

# 74HC4094; 74HCT4094

## 8-stage shift-and-store bus register

Rev. 6 — 31 December 2012

Product data sheet

### 1. General description

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The 74HC4094; 74HCT4094 is an 8-bit serial-in/serial or parallel-out shift register with a storage register and 3-state outputs. Both the shift and storage register have separate clocks. The device features a serial input (D) and two serial outputs (QS1 and QS2) to enable cascading. Data is shifted on the LOW-to-HIGH transitions of the CP input. Data is available at QS1 on the LOW-to-HIGH transitions of the CP input to allow cascading when clock edges are fast. The same data is available at QS2 on the next HIGH-to-LOW transition of the CP input to allow cascading when clock edges are slow. The data in the shift register is transferred to the storage register when the STR input is HIGH. Data in the storage register appears at the outputs whenever the output enable input (OE) is HIGH. A LOW on OE causes the outputs to assume a high-impedance OFF-state. Operation of the OE input does not affect the state of the registers. 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

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- Complies with JEDEC standard JESD7A
- Input levels:
  - ◆ For 74HC4094: CMOS level
  - ◆ For 74HCT4094: TTL level
- Low-power dissipation
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2 000 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

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- Serial-to-parallel data conversion
- Remote control holding register

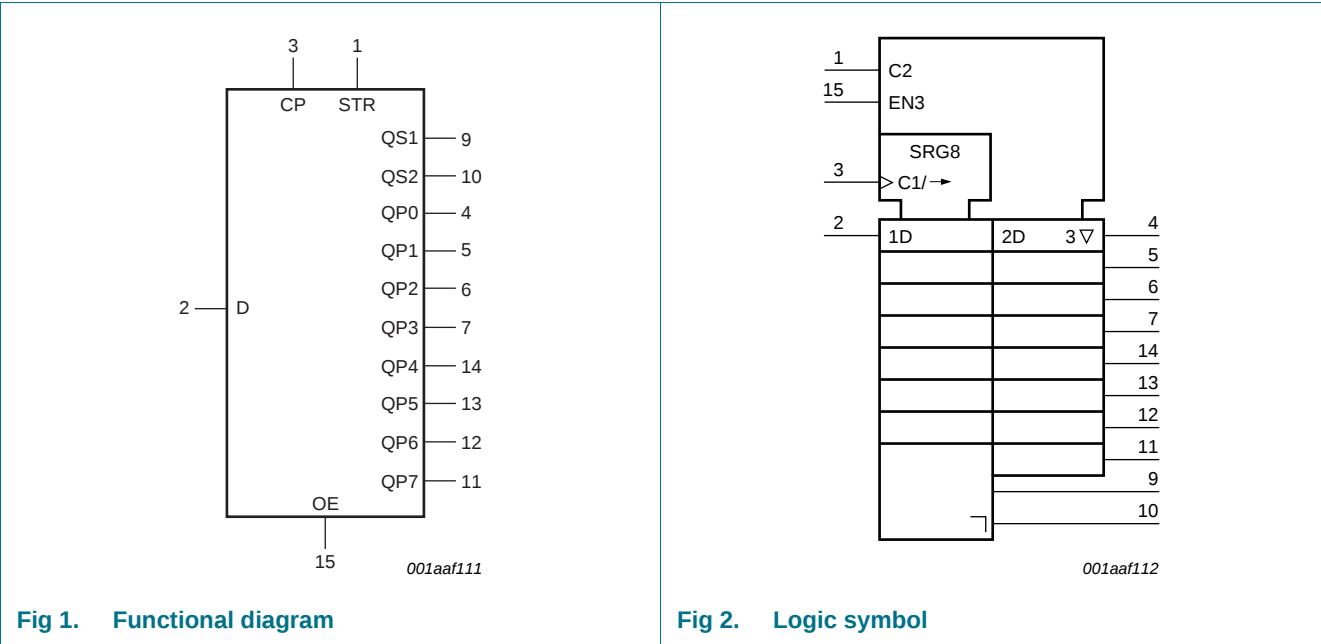


4. Ordering information

Table 1. Ordering information

| Type number | Package           |         |                                                                        |          |
|-------------|-------------------|---------|------------------------------------------------------------------------|----------|
|             | Temperature range | Name    | Description                                                            | Version  |
| 74HC4094N   | −40 °C to +125 °C | DIP16   | plastic dual in-line package; 16 leads (300 mil)                       | SOT38-4  |
| 74HCT4094N  |                   |         |                                                                        |          |
| 74HC4094D   | −40 °C to +125 °C | SO16    | plastic small outline package; 16 leads; body width 3.9 mm             | SOT109-1 |
| 74HCT4094D  |                   |         |                                                                        |          |
| 74HC4094DB  | −40 °C to +125 °C | SSOP16  | plastic shrink small outline package; 16 leads; body width 5.3 mm      | SOT338-1 |
| 74HCT4094DB |                   |         |                                                                        |          |
| 74HC4094PW  | −40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |

