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 80    | 14  | -   | 100              | -   | 120               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 16    | 5   | -   | 20               | -   | 24                | -   | ns   |
|           | $V_{CC} = 6.0$ V | 14   | 4     | -   | 17  | -                | 20  | -                 | ns  |      |
| $t_{rec}$ | recovery time    | $\overline{PL}$ to CP, $\overline{CE}$ ; see <a href="#">Figure 8</a>                  |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 100   | 22  | -   | 125              | -   | 150               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 20    | 8   | -   | 25               | -   | 30                | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 17    | 6   | -   | 21               | -   | 26                | -   | ns   |
| $t_{su}$  | set-up time      | DS to CP, $\overline{CE}$ ; see <a href="#">Figure 10</a>                              |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 80    | 11  | -   | 100              | -   | 120               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 16    | 4   | -   | 20               | -   | 24                | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 14    | 3   | -   | 17               | -   | 20                | -   | ns   |
|           |                  | $\overline{CE}$ to CP and CP to $\overline{CE}$ ;<br>see <a href="#">Figure 10</a>     |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|           |                  | Dn to $\overline{PL}$ ; see <a href="#">Figure 11</a>                                  |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 80    | 22  | -   | 100              | -   | 120               | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 16    | 8   | -   | 20               | -   | 24                | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 14    | 6   | -   | 17               | -   | 20                | -   | ns   |
| $t_h$     | hold time        | DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ;<br>see <a href="#">Figure 10</a> |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 5     | 6   | -   | 5                | -   | 5                 | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 5     | 2   | -   | 5                | -   | 5                 | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 5     | 2   | -   | 5                | -   | 5                 | -   | ns   |
|           |                  | $\overline{CE}$ to CP and CP to $\overline{CE}$ ;<br>see <a href="#">Figure 10</a>     |       |     |     |                  |     |                   |     |      |
|           |                  | $V_{CC} = 2.0$ V   | 5     | -17 | -   | 5                | -   | 5                 | -   | ns   |
|           |                  | $V_{CC} = 4.5$ V   | 5     | -6  | -   | 5                | -   | 5                 | -   | ns   |
|           |                  | $V_{CC} = 6.0$ V   | 5     | -5  | -   | 5                | -   | 5                 | -   | ns   |



**Table 7. Dynamic characteristics ...continued**GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 12](#)

| Symbol          | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $f_{\max}$      | maximum frequency             | CP input; see <a href="#">Figure 7</a>   |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V   | 6     | 17  | -   | 5                | -   | 4                 | -   | MHz  |
|                 |                               | $V_{CC} = 4.5$ V   | 30    | 51  | -   | 24               | -   | 20                | -   | MHz  |
|                 |                               | $V_{CC} = 6.0$ V   | 35    | 61  | -   | 28               | -   | 24                | -   | MHz  |
| $C_{PD}$        | power dissipation capacitance | per package; $V_1 = \text{GND to } V_{CC}$ <a href="#">[3]</a>                                 | -     | 35  | -   | -                | -   | -                 | -   | pF   |
|                 |                               |  |       |     |     |                  |     |                   |     |      |
| <b>74HCT165</b> |                               |  |       |     |     |                  |     |                   |     |      |
| $t_{pd}$        | propagation delay             | $\overline{CE}$ , CP to Q7, $\overline{Q7}$ ; see <a href="#">Figure 7</a> <a href="#">[1]</a> |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | -     | 17  | 34  | -                | 43  | -                 | 51  | ns   |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF  | -     | 14  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | $\overline{PL}$ to Q7, $\overline{Q7}$ ; see <a href="#">Figure 8</a>                          |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | -     | 20  | 40  | -                | 50  | -                 | 60  | ns   |
|                 |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF  | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | D7 to Q7, $\overline{Q7}$ ; see <a href="#">Figure 9</a>                                       |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | -     | 14  | 28  | -                | 35  | -                 | 42  | ns   |
| $t_t$           | transition time               | Q7, $\overline{Q7}$ output; see <a href="#">Figure 7</a> <a href="#">[2]</a>                   |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_{wv}$        | pulse width                   | CP input; see <a href="#">Figure 7</a>   |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                 |                               | $\overline{PL}$ input; see <a href="#">Figure 8</a>  |       |     |     |                  |     |                   |     |      |
| $t_{rec}$       | recovery time                 | $\overline{PL}$ to CP, $\overline{CE}$ ; see <a href="#">Figure 8</a>                          |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | 20    | 8   | -   | 25               | -   | 30                | -   | ns   |
| $t_{su}$        | set-up time                   | DS to CP, $\overline{CE}$ ; see <a href="#">Figure 10</a>                                      |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | 20    | 2   | -   | 25               | -   | 30                | -   | ns   |
|                 |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>                |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | 20    | 7   | -   | 25               | -   | 30                | -   | ns   |
|                 |                               | Dn to $\overline{PL}$ ; see <a href="#">Figure 11</a>  |       |     |     |                  |     |                   |     |      |
| $t_h$           | hold time                     | DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ; see <a href="#">Figure 10</a>            |       |     |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V   | 7     | -1  | -   | 9                | -   | 11                | -   | ns   |
|                 |                               | $\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>                |       |     |     |                  |     |                   |     |      |
|                 | $V_{CC} = 4.5$ V              | 0  | -7    | -   | 0   | -                | 0   | -                 | ns  |      |

