

# 74HC123; 74HCT123

Dual retriggerable monostable multivibrator with reset

Rev. 05 — 13 July 2009

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 ( $n\bar{A}$ ) or the active HIGH-going edge input ( $nB$ ). By repeating this process, the output pulse period ( $nQ = \text{HIGH}$ ,  $n\bar{Q} = \text{LOW}$ ) can be made as long as desired. Alternatively an output delay can be terminated at any time by a LOW-going edge on input  $n\bar{RD}$ , which also inhibits the triggering.
3. An internal connection from  $n\bar{RD}$  to the input gates makes it possible to trigger the circuit by a HIGH-going signal at input  $n\bar{RD}$  as shown in the function table.

Schmitt-trigger action in the  $n\bar{A}$  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

- 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-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC123N 74HCT123N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HC123D 74HCT123D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC123DB 74HCT123DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HC123PW 74HCT123PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
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

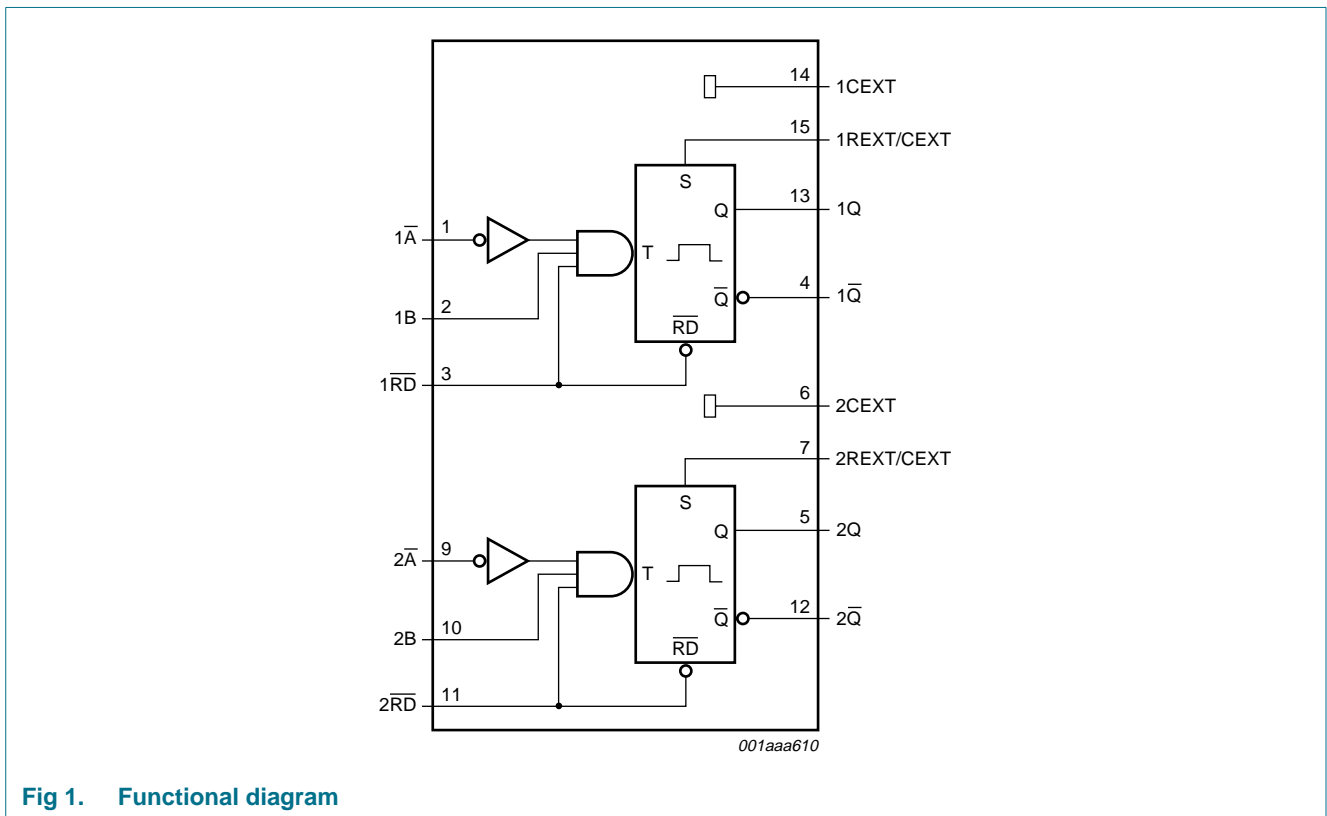


Fig 1. Functional diagram

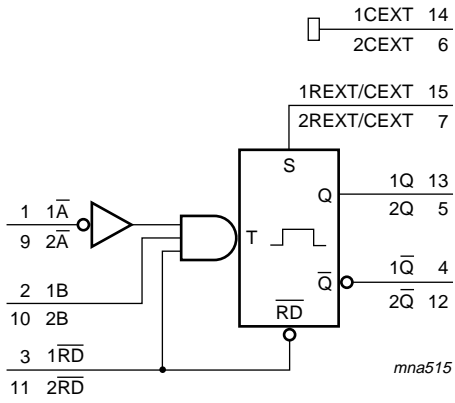


Fig 2. Logic symbol

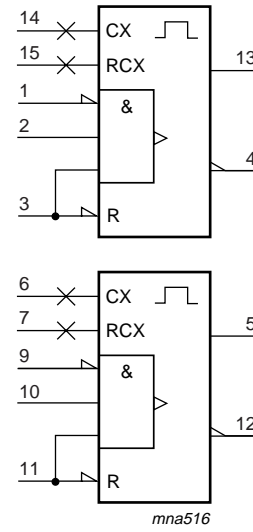


Fig 3. IEC logic symbol

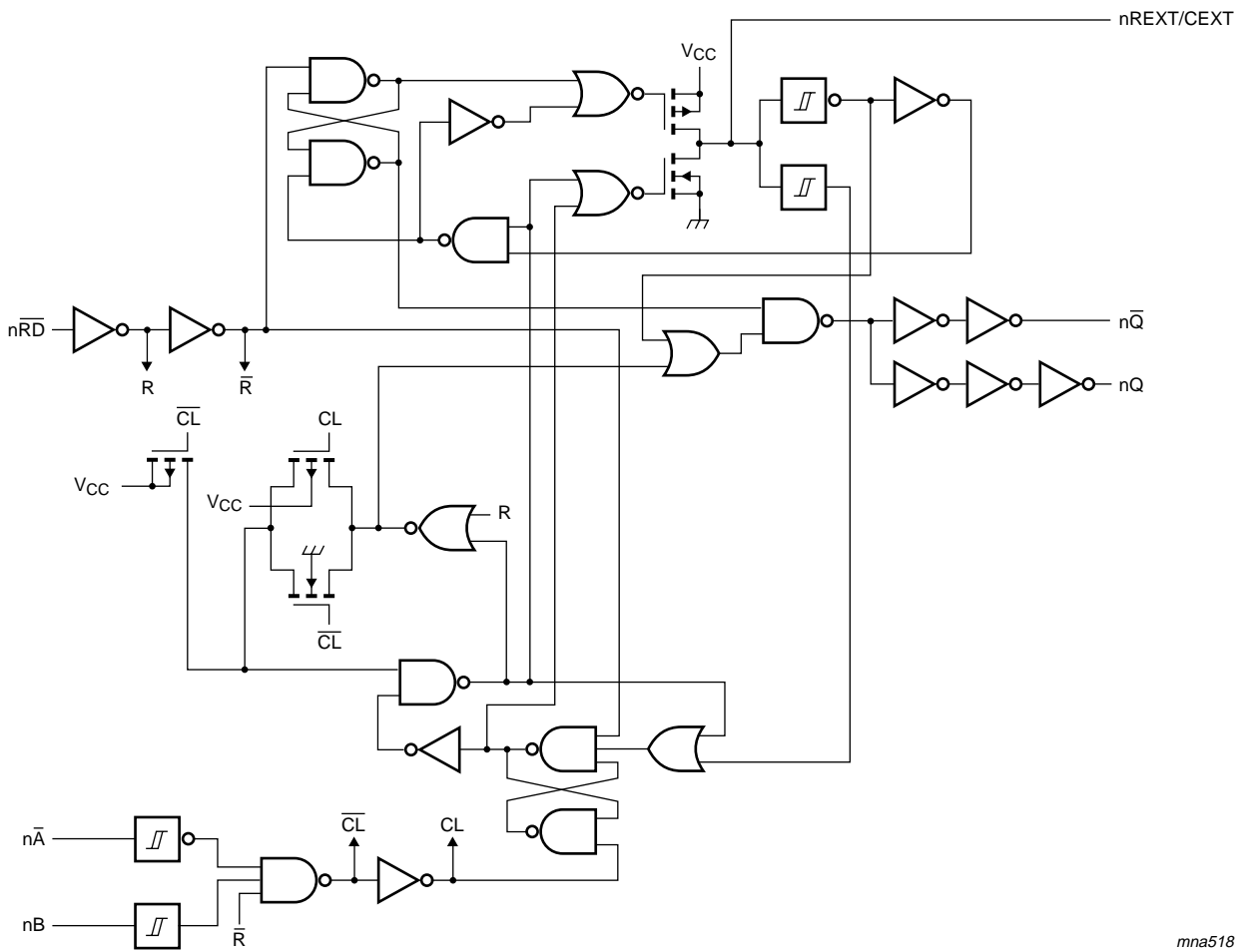
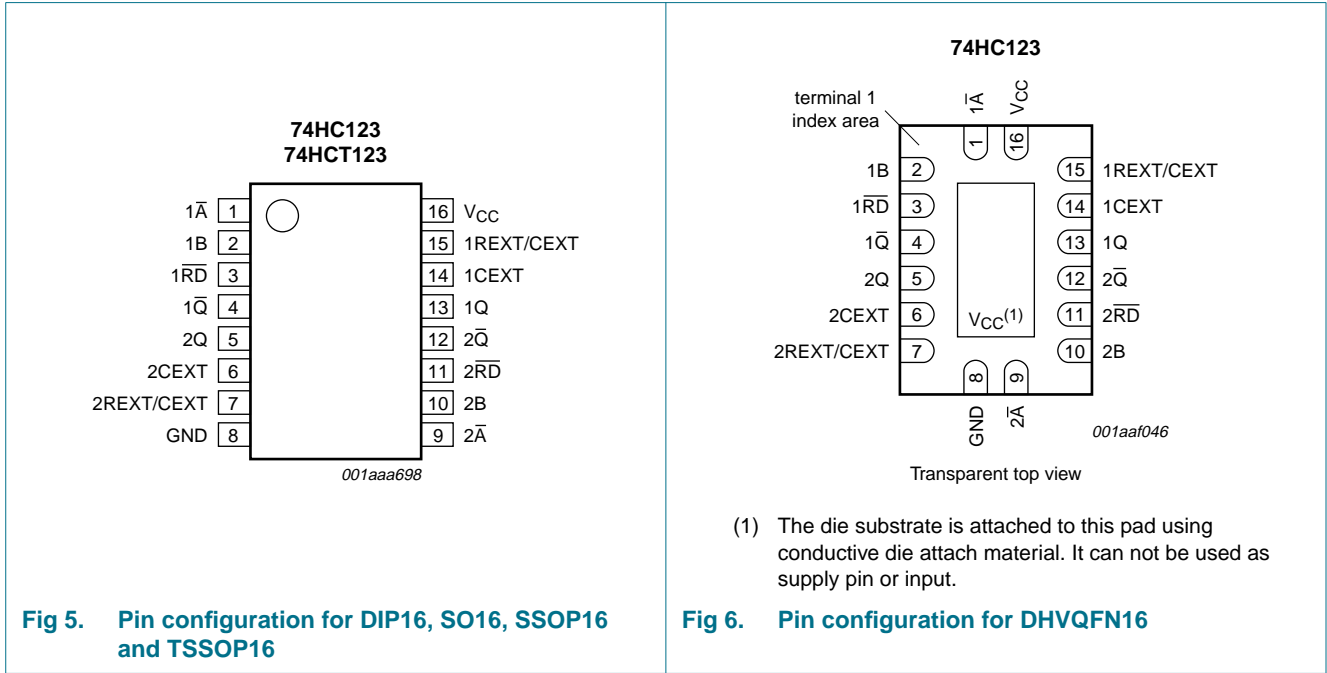