5. Functional diagram



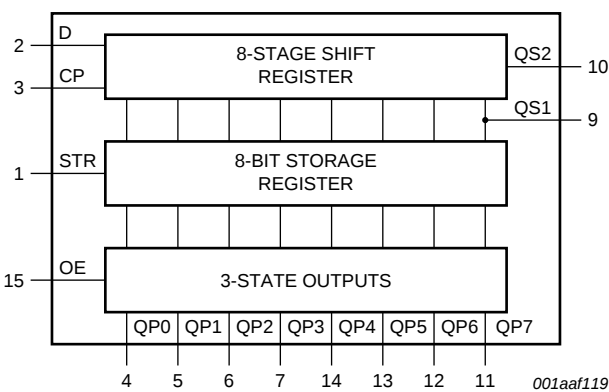


Fig 3. Logic diagram

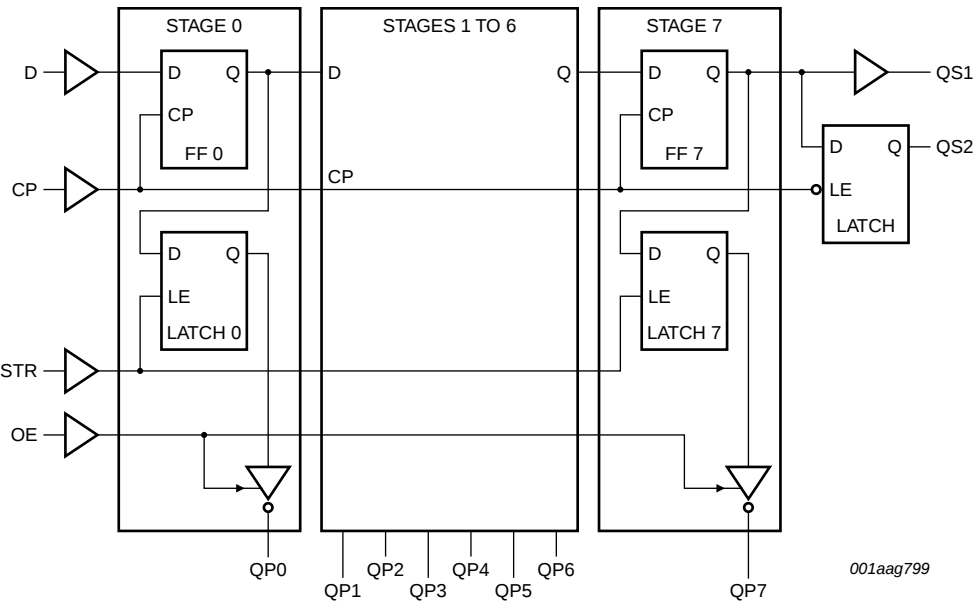
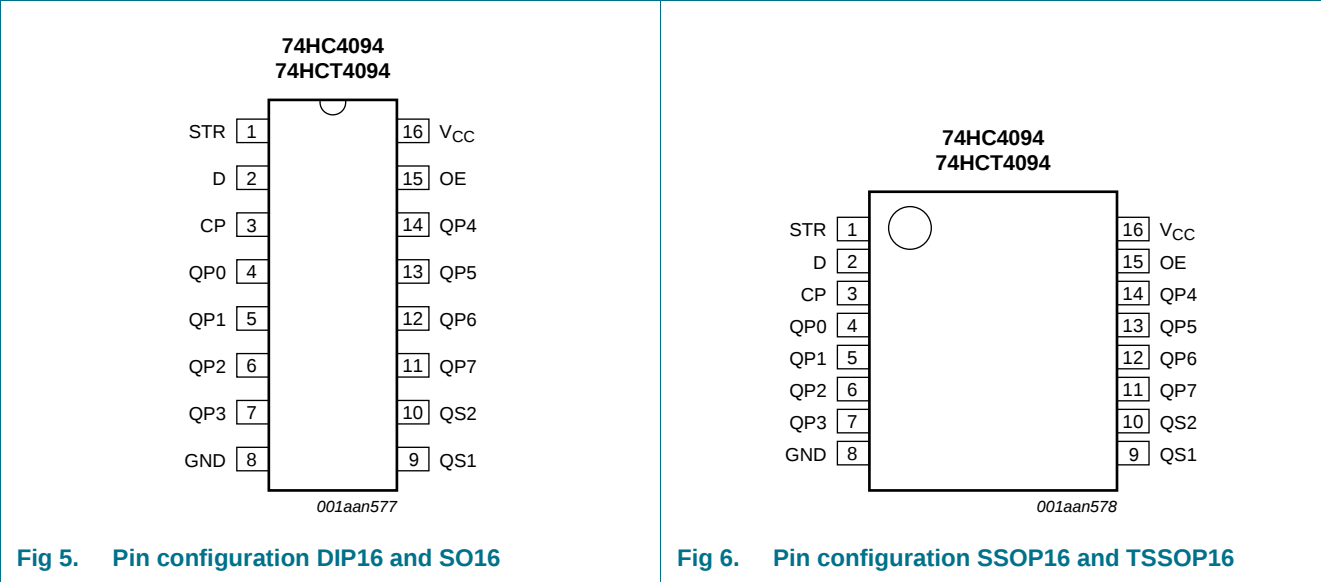


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

| Symbol          | Pin                        | Description           |
|-----------------|----------------------------|-----------------------|
| STR             | 1                          | strobe input          |
| D               | 2                          | data input            |
| CP              | 3                          | clock input           |
| QP0 to QP7      | 4, 5, 6, 7, 14, 13, 12, 11 | parallel output       |
| V <sub>SS</sub> | 8                          | ground supply voltage |
| QS1, QS2        | 9, 10                      | serial output         |
| OE              | 15                         | output enable input   |
| V <sub>DD</sub> | 16                         | supply voltage        |

## 7. Functional description

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

| Inputs |    |     |   | Parallel outputs |        | Serial outputs |     |
|--------|----|-----|---|------------------|--------|----------------|-----|
| CP     | OE | STR | D | QP0              | QPn    | QS1            | QS2 |
| ↑      | L  | X   | X | Z                | Z      | Q6S            | NC  |
| ↓      | L  | X   | X | Z                | Z      | NC             | Q7S |
| ↑      | H  | L   | X | NC               | NC     | Q6S            | NC  |
| ↑      | H  | H   | L | L                | QPn –1 | Q6S            | NC  |
| ↑      | H  | H   | H | H                | QPn –1 | Q6S            | NC  |
| ↓      | H  | H   | H | NC               | NC     | NC             | Q7S |

[1] At the positive clock edge, the information in the 7th register stage is transferred to the 8th register stage and the QSn outputs.

H = HIGH voltage level; L = LOW voltage level; X = don't care;

↑ = positive-going transition; ↓ = negative-going transition;

Z = HIGH-impedance OFF-state; NC = no change;

Q6S = the data in register stage 6 before the LOW to HIGH clock transition;

Q7S = the data in register stage 7 before the HIGH to LOW clock transition.

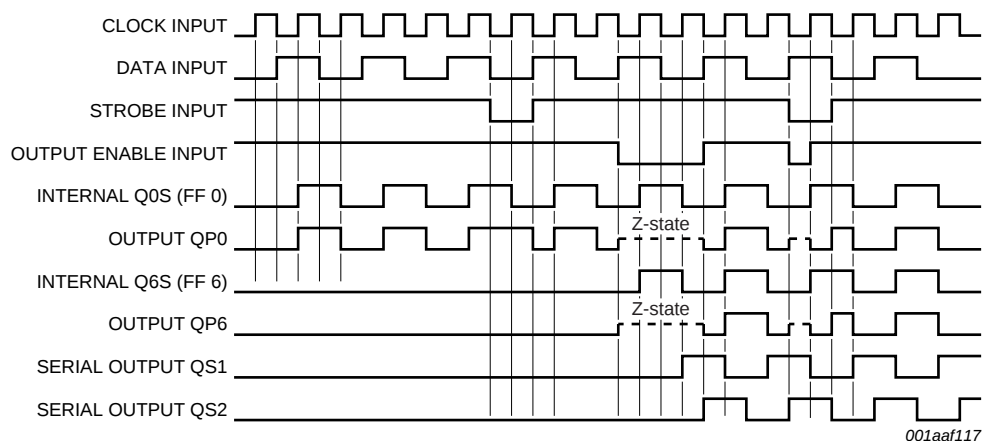


Fig 7. Timing diagram

## 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 $V_I > V_{CC} + 0.5\text{ V}$ | -     | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | -     | $\pm 20$ | mA   |
| $I_O$     | output current          | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$     | -     | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |                                                        | -     | +50      | mA   |
| $I_{GND}$ | ground current          |                                                        | -     | -50      | mA   |
| $T_{stg}$ | storage temperature     |                                                        | -65   | +150     | °C   |
| $P_{tot}$ | total power dissipation | DIP16 package                                          | [1] - | 750      | mW   |
|           |                         | SO16, SSOP16 and TSSOP16 packages                      | [2] - | 500      | mW   |

[1] For DIP16 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.

