# 74HC4538-Q100; 74HCT4538-Q100

## Dual retriggerable precision monostable multivibrator

Rev. 1 — 2 August 2012 Product data sheet

## 1. General description

The 74HC4538-Q100; 74HCT4538-Q100 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-Q100; 74HCT4538-Q100 are dual retriggerable-resettable monostable multivibrators. Each multivibrator has:

- an active LOW trigger/retrigger input ($n\overline{A}$)
- an active HIGH trigger/retrigger input (nB)
- an overriding active LOW direct reset input ($n\overline{CD}$)
- an output (nQ) and its complement ($n\overline{Q}$)
- 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 ±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 $n\overline{CD}$ terminates the output pulse immediately. Schmitt trigger action on pins $n\overline{A}$ and nB makes the circuit highly tolerant of slower rise and fall times.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from −40 °C to +85 °C and from −40 °C to +125 °C
- Tolerant of slow trigger rise and fall times
- Separate reset inputs
- Triggering from falling or rising edge
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74HC4538D-Q100 | −40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HCT4538D-Q100 | | | | |
| 74HC4538PW-Q100 | −40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HCT4538PW-Q100 | | | | |

## 4. Functional diagram

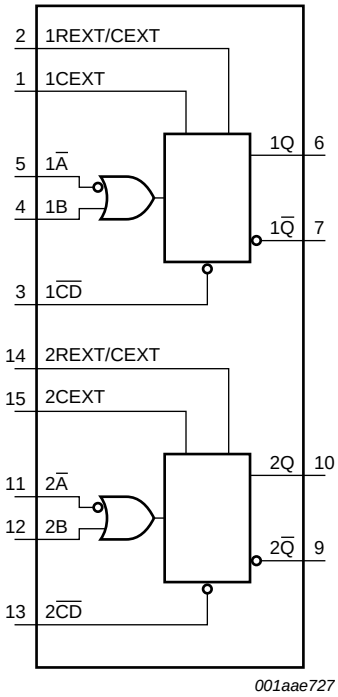



**Fig 1. Functional diagram**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

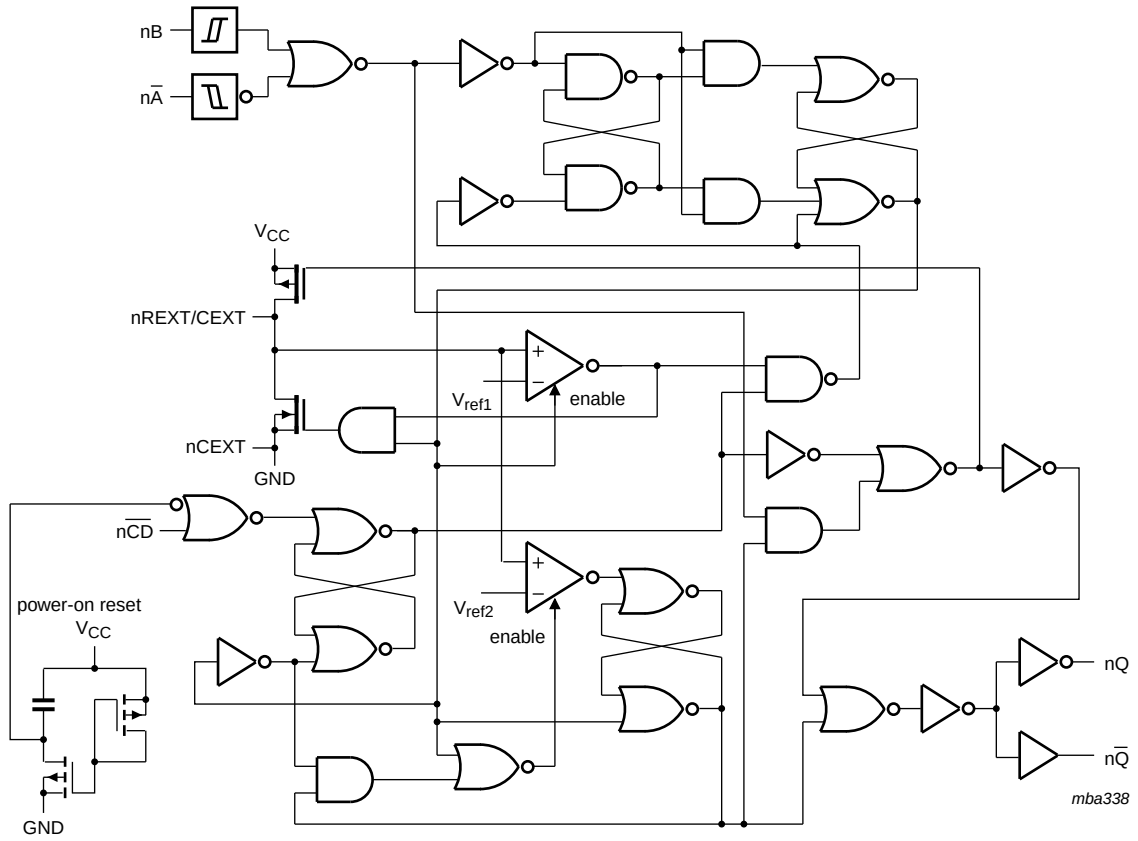



**Fig 2. Logic diagram (one multivibrator)**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

# 5. Pinning information

## 5.1 Pinning

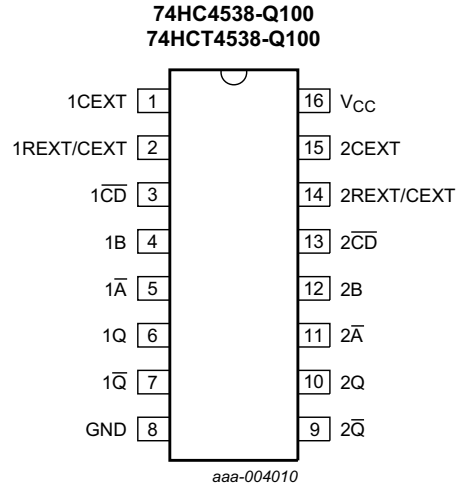



Fig 3. Pin configuration for SO16

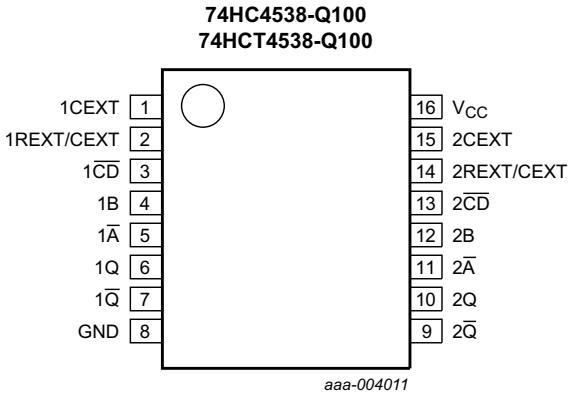



Fig 4. Pin configuration for TSSOP16

## 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 |
| $1\overline{CD}$, $2\overline{CD}$ | 3, 13 | direct reset input (active LOW) |