Fig 4. Logic diagram

## 5. Pinning information

### 5.1 Pinning









### 5.2 Pin description

**Table 2. Pin description**



Symbol	Pin	Description
1 $\bar{A}$	1	negative-edge triggered input 1
1B	2	positive-edge triggered input 1
1 $\bar{RD}$	3	direct reset LOW and positive-edge triggered input 1
1 $\bar{Q}$	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)
2 $\bar{A}$	9	negative-edge triggered input 2
2B	10	positive-edge triggered input 2
2 $\bar{RD}$	11	direct reset LOW and positive-edge triggered input 2
2 $\bar{Q}$	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 <sub>CC</sub>	16	supply voltage

## 6. Functional description

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

Input			Output	
nRD	nA	nB	nQ	nQ
L	X	X	L	H
X	H	X	L <sup>[2]</sup>	H <sup>[2]</sup>
X	X	L	L <sup>[2]</sup>	H <sup>[2]</sup>
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 <sub>CC</sub>	supply voltage		-0.5	+7	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V	-	±20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V	-	±20	mA
I <sub>O</sub>	output current	except for pins nREXT/CEXT; V <sub>O</sub> = -0.5 V to (V <sub>CC</sub> + 0.5 V)	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
I <sub>GND</sub>	ground current		-	-50	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation				
	DIP16 package		<sup>[1]</sup> -	750	mW
	SO16 package		<sup>[2]</sup> -	500	mW
	SSOP16 package		<sup>[3]</sup> -	500	mW
	TSSOP16 package		<sup>[3]</sup> -	500	mW
	DHVQFN16 package		<sup>[4]</sup> -	500	mW

[1] For DIP16 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

[3] For SSOP16 and TSSOP16 packages: P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

[4] For DHVQFN16 package: P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	74HC123			74HCT123			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
Δt/ΔV	input transition rise and fall rate	nRD input							
		V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V <sub>CC</sub> = 6.0 V	-	-	83	-	-	-	ns/V
T <sub>amb</sub>	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	
<b>74HC123</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
		I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	8.0	-	80	-