[2] For SO16:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

For SSOP16 and TSSOP16 packages:  $P_{tot}$  derates linearly with 5.5 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              | 74HC4094 |      |          | 74HCT4094 |      |          | Unit |
|---------------------|-------------------------------------|-------------------------|----------|------|----------|-----------|------|----------|------|
|                     |                                     |                         | Min      | Typ  | Max      | Min       | Typ  | Max      |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0      | 5.0  | 6.0      | 4.5       | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0        | -    | $V_{CC}$ | 0         | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0        | -    | $V_{CC}$ | 0         | -    | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |                         | -40      | +25  | +125     | -40       | +25  | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -        | -    | 625      | -         | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -        | 1.67 | 139      | -         | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -        | -    | 83       | -         | -    | -        | ns/V |

## 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   |      |
| 74HC4094        |                           |                                                                                                                        |       |      |      |                  |      |                   |       |      |
| 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  | 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>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>I</sub>  | input leakage current     | 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    |
|                 |                           | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                                                       | -     | -    | ±0.1 | -                | ±1.0 | -                 | ±1.0  | μA   |
|                 |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V | -     | -    | ±0.5 | -                | ±5.0 | -                 | ±10.0 | μA   |
|                 |                           | 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   |
| 74HCT4094       |                           |                                                                                                                        |       |      |      |                  |      |                   |       |      |
| 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                                                                                                 | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1   | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA                                                                                                | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4   | V    |

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

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

| Symbol          | Parameter                 | Conditions                                                                                                                          | 25 °C |     |           | –40 °C to +85 °C |           | –40 °C to +125 °C |           | Unit          |
|-----------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-----------|------------------|-----------|-------------------|-----------|---------------|
|                 |                           |                                                                                                                                     | Min   | Typ | Max       | Min              | Max       | Min               | Max       |               |
| $I_I$           | input leakage current     | $V_I = V_{CC}$ or GND;<br>$V_{CC} = 5.5$ V                                                                                          | -     | -   | $\pm 0.1$ | -                | $\pm 1.0$ | -                 | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{OZ}$        | OFF-state output current  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 5.5$ V;<br>$V_O = V_{CC}$ or GND per input pin; other inputs at $V_{CC}$ or GND; $I_O = 0$ A | -     | -   | $\pm 0.5$ | -                | $\pm 5.0$ | -                 | $\pm 10$  | $\mu\text{A}$ |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 5.5$ V                                                                             | -     | -   | 8.0       | -                | 80        | -                 | 160       | $\mu\text{A}$ |
| $\Delta I_{CC}$ | additional supply current | $V_I = V_{CC} - 2.1$ V;<br>other inputs at $V_{CC}$ or GND;<br>$V_{CC} = 4.5$ V to 5.5 V;<br>$I_O = 0$ A                            |       |     |           |                  |           |                   |           |               |
|                 |                           | per input pin; STR input                                                                                                            | -     | 100 | 360       | -                | 450       | -                 | 490       | $\mu\text{A}$ |
|                 |                           | per input pin; OE input                                                                                                             | -     | 150 | 540       | -                | 675       | -                 | 735       | $\mu\text{A}$ |
|                 |                           | per input pin; CP input                                                                                                             | -     | 150 | 540       | -                | 675       | -                 | 735       | $\mu\text{A}$ |
|                 |                           | per input pin; D input                                                                                                              | -     | 40  | 144       | -                | 180       | -                 | 196       | $\mu\text{A}$ |
| $C_I$           | input capacitance         |                                                                                                                                     | -     | 3.5 | -         |                  |           |                   |           | pF            |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to 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 |      |
| 74HC4094         |                   |                                                          |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay | CP to QS1; see <a href="#">Figure 8</a> <sup>[1]</sup>   |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 50  | 150 | -                | 190 | -                 | 225 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 18  | 30  | -                | 38  | -                 | 45  | ns   |
|                  |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF            | -     | 15  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 14  | 26  | -                | 33  | -                 | 38  | ns   |
|                  |                   | CP to QS2; see <a href="#">Figure 8</a> <sup>[1]</sup>   |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 44  | 135 | -                | 170 | -                 | 205 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 16  | 27  | -                | 34  | -                 | 41  | ns   |
|                  |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF            | -     | 13  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 13  | 23  | -                | 29  | -                 | 35  | ns   |
|                  |                   | CP to QPn; see <a href="#">Figure 8</a> <sup>[1]</sup>   |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 63  | 195 | -                | 245 | -                 | 295 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 23  | 39  | -                | 49  | -                 | 59  | ns   |
|                  |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF            | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 18  | 33  | -                | 42  | -                 | 50  | ns   |
|                  |                   | STR to QPn; see <a href="#">Figure 9</a> <sup>[1]</sup>  |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 58  | 180 | -                | 225 | -                 | 270 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 21  | 36  | -                | 45  | -                 | 54  | ns   |
|                  |                   | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF            | -     | 18  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 17  | 31  | -                | 38  | -                 | 46  | ns   |
| t <sub>en</sub>  | enable time       | OE to QPn; see <a href="#">Figure 11</a> <sup>[2]</sup>  |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 55  | 175 | -                | 220 | -                 | 265 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 20  | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 16  | 30  | -                | 37  | -                 | 45  | ns   |
| t <sub>dis</sub> | disable time      | OE to QPn; see <a href="#">Figure 11</a> <sup>[3]</sup>  |       |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                  | -     | 41  | 125 | -                | 155 | -                 | 190 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 15  | 25  | -                | 31  | -                 | 38  | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                  | -     | 12  | 21  | -                | 26  | -                 | 32  | ns   |
| t <sub>t</sub>   | transition time   | QPn and QSn; see <a href="#">Figure 8</a> <sup>[4]</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**

Voltages are referenced to 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 HIGH or 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   |
|           |                               | STR HIGH; see <a href="#">Figure 9</a>                    |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 80                | 14  | -   | 100              | -   | 120               | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V                                          | 16                | 5   | -   | 20               | -   | 24                | -   | ns   |
| $t_{SU}$  | set-up time                   | D to CP; see <a href="#">Figure 10</a>                    |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 50                | 14  | -   | 65               | -   | 75                | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V                                          | 10                | 5   | -   | 13               | -   | 15                | -   | ns   |
|           |                               | $V_{CC} = 6.0$ V                                          | 9                 | 4   | -   | 11               | -   | 13                | -   | ns   |
|           |                               | CP to STR; see <a href="#">Figure 9</a>                   |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 100               | 28  | -   | 125              | -   | 150               | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V                                          | 20                | 10  | -   | 25               | -   | 30                | -   | ns   |
| $t_H$     | hold time                     | $V_{CC} = 6.0$ V                                          | 17                | 8   | -   | 21               | -   | 26                | -   | ns   |
|           |                               | D to CP; see <a href="#">Figure 10</a>                    |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 3                 | -6  | -   | 3                | -   | 3                 | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V                                          | 3                 | -2  | -   | 3                | -   | 3                 | -   | ns   |
|           |                               | $V_{CC} = 6.0$ V                                          | 3                 | -2  | -   | 3                | -   | 3                 | -   | ns   |
|           |                               | CP to STR; see <a href="#">Figure 9</a>                   |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 0                 | -14 | -   | 0                | -   | 0                 | -   | ns   |
| $f_{max}$ | maximum frequency             | $V_{CC} = 4.5$ V                                          | 0                 | -5  | -   | 0                | -   | 0                 | -   | ns   |
|           |                               | $V_{CC} = 6.0$ V                                          | 0                 | -4  | -   | 0                | -   | 0                 | -   | ns   |
|           |                               | CP; see <a href="#">Figure 8</a>                          |                   |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V                                          | 6.0               | 28  | -   | 4.8              | -   | 4.0               | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $V_{CC} = 4.5$ V                                          | 30                | 87  | -   | 24               | -   | 20                | -   | MHz  |
|           |                               | $V_{CC} = 5$ V; $C_L = 15$ pF                             | -                 | 95  | -   | -                | -   | -                 | -   | MHz  |
|           |                               | $V_{CC} = 6.0$ V                                          | 35                | 103 | -   | 28               | -   | 24                | -   | MHz  |
|           |                               | $C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND to } V_{CC}$ | <a href="#">5</a> | -   | 83  | -                | -   | -                 | -   | pF   |

