# 74HC123; 74HCT123

## Dual retriggerable monostable multivibrator with reset

Rev. 8 — 16 December 2011 Product data sheet

## 1. General description

The 74HC123; 74HCT123 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 74HC123; 74HCT123 are dual retriggerable monostable multivibrators with output pulse width control by three methods:

1. The basic pulse is programmed by selection of an external resistor ($R_{EXT}$) and capacitor ($C_{EXT}$).
2. Once triggered, the basic output pulse width may be extended by retriggering the gated active LOW-going edge input ($n\overline{A}$) or the active HIGH-going edge input (nB). By repeating this process, the output pulse period (nQ = HIGH, $n\overline{Q}$ = LOW) can be made as long as desired. Alternatively an output delay can be terminated at any time by a LOW-going edge on input $n\overline{RD}$, which also inhibits the triggering.
3. An internal connection from $n\overline{RD}$ to the input gates makes it possible to trigger the circuit by a HIGH-going signal at input $n\overline{RD}$ as shown in the function table.

Schmitt-trigger action in the $n\overline{A}$ and nB inputs, makes the circuit highly tolerant to slower input rise and fall times.

The 74HC123; 74HCT123 are identical to the 74HC423; 74HCT423 but can be triggered via the reset input.

## 2. Features and benefits

- DC triggered from active HIGH or active LOW inputs
- Retriggerable for very long pulses up to 100 % duty factor
- Direct reset terminates output pulse
- Schmitt-trigger action on all inputs except for the reset input
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from −40 °C to +85 °C and from −40 °C to +125 °C

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74HC123N | –40 °C to +125 °C | DIP16 | plastic dual in-line package; 16 leads (300 mil) | SOT38-4 |
| 74HCT123N | | | | |
| 74HC123D | –40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HCT123D | | | | |
| 74HC123DB | –40 °C to +125 °C | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HCT123DB | | | | |
| 74HC123PW | –40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HCT123PW | | | | |
| 74HC123BQ | –40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

## 4. Functional diagram

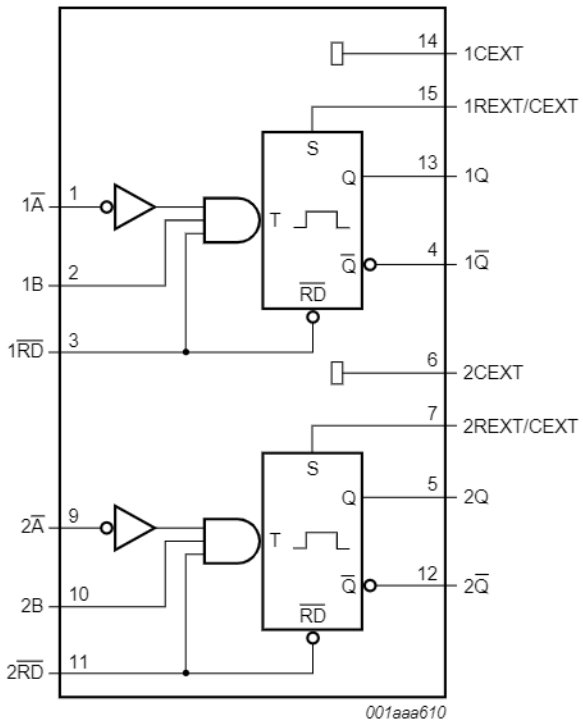



**Fig 1. Functional diagram**


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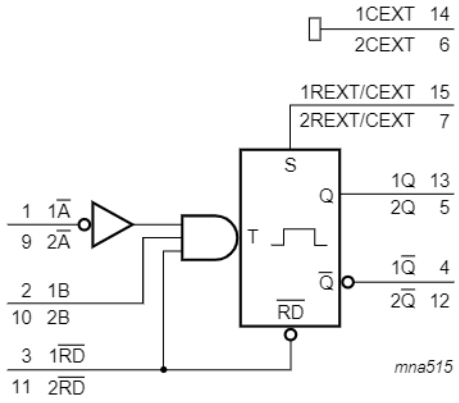



