# 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

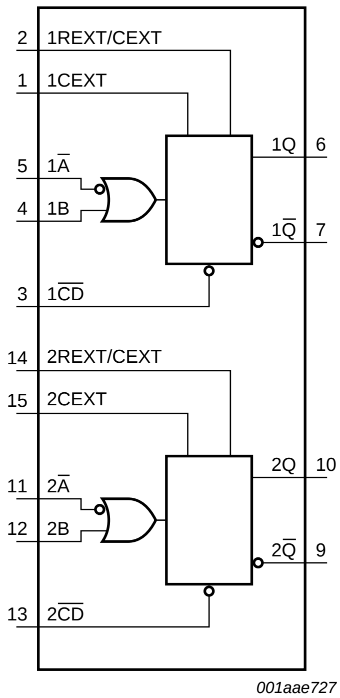



**Fig 1. Functional diagram**

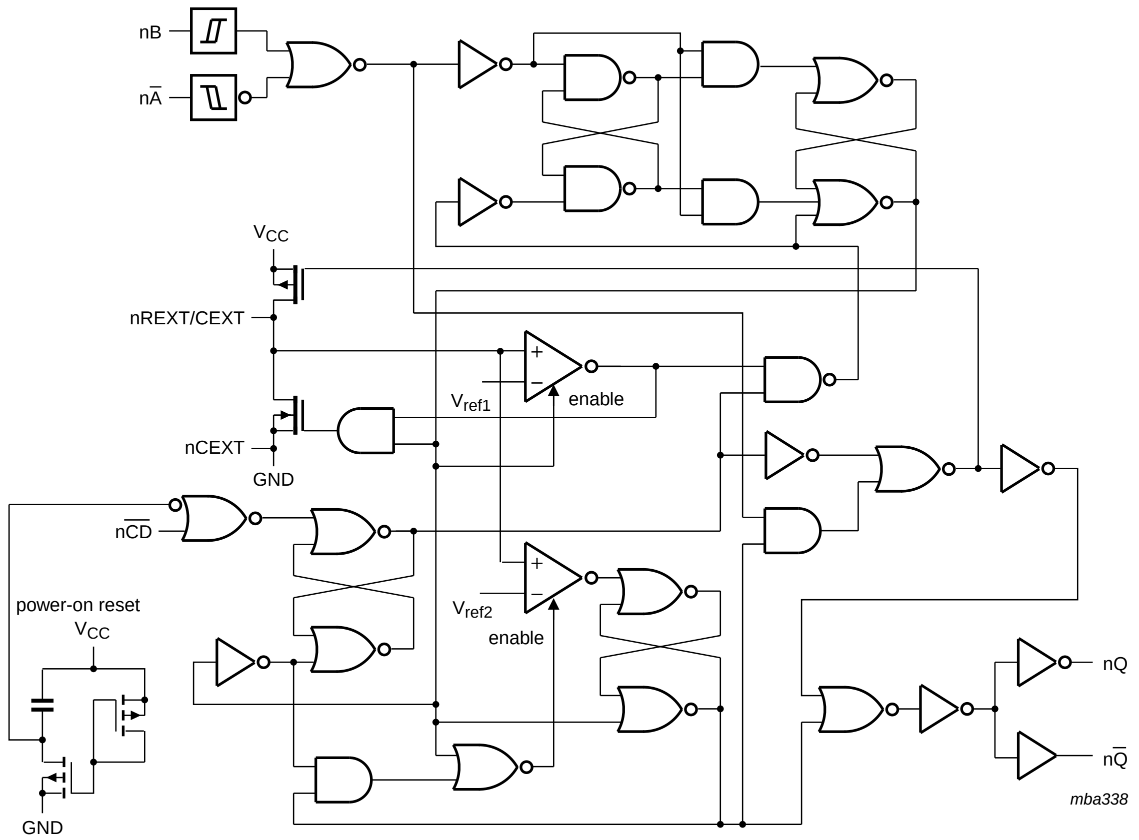



**Fig 2. Logic diagram (one multivibrator)**

# 5. Pinning information

## 5.1 Pinning

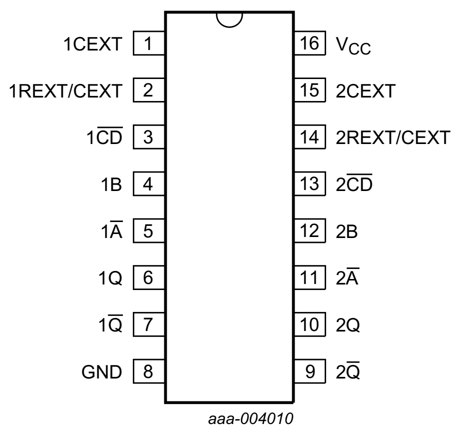



**Fig 3. Pin configuration for SO16**

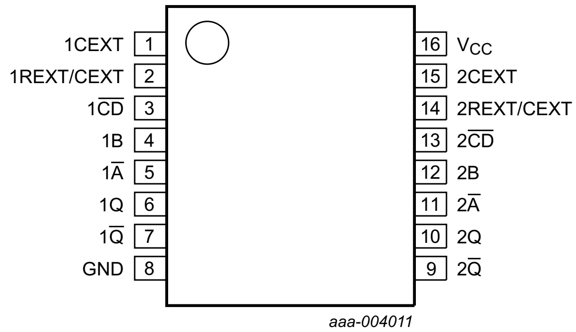



**Fig 4. Pin configuration for TSSOP16**

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

## 6. Functional description

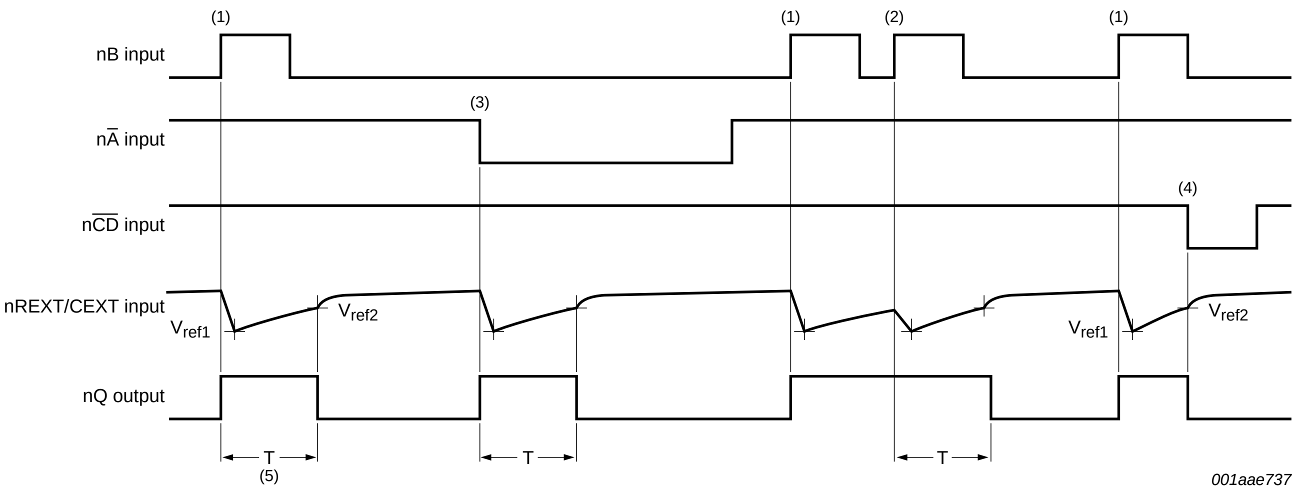
**Table 3. Function table**

| Inputs | | | Outputs | |
|---|---|---|---|---|
| $n\overline{A}$ | nB | $n\overline{CD}$ | nQ | $n\overline{Q}$ |
| ↓ | 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 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**

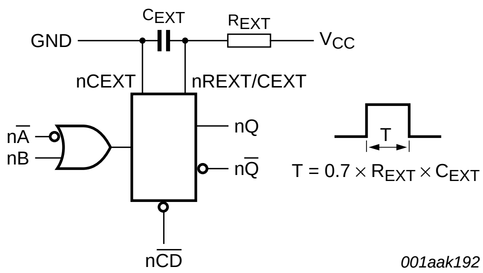



**Fig 6. Connection of the external timing components $R_{EXT}$ and $C_{EXT}$**

# 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.

# 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 |
| Δt/ΔV | 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 |

**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.

## 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 |

**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 |

**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; $X = C_{EXT} / (4.5 \times V_{CC})$ | | | | | | | | |
| | | $V_{CC}$ = 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 | | | | | | | |