| 1B, 2B | 4, 12 | input (LOW to HIGH triggered) |
| $1\overline{A}$, $2\overline{A}$ | 5, 11 | input (HIGH to LOW triggered) |
| 1Q, 2Q | 6, 10 | output |
| $1\overline{Q}$, $2\overline{Q}$ | 7, 9 | complementary output (active LOW) |
| GND | 8 | ground (0 V) |
| $V_{CC}$ | 16 | supply voltage |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

# 6. Functional description

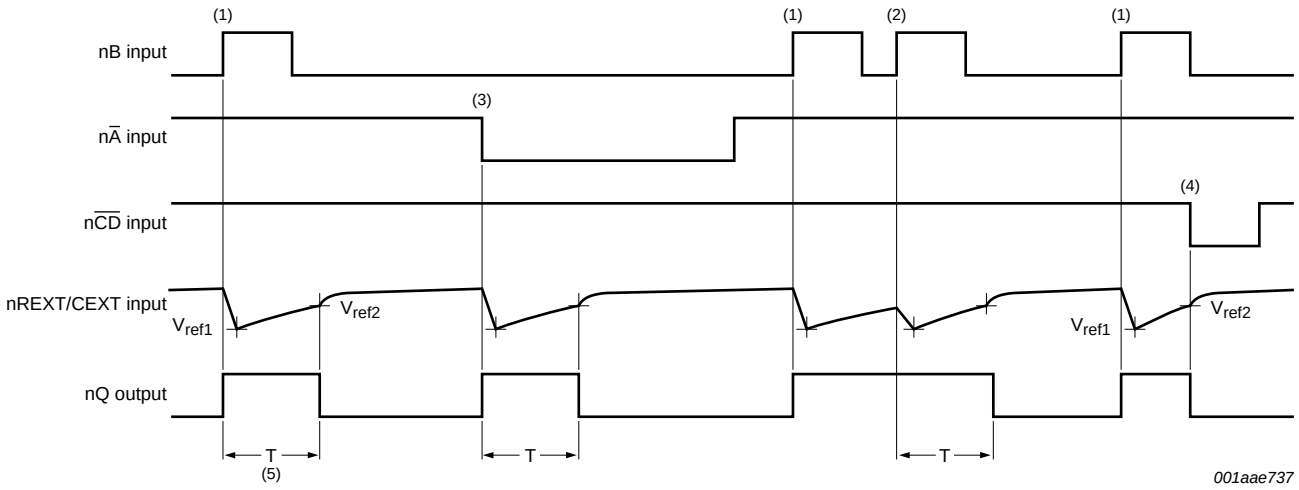
**Table 3. Function table**

| Inputs | | | Outputs | |
|---|---|---|---|---|
| **nA** | **nB** | **nCD** | **nQ** | **nQ** |
| ↓ | 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 pule width determined by $C_{EXT}$ and $R_{EXT}$;

⎍ = one LOW level output pulse, with the pulse width determined by $C_{EXT}$ and $R_{EXT}$.




(1) Positive edge triggering.
(2) Positive edge retriggering (pulse lengthening).
(3) Negative edge triggering.
(4) Reset (pulse shortening).
(5) $T = 0.7 \times R_{EXT} \times C_{EXT}$ (see also Figure 6).

**Fig 5. Timing diagram**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

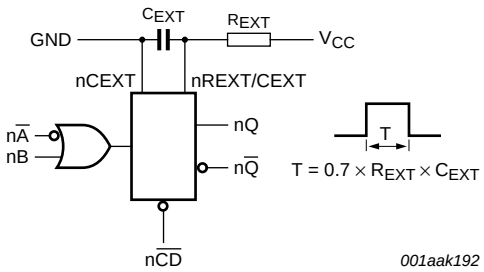



**Fig 6. Connection of the external timing components $R_{EXT}$ and $C_{EXT}$**

## 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 |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | | −0.5 | +7.0 | V |
| $I_{IK}$ | input clamping current | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V | [1] | - | ±20 | mA |
| $I_{OK}$ | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | [1] | - | ±20 | mA |
| $I_O$ | output current | $V_O = -0.5$ V to $V_{CC} + 0.5$ V | | - | ±25 | mA |
| $I_{CC}$ | supply current | | | - | +50 | mA |
| $I_{GND}$ | ground current | | | −50 | - | mA |
| $T_{stg}$ | storage temperature | | | −65 | +150 | °C |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +125 °C | | | | |
| | | SO16 package | [2] | - | 500 | mW |
| | | TSSOP16 package | [3] | - | 500 | mW |

