

# 74HC4538; 74HCT4538

## Dual retriggerable precision monostable multivibrator

Rev. 03 — 8 June 2009

Product data sheet

### 1. General description

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The 74HC4538; 74HCT4538 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC4538; 74HCT4538 are dual retriggerable-resettable monostable multivibrators. Each multivibrator has an active LOW trigger/retrigger input ( $n\bar{A}$ ), an active HIGH trigger/retrigger input ( $nB$ ), an overriding active LOW direct reset input ( $n\bar{CD}$ ), an output ( $nQ$ ) and its complement ( $n\bar{Q}$ ), and two pins ( $nREXT/CEXT$  and  $nCEXT$ ) for connecting the external timing components  $C_{EXT}$  and  $R_{EXT}$ . Typical pulse width variation over the specified temperature range is  $\pm 0.2\%$ .

The multivibrator may be triggered by either the positive or the negative edges of the input pulse. The duration and accuracy of the output pulse are determined by the external timing components  $C_{EXT}$  and  $R_{EXT}$ . The output pulse width ( $t_W$ ) is equal to  $0.7 \times R_{EXT} \times C_{EXT}$ . The linear design techniques guarantee precise control of the output pulse width. A LOW level at  $n\bar{CD}$  terminates the output pulse immediately. Schmitt trigger action on pins  $n\bar{A}$  and  $nB$  makes the circuit highly tolerant of slower rise and fall times.

### 2. Features

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- Tolerant of slow trigger rise and fall times
- Separate reset inputs
- Triggering from falling or rising edge
- Multiple package options
- ESD protection:
  - ◆ HBM JESD22-A114E 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. Ordering information

Table 1. Ordering information

| Type number | Package           |         |  | Version  |
|-------------|-------------------|---------|--|----------|
|             | Temperature range | Name    | Description  |          |
| 74HC4538N   | -40 °C to +125 °C | DIP16   | plastic dual in-line package; 16-leads (300 mil)                       | SOT38-4  |
| 74HCT4538N  |                   |         |  |          |
| 74HC4538D   | -40 °C to +125 °C | SO16    | plastic small outline package; 16 leads; body width 3.9 mm             | SOT109-1 |
| 74HCT4538D  |                   |         |  |          |
| 74HC4538DB  | -40 °C to +125 °C | SSOP16  | plastic shrink small outline package; 16 leads; body width 5.3 mm      | SOT338-1 |
| 74HCT4538DB |                   |         |  |          |
| 74HC4538PW  | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HCT4538PW |                   |         |  |          |

## 4. Functional diagram

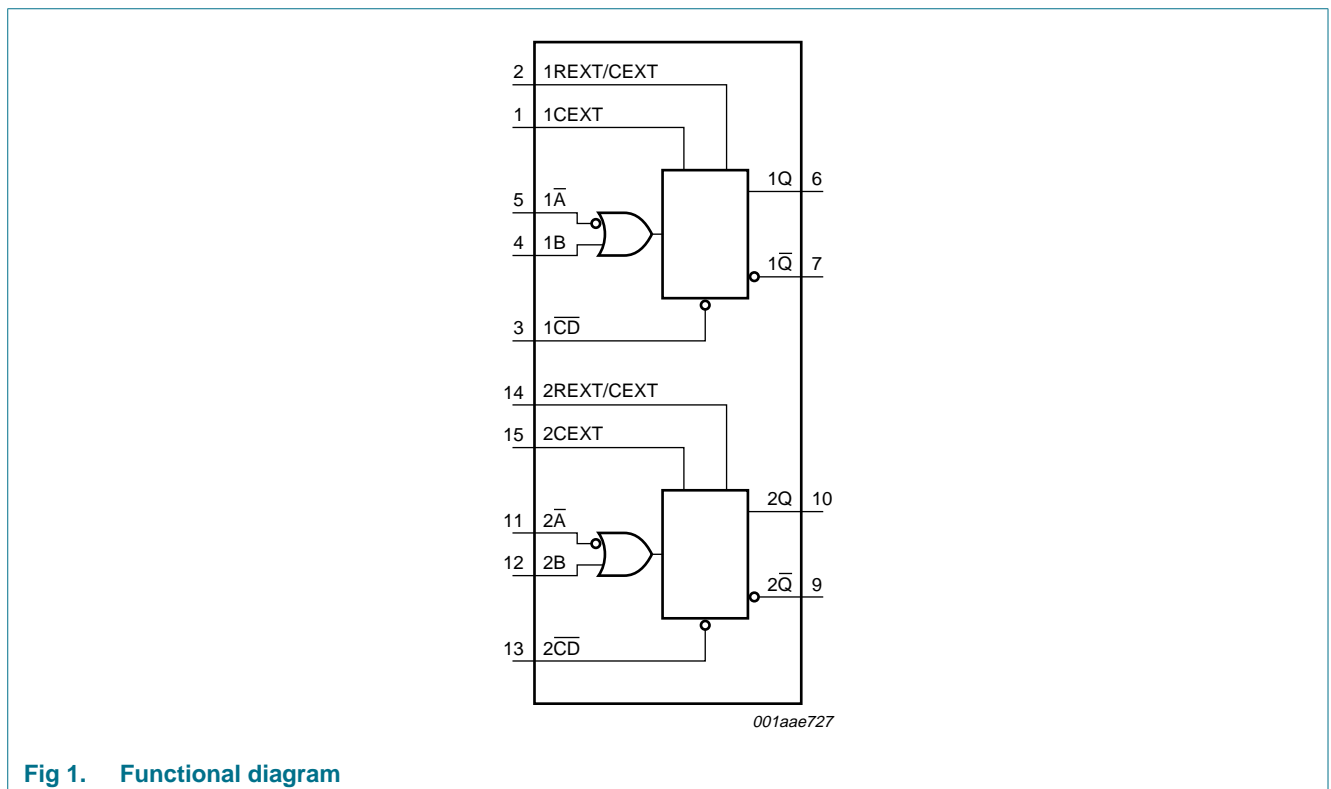


Fig 1. Functional diagram

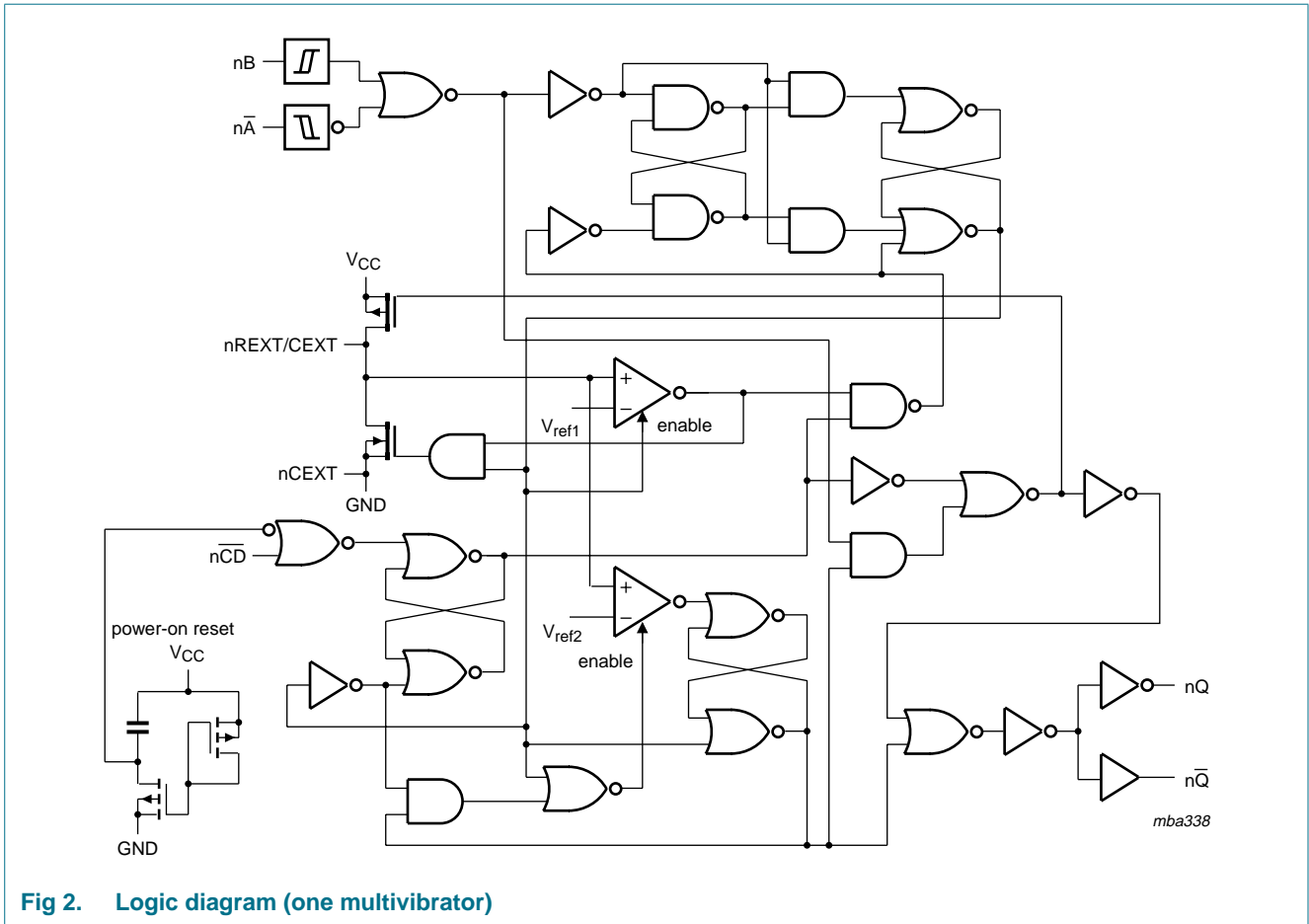


Fig 2. Logic diagram (one multivibrator)