**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;

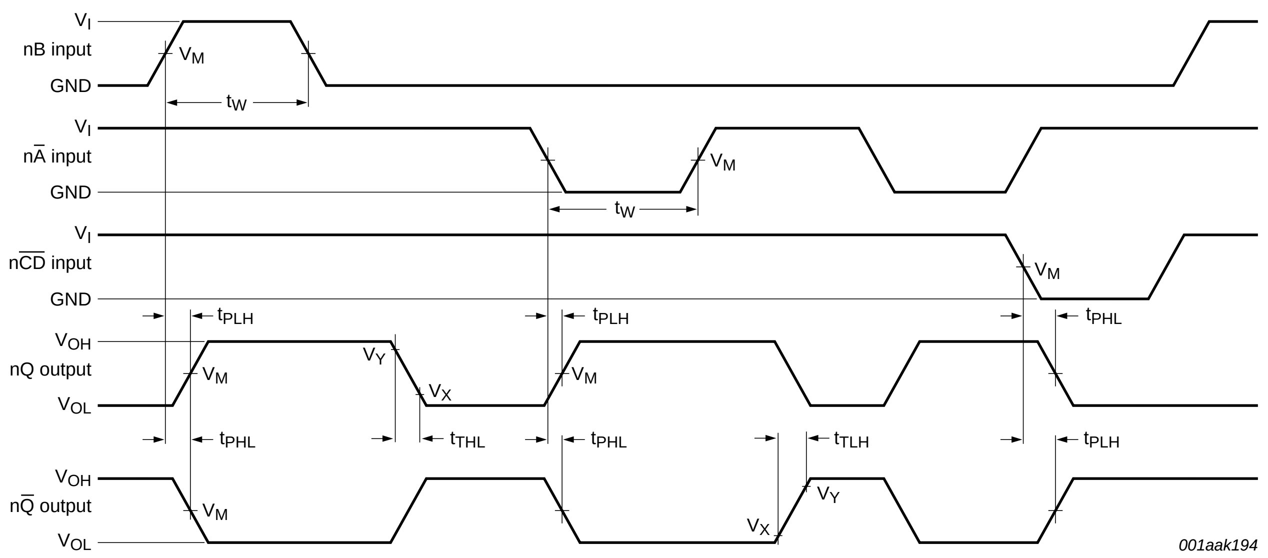
$C_L$ = output load capacitance in pF;

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

D = duty cycle factor in %;

$C_{EXT}$ = external timing capacitance in pF.