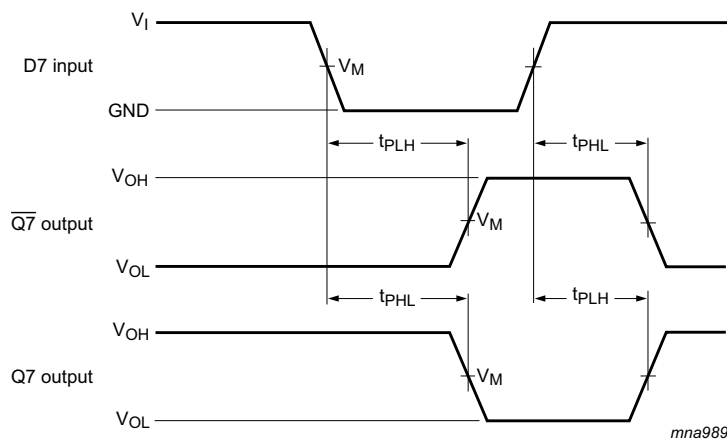




Measurement points are given in [Table 8](#).

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

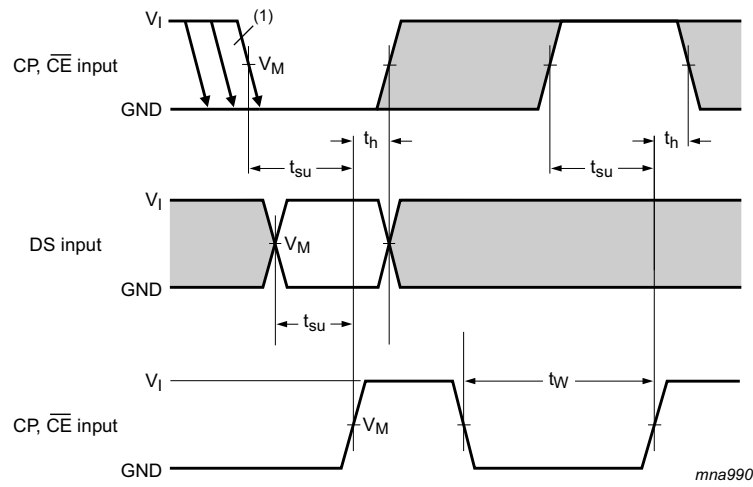
**Fig 8.** The parallel load (PL) pulse width, the parallel load to output (Q7 or  $\overline{Q7}$ ) propagation delays, the parallel load to clock (CP) and clock enable (CE) recovery time