**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 <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF
<b>74HCT123</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 μA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	8.0	-	80	-	160	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; I <sub>O</sub> = 0 A; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V								
		pins nA, nB	-	35	125	-	160	-	170	μA
		pin nRD	-	50	180	-	225	-	245	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V);  $C_L = 50 \text{ pF}$  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	
<b>74HC123</b>										
$t_{pd}$	propagation delay	nRD, nA, nB to nQ or nQ; <a href="#">[1]</a> $C_{EXT} = 0 \text{ pF}$ ; $R_{EXT} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>								
		$V_{CC} = 2.0 \text{ V}$	-	83	255	-	320	-	385	ns
		$V_{CC} = 4.5 \text{ V}$	-	30	51	-	64	-	77	ns
		$V_{CC} = 5 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	26	-	-	-	-	-	ns
		$V_{CC} = 6.0 \text{ V}$	-	24	43	-	54	-	65	ns
		nRD (reset) to nQ or nQ; $C_{EXT} = 0 \text{ pF}$ ; $R_{EXT} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>								
		$V_{CC} = 2.0 \text{ V}$	-	66	215	-	270	-	325	ns
		$V_{CC} = 4.5 \text{ V}$	-	24	43	-	54	-	65	ns
$t_t$	output transition time	see <a href="#">Figure 9</a> <a href="#">[1]</a>								
		$V_{CC} = 2.0 \text{ V}$	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5 \text{ V}$	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0 \text{ V}$	-	6	13	-	16	-	19	ns
$t_W$	pulse width	nA LOW; see <a href="#">Figure 10</a>								
		$V_{CC} = 2.0 \text{ V}$	100	8	-	125	-	150	-	ns
		$V_{CC} = 4.5 \text{ V}$	20	3	-	25	-	30	-	ns
		$V_{CC} = 6.0 \text{ V}$	17	2	-	21	-	26	-	ns
		nB HIGH; see <a href="#">Figure 10</a>								
		$V_{CC} = 2.0 \text{ V}$	100	17	-	125	-	150	-	ns
		$V_{CC} = 4.5 \text{ V}$	20	6	-	25	-	30	-	ns
		$V_{CC} = 6.0 \text{ V}$	17	5	-	21	-	26	-	ns
		nRD LOW; see <a href="#">Figure 11</a>								
		$V_{CC} = 2.0 \text{ V}$	100	14	-	125	-	150	-	ns
		$V_{CC} = 4.5 \text{ V}$	20	5	-	25	-	30	-	ns
		$V_{CC} = 6.0 \text{ V}$	17	4	-	21	-	26	-	ns
nQ HIGH and nQ LOW; <a href="#">[2]</a> $V_{CC} = 5.0 \text{ V}$ ; see <a href="#">Figure 10</a> and <a href="#">11</a>										
$C_{EXT} = 100 \text{ nF}$ ; $R_{EXT} = 10 \text{ k}\Omega$	-	450	-	-	-	-	-	$\mu\text{s}$		
$C_{EXT} = 0 \text{ pF}$ ; $R_{EXT} = 5 \text{ k}\Omega$	-	75	-	-	-	-	-	ns		



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

Voltages are referenced to GND (ground = 0 V);  $C_L = 50 \text{ pF}$  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	
$t_{\text{rtrig}}$	retrigger time	$n\bar{A}$ , $nB$ ; $C_{\text{EXT}} = 0 \text{ pF}$ ; $R_{\text{EXT}} = 5 \text{ k}\Omega$ ; $V_{\text{CC}} = 5.0 \text{ V}$ ; see <a href="#">Figure 10</a>	[3][4]	-	110	-	-	-	-	ns
$R_{\text{EXT}}$	external timing resistor	see <a href="#">Figure 7</a>								
		$V_{\text{CC}} = 2.0 \text{ V}$		10	-	1000	-	-	-	k $\Omega$
		$V_{\text{CC}} = 5.0 \text{ V}$		2	-	1000	-	-	-	k $\Omega$
$C_{\text{EXT}}$	external timing capacitor	$V_{\text{CC}} = 5.0 \text{ V}$ ; see <a href="#">Figure 7</a>	[4]	-	-	-	-	-	-	pF
$C_{\text{PD}}$	power dissipation capacitance	per monostable; $V_I = \text{GND to } V_{\text{CC}}$	[5]	-	54	-	-	-	-	pF

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$t_{\text{PHL}}$	HIGH to LOW propagation delay	$n\bar{RD}$ , $n\bar{A}$ , $nB$ to $nQ$ or $n\bar{Q}$ ; $C_{\text{EXT}} = 0 \text{ pF}$ ; $R_{\text{EXT}} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>									
		$V_{\text{CC}} = 4.5 \text{ V}$	-	30	51	-	64	-	77	ns	
		$V_{\text{CC}} = 5 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	26	-	-	-	-	-	ns	
		$n\bar{RD}$ (reset) to $nQ$ or $n\bar{Q}$ ; $C_{\text{EXT}} = 0 \text{ pF}$ ; $R_{\text{EXT}} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>									
		$V_{\text{CC}} = 4.5 \text{ V}$	-	27	46	-	58	-	69	ns	
		$V_{\text{CC}} = 5 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	23	-	-	-	-	-	ns	
$t_{\text{PLH}}$	LOW to HIGH propagation delay	$n\bar{RD}$ , $n\bar{A}$ , $nB$ to $nQ$ or $n\bar{Q}$ ; $C_{\text{EXT}} = 0 \text{ pF}$ ; $R_{\text{EXT}} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>									
		$V_{\text{CC}} = 4.5 \text{ V}$	-	28	51	-	64	-	77	ns	
		$V_{\text{CC}} = 5 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	26	-	-	-	-	-	ns	
		$n\bar{RD}$ (reset) to $nQ$ or $n\bar{Q}$ ; $C_{\text{EXT}} = 0 \text{ pF}$ ; $R_{\text{EXT}} = 5 \text{ k}\Omega$ ; see <a href="#">Figure 9</a>									
		$V_{\text{CC}} = 4.5 \text{ V}$	-	23	46	-	58	-	69	ns	
		$V_{\text{CC}} = 5 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	23	-	-	-	-	-	ns	
$t_t$	output transition time	$V_{\text{CC}} = 4.5 \text{ V}$ ; see <a href="#">Figure 9</a>	[1]	-	7	15	-	19	-	22	ns