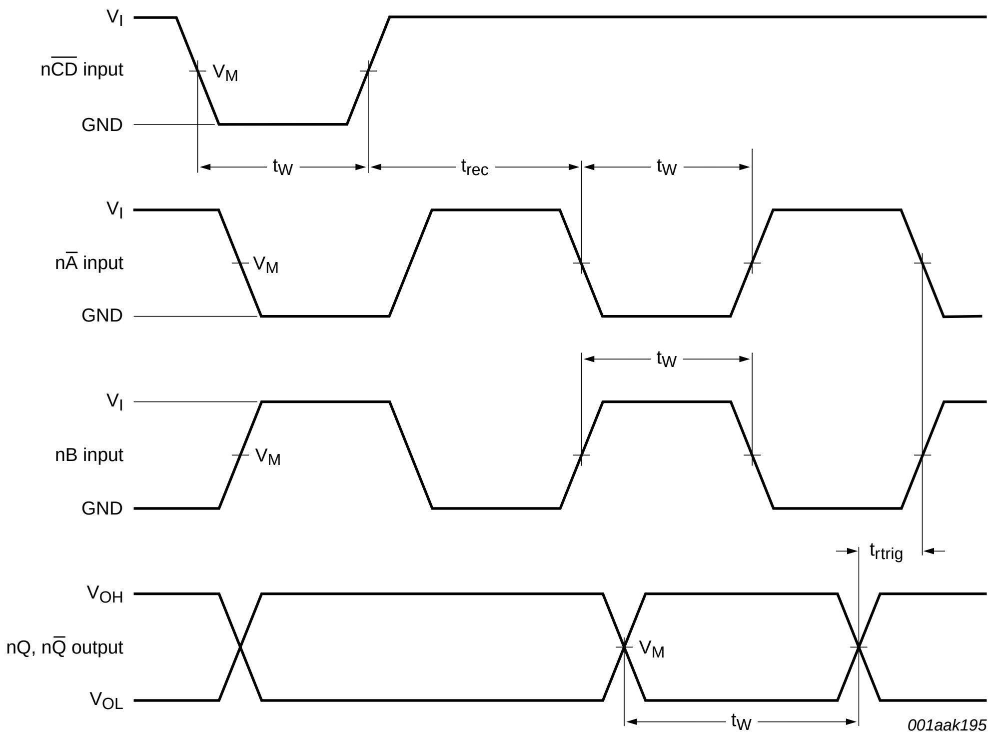
## 11. Waveforms




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**



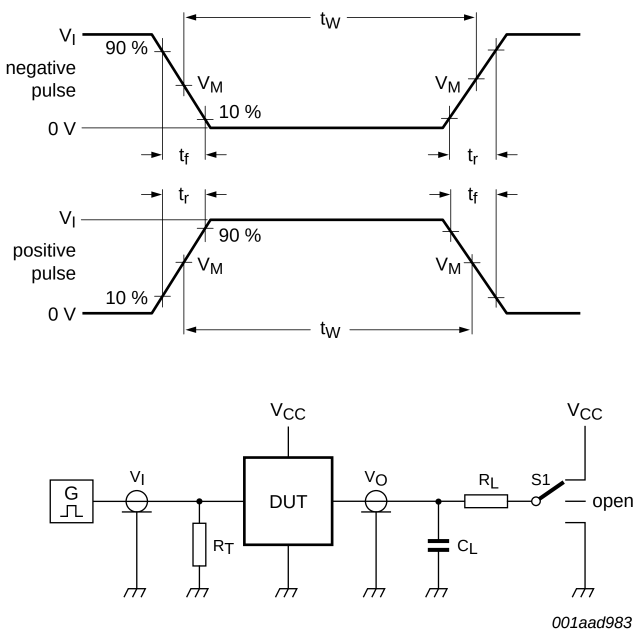

Measurement points are given in Table 8.

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 | $0.1V_{CC}$ | $0.9V_{CC}$ |




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 |

# 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

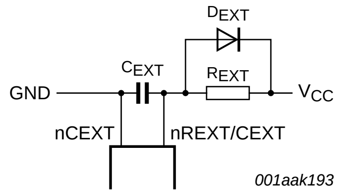
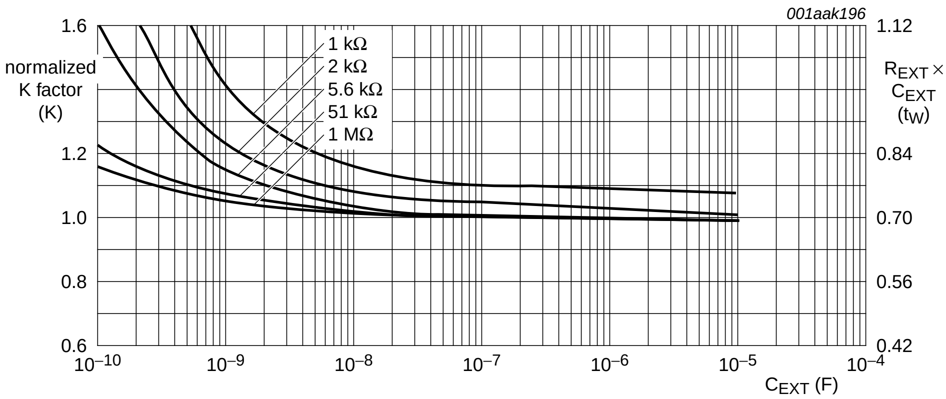