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

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

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


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

*Voltages are referenced to GND (ground = 0 V)*

| Symbol | Parameter | Conditions | 74HC4538-Q100 | | | 74HCT4538-Q100 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Typ | Max | |
| $V_{CC}$ | supply voltage | | 2.0 | 5.0 | 6.0 | 4.5 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | - | $V_{CC}$ | 0 | - | $V_{CC}$ | V |
| $V_O$ | output voltage | | 0 | - | $V_{CC}$ | 0 | - | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | –40 | - | +125 | –40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC}$ = 2.0 V | - | - | 625 | - | - | - | ns/V |
| | | $V_{CC}$ = 4.5 V | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | $V_{CC}$ = 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 | |
| **74HC4538-Q100** | | | | | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | $V_{CC}$ = 6.0 V | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0 V | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | $V_{CC}$ = 6.0 V | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = –20 μA; $V_{CC}$ = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | $I_O$ = –4.0 mA; $V_{CC}$ = 4.5 V | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | $I_O$ = –5.2 mA; $V_{CC}$ = 6.0 V | 5.48 | 5.81 | - | 5.34 | - | 5.2 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 6.0 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 |
| | | $I_O$ = 5.2 mA; $V_{CC}$ = 6.0 V | - | 0.16 | 0.26 | - | 0.33 | - | 0.4 | V |
| $I_I$ | input leakage current | $V_I$ = $V_{CC}$ or GND; $V_{CC}$ = 6.0 V | - | - | ±0.1 | - | ±1 | - | ±1 | μA |
| | | pin nREXT/CEXT; $V_I$ = 2.0 V or GND; other inputs at $V_{CC}$ or GND; $V_{CC}$ = 6.0 V [1] | - | - | ±0.5 | - | ±5 | - | ±10 | μA |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

**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; $V_{CC} = 6.0$ V | - | - | 8.0 | - | 80 | - | 160 | µA |
| $C_I$ | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| **74HCT4538-Q100** | | | | | | | | | | |
| $V_{IH}$ | 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 | | | | | | | | |
| | | $I_O = -20$ µA | 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 | | | | | | | | |
| | | $I_O = 20$ µA; $V_{CC} = 4.5$ 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; $V_{CC} = 5.5$ V | - | - | ±0.1 | - | ±1 | - | ±1 | µA |
| | | pin nREXT/CEXT; $V_I = 2.0$ V or GND; other inputs at $V_{CC}$ or GND; $V_{CC} = 5.5$ V [1] | - | - | ±0.5 | - | ±5 | - | ±10 | µA |
| $I_{CC}$ | supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V | - | - | 8.0 | - | 80 | - | 160 | µA |
| $\Delta I_{CC}$ | additional supply current | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ A; other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5$ V to 5.5 V | | | | | | | | |
| | | pin $n\overline{A}$, nB | - | 50 | 180 | - | 225 | - | 245 | µA |
| | | pin $n\overline{CD}$ | - | 65 | 234 | - | 293 | - | 319 | µA |
| $C_I$ | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

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


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

## 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[1] | Max | Min | Max | Min | Max | |
| **74HC4538-Q100** | | | | | | | | | | |
| $t_{PLH}$ | LOW to HIGH propagation delay | $n\overline{A}$, nB to nQ; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 85 | 265 | - | 330 | - | 400 | ns |
| | | $V_{CC}$ = 4.5 V | - | 31 | 53 | - | 66 | - | 80 | ns |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 27 | - | - | - | - | - | ns |
| | | $V_{CC}$ = 6.0 V | - | 25 | 45 | - | 56 | - | 68 | ns |
| | | $n\overline{CD}$ to $n\overline{Q}$; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 83 | 265 | - | 340 | - | 400 | ns |
| | | $V_{CC}$ = 4.5 V | - | 30 | 53 | - | 68 | - | 80 | ns |
| | | $V_{CC}$ = 6.0 V | - | 24 | 45 | - | 58 | - | 68 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | $n\overline{A}$, nB to $n\overline{Q}$; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 83 | 265 | - | 330 | - | 400 | ns |
| | | $V_{CC}$ = 4.5 V | - | 30 | 53 | - | 66 | - | 80 | ns |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 27 | - | - | - | - | - | ns |
| | | $V_{CC}$ = 6.0 V | - | 24 | 45 | - | 56 | - | 68 | ns |
| | | $n\overline{CD}$ to nQ; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 80 | 265 | - | 330 | - | 400 | ns |
| | | $V_{CC}$ = 4.5 V | - | 29 | 53 | - | 66 | - | 80 | ns |
| | | $V_{CC}$ = 6.0 V | - | 23 | 45 | - | 56 | - | 68 | ns |
| $t_t$ | transition time | nQ and $n\overline{Q}$; see Figure 7 [2] | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 19 | 75 | - | 95 | - | 119 | ns |
| | | $V_{CC}$ = 4.5 V | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | $V_{CC}$ = 6.0 V | - | 6 | 13 | - | 16 | - | 19 | ns |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

**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[1] | Max | Min | Max | Min | Max | |
| $t_W$ | pulse width | $n\overline{A}$ LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | 80 | 17 | - | 100 | - | 120 | - | ns |
| | | $V_{CC}$ = 4.5 V | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | $V_{CC}$ = 6.0 V | 14 | 5 | - | 17 | - | 20 | - | ns |
| | | nB HIGH; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | 80 | 17 | - | 100 | - | 120 | - | ns |
| | | $V_{CC}$ = 4.5 V | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | $V_{CC}$ = 6.0 V | 14 | 5 | - | 17 | - | 20 | - | ns |
| | | $n\overline{CD}$ LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | 80 | 19 | - | 100 | - | 120 | - | ns |
| | | $V_{CC}$ = 4.5 V | 16 | 7 | - | 20 | - | 24 | - | ns |
| | | $V_{CC}$ = 6.0 V | 14 | 6 | - | 17 | - | 20 | - | ns |
| | | nQ and $n\overline{Q}$ HIGH or LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 5.0 V; $C_{EXT}$ = 0.1 μF; $R_{EXT}$ = 10 kΩ | 630 | 700 | 770 | 602 | 798 | 595 | 805 | μs |
| $t_{rec}$ | recovery time | $n\overline{CD}$ to $n\overline{A}$, nB; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | 35 | 6 | - | 45 | - | 55 | - | ns |
| | | $V_{CC}$ = 4.5 V | 7 | 2 | - | 9 | - | 11 | - | ns |
| | | $V_{CC}$ = 6.0 V | 6 | 2 | - | 8 | - | 9 | - | ns |
| $t_{rtrig}$ | retrigger time | $n\overline{A}$, nB; see Figure 8; $X = C_{EXT} / (4.5 \times V_{CC})$ | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | - | 455 + X | - | - | - | - | - | ns |
| | | $V_{CC}$ = 4.5 V | - | 80 + X | - | - | - | - | - | ns |
| | | $V_{CC}$ = 6.0 V | - | 55 + X | - | - | - | - | - | ns |
| $R_{EXT}$ | external resistance | $V_{CC}$ = 2.0 V | 10 | - | 1000 | - | - | - | - | kΩ |
| | | $V_{CC}$ = 5.0 V | 2 | - | 1000 | - | - | - | - | kΩ |
| $C_{EXT}$ | external capacitance | | | | | no limits | | | | |
| $C_{PD}$ | power dissipation capacitance | per multivibrator; $V_I$ = GND to $V_{CC}$ [3] | - | 136 | - | - | - | - | - | pF |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