## 5. Pinning information

### 5.1 Pinning

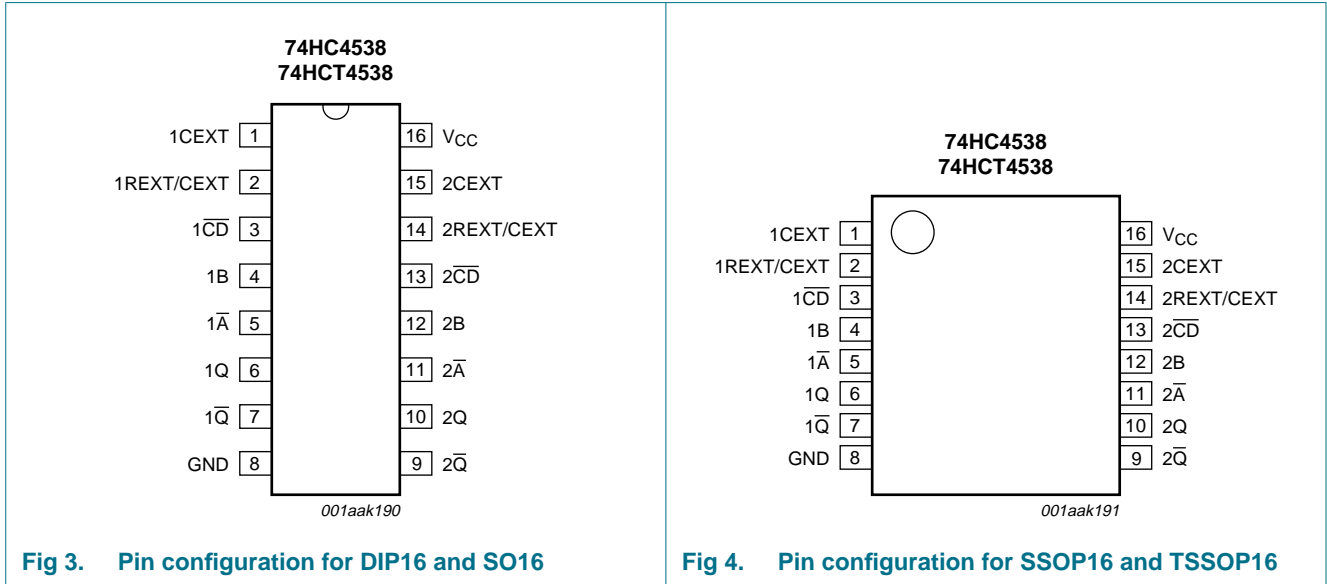


Fig 3. Pin configuration for DIP16 and SO16

Fig 4. Pin configuration for SSOP16 and TSSOP16

### 5.2 Pin description

Table 2. Pin description

| Symbol                 | Pin   | Description  |
|------------------------|-------|--|
| 1CEXT, 2CEXT           | 1, 15 | external capacitor connection (always connected to ground) |
| 1REXT/CEXT, 2REXT/CEXT | 2, 14 | external capacitor/resistor connection                     |
| 1CD, 2CD               | 3, 13 | direct reset input (active LOW)                            |
| 1B, 2B                 | 4, 12 | input (LOW to HIGH triggered)                              |
| 1A, 2A                 | 5, 11 | input (HIGH to LOW triggered)                              |
| 1Q, 2Q                 | 6, 10 | output   |
| 1Q, 2Q                 | 7, 9  | complementary output (active LOW)                          |
| GND                    | 8     | ground (0 V)   |
| VCC                    | 16    | supply voltage   |

## 6. Functional description

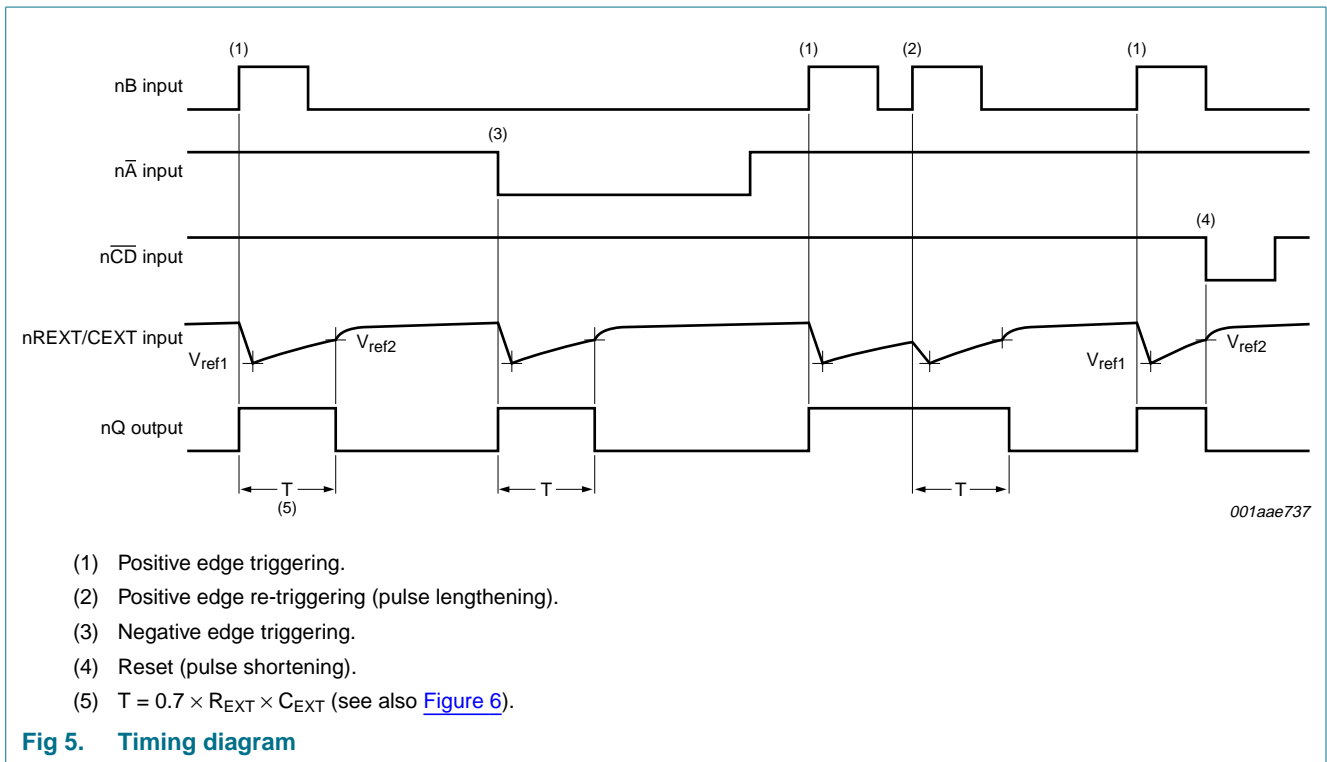
Table 3. Function table

| Inputs      |    |              | Outputs |             |
|-------------|----|--------------|---------|-------------|
| n $\bar{A}$ | nB | n $\bar{CD}$ | nQ      | n $\bar{Q}$ |
| ↓           | L  | H            |         |             |
| H           | ↑  | H            |         |             |
| X           | X  | L            | L       | H           |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care;  
 ↑ = positive-going transition; ↓ = negative-going transition;

= one HIGH level output pulse, with the pulse width determined by C<sub>EXT</sub> and R<sub>EXT</sub>;

= one LOW level output pulse, with the pulse width determined by C<sub>EXT</sub> and R<sub>EXT</sub>.