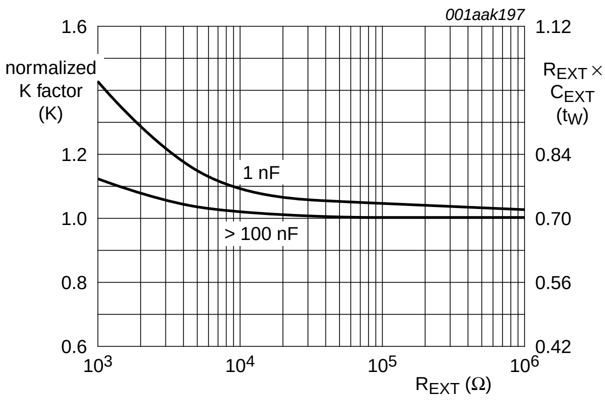

**Fig 10. Power-down protection circuit**

## 12.2 Graphs



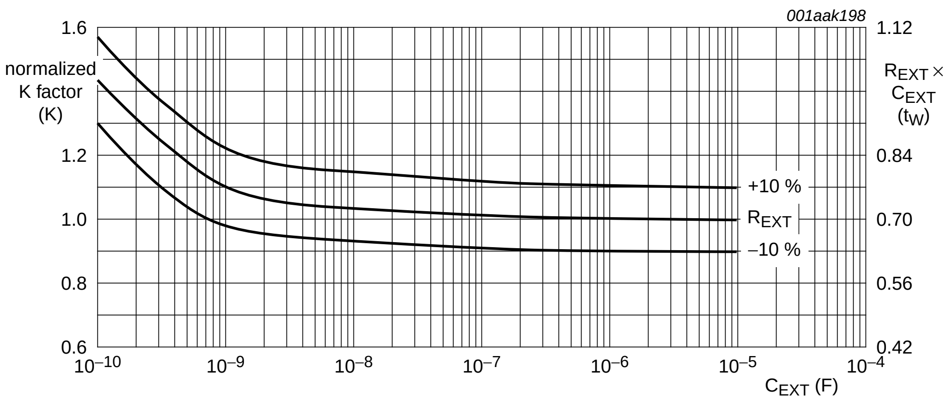

$V_{CC}$ = 4.5 V; $T_{amb}$ = 25 °C.

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



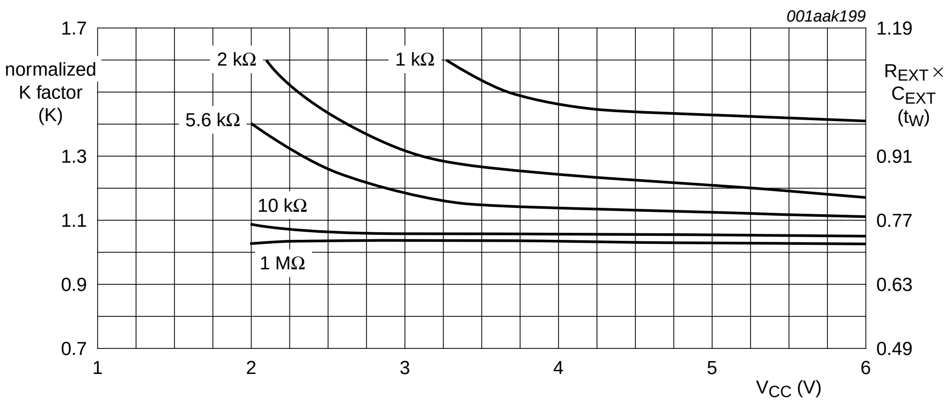

$V_{CC}$ = 4.5 V; $T_{amb}$ = 25 °C.

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



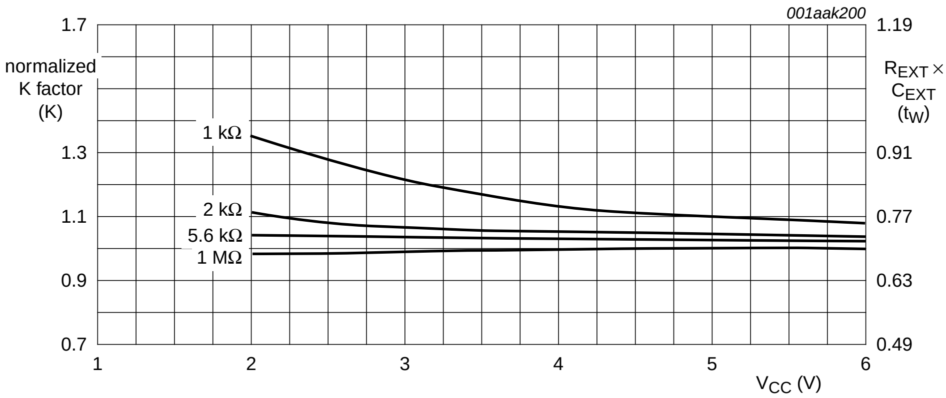

$V_{CC}$ = 4.5 V; $R_{EXT}$ = 10 kΩ; $T_{amb}$ = 25 °C.