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 PL is LOW

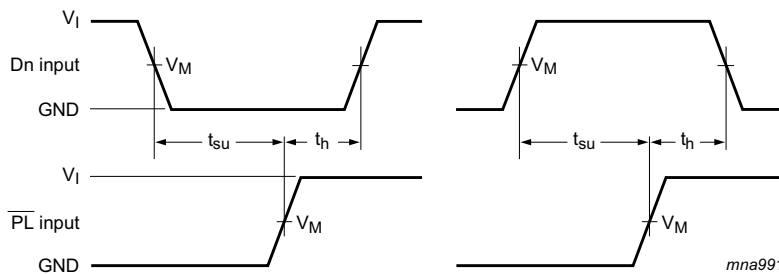


The shaded areas indicate when the input is permitted to change for predictable output performance  
 Measurement points are given in [Table 8](#).

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

- (1)  $\overline{CE}$  may change only from HIGH-to-LOW while CP is LOW, see [Section 1](#).

**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 (CE) to the clock input (CP) and from the clock input (CP) to the clock enable input ( $\overline{CE}$ )



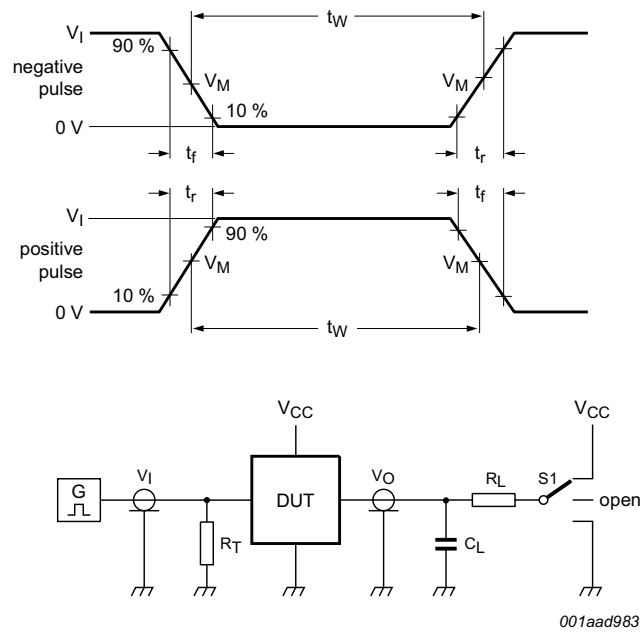
Measurement points are given in [Table 8](#).

$V_{OL}$  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  | $V_{CC}$ | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT165 | 3 V      | 1.3 V       | 1.3 V       |



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

Definitions for 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 12. Test circuit for measuring switching times**