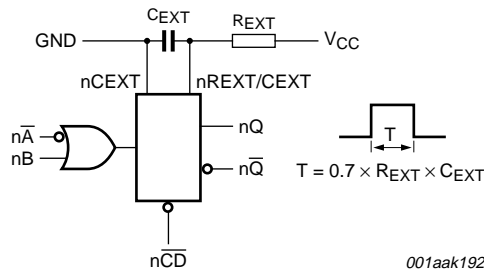


Fig 6. Connection of the external timing components R<sub>EXT</sub> and C<sub>EXT</sub>

## 7. Limiting values

Table 4. Limiting values

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

| Symbol           | Parameter               | Conditions  | Min   | Max  | Unit |
|------------------|-------------------------|---|-------|------|------|
| V <sub>CC</sub>  | supply voltage          |   | -0.5  | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | [1] - | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V | [1] - | ±20  | mA   |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = -0.5 V to V <sub>CC</sub> + 0.5 V                  | -     | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |   | -     | +50  | mA   |
| I <sub>GND</sub> | ground current          |   | -50   | -    | mA   |
| T <sub>stg</sub> | storage temperature     |   | -65   | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C                                |       |      |      |
|                  |                         | DIP16 package   | [2] - | 750  | mW   |
|                  |                         | SO16 package  | [3] - | 500  | mW   |
|                  |                         | (T)SSOP16 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<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

[3] P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

[4] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC4538 |      |                 | 74HCT4538 |      |                 | Unit |
|------------------|-------------------------------------|-------------------------|----------|------|-----------------|-----------|------|-----------------|------|
|                  |                                     |                         | Min      | Typ  | Max             | Min       | Typ  | Max             |      |
| V <sub>CC</sub>  | supply voltage                      |                         | 2.0      | 5.0  | 6.0             | 4.5       | 5.0  | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                         | 0        | -    | V <sub>CC</sub> | 0         | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                         | 0        | -    | V <sub>CC</sub> | 0         | -    | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                         | -40      | -    | +125            | -40       | -    | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V | -        | -    | 625             | -         | -    | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 4.5 V | -        | 1.67 | 139             | -         | 1.67 | 139             | ns/V |
|                  |                                     | V <sub>CC</sub> = 6.0 V | -        | -    | 83              | -         | -    | -               | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol          | Parameter                 | Conditions   | 25 °C |      |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|--|-------|------|------|------------------|------|-------------------|------|------|
|                 |                           |  | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| <b>74HC4538</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    |
|                 |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V  | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>  |       |      |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V  | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V  | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V  | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V   | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V   | -     | 0.16 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V   | -     | -    | ±0.1 | -                | ±1   | -                 | ±1   | μA   |
|                 |                           | pin nREXT/CEXT; V <sub>I</sub> = 2.0 V or GND; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V <a href="#">[1]</a> | -     | -    | ±0.5 | -                | ±5   | -                 | ±10  | 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      |         |
| $I_{CC}$         | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 6.0$ V   | -     | -    | 8.0       | -                | 80      | -                 | 160      | $\mu$ A |
| $C_I$            | input capacitance         |   | -     | 3.5  | -         | -                | -       | -                 | -        | pF      |
| <b>74HCT4538</b> |                           |   |       |      |           |                  |         |                   |          |         |
| $V_{IH}$         | HIGH-level input voltage  | $V_{CC} = 4.5$ V to 5.5 V   | 2.0   | 1.6  | -         | 2.0              | -       | 2.0               | -        | V       |
| $V_{IL}$         | LOW-level input voltage   | $V_{CC} = 4.5$ V to 5.5 V   | -     | 1.2  | 0.8       | -                | 0.8     | -                 | 0.8      | V       |
| $V_{OH}$         | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5$ V   |       |      |           |                  |         |                   |          |         |
|                  |                           | $I_O = -20$ $\mu$ A   | 4.4   | 4.5  | -         | 4.4              | -       | 4.4               | -        | V       |
|                  |                           | $I_O = -4.0$ mA   | 3.98  | 4.32 | -         | 3.84             | -       | 3.7               | -        | V       |
| $V_{OL}$         | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5$ V   |       |      |           |                  |         |                   |          |         |
|                  |                           | $I_O = 20$ $\mu$ A; $V_{CC} = 4.5$ V  | -     | 0    | 0.1       | -                | 0.1     | -                 | 0.1      | V       |
|                  |                           | $I_O = 4.0$ mA; $V_{CC} = 4.5$ V  | -     | 0.15 | 0.26      | -                | 0.33    | -                 | 0.4      | V       |
| $I_I$            | input leakage current     | $V_I = V_{CC}$ or GND;<br>$V_{CC} = 5.5$ V  | -     | -    | $\pm 0.1$ | -                | $\pm 1$ | -                 | $\pm 1$  | $\mu$ A |
|                  |                           | pin nREXT/CEXT;<br>$V_I = 2.0$ V or GND; other inputs at $V_{CC}$ or GND;<br>$V_{CC} = 5.5$ V [1]     | -     | -    | $\pm 0.5$ | -                | $\pm 5$ | -                 | $\pm 10$ | $\mu$ 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      | $\mu$ A |
| $\Delta I_{CC}$  | additional supply current | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ A;<br>other inputs at $V_{CC}$ or GND;<br>$V_{CC} = 4.5$ V to 5.5 V |       |      |           |                  |         |                   |          |         |
|                  |                           | pin nA, nB  | -     | 50   | 180       | -                | 225     | -                 | 245      | $\mu$ A |
|                  |                           | pin nCD   | -     | 65   | 234       | -                | 293     | -                 | 319      | $\mu$ A |
| $C_I$            | input capacitance         |   | -     | 3.5  | -         | -                | -       | -                 | -        | pF      |

[1] This measurement can only be carried out after a trigger pulse is applied.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 9](#).

| Symbol           | Parameter                     | Conditions   | 25 °C |                    |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|--|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |  | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| <b>74HC4538</b>  |                               |  |       |                    |     |                  |     |                   |     |      |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | n $\bar{A}$ , nB to nQ; see <a href="#">Figure 7</a>             |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V  | -     | 85                 | 265 | -                | 330 | -                 | 400 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V  | -     | 31                 | 53  | -                | 66  | -                 | 80  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                  | -     | 27                 | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V  | -     | 25                 | 45  | -                | 56  | -                 | 68  | ns   |
|                  |                               | n $\bar{CD}$ to n $\bar{Q}$ ; see <a href="#">Figure 7</a>       |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V  | -     | 83                 | 265 | -                | 340 | -                 | 400 | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | n $\bar{A}$ , nB to n $\bar{Q}$ ; see <a href="#">Figure 7</a>   |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V  | -     | 83                 | 265 | -                | 330 | -                 | 400 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V  | -     | 30                 | 53  | -                | 66  | -                 | 80  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                  | -     | 27                 | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V  | -     | 24                 | 45  | -                | 56  | -                 | 68  | ns   |
|                  |                               | n $\bar{CD}$ to nQ; see <a href="#">Figure 7</a>                 |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V  | -     | 80                 | 265 | -                | 330 | -                 | 400 | ns   |
| t <sub>t</sub>   | transition time               | nQ and n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[2]</sup> |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V  | -     | 19                 | 75  | -                | 95  | -                 | 119 | 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); for test circuit see [Figure 9](#).

| Symbol   | Parameter                     | Conditions  | 25 °C          |                    |           | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|--|-------------------------------|---|----------------|--------------------|-----------|------------------|-----|-------------------|-----|------|
|  |                               |   | Min            | Typ <sup>[1]</sup> | Max       | Min              | Max | Min               | Max |      |
| t <sub>w</sub>   | pulse width                   | n $\bar{A}$ LOW; see <a href="#">Figure 8</a>   |                |                    |           |                  |     |                   |     |      |
|  |                               | V <sub>CC</sub> = 2.0 V   | 80             | 17                 | -         | 100              | -   | 120               | -   | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V   | 16             | 6                  | -         | 20               | -   | 24                | -   | ns   |
|  |                               | V <sub>CC</sub> = 6.0 V   | 14             | 5                  | -         | 17               | -   | 20                | -   | ns   |
|  |                               | nB HIGH; see <a href="#">Figure 8</a>   |                |                    |           |                  |     |                   |     |      |
|  |                               | V <sub>CC</sub> = 2.0 V   | 80             | 17                 | -         | 100              | -   | 120               | -   | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V   | 16             | 6                  | -         | 20               | -   | 24                | -   | ns   |
|  |                               | V <sub>CC</sub> = 6.0 V   | 14             | 5                  | -         | 17               | -   | 20                | -   | ns   |
|  |                               | n $\overline{CD}$ LOW; see <a href="#">Figure 8</a>   |                |                    |           |                  |     |                   |     |      |
|  |                               | V <sub>CC</sub> = 2.0 V   | 80             | 19                 | -         | 100              | -   | 120               | -   | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V   | 16             | 7                  | -         | 20               | -   | 24                | -   | ns   |
|  |                               | V <sub>CC</sub> = 6.0 V   | 14             | 6                  | -         | 17               | -   | 20                | -   | ns   |
|  |                               | nQ and n $\overline{Q}$ HIGH or LOW; see <a href="#">Figure 8</a>                                   |                |                    |           |                  |     |                   |     |      |
| V <sub>CC</sub> = 5.0 V;<br>C <sub>EXT</sub> = 0.1 μF;<br>R <sub>EXT</sub> = 10 kΩ | 630                           | 700   | 770            | 602                | 798       | 595              | 805 | μs                |     |      |
| t <sub>rec</sub>   | recovery time                 | n $\overline{CD}$ to n $\bar{A}$ , nB; see <a href="#">Figure 8</a>                                 |                |                    |           |                  |     |                   |     |      |
|  |                               | V <sub>CC</sub> = 2.0 V   | 35             | 6                  | -         | 45               | -   | 55                | -   | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V   | 7              | 2                  | -         | 9                | -   | 11                | -   | ns   |
|  |                               | V <sub>CC</sub> = 6.0 V   | 6              | 2                  | -         | 8                | -   | 9                 | -   | ns   |
| t <sub>rtrig</sub>   | retrigger time                | n $\bar{A}$ , nB; see <a href="#">Figure 8</a> ;<br>X = C <sub>EXT</sub> / (4.5 × V <sub>CC</sub> ) |                |                    |           |                  |     |                   |     |      |
|  |                               | V <sub>CC</sub> = 2.0 V   | -              | 455 + X            | -         | -                | -   | -                 | -   | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V   | -              | 80 + X             | -         | -                | -   | -                 | -   | ns   |
|  |                               | V <sub>CC</sub> = 6.0 V   | -              | 55 + X             | -         | -                | -   | -                 | -   | ns   |
| R <sub>EXT</sub>   | external timing resistor      | V <sub>CC</sub> = 2.0 V   | 10             | -                  | 1000      | -                | -   | -                 | -   | kΩ   |
|  |                               | V <sub>CC</sub> = 5.0 V   | 2              | -                  | 1000      | -                | -   | -                 | -   | kΩ   |
| C <sub>EXT</sub>   | external timing capacitor     |   |                |                    | no limits |                  |     |                   |     |      |
| C <sub>PD</sub>  | power dissipation capacitance | per multivibrator;<br>V <sub>I</sub> = GND to V <sub>CC</sub>                                       | <sup>[3]</sup> | -                  | 136       | -                | -   | -                 | -   | pF   |