Fig 2. Logic symbol

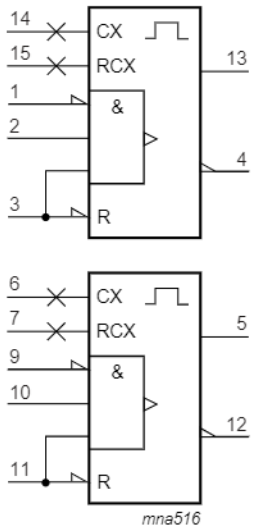



Fig 3. IEC logic symbol

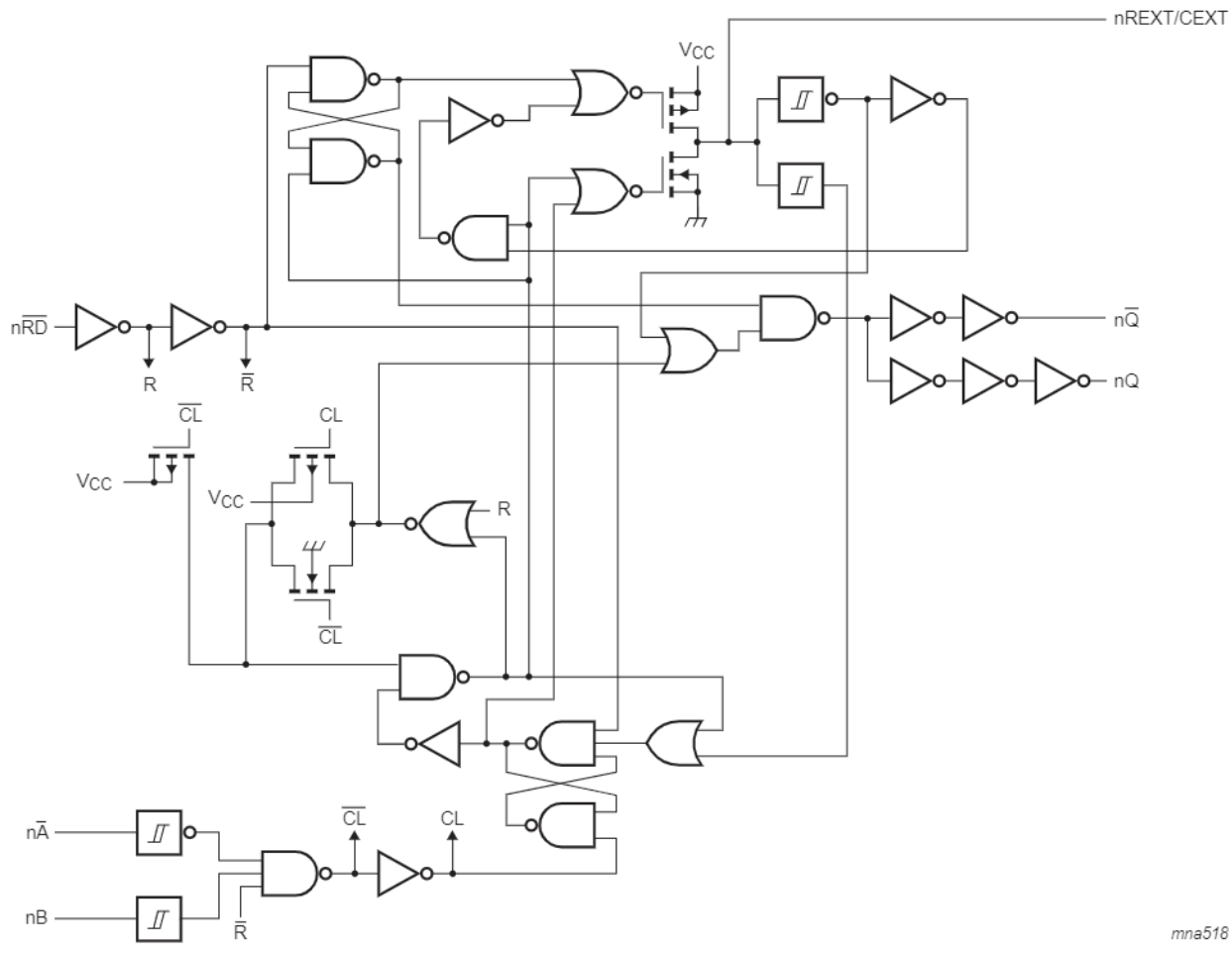



Fig 4. Logic diagram


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# 5. Pinning information

## 5.1 Pinning

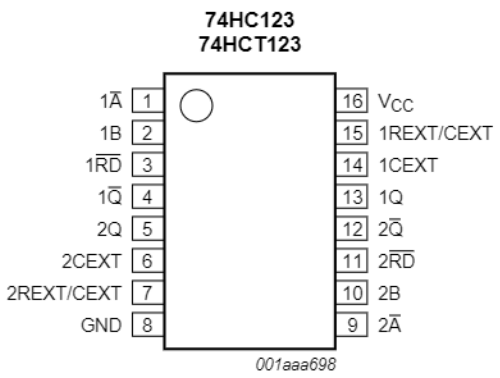
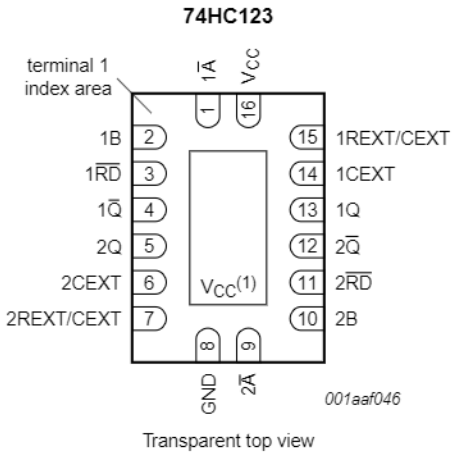



Fig 5. Pin configuration for DIP16, SO16, SSOP16 and TSSOP16




Transparent top view

(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as supply pin or input.

Fig 6. Pin configuration for DHVQFN16

## 5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|---|---|---|
| 1Ā | 1 | negative-edge triggered input 1 |
| 1B | 2 | positive-edge triggered input 1 |
| 1RD | 3 | direct reset LOW and positive-edge triggered input 1 |
| 1Q | 4 | active LOW output 1 |
| 2Q | 5 | active HIGH output 2 |
| 2CEXT | 6 | external capacitor connection 2 |
| 2REXT/CEXT | 7 | external resistor and capacitor connection 2 |
| GND | 8 | ground (0 V) |
| 2Ā | 9 | negative-edge triggered input 2 |
| 2B | 10 | positive-edge triggered input 2 |
| 2RD | 11 | direct reset LOW and positive-edge triggered input 2 |
| 2Q | 12 | active LOW output 2 |
| 1Q | 13 | active HIGH output 1 |
| 1CEXT | 14 | external capacitor connection 1 |
| 1REXT/CEXT | 15 | external resistor and capacitor connection 1 |
| $V_{CC}$ | 16 | supply voltage |


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## 6. Functional description

**Table 3. Function table[1]**

| Input | | | Output | |
|---|---|---|---|---|
| $n\overline{RD}$ | $n\overline{A}$ | nB | nQ | $n\overline{Q}$ |
| L | X | X | L | H |
| X | H | X | L[2] | H[2] |
| X | X | L | L[2] | H[2] |
| H | L | ↑ | ⎍ | ⎍ |
| H | ↓ | H | ⎍ | ⎍ |
| ↑ | L | H | ⎍ | ⎍ |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; ↑ = LOW-to-HIGH transition; ↓ = HIGH-to-LOW transition; ⎍ = one HIGH level output pulse; ⎍ = one LOW level output pulse.

[2] If the monostable was triggered before this condition was established, the pulse will continue as programmed.

## 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 | V |
| $I_{IK}$ | input clamping current | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V | | - | ±20 | mA |
| $I_{OK}$ | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | | - | ±20 | mA |
| $I_O$ | output current | except for pins nREXT/CEXT; $V_O = -0.5$ 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 | | | | | |
| | DIP16 package | | [1] | - | 750 | mW |
| | SO16 package | | [2] | - | 500 | mW |
| | SSOP16 package | | [3] | - | 500 | mW |
| | TSSOP16 package | | [3] | - | 500 | mW |
| | DHVQFN16 package | | [4] | - | 500 | mW |

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

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

[3] For SSOP16 and TSSOP16 packages: $P_{tot}$ derates linearly with 5.5 mW/K above 60 °C.

[4] For DHVQFN16 package: $P_{tot}$ derates linearly with 4.5 mW/K above 60 °C.