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

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$t_W$	pulse width	$V_{CC} = 4.5$ V								
		n $\bar{A}$ LOW; see <a href="#">Figure 10</a>	20	3	-	25	-	30	-	ns
		nB HIGH; see <a href="#">Figure 10</a>	20	5	-	25	-	30	-	ns
		n $\bar{R}\bar{D}$ LOW; see <a href="#">Figure 11</a>	20	7	-	25	-	30	-	ns
		nQ HIGH and n $\bar{Q}$ LOW; <a href="#">[2]</a> $V_{CC} = 5.0$ V; see <a href="#">Figure 10</a> and <a href="#">11</a>								
$t_{trig}$	retrigger time	$C_{EXT} = 100$ nF; $R_{EXT} = 10$ k $\Omega$	-	450	-	-	-	-	-	$\mu$ s
		$C_{EXT} = 0$ pF; $R_{EXT} = 5$ k $\Omega$	-	75	-	-	-	-	-	ns
$t_{trig}$	retrigger time	n $\bar{A}$ , nB; $C_{EXT} = 0$ pF; $R_{EXT} = 5$ k $\Omega$ ; $V_{CC} = 5.0$ V; see <a href="#">Figure 10</a>	<a href="#">[3][4]</a>	-	110	-	-	-	-	ns
$R_{EXT}$	external timing resistor	$V_{CC} = 5.0$ V; see <a href="#">Figure 7</a>	2	-	1000	-	-	-	-	k $\Omega$
$C_{EXT}$	external timing capacitor	$V_{CC} = 5.0$ V; see <a href="#">Figure 7</a>	<a href="#">[4]</a>	-	-	-	-	-	-	pF
$C_{PD}$	power dissipation capacitance	per monostable; $V_I = GND$ to $V_{CC}$	<a href="#">[5]</a>	-	56	-	-	-	-	pF

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

$$t_W = K \times R_{EXT} \times C_{EXT}, \text{ where:}$$

$t_W$  = typical output pulse width in ns;

$R_{EXT}$  = external resistor in k $\Omega$ ;

$C_{EXT}$  = 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:

$$t_{trig} = 30 + 0.19 \times R_{EXT} \times C_{EXT}^{0.9} + 13 \times R_{EXT}^{1.05}, \text{ where:}$$

$t_{trig}$  = retrigger time in ns;

$C_{EXT}$  = external capacitor in pF;  $R_{EXT}$  = external resistor in k $\Omega$ .

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  $\mu$ W).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum(C_L \times V_{CC}^2 \times f_o) + 0.75 \times C_{EXT} \times V_{CC}^2 \times f_o + D \times 16 \times V_{CC} \text{ where:}$$

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

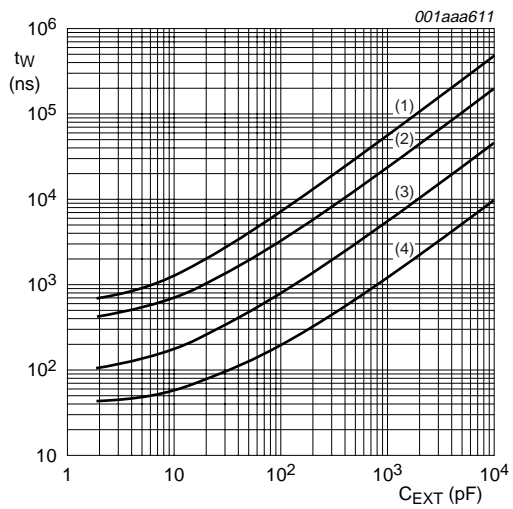
D = duty factor in %;

$C_L$  = output load capacitance in pF;

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

$C_{EXT}$  = timing capacitance in pF;

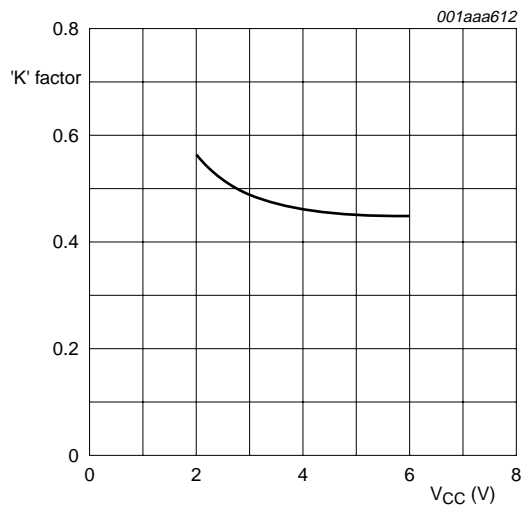
$\sum(C_L \times V_{CC}^2 \times f_o)$  sum of outputs.



$V_{CC} = 5.0\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$

- (1)  $R_{EXT} = 100\text{ k}\Omega$
- (2)  $R_{EXT} = 50\text{ k}\Omega$
- (3)  $R_{EXT} = 10\text{ k}\Omega$
- (4)  $R_{EXT} = 2\text{ k}\Omega$