**Table 7. Dynamic characteristics ...continued**  
 Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 9](#).

| Symbol            | Parameter                     | Conditions   | 25 °C     |                    |      | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-------------------|-------------------------------|--|-----------|--------------------|------|------------------|-----|-------------------|-----|------|
|                   |                               |  | Min       | Typ <sup>[1]</sup> | Max  | Min              | Max | Min               | Max |      |
| <b>74HCT4538</b>  |                               |  |           |                    |      |                  |     |                   |     |      |
| t <sub>PLH</sub>  | LOW to HIGH propagation delay | n $\bar{A}$ , nB to nQ; see <a href="#">Figure 7</a>   |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | -         | 35                 | 60   | -                | 75  | -                 | 90  | ns   |
|                   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -         | 30                 | -    | -                | -   | -                 | -   | ns   |
| t <sub>PHL</sub>  | HIGH to LOW propagation delay | n $\bar{A}$ , nB to n $\bar{Q}$ ; see <a href="#">Figure 7</a>                                   |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | -         | 35                 | 60   | -                | 75  | -                 | 90  | ns   |
|                   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -         | 30                 | -    | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>    | transition time               | n $\bar{CD}$ to n $\bar{Q}$ ; see <a href="#">Figure 7</a>                                       |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | -         | 35                 | 60   | -                | 75  | -                 | 90  | ns   |
|                   |                               | nQ and n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[2]</sup>                                 |           |                    |      |                  |     |                   |     |      |
| t <sub>w</sub>    | pulse width                   | n $\bar{A}$ LOW; see <a href="#">Figure 8</a>  |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | 20        | 11                 | -    | 25               | -   | 30                | -   | ns   |
|                   |                               | nB HIGH; see <a href="#">Figure 8</a>  |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | 16        | 5                  | -    | 20               | -   | 24                | -   | ns   |
|                   |                               | n $\bar{CD}$ LOW; see <a href="#">Figure 8</a>   |           |                    |      |                  |     |                   |     |      |
| t <sub>rec</sub>  | recovery time                 | nQ and n $\bar{Q}$ HIGH or LOW; see <a href="#">Figure 8</a>                                     |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 5.0 V; C <sub>EXT</sub> = 0.1 μF; R <sub>EXT</sub> = 10 kΩ                     | 630       | 700                | 770  | 602              | 798 | 595               | 805 | μs   |
|                   |                               | V <sub>CC</sub> = 4.5 V  | 7         | 2                  | -    | 9                | -   | 11                | -   | ns   |
| t <sub>trig</sub> | retrigger time                | n $\bar{A}$ , nB; see <a href="#">Figure 8</a> ; X = C <sub>EXT</sub> / (4.5 × V <sub>CC</sub> ) |           |                    |      |                  |     |                   |     |      |
|                   |                               | V <sub>CC</sub> = 4.5 V  | -         | 80 + X             | -    | -                | -   | -                 | -   | ns   |
| R <sub>EXT</sub>  | external timing resistor      | V <sub>CC</sub> = 5.0 V  | 2         | -                  | 1000 | -                | -   | -                 | -   | kΩ   |
| C <sub>EXT</sub>  | external timing capacitor     | V <sub>CC</sub> = 5.0 V  | no limits |                    |      |                  |     |                   |     |      |

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

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 9](#).

| Symbol          | Parameter                     | Conditions  | 25 °C |                    |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|---|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                 |                               |   | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| C <sub>PD</sub> | power dissipation capacitance | per multivibrator;<br>V <sub>I</sub> = GND to (V <sub>CC</sub> - 1.5 V) | -     | 138                | -   | -                | -   | -                 | -   | pF   |

[1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).

[2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times \Sigma(C_L \times V_{CC}^2 \times f_o) + 0.48 \times C_{EXT} \times V_{CC}^2 \times f_o + D \times 0.8 \times V_{CC}$$

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

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

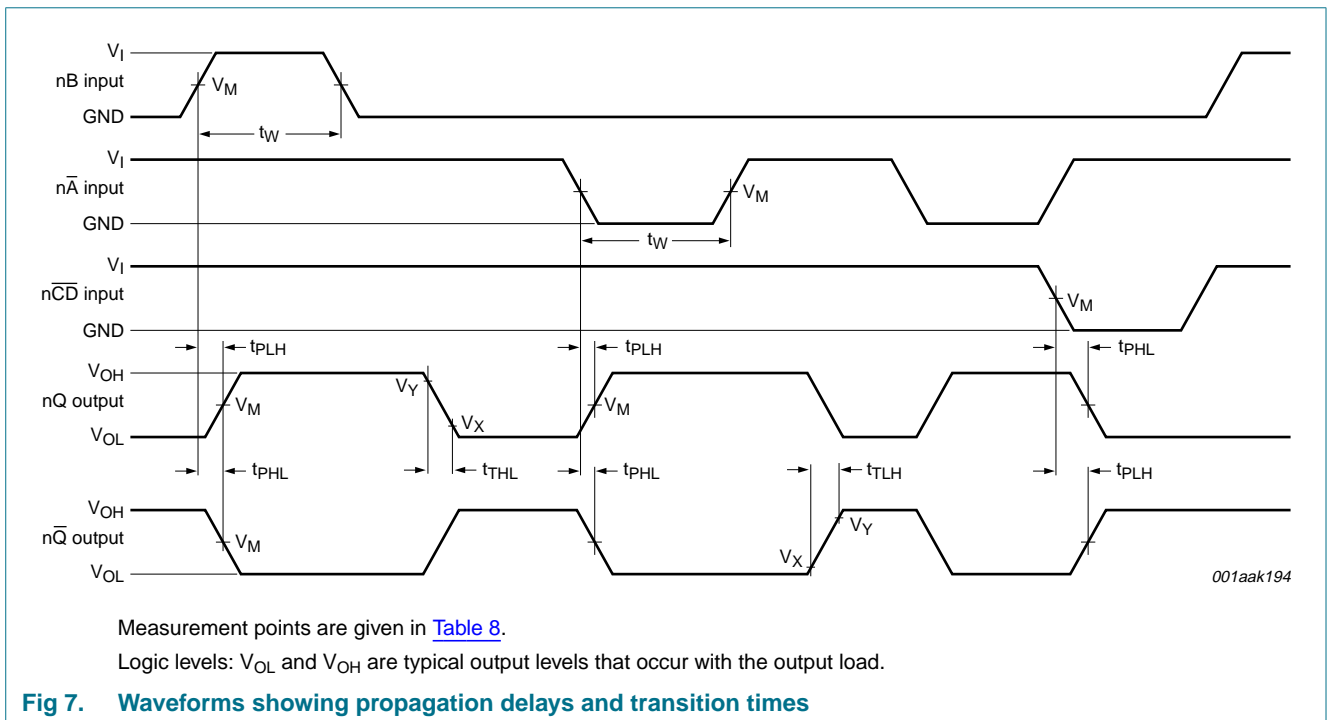
C<sub>L</sub> = output load capacitance in pF;