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



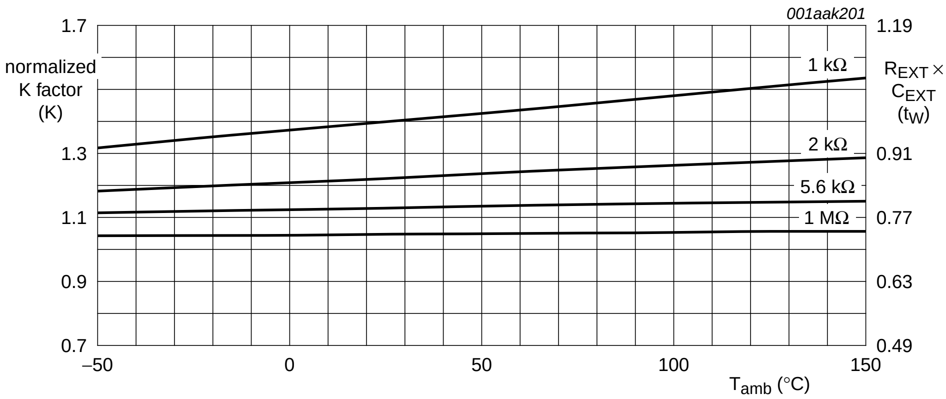

$C_{EXT}$ = 1 nF; $T_{amb}$ = 25 °C.

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



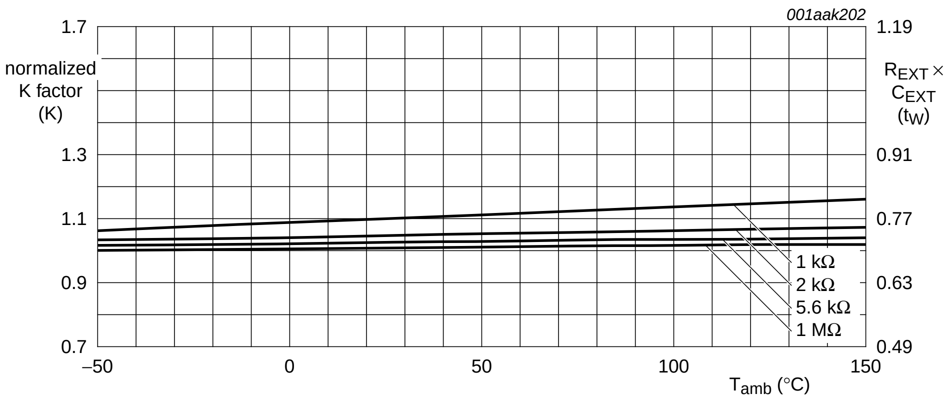

$C_{EXT}$ = 100 nF; $T_{amb}$ = 25 °C.