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

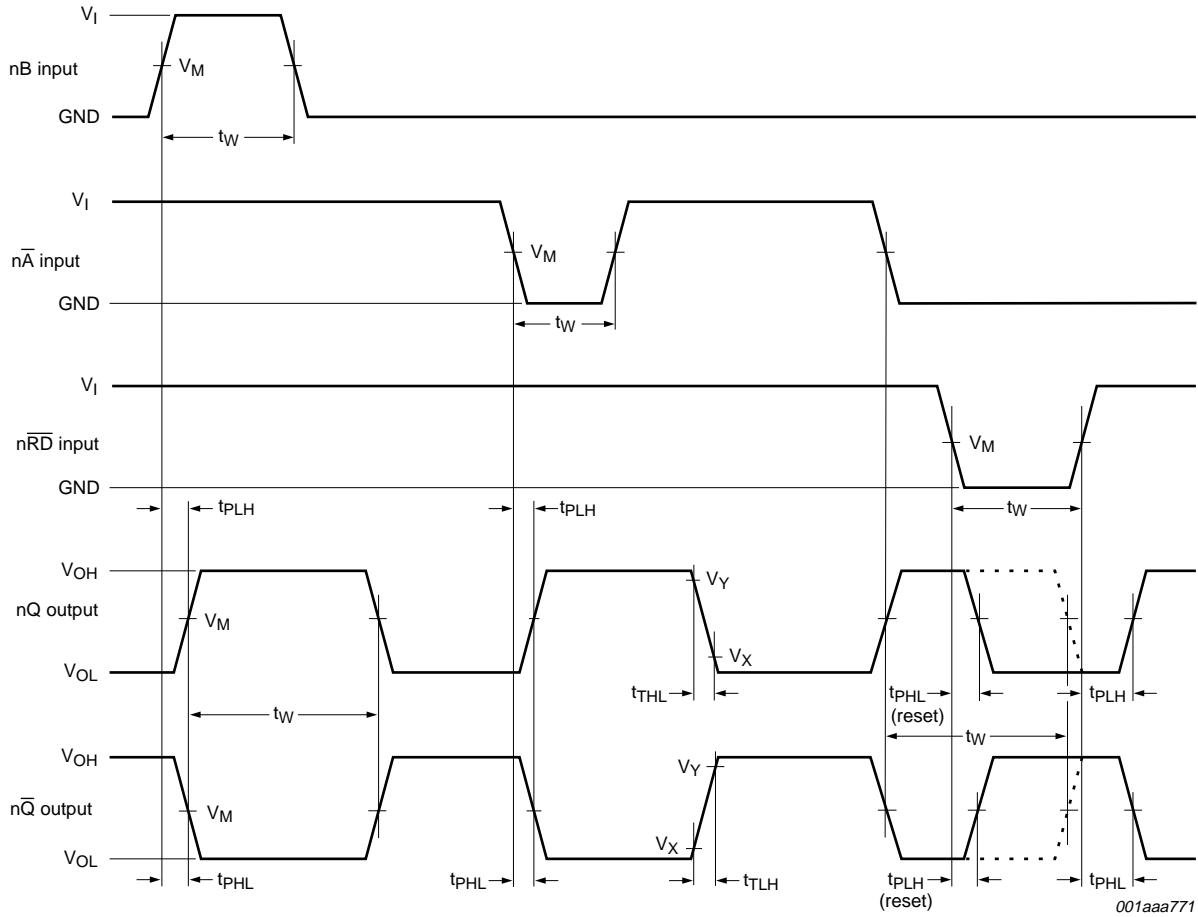


$C_{EXT} = 10\text{ nF}; R_{EXT} = 10\text{ k}\Omega\text{ to }100\text{ k}\Omega.$

$T_{amb} = 25\text{ }^{\circ}\text{C}.$

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

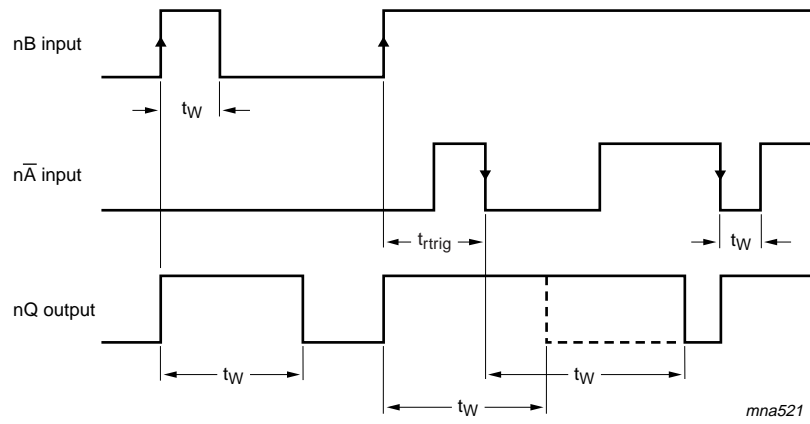
11. Waveforms



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

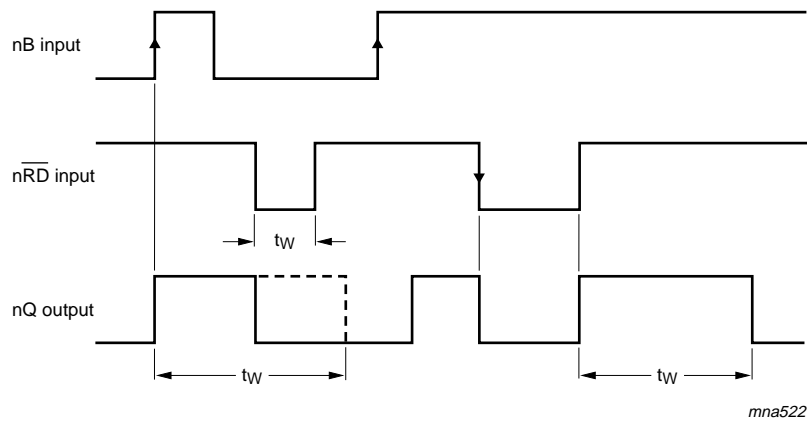
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