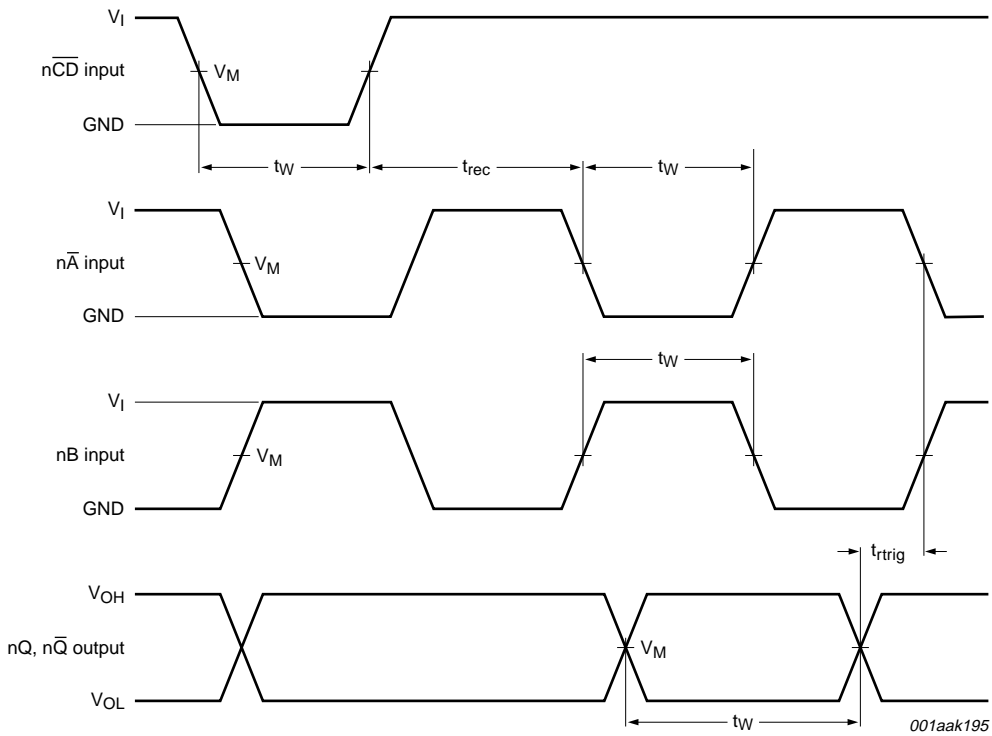
V<sub>CC</sub> = supply voltage in V;

D = duty cycle factor in %;

C<sub>EXT</sub> = external timing capacitance in pF.

## 11. Waveforms





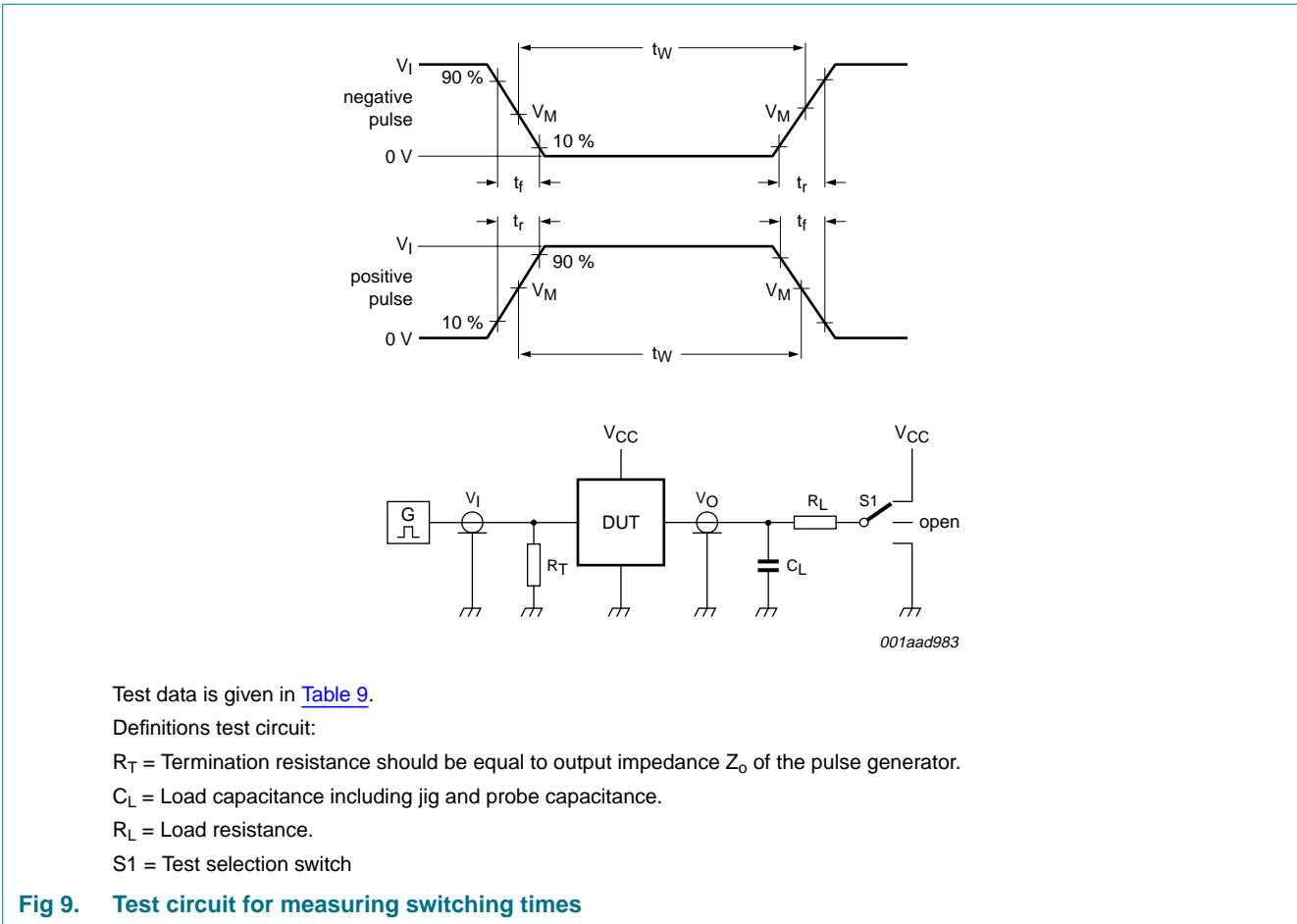
Measurement points are given in [Table 8](#).

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

**Fig 8. Waveforms showing  $n\overline{A}$ ,  $nB$ ,  $nQ$ ,  $n\overline{Q}$  pulse widths, recovery and retrigger times**

**Table 8. Measurement points**

| Type      | Input       | Output      |             |             |
|-----------|-------------|-------------|-------------|-------------|
|           | $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| 74HC4538  | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT4538 | 1.3 V       | 1.3 V       | $0.1V_{CC}$ | $0.9V_{CC}$ |



**Table 9. Test data**

| Type      | Input    |            | Load         |              | S1 position        |
|-----------|----------|------------|--------------|--------------|--------------------|
|           | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ |
| 74HC4538  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               |
| 74HCT4538 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               |

## 12. Application information

### 12.1 Power-down considerations

A large capacitor ( $C_{EXT}$ ) may cause problems when powering-down the monostable due to energy stored in this capacitor. When a system containing this device is powered-down or rapid decrease of  $V_{CC}$  to zero occurs, the monostable may sustain damage, due to the capacitor discharging through the input protection diodes. To avoid this possibility, use a damping diode ( $D_{EXT}$ ) preferably a germanium or Schottky type diode able to withstand large current surges and connect as shown in [Figure 10](#)