**Table 9. Test data**

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

13. Package outline

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

SOT109-1

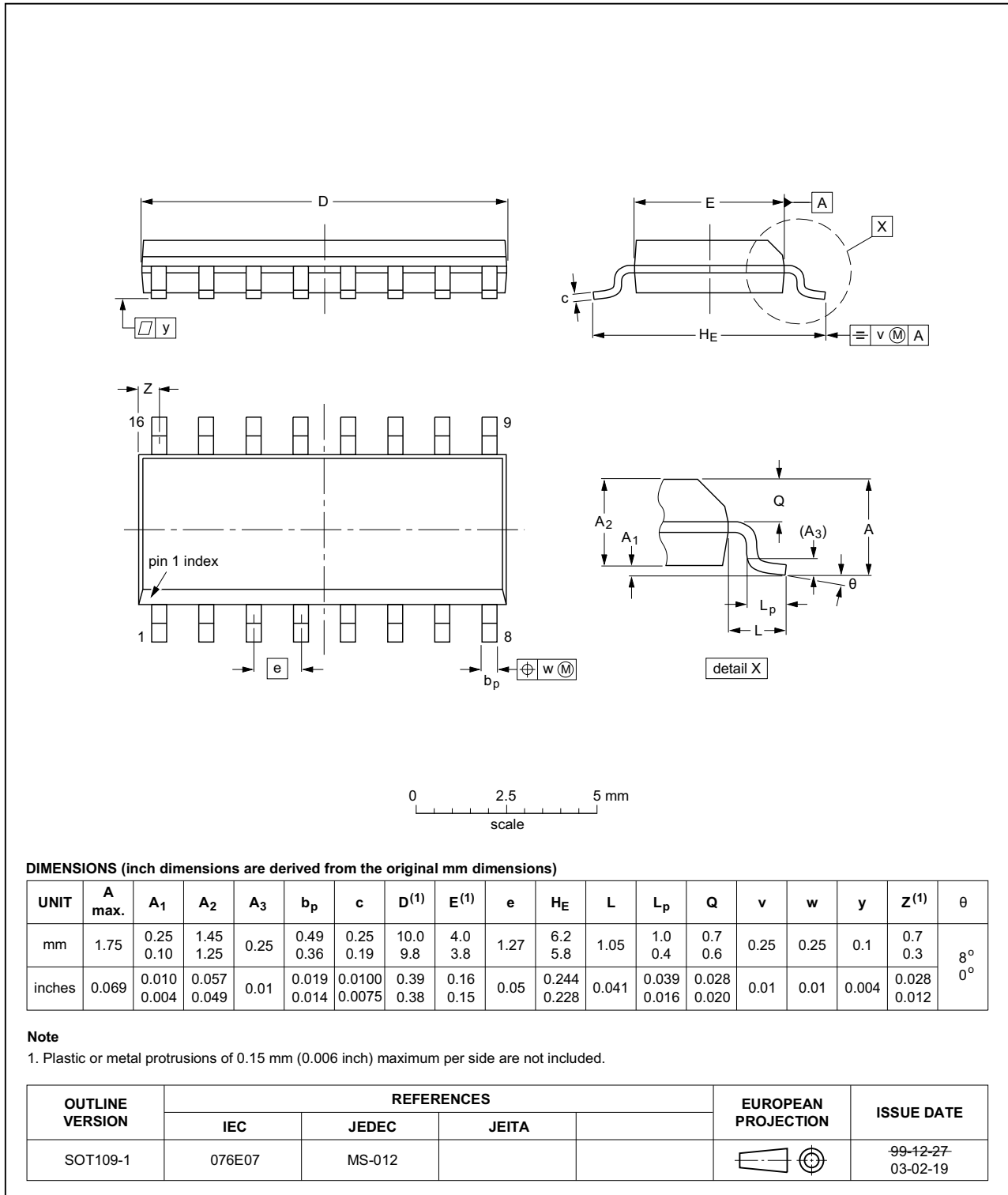


Fig 13. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

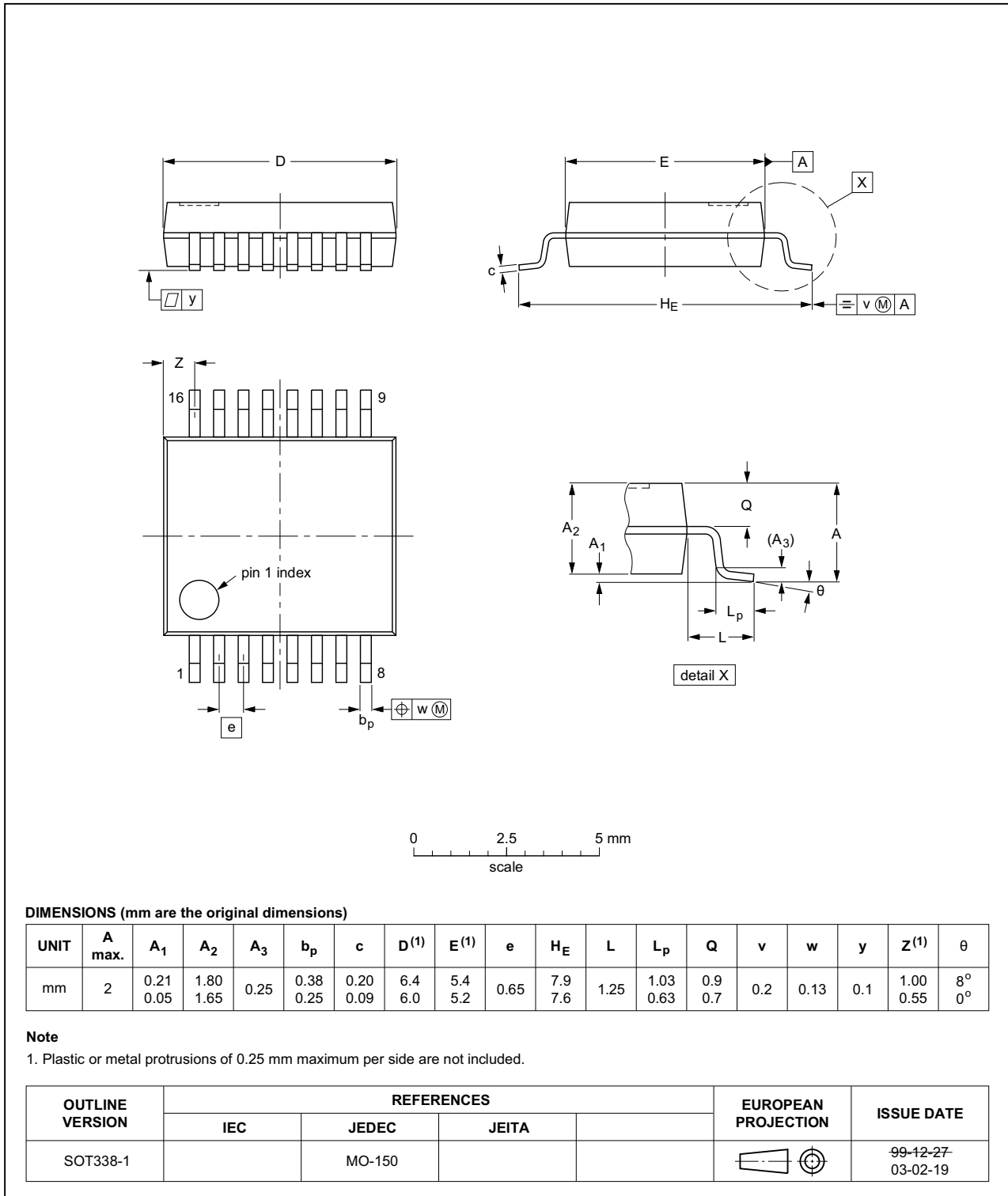


Fig 14. Package outline SOT338-1 (SSOP16)