**Table 7. Dynamic characteristics ...continued**

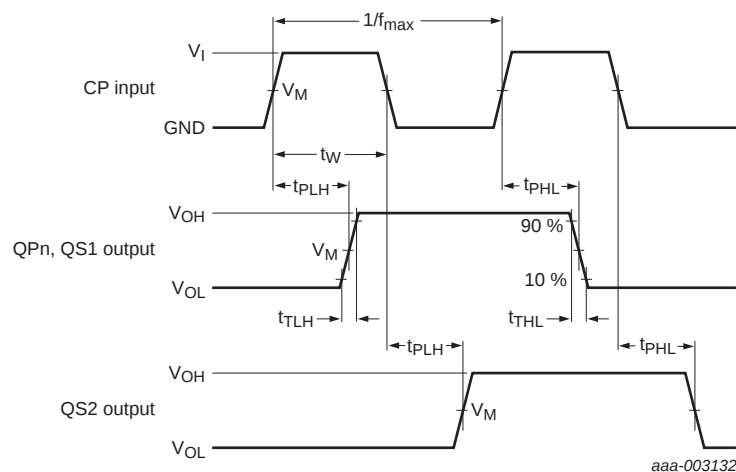
Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 12](#).

| Symbol                                        | Parameter                     | Conditions                                                                                | 25 °C |     |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|-----------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                                               |                               |                                                                                           | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HCT4094                                     |                               |                                                                                           |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>                               | propagation delay             | CP to QS1; see <a href="#">Figure 8</a> <sup>[1]</sup>                                    |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 23  | 39  | -                | 49  | -                 | 59  | ns   |
|                                               |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                             | -     | 19  | -   | -                | -   | -                 | -   | ns   |
|                                               |                               | CP to QS2; see <a href="#">Figure 8</a> <sup>[1]</sup>                                    |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 21  | 36  | -                | 45  | -                 | 54  | ns   |
|                                               |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                             | -     | 18  | -   | -                | -   | -                 | -   | ns   |
|                                               |                               | CP to QPn; see <a href="#">Figure 8</a> <sup>[1]</sup>                                    |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 25  | 43  | -                | 54  | -                 | 65  | ns   |
|                                               |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                             | -     | 21  | -   | -                | -   | -                 | -   | ns   |
|                                               |                               | STR to QPn; see <a href="#">Figure 9</a> <sup>[1]</sup>                                   |       |     |     |                  |     |                   |     |      |
| V <sub>CC</sub> = 4.5 V                       | -                             | 22                                                                                        | 39    | -   | 49  | -                | 59  | ns                |     |      |
| V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF | -                             | 19                                                                                        | -     | -   | -   | -                | -   | ns                |     |      |
| t <sub>en</sub>                               | enable time                   | OE to QPn; see <a href="#">Figure 11</a> <sup>[2]</sup>                                   |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 20  | 35  | -                | 44  | -                 | 53  | ns   |
| t <sub>dis</sub>                              | disable time                  | OE to QPn; see <a href="#">Figure 11</a> <sup>[3]</sup>                                   |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 21  | 35  | -                | 44  | -                 | 53  | ns   |
| t <sub>t</sub>                                | transition time               | QPn and QSn; see <a href="#">Figure 8</a> <sup>[4]</sup>                                  |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| t <sub>w</sub>                                | pulse width                   | CP HIGH or LOW; see <a href="#">Figure 8</a>                                              |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |
|                                               |                               | STR HIGH; see <a href="#">Figure 9</a>                                                    |       |     |     |                  |     |                   |     |      |
| V <sub>CC</sub> = 4.5 V                       | 16                            | 5                                                                                         | -     | 20  | -   | 24               | -   | ns                |     |      |
| t <sub>su</sub>                               | set-up time                   | Dn to CP; see <a href="#">Figure 10</a>                                                   |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | 10    | 4   | -   | 13               | -   | 15                | -   | ns   |
|                                               |                               | CP to STR; see <a href="#">Figure 9</a>                                                   |       |     |     |                  |     |                   |     |      |
| V <sub>CC</sub> = 4.5 V                       | 20                            | 9                                                                                         | -     | 25  | -   | 30               | -   | ns                |     |      |
| t <sub>h</sub>                                | hold time                     | Dn to CP; see <a href="#">Figure 10</a>                                                   |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | 4     | 0   | -   | 4                | -   | 4                 | -   | ns   |
|                                               |                               | CP to STR; see <a href="#">Figure 9</a>                                                   |       |     |     |                  |     |                   |     |      |
| V <sub>CC</sub> = 4.5 V                       | 0                             | −4                                                                                        | -     | 0   | -   | 0                | -   | ns                |     |      |
| f <sub>max</sub>                              | maximum frequency             | CP; see <a href="#">Figure 8</a>                                                          |       |     |     |                  |     |                   |     |      |
|                                               |                               | V <sub>CC</sub> = 4.5 V                                                                   | 30    | 80  | -   | 24               | -   | 20                | -   | MHz  |
|                                               |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                             | -     | 86  | -   | -                | -   | -                 | -   | MHz  |
| C <sub>PD</sub>                               | power dissipation capacitance | C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[5]</sup> | -     | 92  | -   | -                | -   | -                 | -   | pF   |

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

- [2]  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ .
- [3]  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .
- [4]  $t_i$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [5]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).
- $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$  where:
- $f_i$  = input frequency in MHz;
- $f_o$  = output frequency in MHz;
- $C_L$  = output load capacitance in pF;
- $V_{CC}$  = supply voltage in V;
- $N$  = number of inputs switching;
- $\sum(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