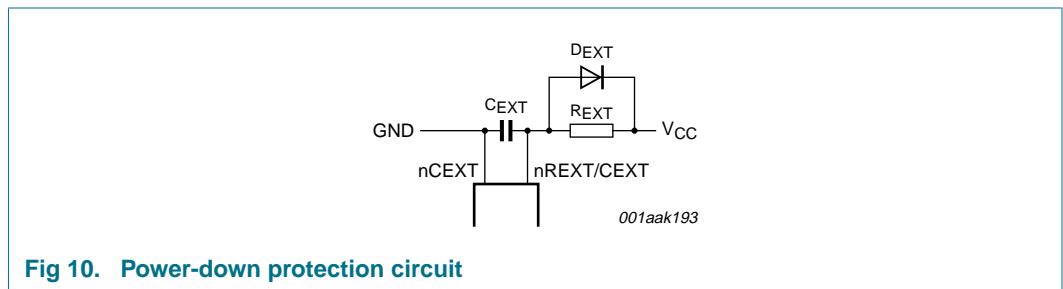


Fig 10. Power-down protection circuit

### 12.2 Graphs

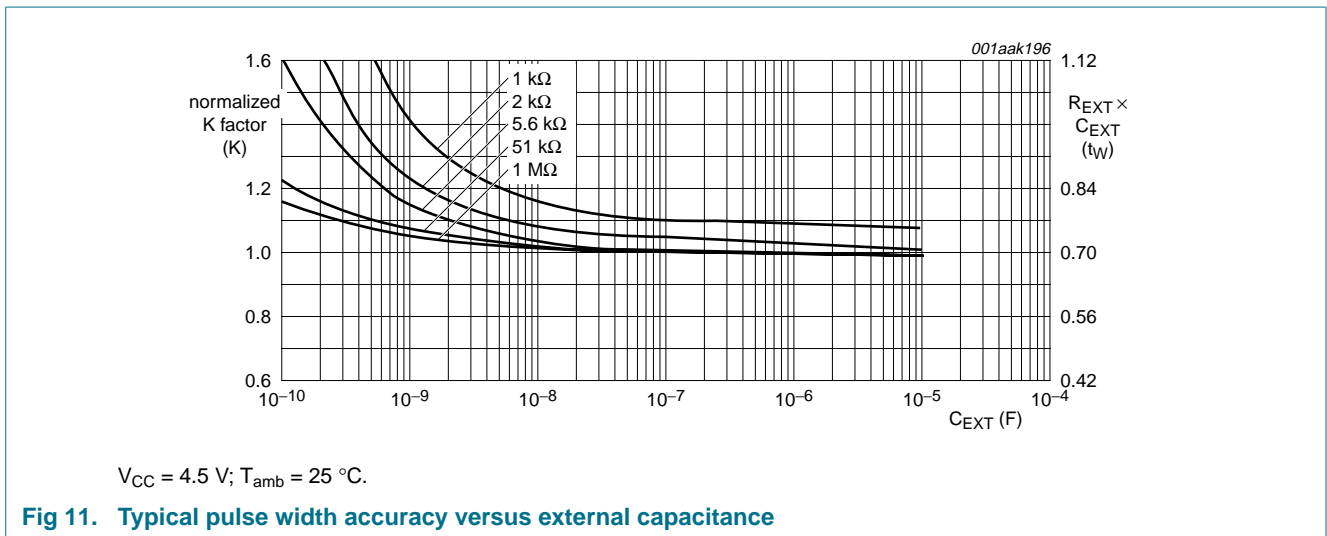
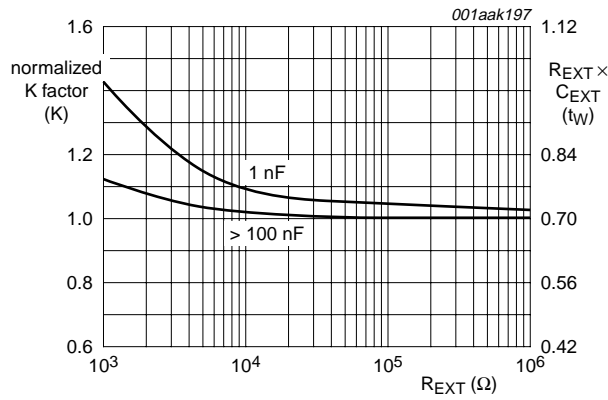
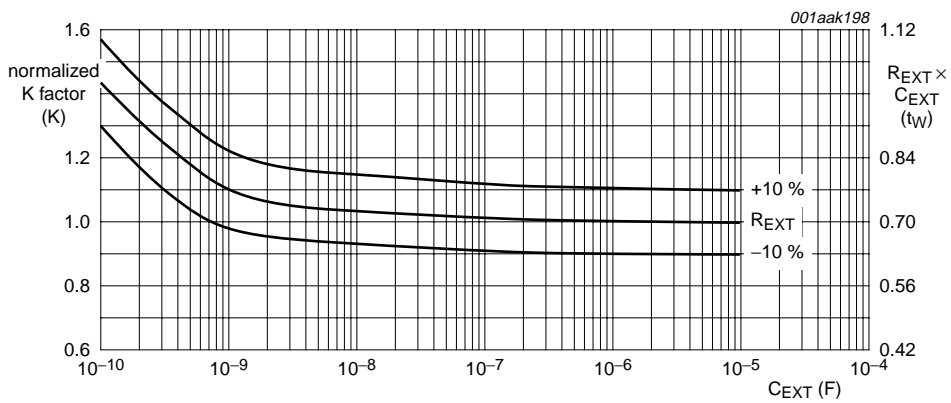


Fig 11. Typical pulse width accuracy versus external capacitance



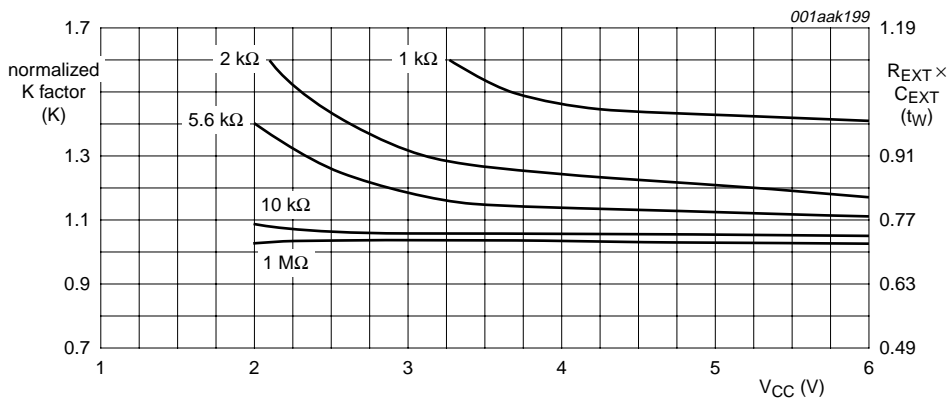
$V_{CC} = 4.5 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}.$

**Fig 12. Typical pulse width accuracy versus external resistance**



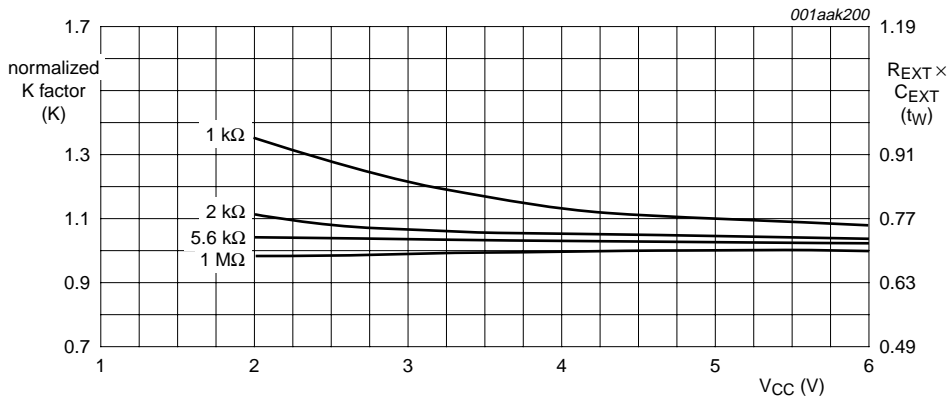
$V_{CC} = 4.5 \text{ V}; R_{EXT} = 10 \text{ k}\Omega; T_{amb} = 25 \text{ }^\circ\text{C}.$

**Fig 13. Typical pulse width accuracy versus external capacitance**



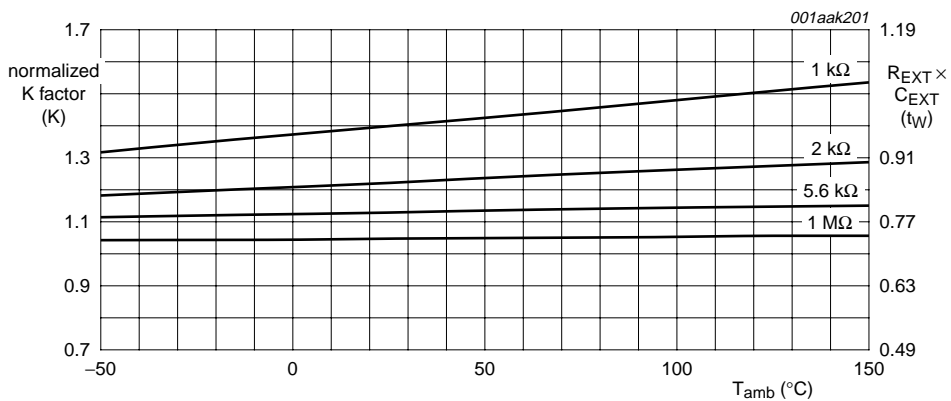
$C_{EXT} = 1 \text{ nF}; T_{amb} = 25 \text{ }^\circ\text{C}.$

**Fig 14. Typical pulse width accuracy versus power supply**



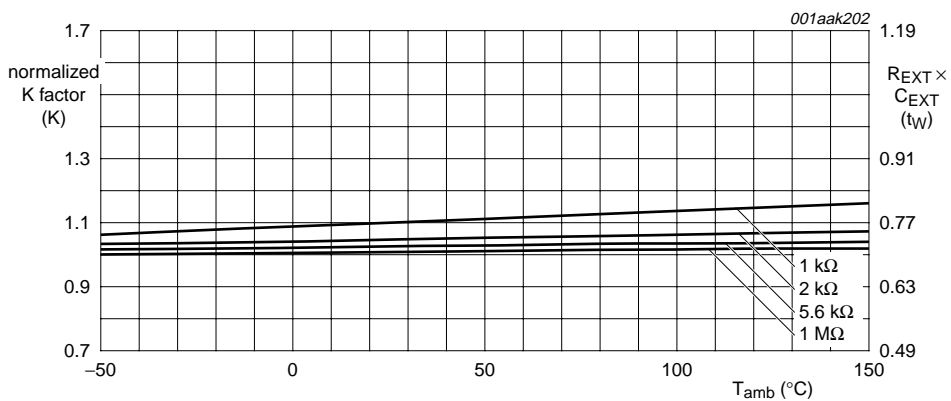
C<sub>EXT</sub> = 100 nF; T<sub>amb</sub> = 25 °C.