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



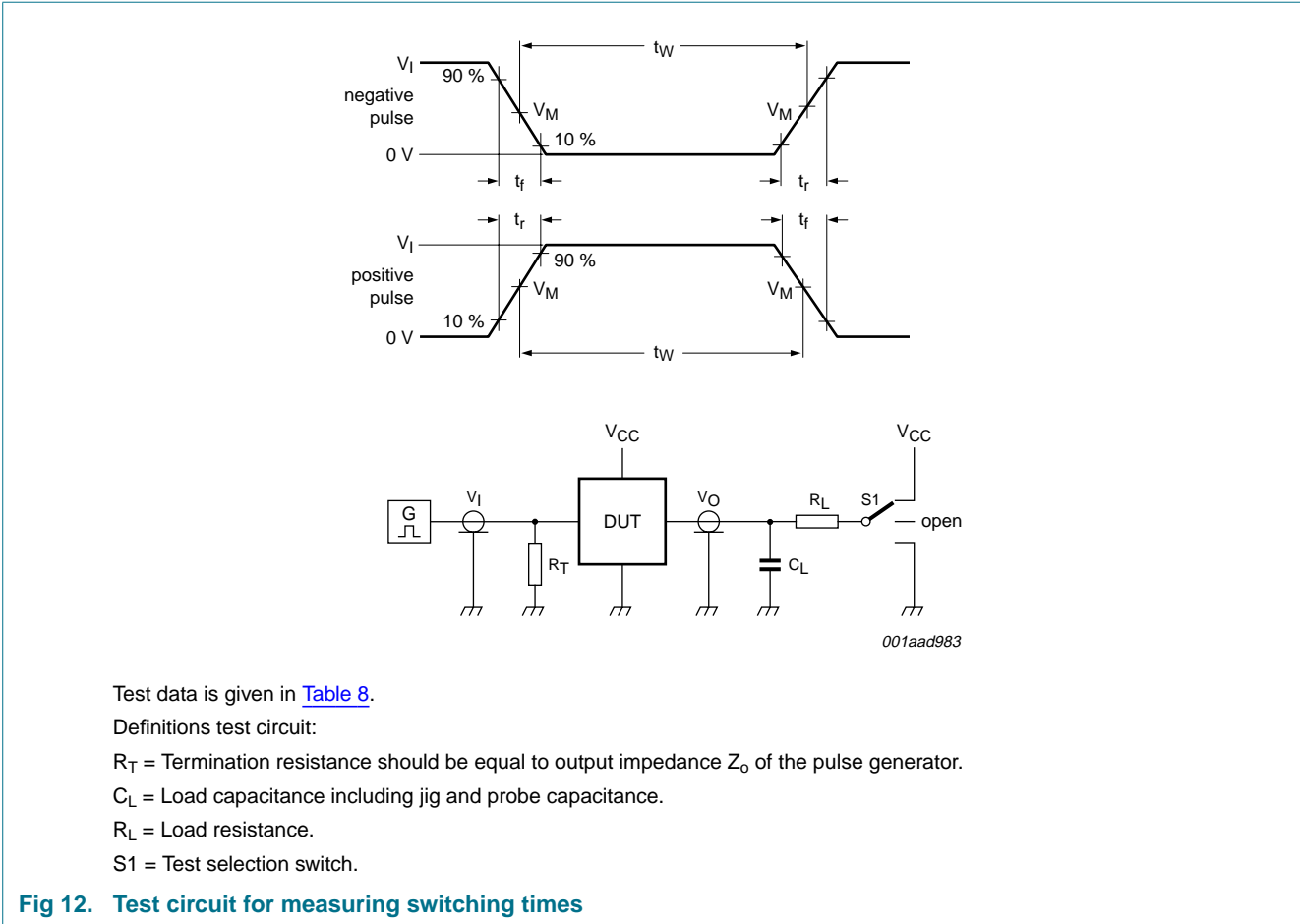
$n\overline{RD} = \text{HIGH}$

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



$n\overline{A} = \text{LOW}$

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



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**

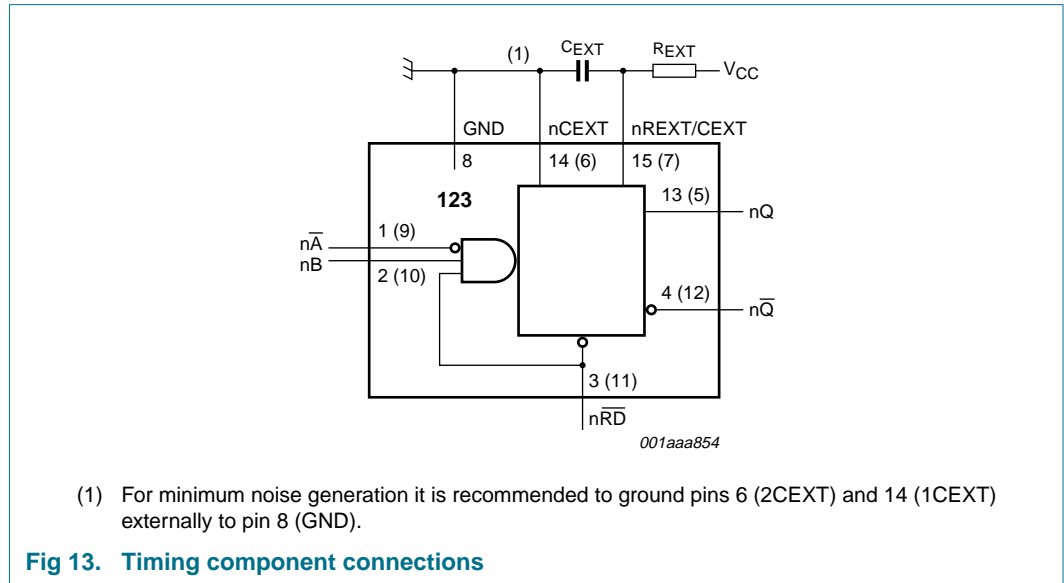
**Table 8. Test data**

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 k $\Omega$	open
74HCT123	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	open