**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[1] | Max | Min | Max | Min | Max | |
| **74HCT4538-Q100** | | | | | | | | | | |
| $t_{PLH}$ | LOW to HIGH propagation delay | $n\overline{A}$, nB to nQ; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 35 | 60 | - | 75 | - | 90 | ns |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 30 | - | - | - | - | - | ns |
| | | $n\overline{CD}$ to $n\overline{Q}$; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 35 | 60 | - | 75 | - | 90 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | $n\overline{A}$, nB to $n\overline{Q}$; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 35 | 60 | - | 75 | - | 90 | ns |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 30 | - | - | - | - | - | ns |
| | | $n\overline{CD}$ to nQ; see Figure 7 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 35 | 60 | - | 75 | - | 90 | ns |
| $t_t$ | transition time | nQ and $n\overline{Q}$; see Figure 7 [2] | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 7 | 15 | - | 19 | - | 21 | ns |
| $t_W$ | pulse width | $n\overline{A}$ LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | 20 | 11 | - | 25 | - | 30 | - | ns |
| | | nB HIGH; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | 16 | 5 | - | 20 | - | 24 | - | ns |
| | | $n\overline{CD}$ LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | 20 | 11 | - | 25 | - | 30 | - | ns |
| | | nQ and $n\overline{Q}$ HIGH or LOW; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 5.0 V; $C_{EXT}$ = 0.1 μF; $R_{EXT}$ = 10 kΩ | 630 | 700 | 770 | 602 | 798 | 595 | 805 | μs |
| $t_{rec}$ | recovery time | $n\overline{CD}$ to $n\overline{A}$, nB; see Figure 8 | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | 7 | 2 | - | 9 | - | 11 | - | ns |
| $t_{rtrig}$ | retrigger time | $n\overline{A}$, nB; see Figure 8; X = $C_{EXT}$ / (4.5 × $V_{CC}$) | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | - | 80 + X | - | - | - | - | - | ns |
| $R_{EXT}$ | external resistance | $V_{CC}$ = 5.0 V | 2 | - | 1000 | - | - | - | - | kΩ |
| $C_{EXT}$ | external capacitance | $V_{CC}$ = 5.0 V | | | | no limits | | | | |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

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

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

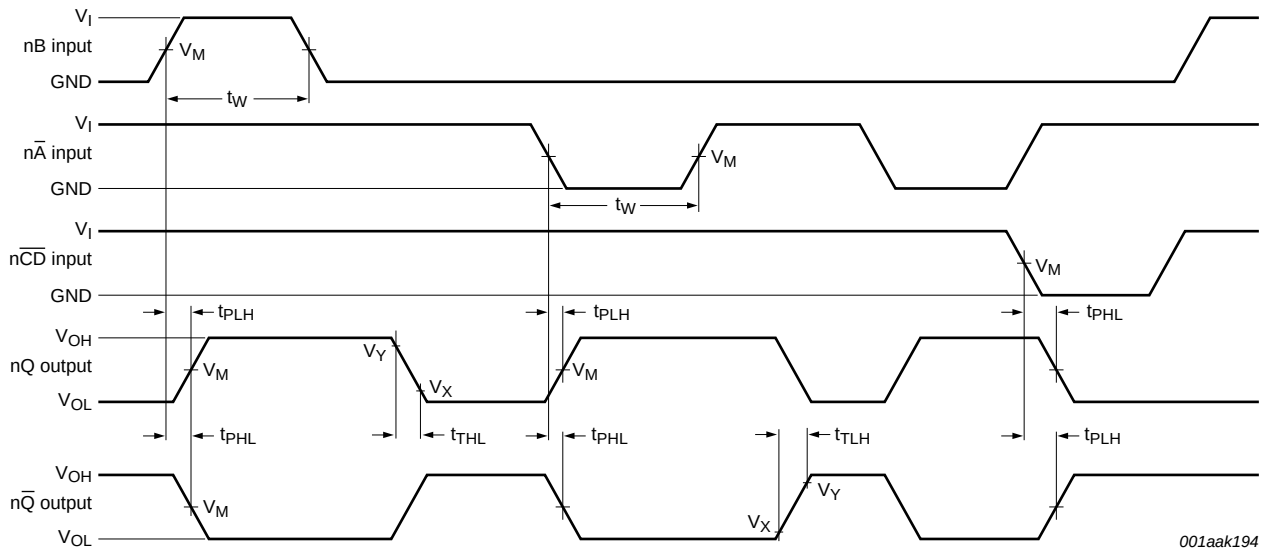
| Symbol | Parameter | Conditions | 25 °C | | | –40 °C to +85 °C | | –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| $C_{PD}$ | power dissipation capacitance | per multivibrator; $V_I$ = GND to ($V_{CC}$ – 1.5 V) [3] | - | 138 | - | - | - | - | - | pF |

[1] Typical values are measured at nominal supply voltage ($V_{CC}$ = 3.3 V and $V_{CC}$ = 5.0 V).

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

[3] $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times \Sigma(C_L \times V_{CC}^2 \times f_o) + 0.48 \times C_{EXT} \times V_{CC}^2 \times f_o + D \times 0.8 \times V_{CC}$ where:
$f_i$ = input frequency in MHz;
$f_o$ = output frequency in MHz;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs;
$C_L$ = output load capacitance in pF;
$V_{CC}$ = supply voltage in V;
D = duty cycle factor in %;
$C_{EXT}$ = external timing capacitance in pF.