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## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Conditions | 74HC123 | | | 74HCT123 | | | 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 |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $n\overline{RD}$ input | | | | | | | |
| | | $V_{CC}$ = 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 |
| $T_{amb}$ | ambient temperature | | –40 | +25 | +125 | –40 | +25 | +125 | °C |

## 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 | |
| **74HC123** | | | | | | | | | | |
| $V_{IH}$ | 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 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 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 | - | ±1.0 | - | ±1.0 | µA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 6.0 V | - | - | 8.0 | - | 80 | - | 160 | µA |


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**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 | |
| $C_I$ | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| **74HCT123** | | | | | | | | | | |
| $V_{IH}$ | 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 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 | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 4.0 mA | - | 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 | - | ±1.0 | - | ±1.0 | 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 | per input pin; $I_O$ = 0 A; $V_I$ = $V_{CC}$ – 2.1 V; other inputs at $V_{CC}$ or GND; $V_{CC}$ = 4.5 V to 5.5 V | | | | | | | | |
| | | pins $n\overline{A}$, nB | - | 35 | 125 | - | 160 | - | 170 | μA |
| | | pin $n\overline{RD}$ | - | 50 | 180 | - | 225 | - | 245 | μA |
| $C_I$ | input capacitance | | - | 3.5 | - | - | - | - | - | pF |


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## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

| Symbol | Parameter | Conditions | | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| **74HC123** | | | | | | | | | | | |
| $t_{pd}$ | propagation delay | $n\overline{RD}$, nA, nB to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | [1] | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | - | 83 | 255 | - | 320 | - | 385 | ns |
| | | $V_{CC}$ = 4.5 V | | - | 30 | 51 | - | 64 | - | 77 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 26 | - | - | - | - | - | ns |
| | | $V_{CC}$ = 6.0 V | | - | 24 | 43 | - | 54 | - | 65 | ns |
| | | $n\overline{RD}$ (reset) to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | - | 66 | 215 | - | 270 | - | 325 | ns |
| | | $V_{CC}$ = 4.5 V | | - | 24 | 43 | - | 54 | - | 65 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 20 | - | - | - | - | - | ns |
| | | $V_{CC}$ = 6.0 V | | - | 19 | 37 | - | 46 | - | 55 | ns |
| $t_t$ | transition time | see Figure 9 | [1] | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | - | 19 | 75 | - | 95 | - | 110 | ns |
| | | $V_{CC}$ = 4.5 V | | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | $V_{CC}$ = 6.0 V | | - | 6 | 13 | - | 16 | - | 19 | ns |
| $t_W$ | pulse width | nA LOW; see Figure 10 | | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | 100 | 8 | - | 125 | - | 150 | - | ns |
| | | $V_{CC}$ = 4.5 V | | 20 | 3 | - | 25 | - | 30 | - | ns |
| | | $V_{CC}$ = 6.0 V | | 17 | 2 | - | 21 | - | 26 | - | ns |
| | | nB HIGH; see Figure 10 | | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | 100 | 17 | - | 125 | - | 150 | - | ns |
| | | $V_{CC}$ = 4.5 V | | 20 | 6 | - | 25 | - | 30 | - | ns |
| | | $V_{CC}$ = 6.0 V | | 17 | 5 | - | 21 | - | 26 | - | ns |
| | | $n\overline{RD}$ LOW; see Figure 11 | | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | 100 | 14 | - | 125 | - | 150 | - | ns |
| | | $V_{CC}$ = 4.5 V | | 20 | 5 | - | 25 | - | 30 | - | ns |
| | | $V_{CC}$ = 6.0 V | | 17 | 4 | - | 21 | - | 26 | - | ns |
| | | nQ HIGH and $n\overline{Q}$ LOW; $V_{CC}$ = 5.0 V; see Figure 10 and 11 | [2] | | | | | | | | |
| | | $C_{EXT}$ = 100 nF; $R_{EXT}$ = 10 kΩ | | - | 450 | - | - | - | - | - | µs |
| | | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ | | - | 75 | - | - | - | - | - | ns |


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

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

| Symbol | Parameter | Conditions | | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_{rtrig}$ | retrigger time | $n\overline{A}$, nB; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; $V_{CC}$ = 5.0 V; see Figure 10 | [3][4] | - | 110 | - | - | - | - | - | ns |
| $R_{EXT}$ | external timing resistor | see Figure 7 | | | | | | | | | |
| | | $V_{CC}$ = 2.0 V | | 10 | - | 1000 | - | - | - | - | kΩ |
| | | $V_{CC}$ = 5.0 V | | 2 | - | 1000 | - | - | - | - | kΩ |
| $C_{EXT}$ | external timing capacitor | $V_{CC}$ = 5.0 V; see Figure 7 | [4] | - | - | - | - | - | - | - | pF |
| $C_{PD}$ | power dissipation capacitance | per monostable; $V_I$ = GND to $V_{CC}$ | [5] | - | 54 | - | - | - | - | - | pF |
| **74HCT123** | | | | | | | | | | | |
| $t_{PHL}$ | HIGH to LOW propagation delay | $n\overline{RD}$, $n\overline{A}$, nB to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | | - | 30 | 51 | - | 64 | - | 77 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 26 | - | - | - | - | - | ns |
| | | $n\overline{RD}$ (reset) to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | | - | 27 | 46 | - | 58 | - | 69 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 23 | - | - | - | - | - | ns |
| $t_{PLH}$ | LOW to HIGH propagation delay | $n\overline{RD}$, $n\overline{A}$, nB to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | | - | 28 | 51 | - | 64 | - | 77 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 26 | - | - | - | - | - | ns |
| | | $n\overline{RD}$ (reset) to nQ or $n\overline{Q}$; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figure 9 | | | | | | | | | |
| | | $V_{CC}$ = 4.5 V | | - | 23 | 46 | - | 58 | - | 69 | ns |
| | | $V_{CC}$ = 5 V; $C_L$ = 15 pF | | - | 23 | - | - | - | - | - | ns |
| $t_t$ | transition time | $V_{CC}$ = 4.5 V; see Figure 9 | [1] | - | 7 | 15 | - | 19 | - | 22 | ns |


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

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

| Symbol | Parameter | Conditions | | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_W$ | pulse width | $V_{CC}$ = 4.5 V | | | | | | | | | |
| | | $n\overline{A}$ LOW; see Figure 10 | | 20 | 3 | - | 25 | - | 30 | - | ns |
| | | nB HIGH; see Figure 10 | | 20 | 5 | - | 25 | - | 30 | - | ns |
| | | $n\overline{RD}$ LOW; see Figure 11 | | 20 | 7 | - | 25 | - | 30 | - | ns |
| | | nQ HIGH and $n\overline{Q}$ LOW; $V_{CC}$ = 5.0 V; see Figure 10 and 11 | [2] | | | | | | | | |
| | | $C_{EXT}$ = 100 nF; $R_{EXT}$ = 10 kΩ | | - | 450 | - | - | - | - | - | µs |
| | | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ | | - | 75 | - | - | - | - | - | ns |
| $t_{rtrig}$ | retrigger time | $n\overline{A}$, nB; $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; $V_{CC}$ = 5.0 V; see Figure 10 | [3][4] | - | 110 | - | - | - | - | - | ns |
| $R_{EXT}$ | external timing resistor | $V_{CC}$ = 5.0 V; see Figure 7 | | 2 | - | 1000 | - | - | - | - | kΩ |
| $C_{EXT}$ | external timing capacitor | $V_{CC}$ = 5.0 V; see Figure 7 | [4] | - | - | - | - | - | - | - | pF |
| $C_{PD}$ | power dissipation capacitance | per monostable; $V_I$ = GND to $V_{CC}$ | [5] | - | 56 | - | - | - | - | - | pF |