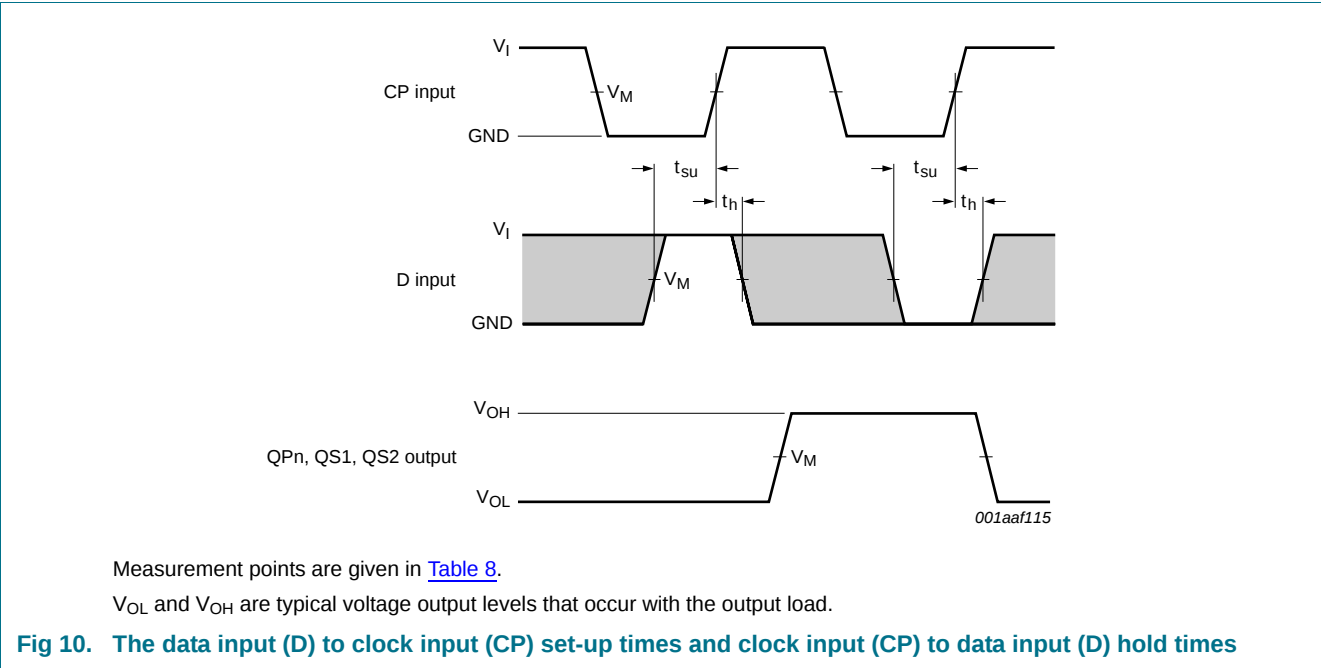
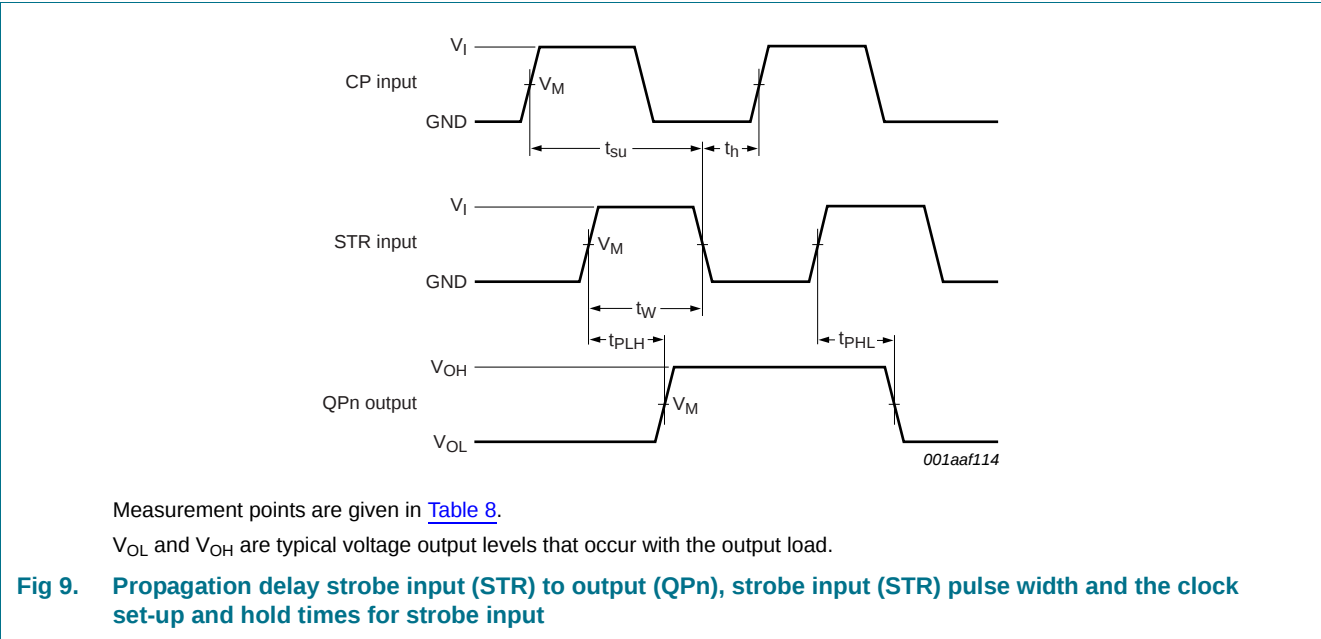
## 12. Waveforms



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. Propagation delay input (CP) to output (QPn, QS1, QS2), output transition time, clock input (CP) pulse width and the maximum frequency (CP)**