## 11. Waveforms



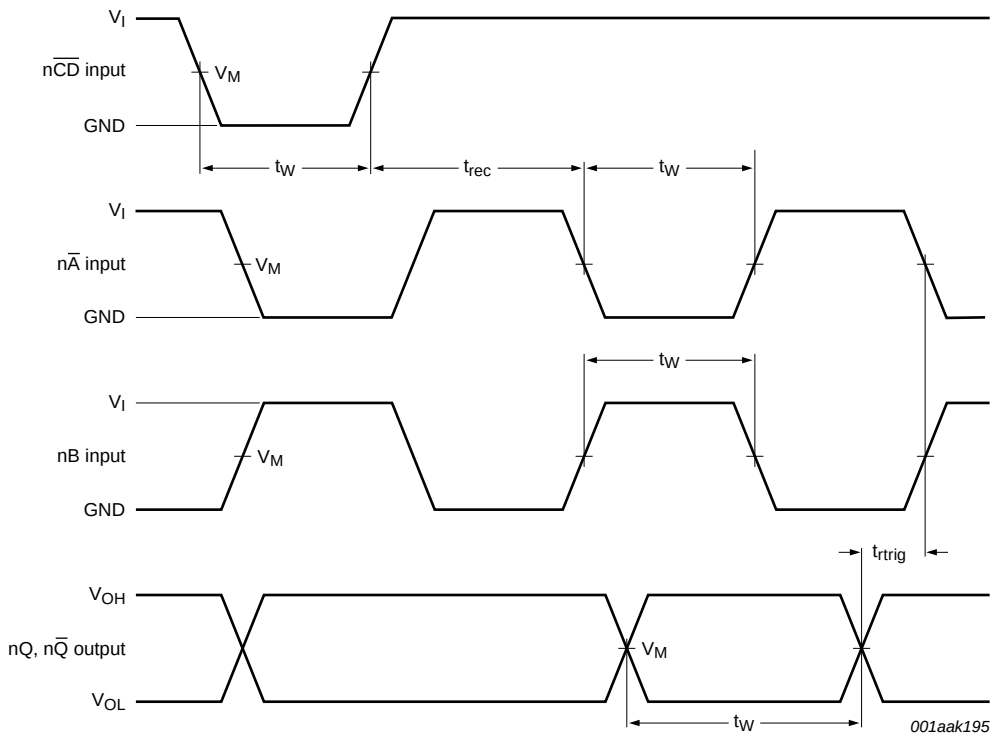

Measurement points are given in Table 8.

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

**Fig 7. Waveforms showing propagation delays and transition times**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.




Measurement points are given in Table 8.

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

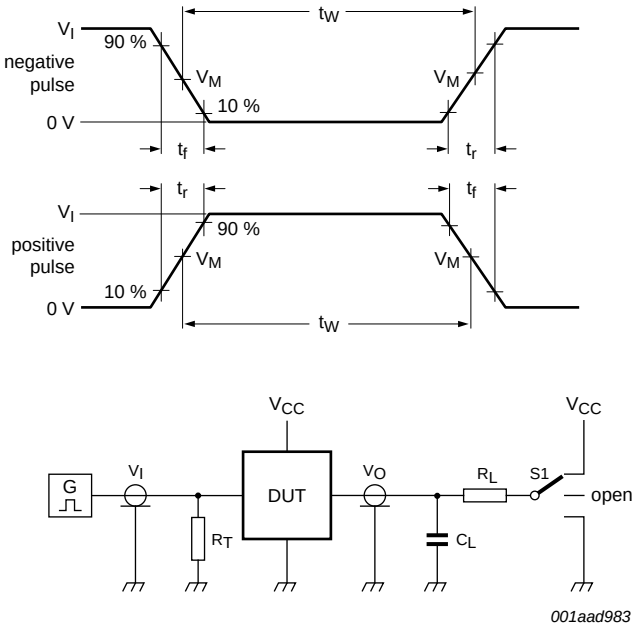
**Fig 8. Waveforms showing nA, nB, nQ, nQ pulse widths, recovery and retrigger times**

**Table 8. Measurement points**

| Type | Input | Output | | |
|---|---|---|---|---|
| | $V_M$ | $V_M$ | $V_X$ | $V_Y$ |
| 74HC4538-Q100 | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT4538-Q100 | 1.3 V | 1.3 V | $0.1V_{CC}$ | $0.9V_{CC}$ |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.




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 9. Test circuit for measuring switching times**

**Table 9. Test data**

| Type | Input | | Load | | S1 position |
|---|---|---|---|---|---|
| | $V_I$ | $t_r$, $t_f$ | $C_L$ | $R_L$ | $t_{PHL}$, $t_{PLH}$ |
| 74HC4538-Q100 | $V_{CC}$ | 6 ns | 15 pF, 50 pF | 1 kΩ | open |
| 74HCT4538-Q100 | 3 V | 6 ns | 15 pF, 50 pF | 1 kΩ | open |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

# 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

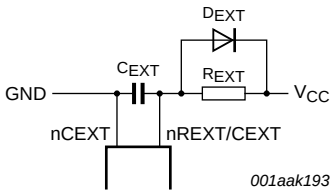
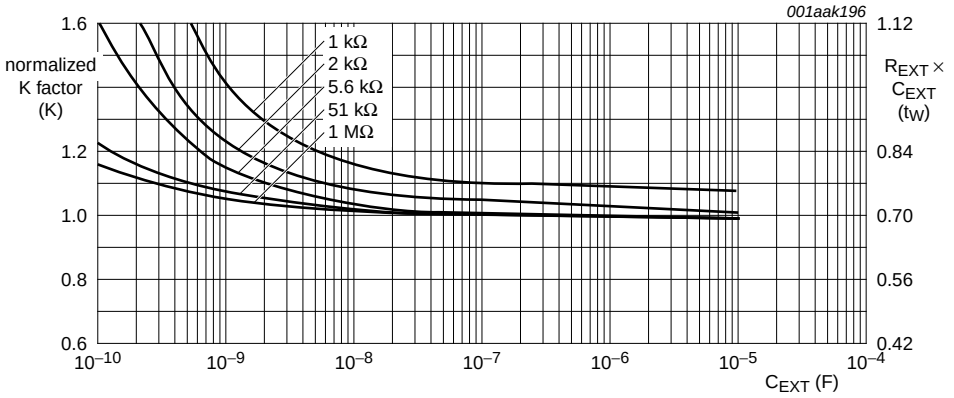