[1] $t_{pd}$ is the same as $t_{PHL}$ and $t_{PLH}$; $t_t$ is the same as $t_{THL}$ and $t_{TLH}$

[2] For other $R_{EXT}$ and $C_{EXT}$ combinations see Figure 7. If $C_{EXT}$ > 10 nF, the next formula is valid.
$t_W = K \times R_{EXT} \times C_{EXT}$, where:
$t_W$ = typical output pulse width in ns;
$R_{EXT}$ = external resistor in kΩ;
$C_{EXT}$ = external capacitor in pF;
K = constant = 0.45 for $V_{CC}$ = 5.0 V and 0.55 for $V_{CC}$ = 2.0 V.
The inherent test jig and pin capacitance at pins 15 and 7 (nREXT/CEXT) is approximately 7 pF.

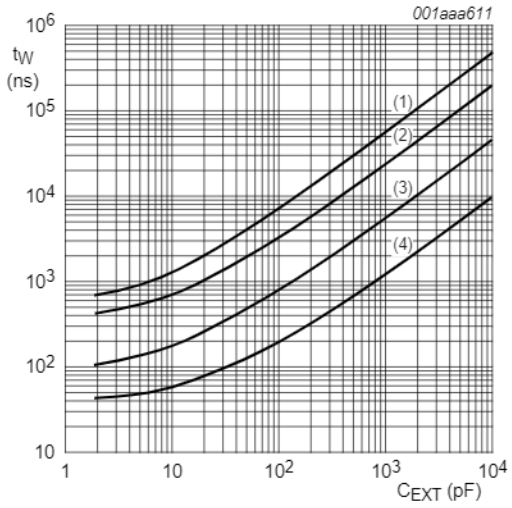
[3] The time to retrigger the monostable multivibrator depends on the values of $R_{EXT}$ and $C_{EXT}$. The output pulse width will only be extended when the time between the active-going edges of the trigger input pulses meets the minimum retrigger time. If $C_{EXT}$ >10 pF, the next formula (at $V_{CC}$ = 5.0 V) for the setup time of a retrigger pulse is valid:
$t_{rtrig} = 30 + 0.19 \times R_{EXT} \times C_{EXT}^{0.9} + 13 \times R_{EXT}^{1.05}$, where:
$t_{rtrig}$ = retrigger time in ns;
$C_{EXT}$ = external capacitor in pF; $R_{EXT}$ = external resistor in kΩ.
The inherent test jig and pin capacitance at pins 15 and 7 (nREXT/CEXT) is 7 pF.

[4] When the device is powered-up, initiate the device via a reset pulse, when $C_{EXT}$ < 50 pF.

[5] $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma(C_L \times V_{CC}^2 \times f_o) + 0.75 \times C_{EXT} \times V_{CC}^2 \times f_o + D \times 16 \times V_{CC}$ where:
$f_i$ = input frequency in MHz;
$f_o$ = output frequency in MHz;
D = duty factor in %;
$C_L$ = output load capacitance in pF;
$V_{CC}$ = supply voltage in V;
$C_{EXT}$ = timing capacitance in pF;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ sum of outputs.


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$V_{CC}$ = 5.0 V; $T_{amb}$ = 25 °C.

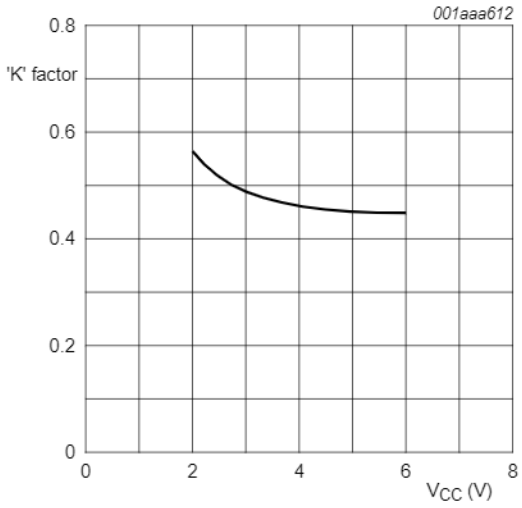
(1) $R_{EXT}$ = 100 kΩ

(2) $R_{EXT}$ = 50 kΩ

(3) $R_{EXT}$ = 10 kΩ

(4) $R_{EXT}$ = 2 kΩ

**Fig 7. Typical output pulse width as a function of the external capacitor value**




$C_{EXT}$ = 10 nF; $R_{EXT}$ = 10 kΩ to 100 kΩ.

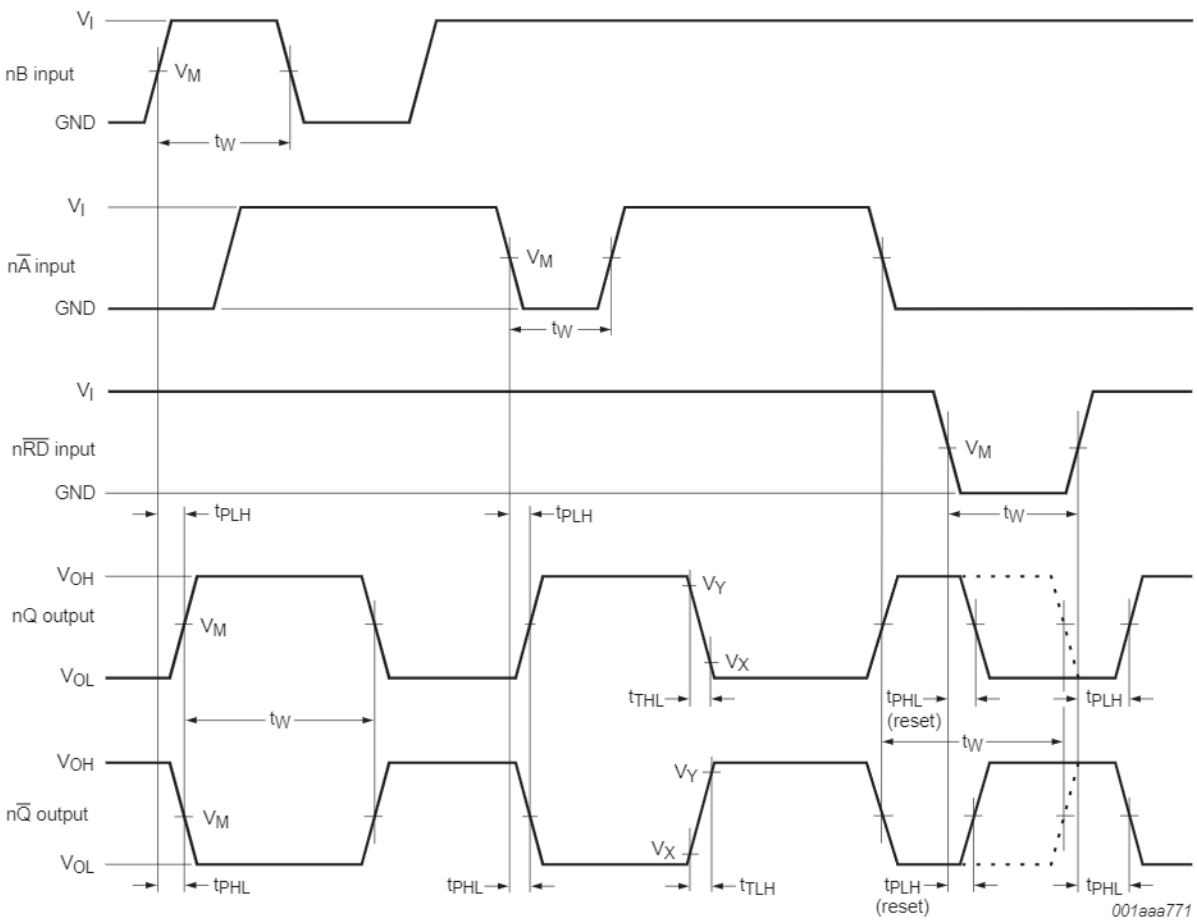
$T_{amb}$ = 25 °C.