**Fig 15. Typical pulse width accuracy versus power supply**



V<sub>CC</sub> = 4.5 V; C<sub>EXT</sub> = 1 nF; T<sub>amb</sub> = 25 °C.

**Fig 16. Typical pulse width accuracy versus temperature**



V<sub>CC</sub> = 4.5 V; C<sub>EXT</sub> = 1 μF; T<sub>amb</sub> = 25 °C.

**Fig 17. Typical pulse width accuracy versus temperature**

13. Package outline

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

SOT38-4

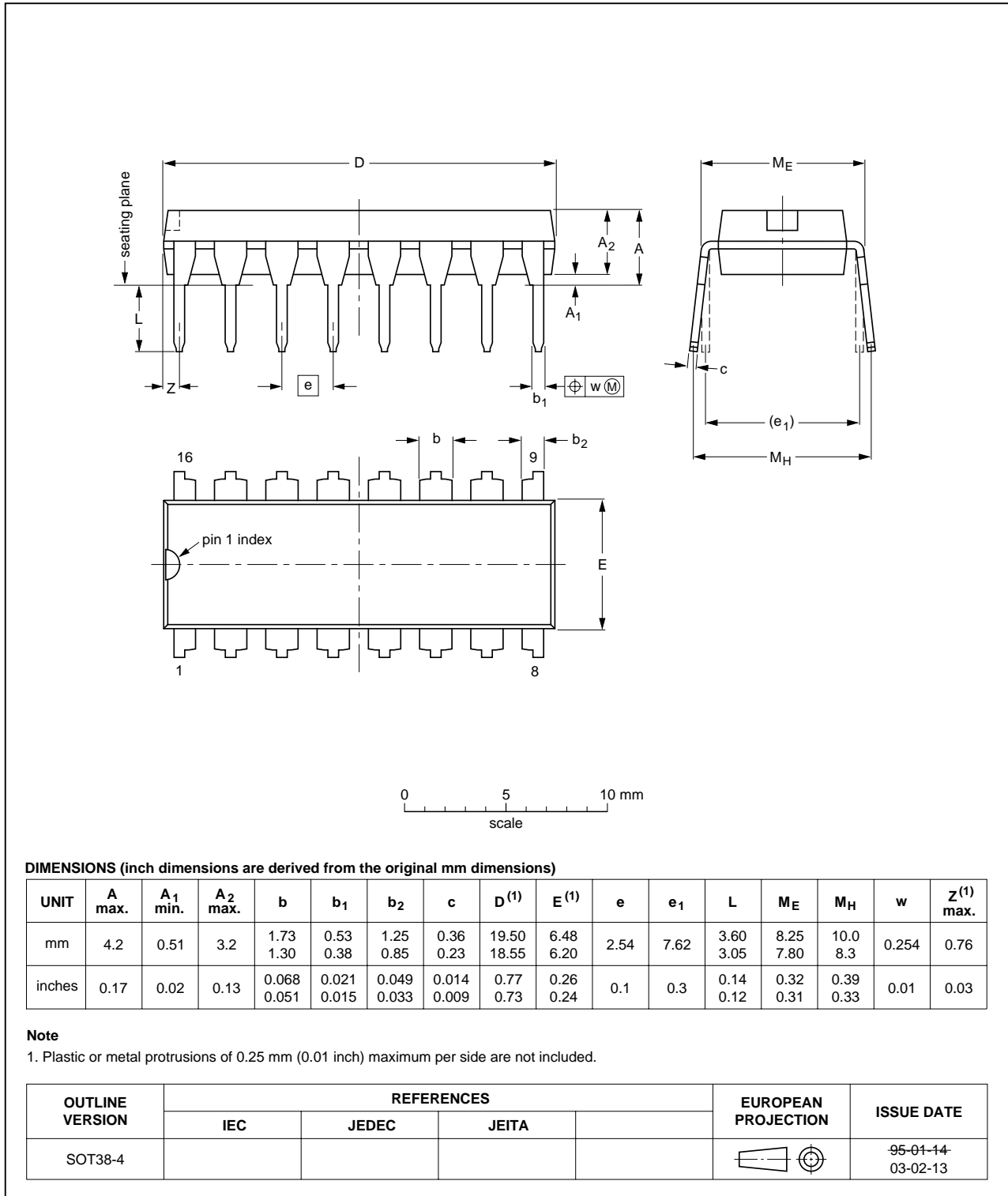


Fig 18. Package outline SOT38-4 (DIP16)

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

SOT109-1

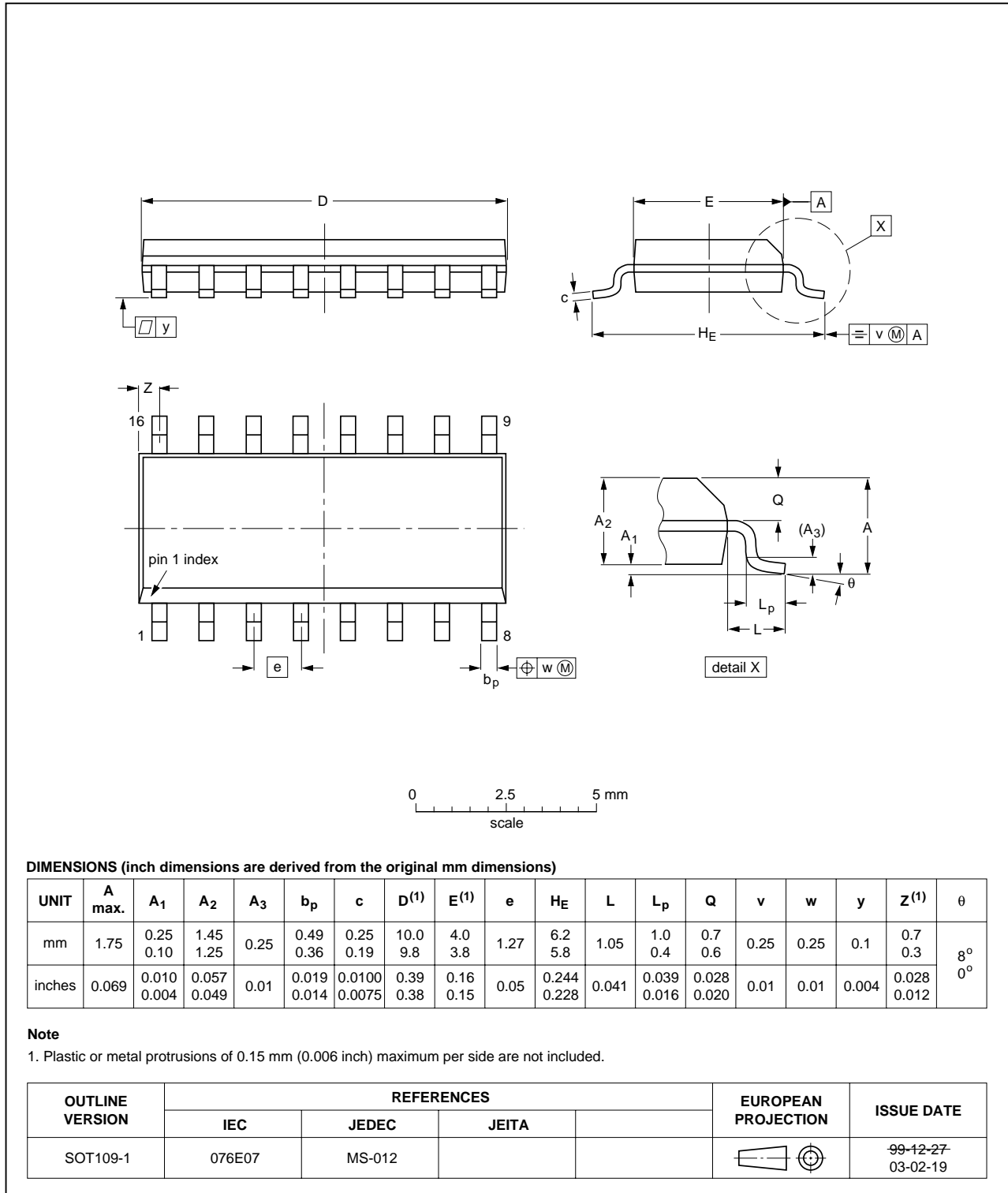


Fig 19. Package outline SOT109-1 (SO16)