**Fig 10. Power-down protection circuit**

## 12.2 Graphs

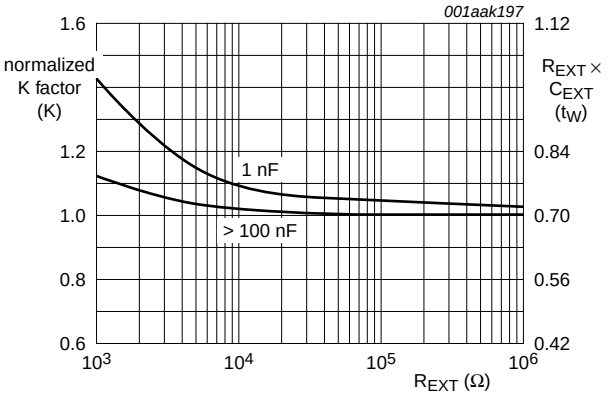



$V_{CC}$ = 4.5 V; $T_{amb}$ = 25 °C.

**Fig 11. Typical pulse width accuracy versus external capacitance**

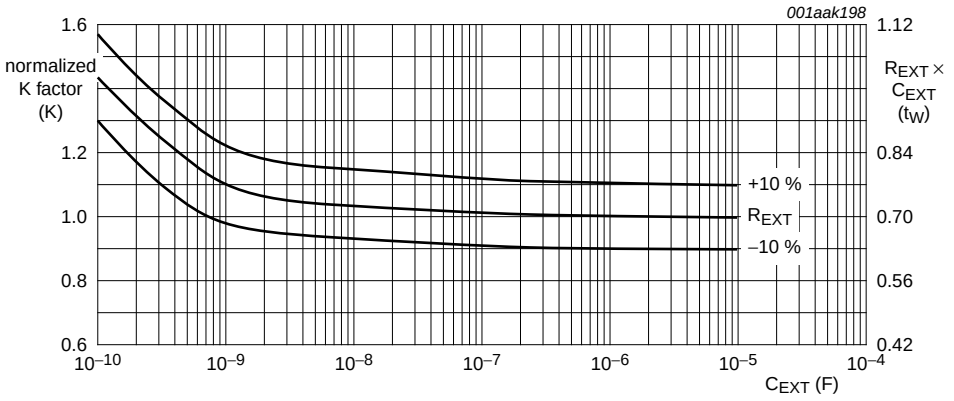

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.



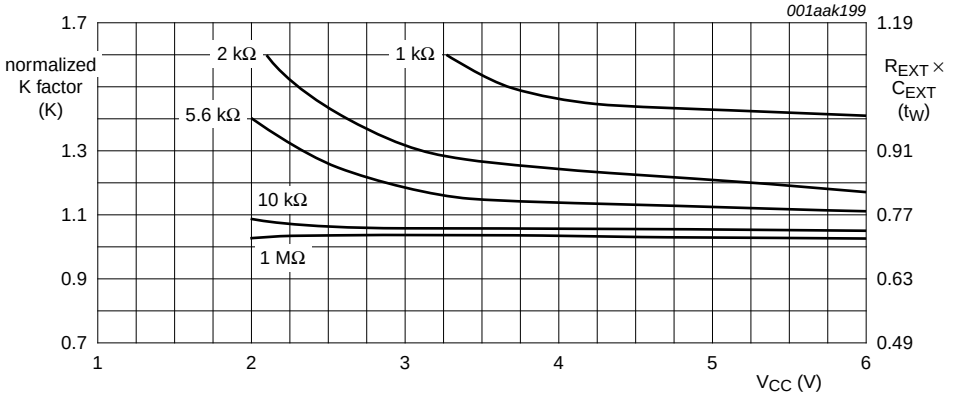

$V_{CC}$ = 4.5 V; $T_{amb}$ = 25 °C.

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




$V_{CC}$ = 4.5 V; $R_{EXT}$ = 10 kΩ; $T_{amb}$ = 25 °C.

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

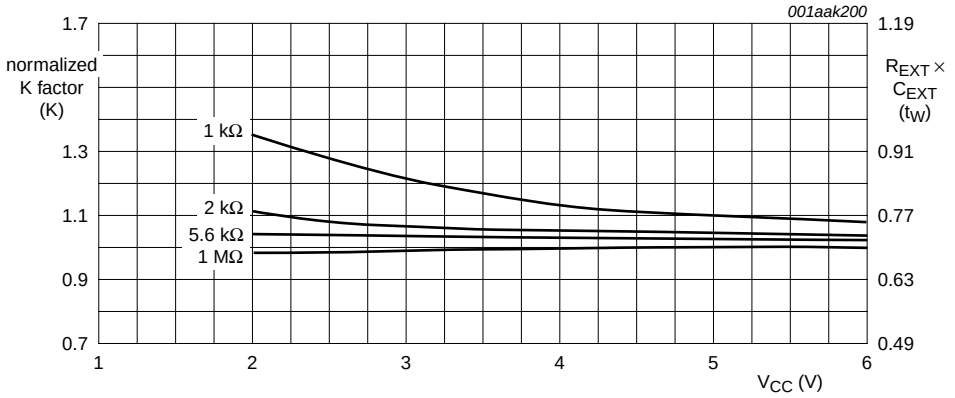



$C_{EXT}$ = 1 nF; $T_{amb}$ = 25 °C.

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

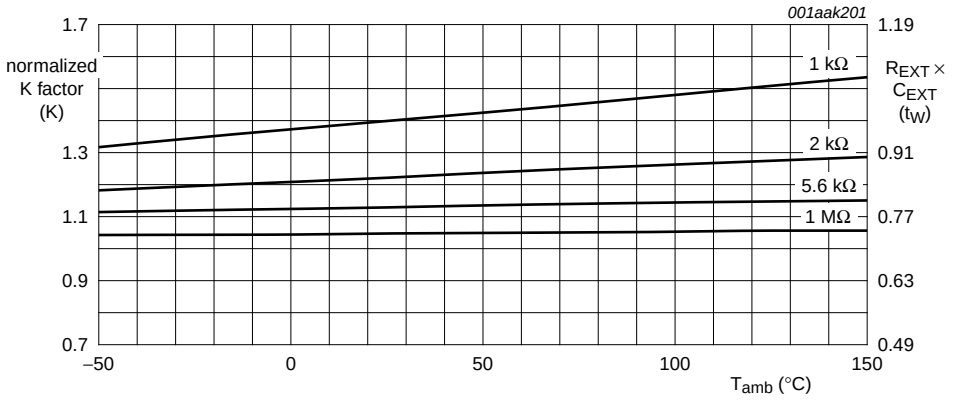

All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.