**Fig 8. 74HC123 typical 'K' factor as function of $V_{CC}$**


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## 11. Waveforms



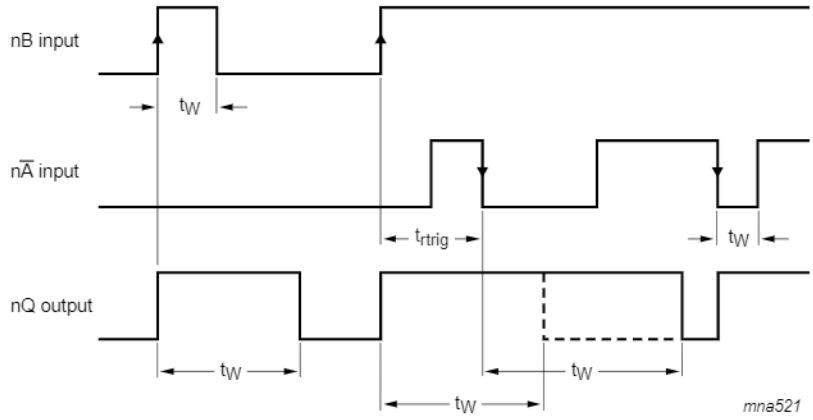

Measurement points are given in Table 8.

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

**Fig 9. Propagation delays from inputs (nA, nB, nRD) to outputs (nQ, nQ) and output transition times**

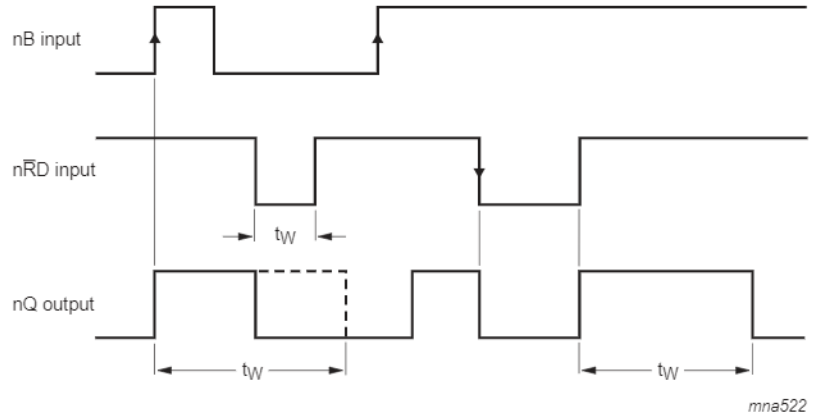

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$n\overline{RD}$ = HIGH

**Fig 10. Output pulse control using retrigger pulse**

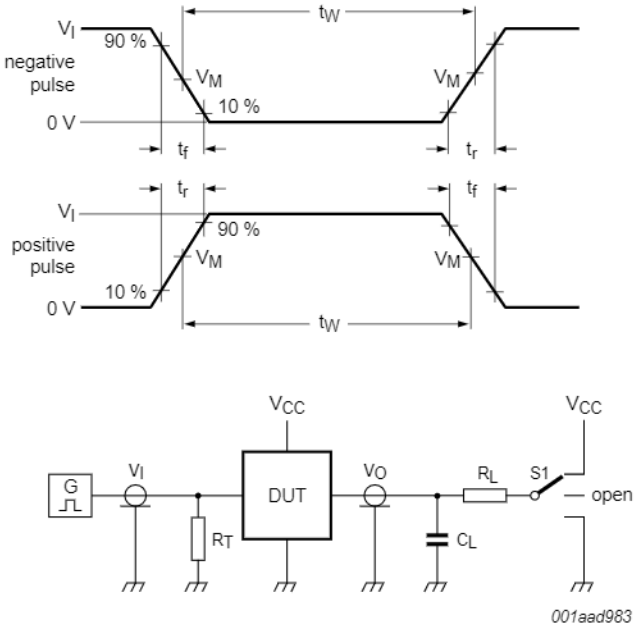



$n\overline{A}$ = LOW

**Fig 11. Output pulse control using reset input $n\overline{RD}$**


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Test data is given in Table 8.

Definitions test circuit:

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

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

$R_L$ = Load resistance.

S1 = Test selection switch.

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

**Table 8. Test data**

| Type | Input | | Load | | S1 position |
|---|---|---|---|---|---|
| | $V_I$ | $t_r$, $t_f$ | $C_L$ | $R_L$ | $t_{PHL}$, $t_{PLH}$ |
| 74HC123 | $V_{CC}$ | 6 ns | 15 pF, 50 pF | 1 kΩ | open |
| 74HCT123 | 3 V | 6 ns | 15 pF, 50 pF | 1 kΩ | open |

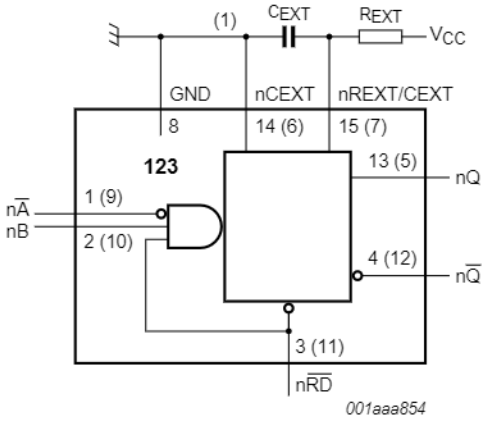

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# 12. Application information

## 12.1 Timing component connections

The basic output pulse width is essentially determined by the values of the external timing components $R_{EXT}$ and $C_{EXT}$.