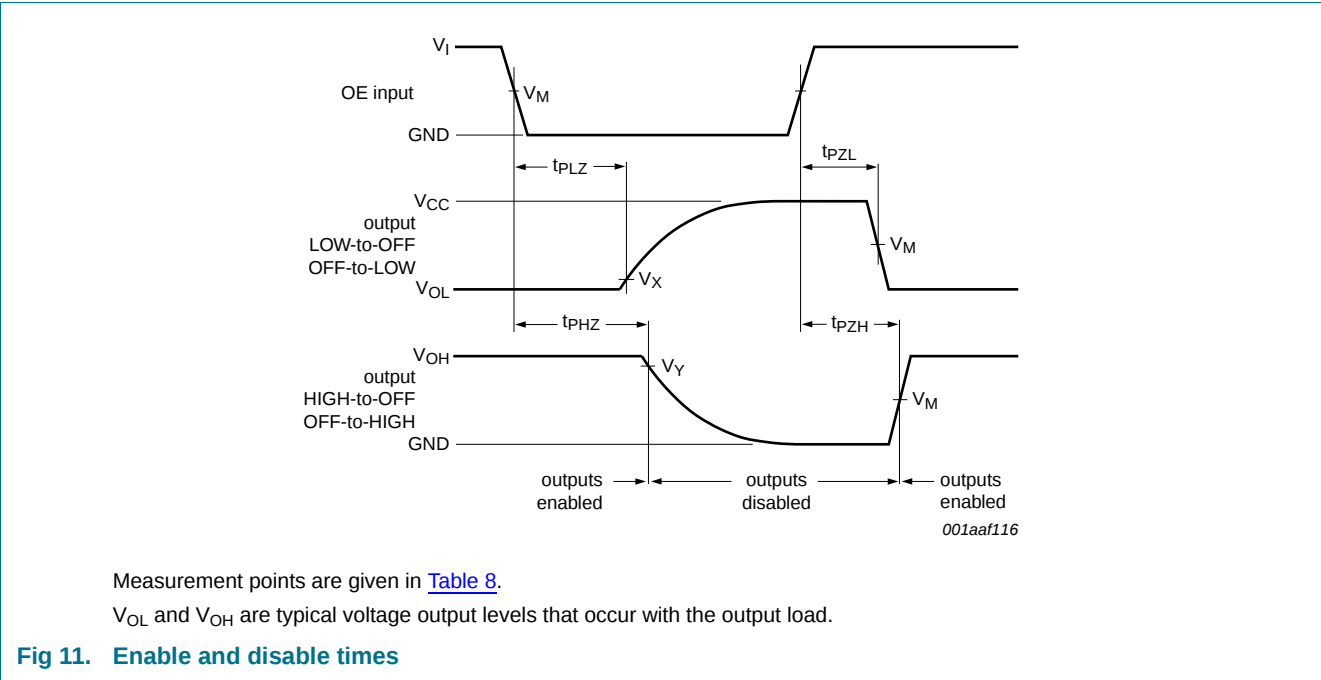
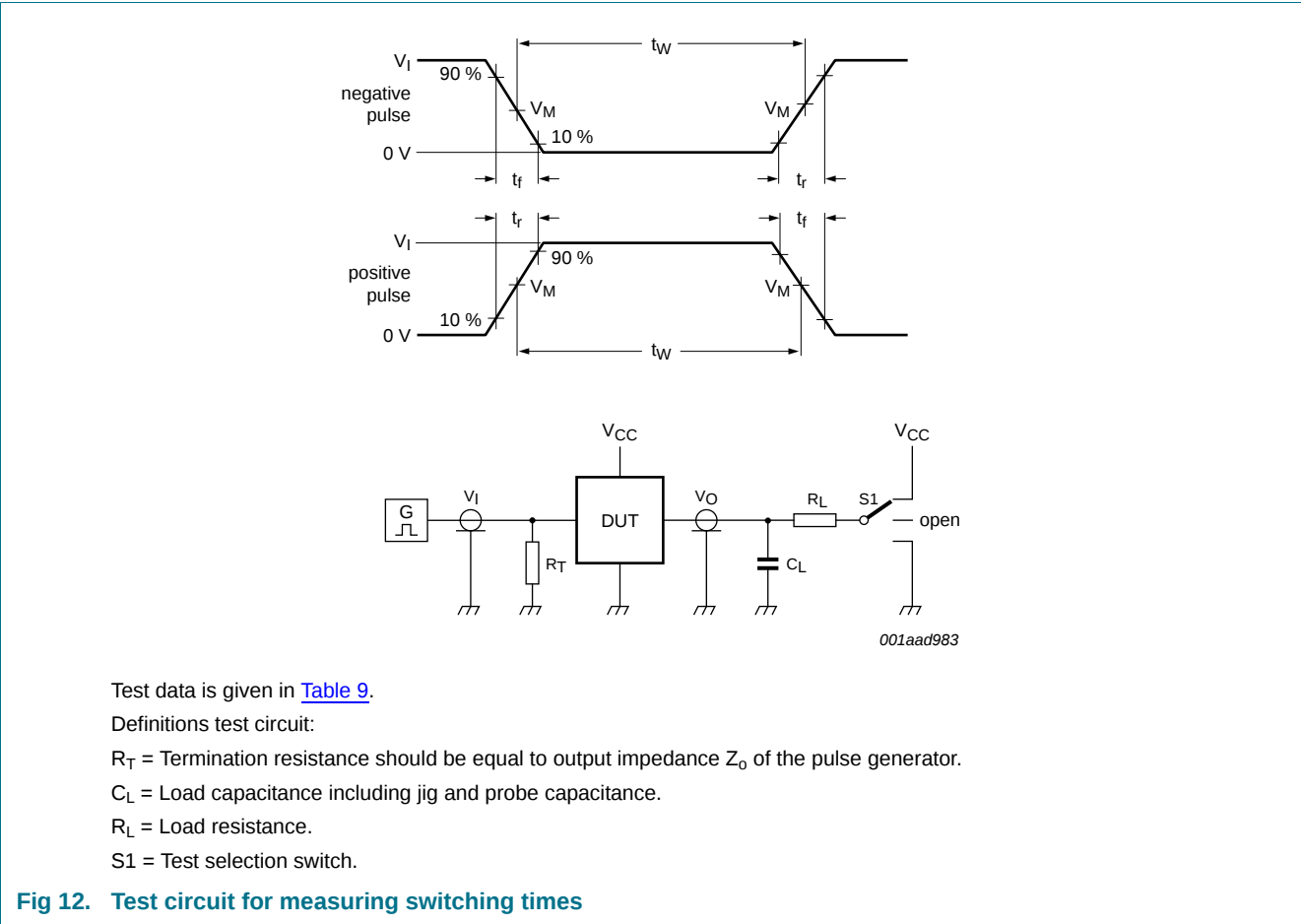


Table 8. Measurement points

| Type      | Input       | Output      |             |             |
|-----------|-------------|-------------|-------------|-------------|
|           | $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| 74HC4094  | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{OH}$ | $0.9V_{OH}$ |
| 74HCT4094 | 1.3 V       | 1.3 V       | $0.1V_{OH}$ | $0.9V_{OH}$ |



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

Definitions test circuit:

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

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

$R_L$  = Load resistance.

$S1$  = Test selection switch.

Fig 12. Test circuit for measuring switching times

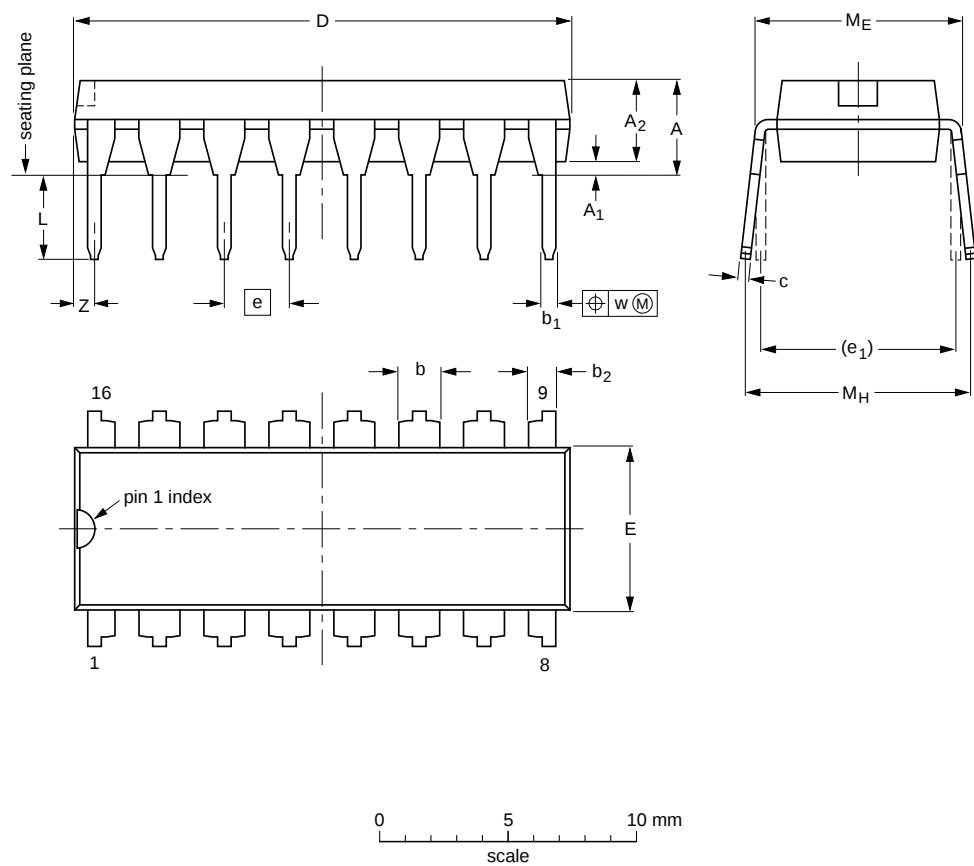
Table 9. Test data

| Type      | Input    |            | Load         |              | S1 position        |                    |                    |
|-----------|----------|------------|--------------|--------------|--------------------|--------------------|--------------------|
|           | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74HC4094  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |
| 74HCT4094 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |

13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



| DIMENSIONS (inch dimensions are derived from the original mm dimensions) |           |                        |                        |                |                |                |                |                  |                  |      |                |              |                |                |       |                          |
|--------------------------------------------------------------------------|-----------|------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| UNIT                                                                     | A<br>max. | A <sub>1</sub><br>min. | A <sub>2</sub><br>max. | b              | b <sub>1</sub> | b <sub>2</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup><br>max. |
| mm                                                                       | 4.2       | 0.51                   | 3.2                    | 1.73<br>1.30   | 0.53<br>0.38   | 1.25<br>0.85   | 0.36<br>0.23   | 19.50<br>18.55   | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 0.76                     |
| inches                                                                   | 0.17      | 0.02                   | 0.13                   | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 0.014<br>0.009 | 0.77<br>0.73     | 0.26<br>0.24     | 0.1  | 0.3            | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.03                     |

**Note**  
1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|-------|-------|--|---------------------------------------------------------------------------------------|----------------------|
|                    | IEC        | JEDEC | JEITA |  |                                                                                       |                      |
| SOT38-4            |            |       |       |  |  | 95-01-14<br>03-02-13 |

Fig 13. Package outline SOT38-4 (DIP16)

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

SOT109-1

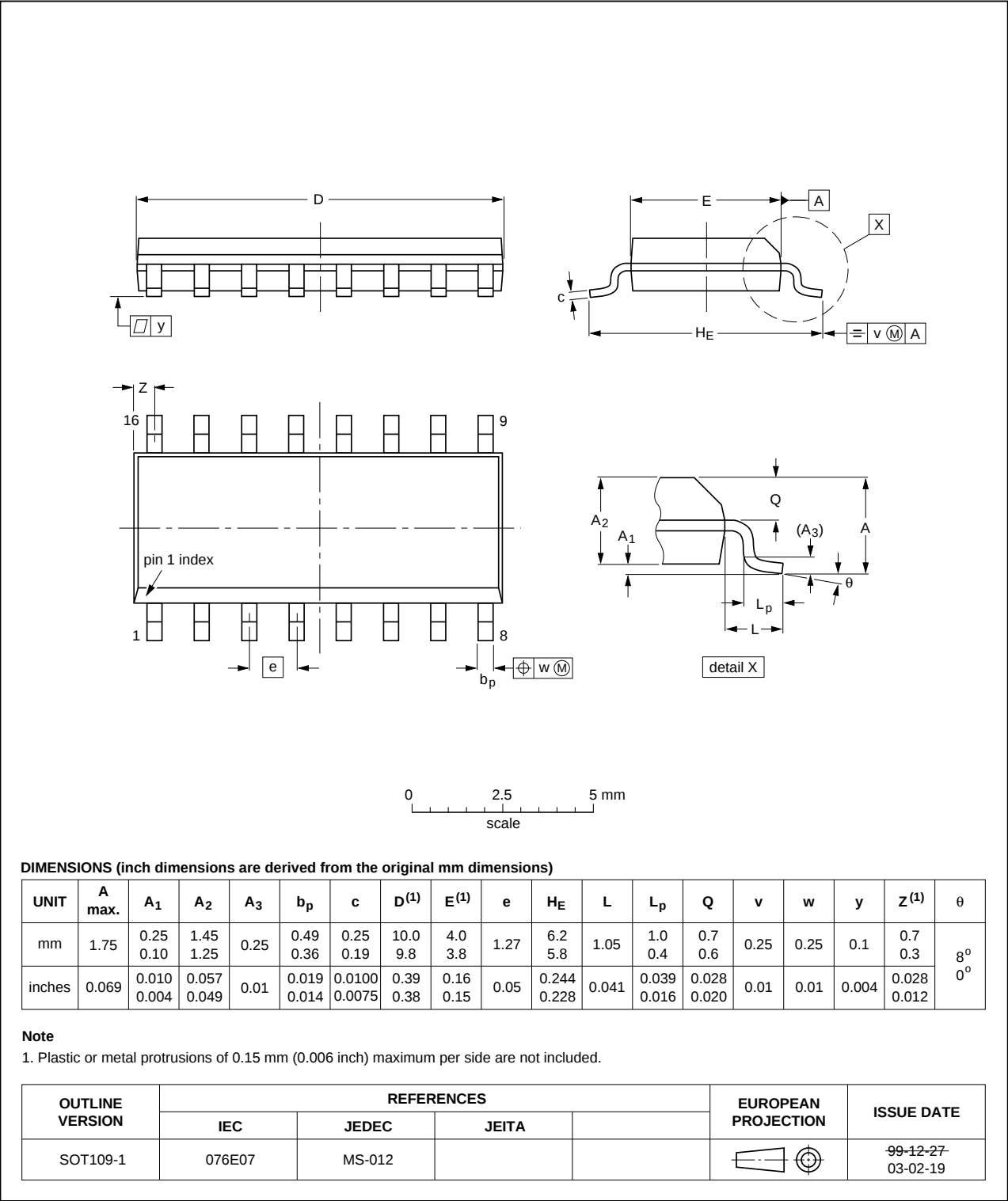


Fig 14. Package outline SOT109-1 (SO16)