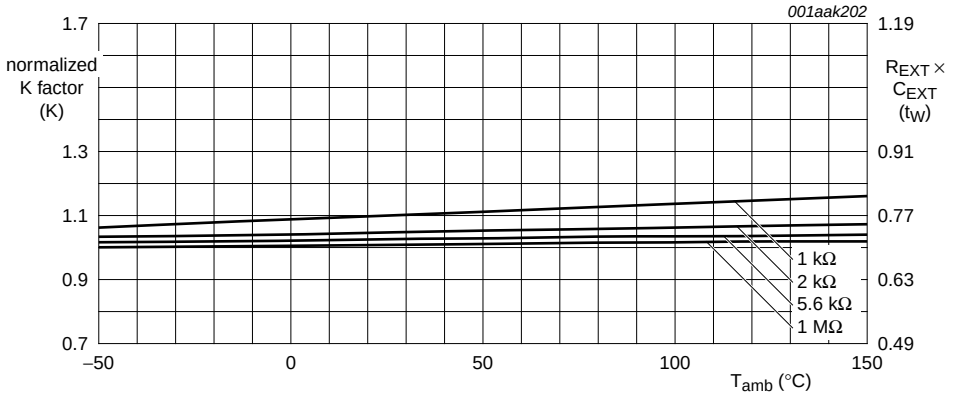

$C_{EXT}$ = 100 nF; $T_{amb}$ = 25 °C.

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




$V_{CC}$ = 4.5 V; $C_{EXT}$ = 1 nF; $T_{amb}$ = 25 °C.

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




$V_{CC}$ = 4.5 V; $C_{EXT}$ = 1 µF; $T_{amb}$ = 25 °C.

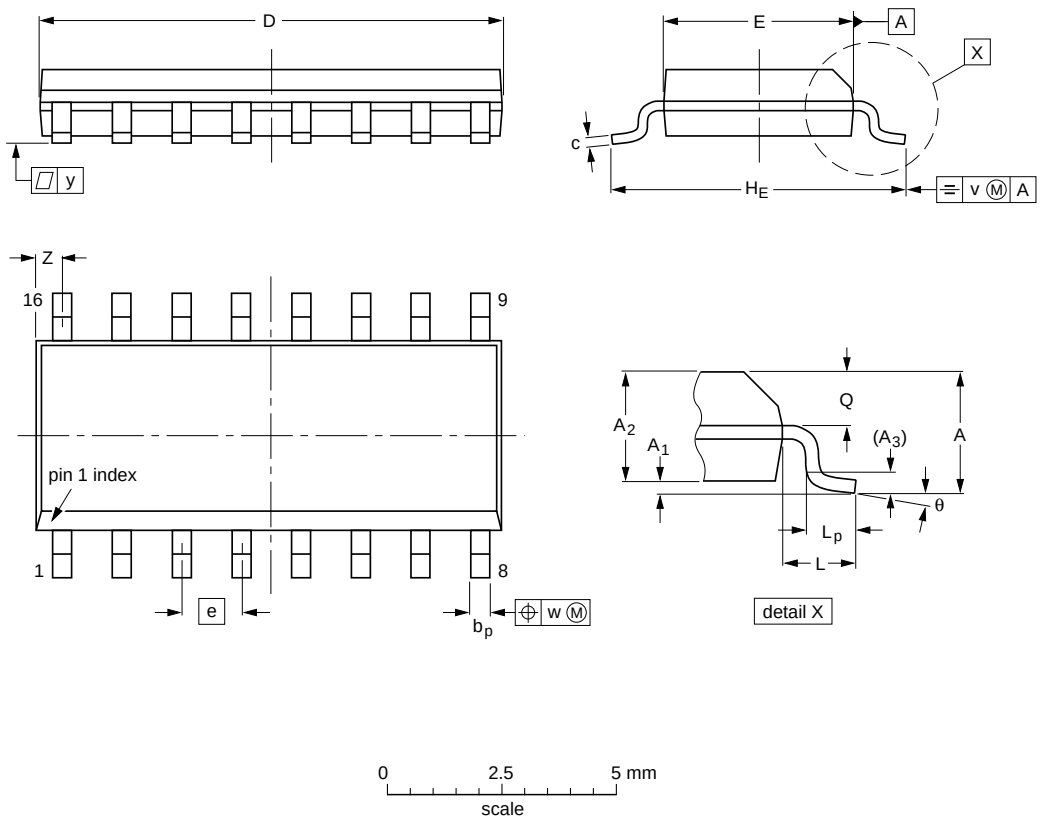
**Fig 17. Typical pulse width accuracy versus temperature**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

## 13. Package outline

**SO16: plastic small outline package; 16 leads; body width 3.9 mm** **SOT109-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 10.0<br>9.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