(1) For minimum noise generation it is recommended to ground pins 6 (2CEXT) and 14 (1CEXT) externally to pin 8 (GND).

**Fig 13. Timing component connections**

## 12.2 Power-up considerations

When the monostable is powered-up it may produce an output pulse, with a pulse width defined by the values of $R_{EXT}$ and $C_{EXT}$. This output pulse can be eliminated using the circuit shown in Figure 14.

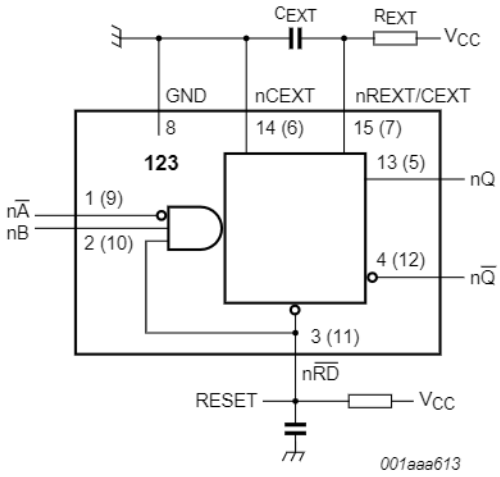



**Fig 14. Power-up output pulse elimination circuit**


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## 12.3 Power-down considerations

A large capacitor $C_{EXT}$ may cause problems when powering-down the monostable due to the energy stored in this capacitor. When a system containing this device is powered-down or a 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 15.

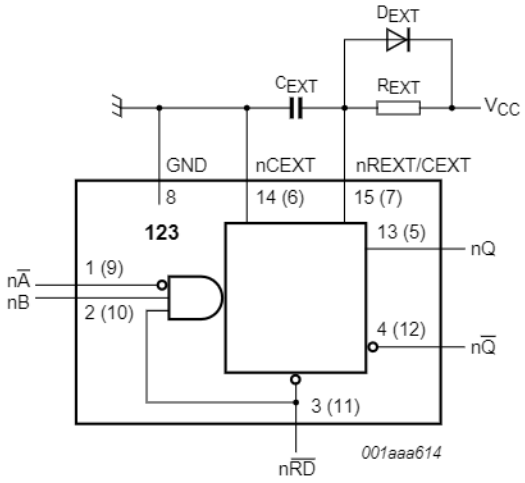


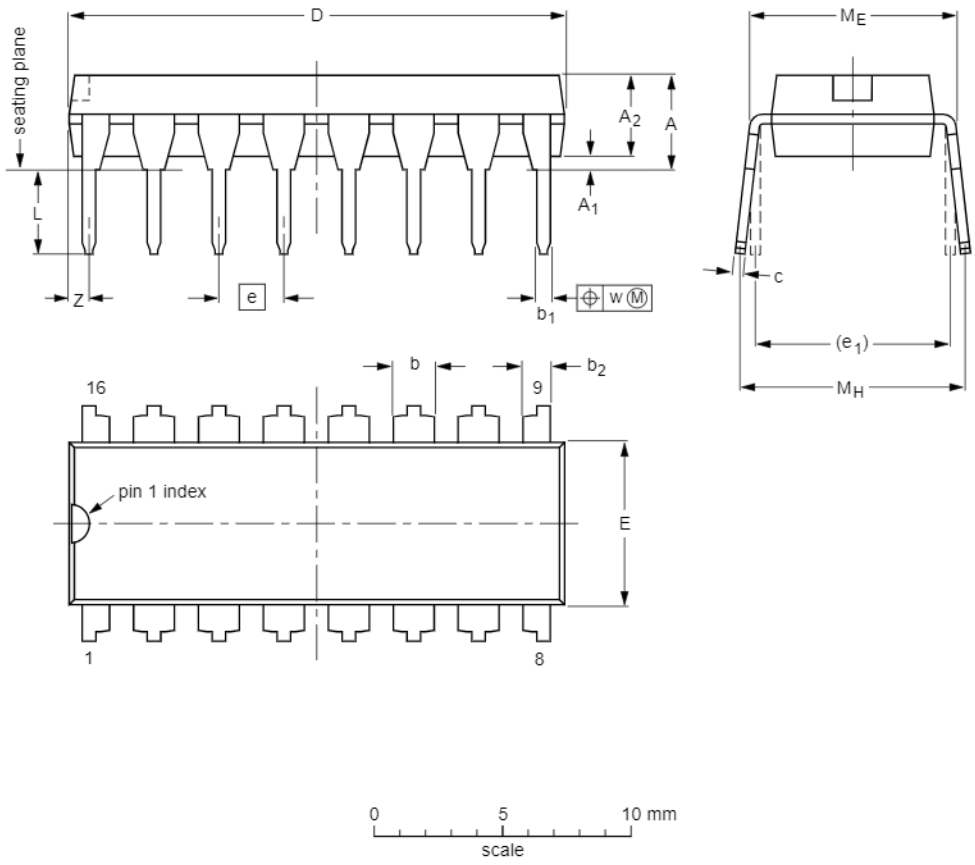

**Fig 15. Power-down protection circuit**


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## 13. Package outline

**DIP16: plastic dual in-line package; 16 leads (300 mil)** **SOT38-4**




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

| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | $b_2$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.30 | 0.53<br>0.38 | 1.25<br>0.85 | 0.36<br>0.23 | 19.50<br>18.55 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 0.76 |
| inches | 0.17 | 0.02 | 0.13 | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 0.014<br>0.009 | 0.77<br>0.73 | 0.26<br>0.24 | 0.1 | 0.3 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.03 |