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

SOT403-1

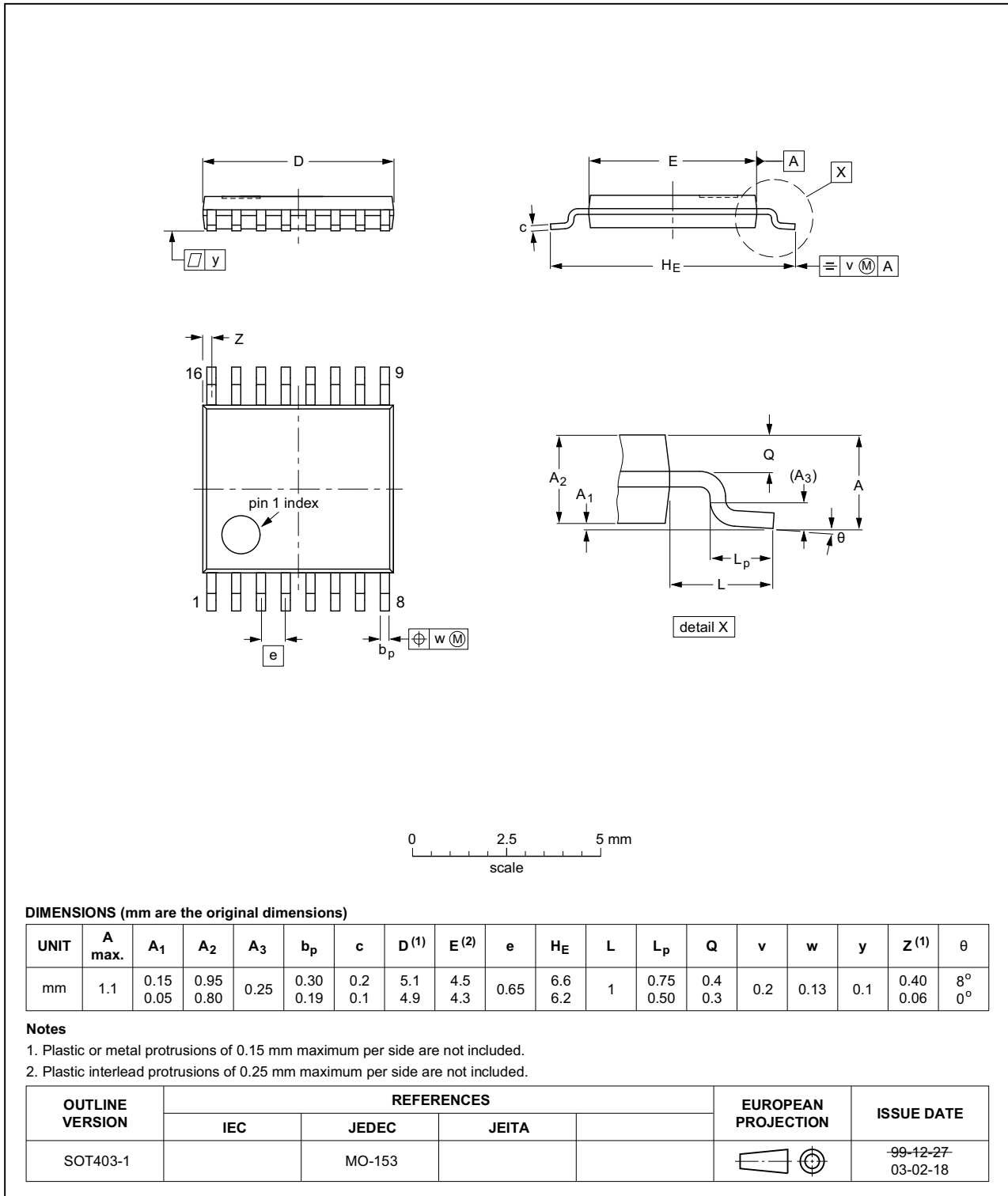
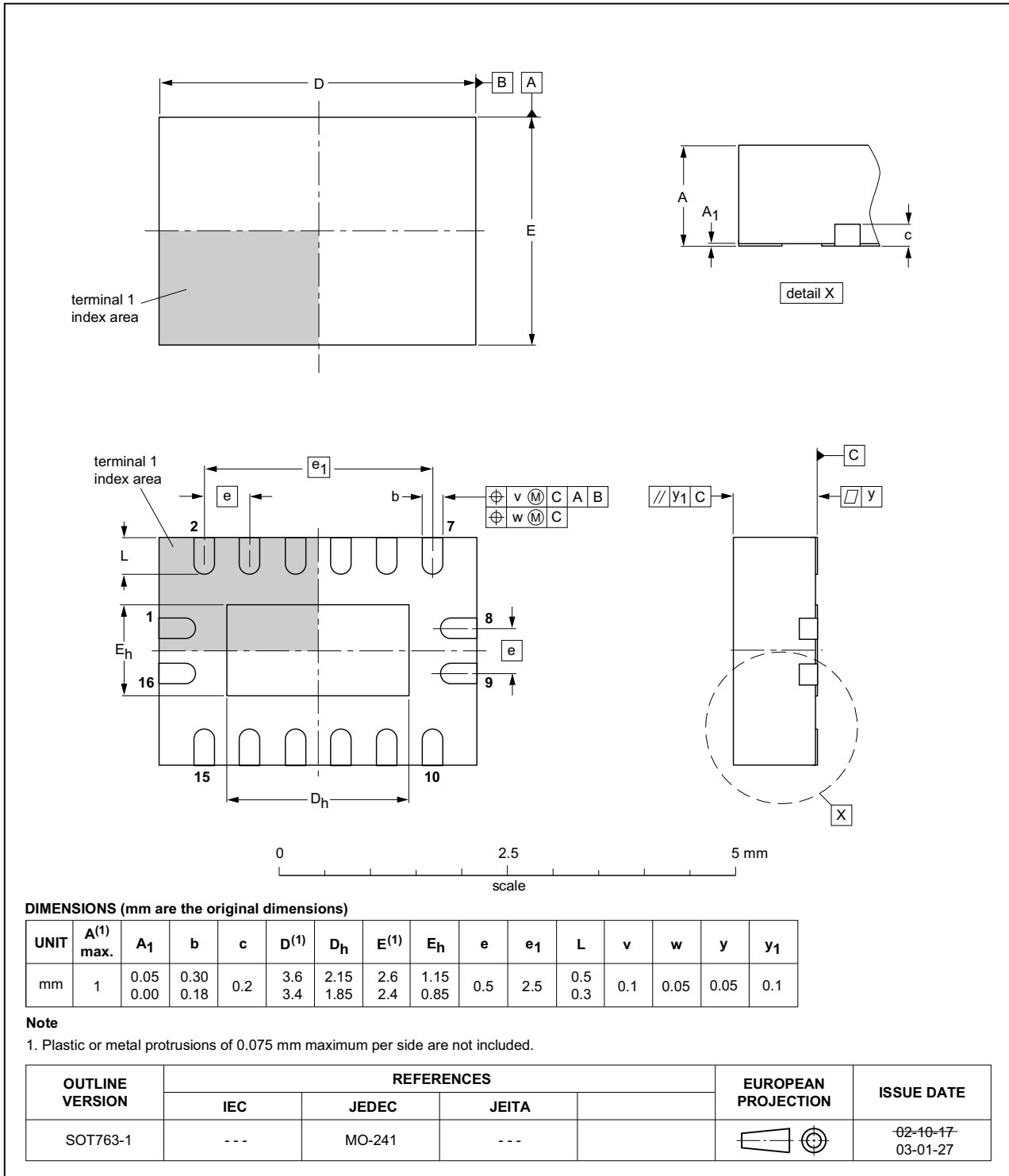


Fig 15. Package outline SOT403-1 (TSSOP16)



**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 16. Package outline SOT763-1 (DHVQFN16)**

## 14. Abbreviations

Table 10. Abbreviations

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

## 15. Revision history

Table 11. Revision history

| Document ID         | Release date   | Data sheet status     | Change notice | Supersedes          |
|---------------------|--|-----------------------|---------------|---------------------|
| 74HC_HCT165 v.4     | 20151228   | Product data sheet    | -             | 74HC_HCT165 v.3     |
| Modifications:      | <ul style="list-style-type: none"> <li>Type numbers 74HC165N and 74HCT165N (SOT38-4) removed.</li> </ul>   |                       |               |                     |
| 74HC_HCT165 v.3     | 20080314   | Product data sheet    | -             | 74HC_HCT165_CNV v.2 |
| Modifications:      | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Package SOT763-1 (DHVQFN16) added to <a href="#">Section 4 “Ordering information”</a> and <a href="#">Section 13 “Package outline”</a>.</li> <li>Family data added, see <a href="#">Section 10 “Static characteristics”</a></li> </ul> |                       |               |                     |
| 74HC_HCT165_CNV v.2 | December 1990  | Product specification | -             | -                   |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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