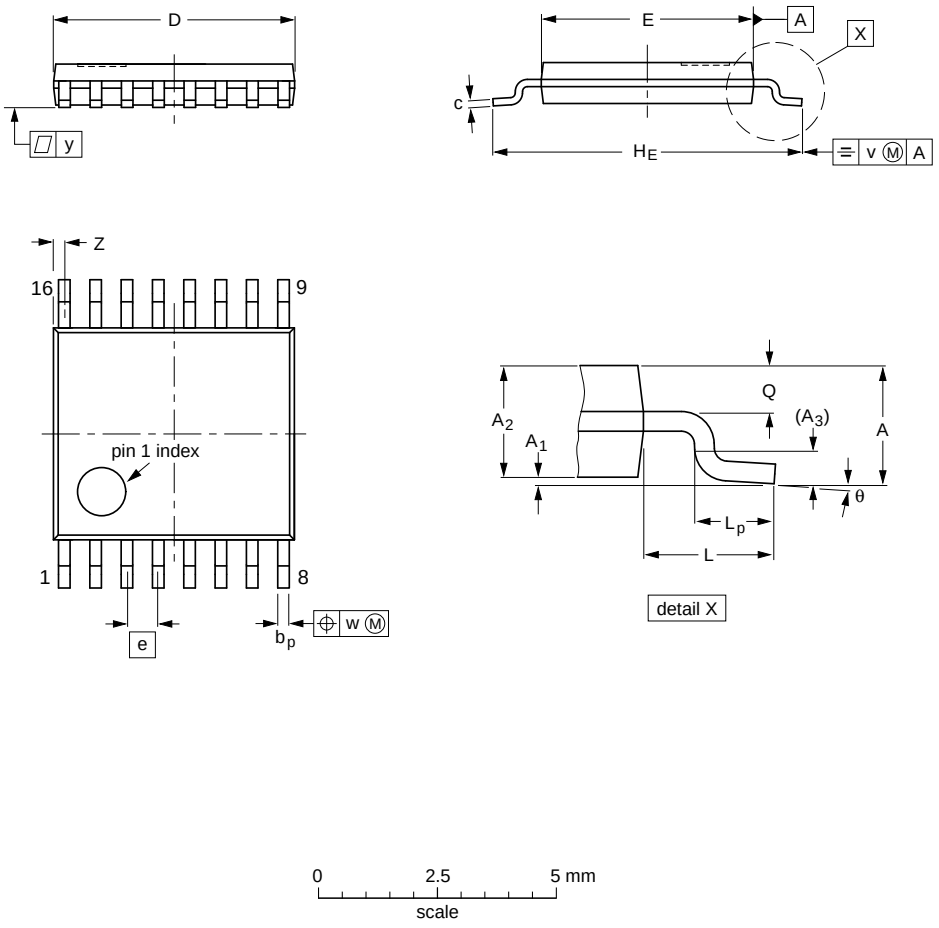
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT109-1 | 076E07 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 18. Package outline SOT109-1 (SO16)**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

**TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm** **SOT403-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.40<br>0.06 | $8^o$<br>$0^o$ |

**Notes**

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

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT403-1 | | MO-153 | | | | ~~99-12-27~~<br>03-02-18 |

**Fig 19. Package outline SOT403-1 (TSSOP16)**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

## 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 |
| MIL | Military |

## 15. Revision history

**Table 11. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74HC_HCT4538_Q100 v.1 | 20120802 | Product data sheet | - | 74HC_HCT4538_CNV_2 |


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

# 16. Legal information

## 16.1 Data sheet status

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

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

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

[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.

## 16.2 Definitions

**Draft —** The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet —** A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification —** The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

## 16.3 Disclaimers

**Limited warranty and liability —** Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

**Right to make changes —** NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use in automotive applications —** This NXP Semiconductors product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications —** Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

**Limiting values —** Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

**Terms and conditions of commercial sale —** NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

**No offer to sell or license —** Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control —** This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Translations —** A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

### 16.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 17. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**


All information provided in this document is subject to legal disclaimers.

© NXP B.V. 2012. All rights reserved.

## 18. Contents


**1 General description . . . . . 1**
**2 Features and benefits . . . . . 1**
**3 Ordering information . . . . . 2**
**4 Functional diagram . . . . . 2**
**5 Pinning information . . . . . 4**
5.1 Pinning . . . . . 4
5.2 Pin description . . . . . 4
**6 Functional description . . . . . 5**
**7 Limiting values . . . . . 6**
**8 Recommended operating conditions . . . . . 7**
**9 Static characteristics . . . . . 7**
**10 Dynamic characteristics . . . . . 9**
**11 Waveforms . . . . . 12**
**12 Application information . . . . . 15**
12.1 Power-down considerations . . . . . 15
12.2 Graphs . . . . . 15
**13 Package outline . . . . . 18**
**14 Abbreviations . . . . . 20**
**15 Revision history . . . . . 20**
**16 Legal information . . . . . 21**
16.1 Data sheet status . . . . . 21
16.2 Definitions . . . . . 21
16.3 Disclaimers . . . . . 21
16.4 Trademarks . . . . . 22
**17 Contact information . . . . . 22**
**18 Contents . . . . . 23**


Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

**© NXP B.V. 2012.** **All rights reserved.**

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

**Date of release: 2 August 2012**
**Document identifier: 74HC_HCT4538_Q100**

TradeElectronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

## О компании

ООО "ТрейдЭлектроникс" - это оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов. Реализуемая нашей компанией продукция насчитывает более полумиллиона наименований.

Благодаря этому наша компания предлагает к поставке практически не ограниченный ассортимент компонентов как оптовыми, мелкооптовыми партиями, так и в розницу.

Наличие собственной эффективной системы логистики обеспечивает надежную поставку продукции по конкурентным ценам в точно указанные сроки.

Срок поставки со стоков в **Европе и Америке – от 3 до 14 дней.**

Срок поставки из **Азии – от 10 дней.**

Благодаря развитой сети поставщиков, помогаем в поиске и приобретении экзотичных или снятых с производства компонентов.

Предоставляем спец цены на элементы для создания инженерных сэмплов.

**Упорный труд, качественный результат дают нам право быть уверенными в себе и надежными для наших клиентов.**

## Наша компания это:

- Гарантия качества поставляемой продукции
- Широкий ассортимент
- Минимальные сроки поставок
- Техническая поддержка
- Подбор комплектации
- Индивидуальный подход
- Гибкое ценообразование

Наша организация особенно сильна в поставках модулей, микросхем, пассивных компонентов, ксайленсах (XC), EPF, EPM и силовой электроники.

Большой выбор предлагаемой продукции, различные виды оплаты и доставки, позволят Вам сэкономить время и получить максимум выгоды от сотрудничества с нами!

Trade Electronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

## Перечень производителей, продукцию которых мы поставляем на российский рынок



Trade Electronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

С удовольствием будем прорабатывать для Вас поставки всех необходимых компонентов по текущим запросам для скорейшего выявления групп элементов, по которым сотрудничество именно с нашей компанией будет для Вас максимально выгодным!

С уважением,

Менеджер отдела продаж ООО

«Трейд Электроникс»

Шишлаков Евгений

8 (495)668-30-28 доб 169

manager28@tradeelectronics.ru

http://www.tradeelectronics.ru/