**Note**

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

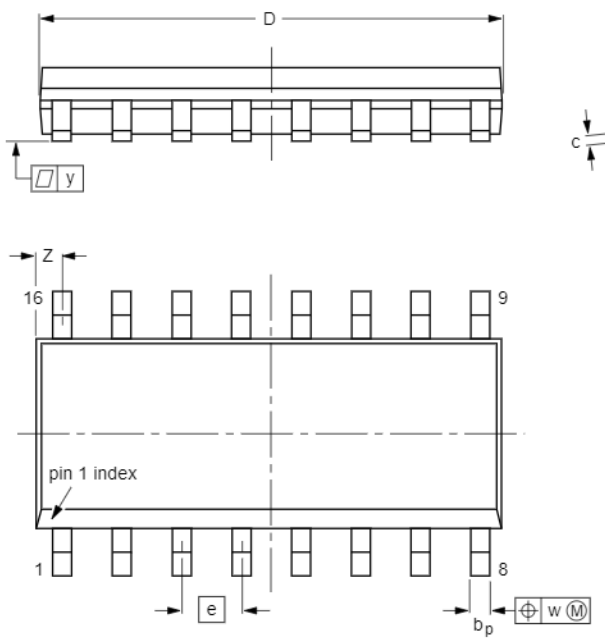
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT38-4 | | | | | | ~~95-01-14~~<br>03-02-13 |

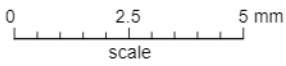
**Fig 16. Package outline SOT38-4 (DIP16)**


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**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°<br>0° |
| 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.

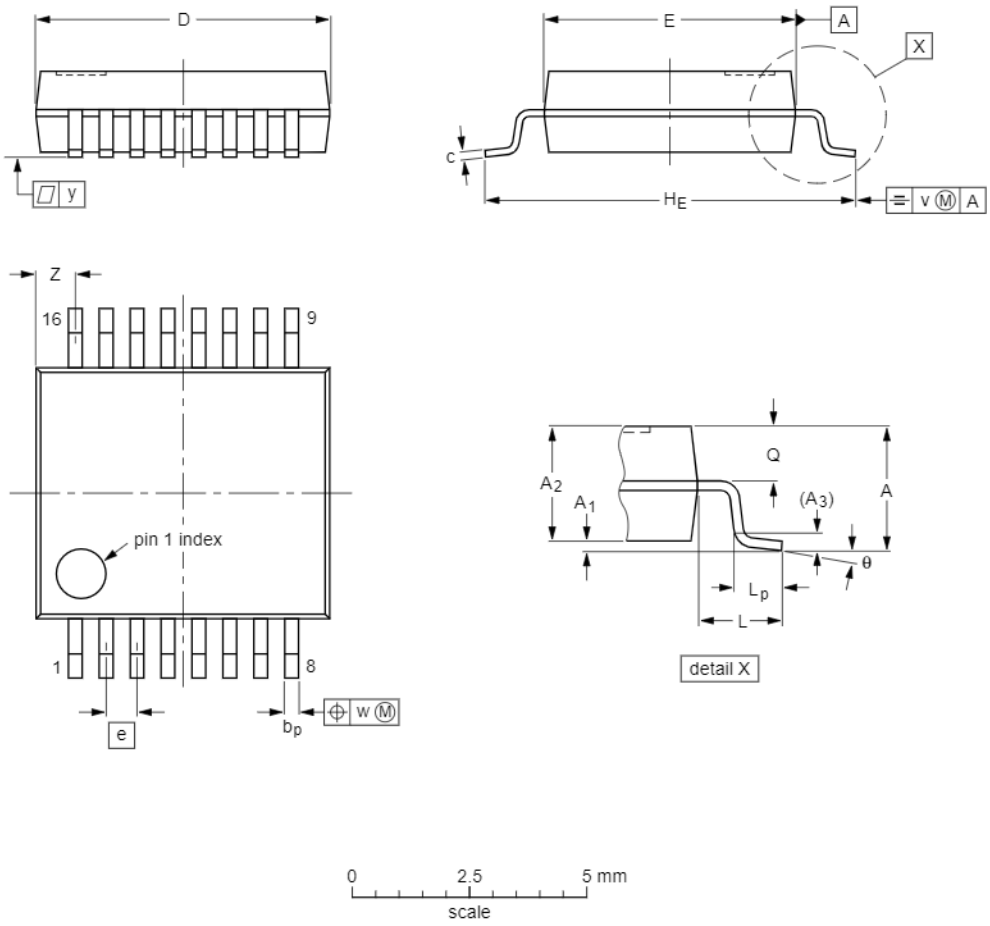
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT109-1 | 076E07 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 17. Package outline SOT109-1 (SO16)**


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**SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm** **SOT338-1**




**DIMENSIONS (mm are the original 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 | 2 | 0.21<br>0.05 | 1.80<br>1.65 | 0.25 | 0.38<br>0.25 | 0.20<br>0.09 | 6.4<br>6.0 | 5.4<br>5.2 | 0.65 | 7.9<br>7.6 | 1.25 | 1.03<br>0.63 | 0.9<br>0.7 | 0.2 | 0.13 | 0.1 | 1.00<br>0.55 | 8°<br>0° |

**Note**

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

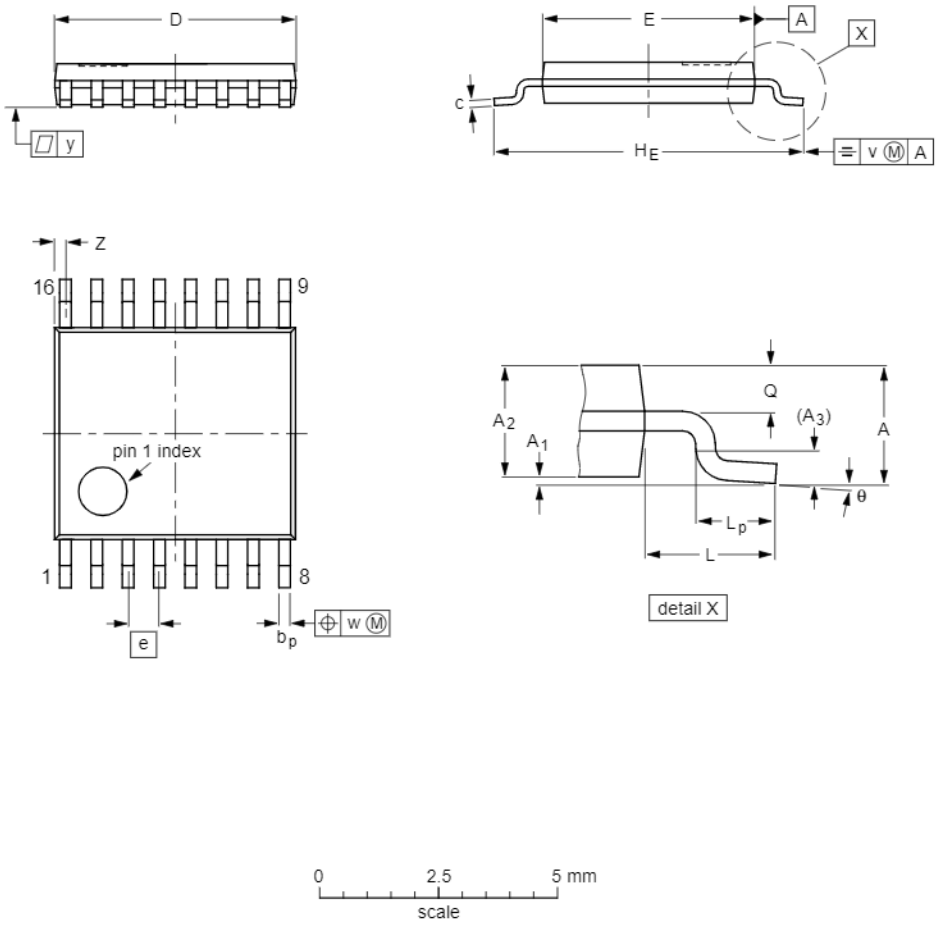
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT338-1 | | MO-150 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 18. Package outline SOT338-1 (SSOP16)**