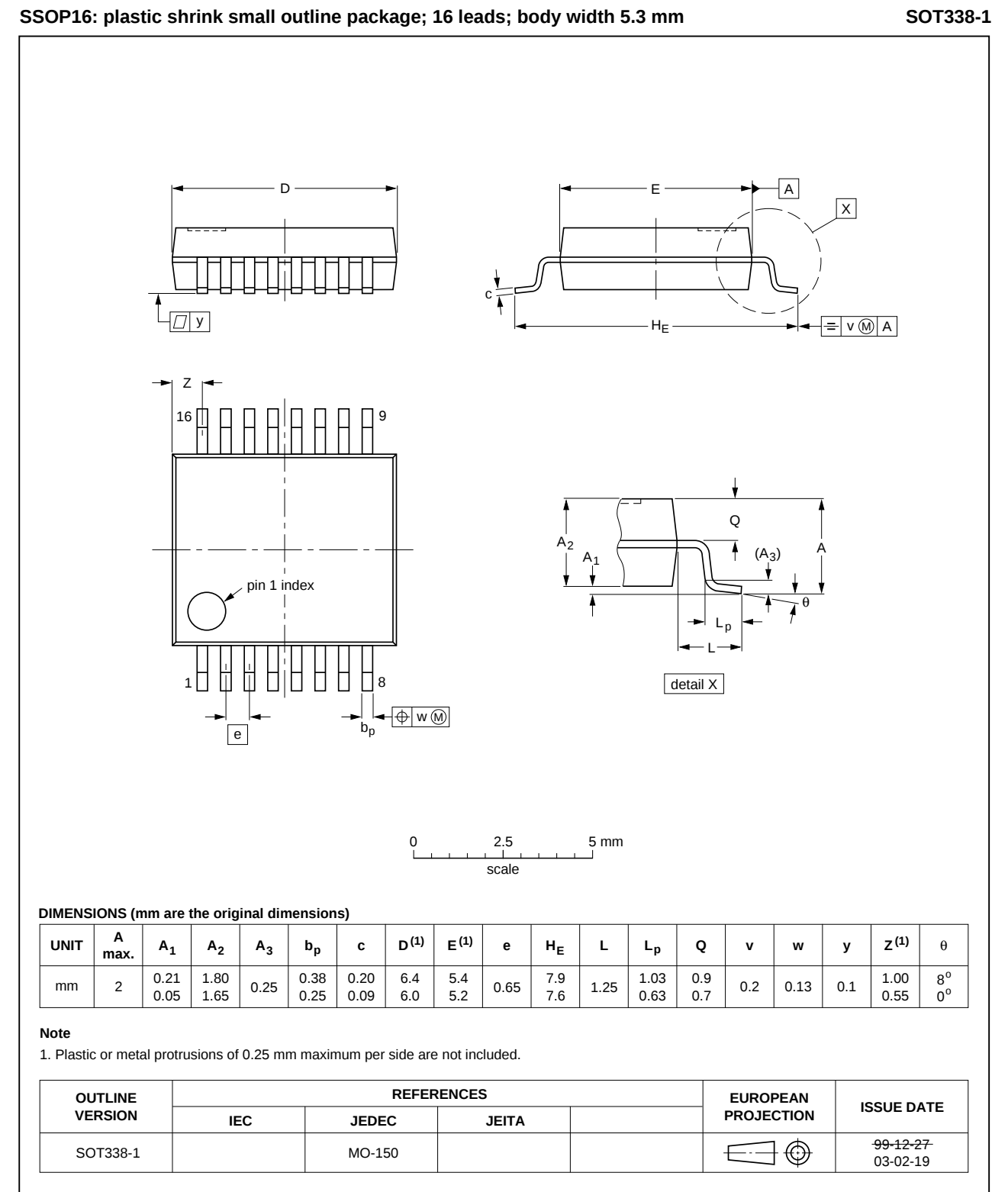


Fig 15. Package outline SOT338-1 (SSOP16)

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

SOT403-1

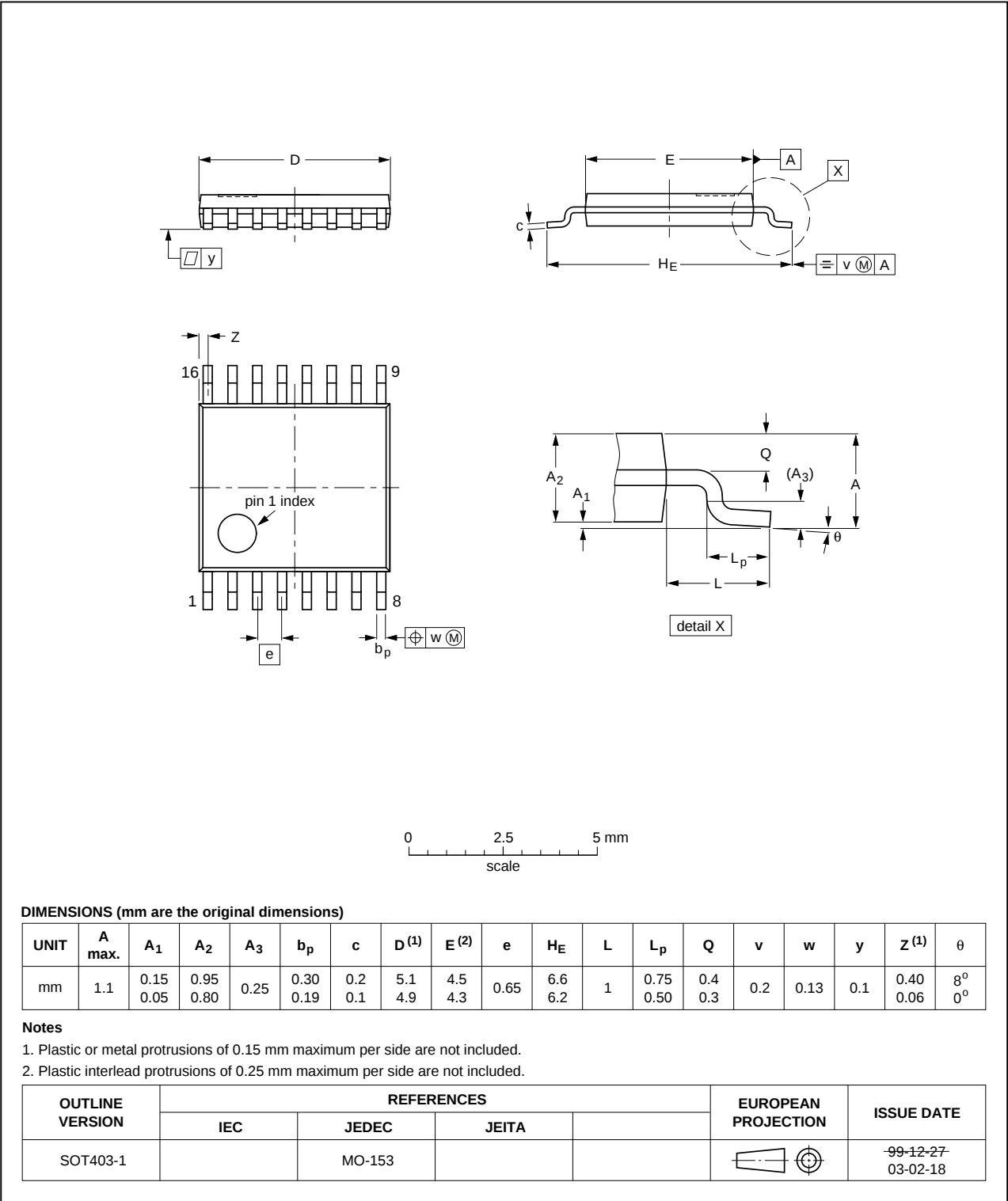


Fig 16. Package outline SOT403-1 (TSSOP16)

## 14. Abbreviations

**Table 10. Abbreviations**

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal Oxide Semiconductor |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |

## 15. Revision history

**Table 11. Revision history**

| Document ID          | Release date                                           | Data sheet status     | Change notice | Supersedes           |
|----------------------|--------------------------------------------------------|-----------------------|---------------|----------------------|
| 74HC_HCT4094 v.6     | 20121231                                               | Product data sheet    | -             | 74HC_HCT4094 v.5     |
| Modifications:       | • General description updated.                         |                       |               |                      |
| 74HC_HCT4094 v.5     | 20120628                                               | Product data sheet    | -             | 74HC_HCT4094 v.4     |
| Modifications:       | • $V_X$ and $V_Y$ measurement points added to Table 8. |                       |               |                      |
| 74HC_HCT4094 v.4     | 20111219                                               | Product data sheet    | -             | 74HC_HCT4094 v.3     |
| Modifications:       | • Legal pages updated.                                 |                       |               |                      |
| 74HC_HCT4094 v.3     | 20110214                                               | Product data sheet    | -             | 74HC_HCT4094_CNV v.2 |
| 74HC_HCT4094_CNV v.2 | 19970901                                               | 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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