**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**

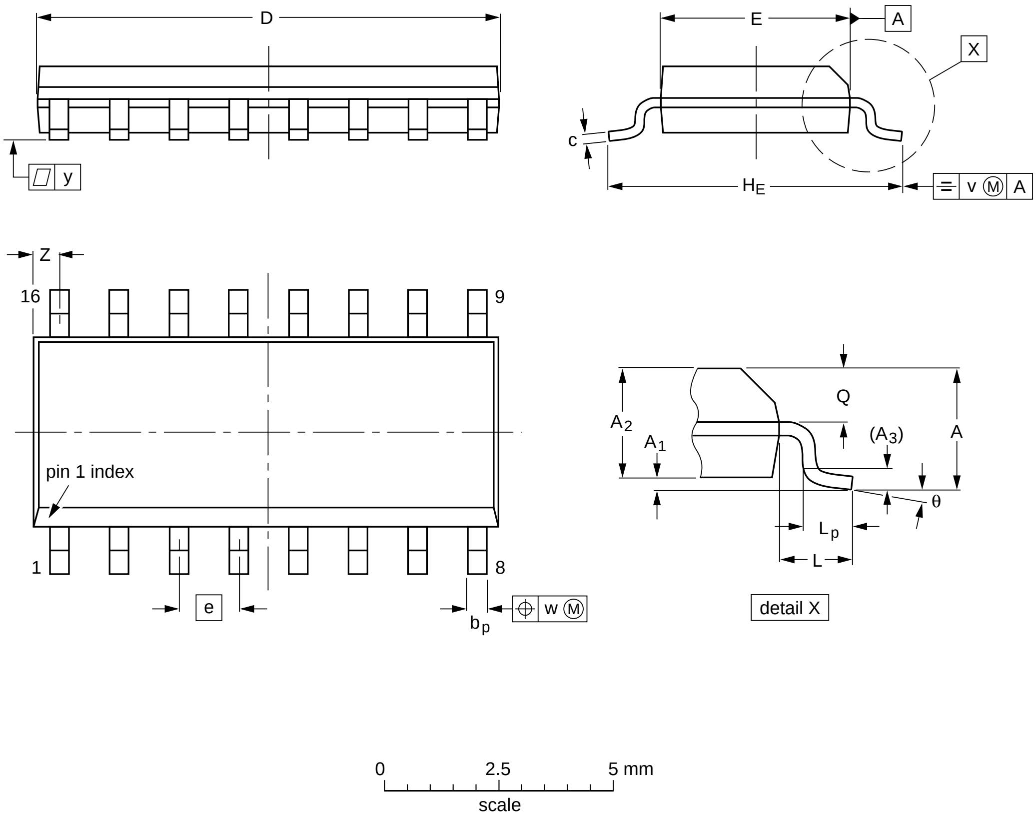



$V_{CC}$ = 4.5 V; $C_{EXT}$ = 1 μF; $T_{amb}$ = 25 °C.

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

## 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 | |

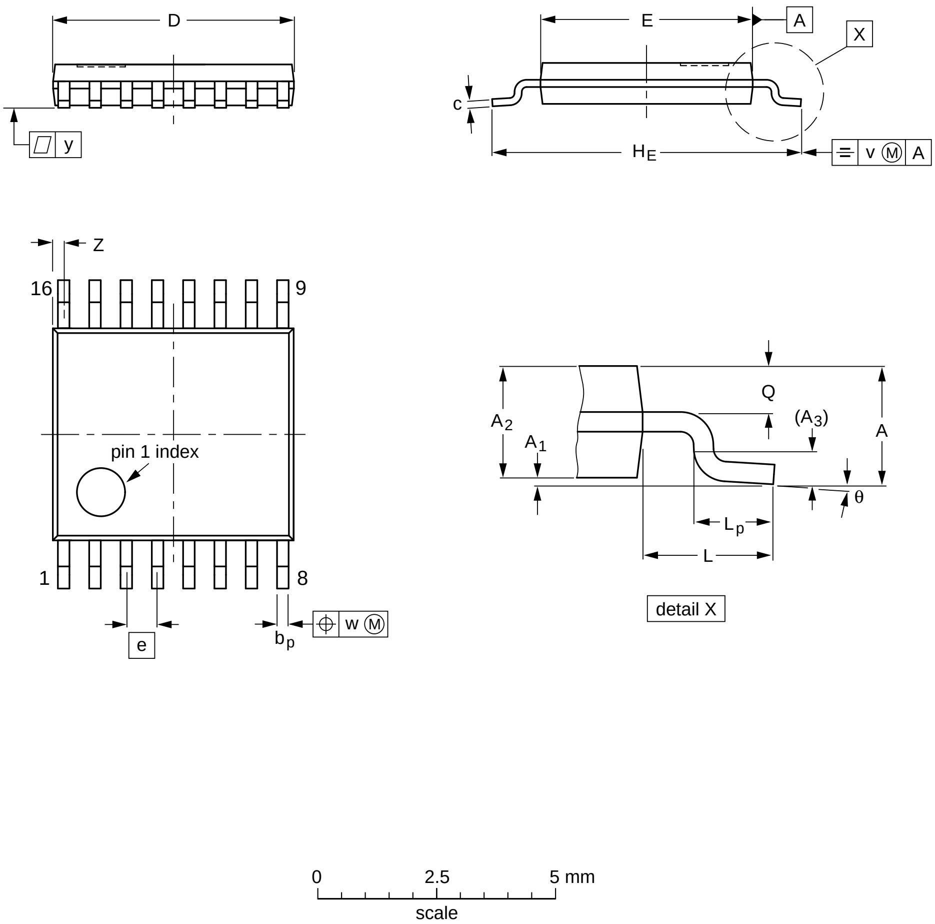
**Note**

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)**

**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)**

## 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 |

# 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.

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## 18. Contents





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**Document identifier: 74HC_HCT4538_Q100**