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**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.

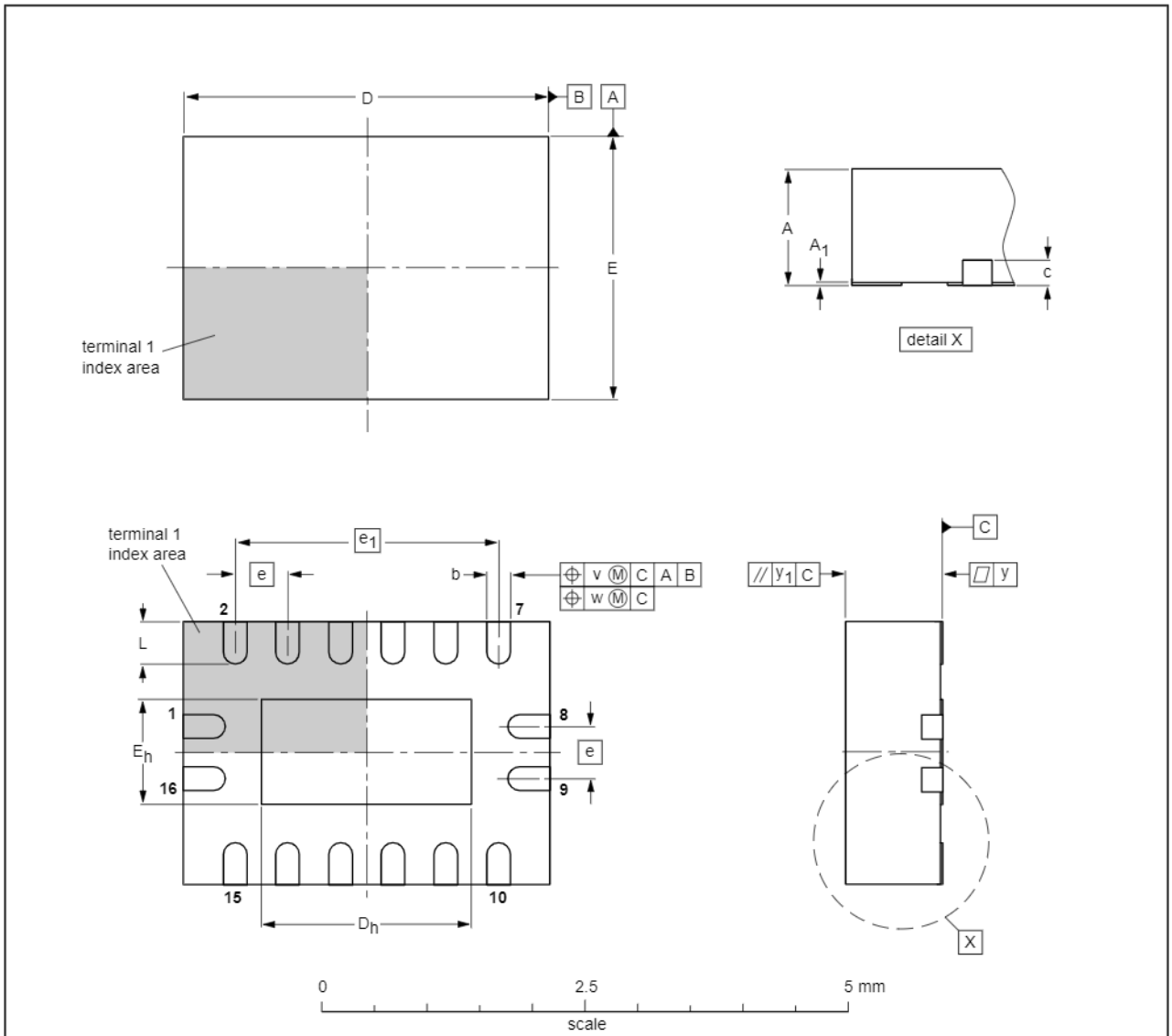
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT403-1 | | MO-153 | | | | ~~99-12-27~~<br>03-02-18 |

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


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**DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm** **SOT763-1**




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

| UNIT | A(1) max. | $A_1$ | b | c | D(1) | $D_h$ | E(1) | $E_h$ | e | $e_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.30<br>0.18 | 0.2 | 3.6<br>3.4 | 2.15<br>1.85 | 2.6<br>2.4 | 1.15<br>0.85 | 0.5 | 2.5 | 0.5<br>0.3 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT763-1 | - - - | MO-241 | - - - | | | ~~02-10-17~~<br>03-01-27 |

**Fig 20. Package outline SOT763-1 (DHVQFN16)**


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## 14. Abbreviations

**Table 9. Abbreviations**

| Acronym | Abbreviation |
|---|---|
| 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 |

## 15. Revision history

**Table 10. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74HC_HCT123 v.8 | 20111216 | Product data sheet | - | 74HC_HCT123 v.7 |
| Modifications: | • Legal pages updated. | | | |
| 74HC_HCT123 v.7 | 20110825 | Product data sheet | - | 74HC_HCT123 v.6 |
| 74HC_HCT123 v.6 | 20110314 | Product data sheet | - | 74HC_HCT123 v.5 |
| 74HC_HCT123 v.5 | 20090713 | Product data sheet | - | 74HC_HCT123 v.4 |
| 74HC_HCT123 v.4 | 20060616 | Product data sheet | - | 74HC_HCT123 v.3 |
| 74HC_HCT123 v.3 | 20040511 | Product specification | - | 74HC_HCT123_CNV v.2 |
| 74HC_HCT123_CNV v.2 | 19980708 | Product specification | - | - |


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# 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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Date of release: 16 December 2011
Document identifier: 74HC_HCT123