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

SOT338-1

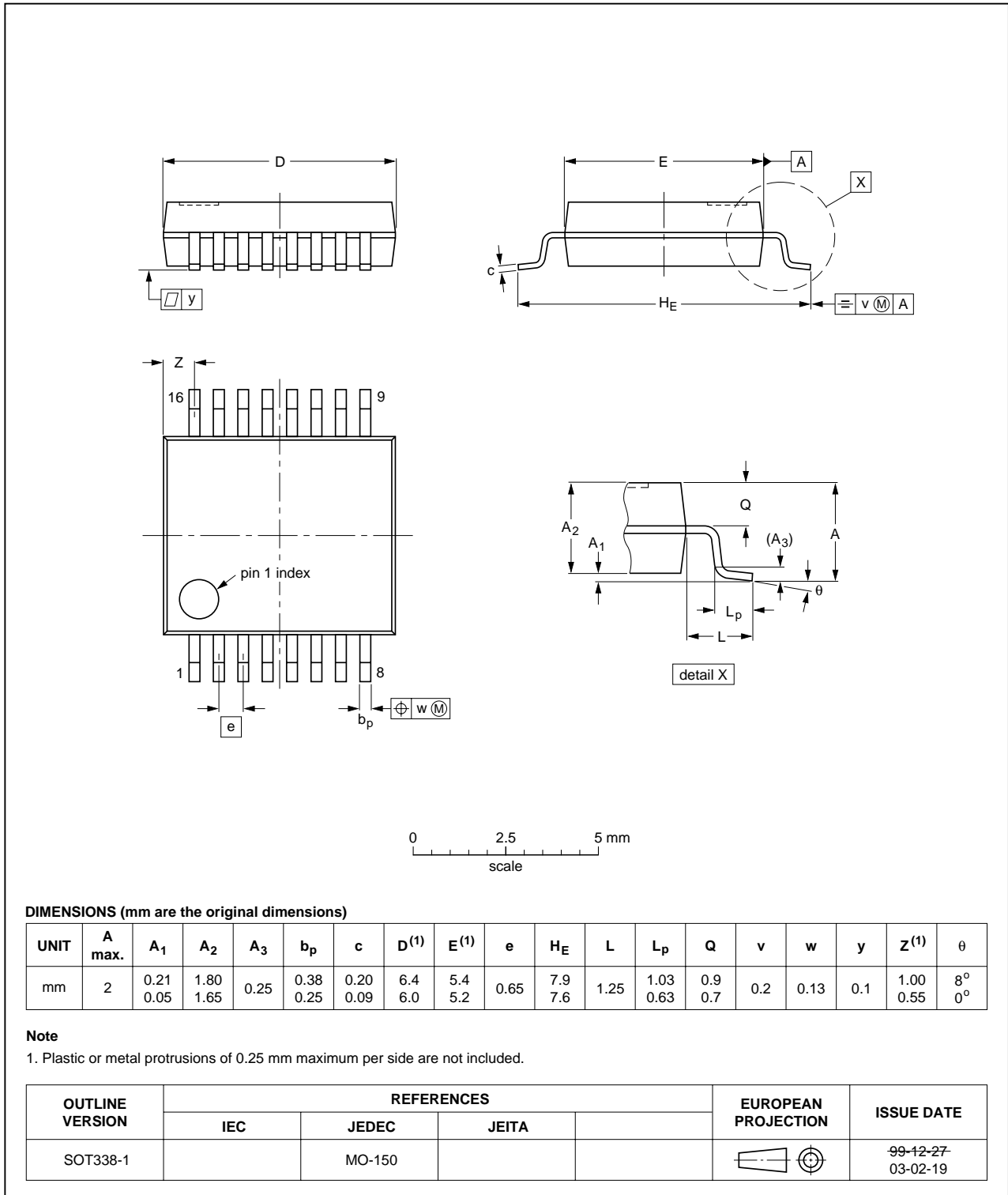


Fig 20. Package outline SOT338-1 (SSOP16)

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

SOT403-1

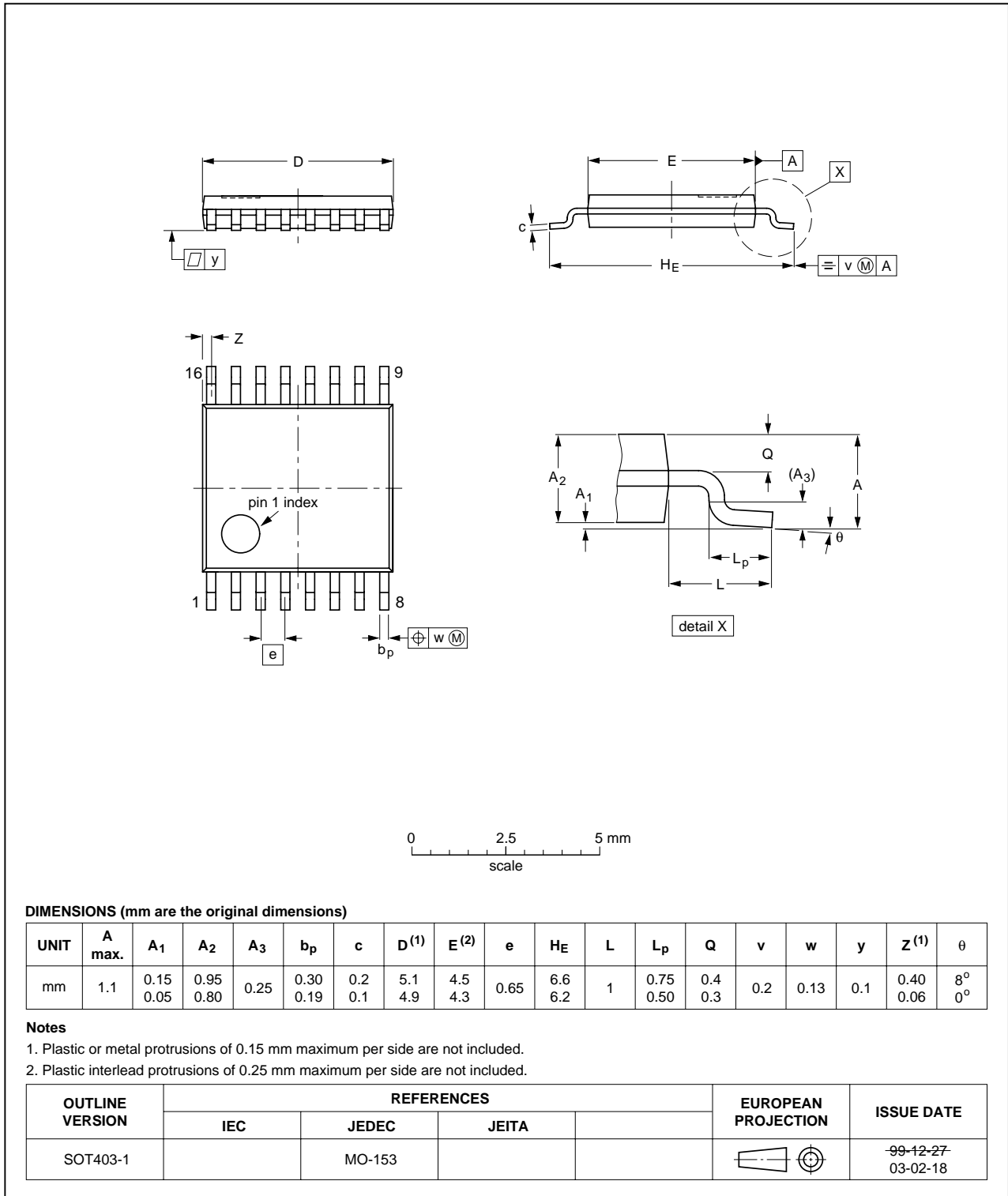


Fig 21. Package outline SOT403-1 (TSSOP16)

## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Description                                    |
|---------|--|
| CMOS    | Complementary Metal-Oxide Semiconductor        |
| DUT     | Device Under Test                              |
| ESD     | ElectroStatic Discharge                        |
| HBM     | Human Body Model                               |
| LSTTL   | Low-power Schottky Transistor-Transistor Logic |
| 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_HCT4538_3     | 20090608     | Product data sheet  | -             | 74HC_HCT4538_CNV_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>Pin names changed throughout.</li> <li>Section <a href="#">Section 7</a>, <a href="#">Section 8</a> and <a href="#">Section 9</a> added, taken from the 74HC/T HCMOS Family characteristics/specification (March 1988).</li> <li>Test circuit added: <a href="#">Figure 9</a>.</li> <li>Quick reference data incorporated in to <a href="#">Section 9</a> and <a href="#">Section 10</a>.</li> <li>Package information added for DIP16, SO16, SSOP16 and TSSOP16 packages.</li> </ul> |               |                    |
| 74HC_HCT4538_CNV_2 | 19970902     | 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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