## 12. Application information

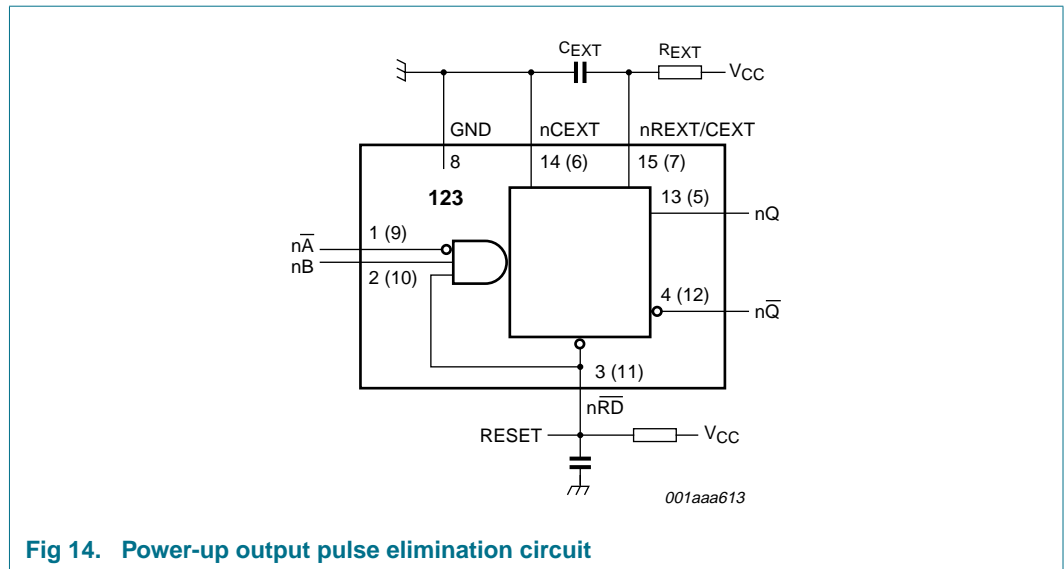
### 12.1 Timing component connections

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



### 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](#).



### 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](#).

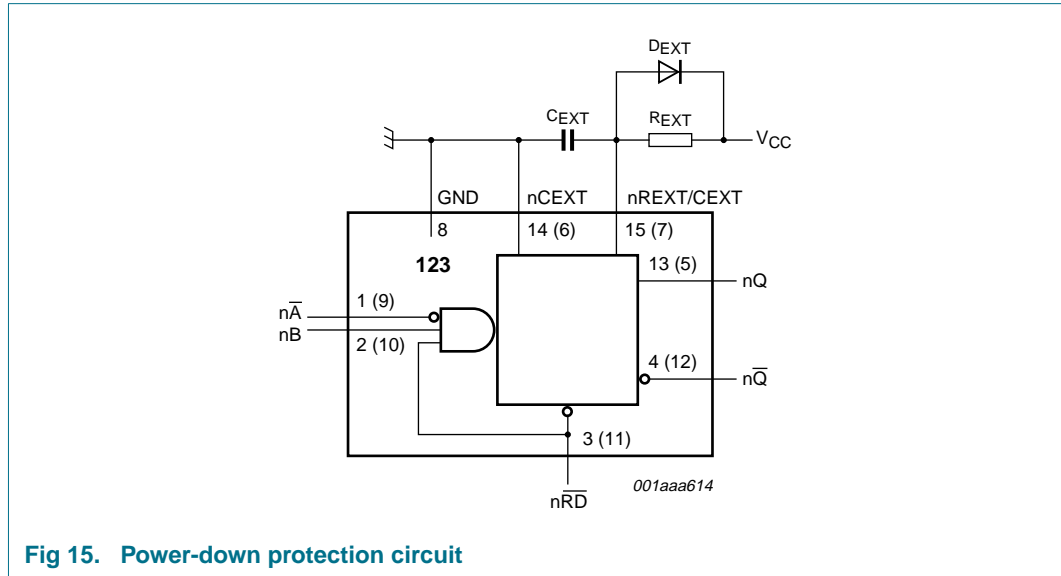


Fig 15. Power-down protection circuit



13. Package outline

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

SOT38-4

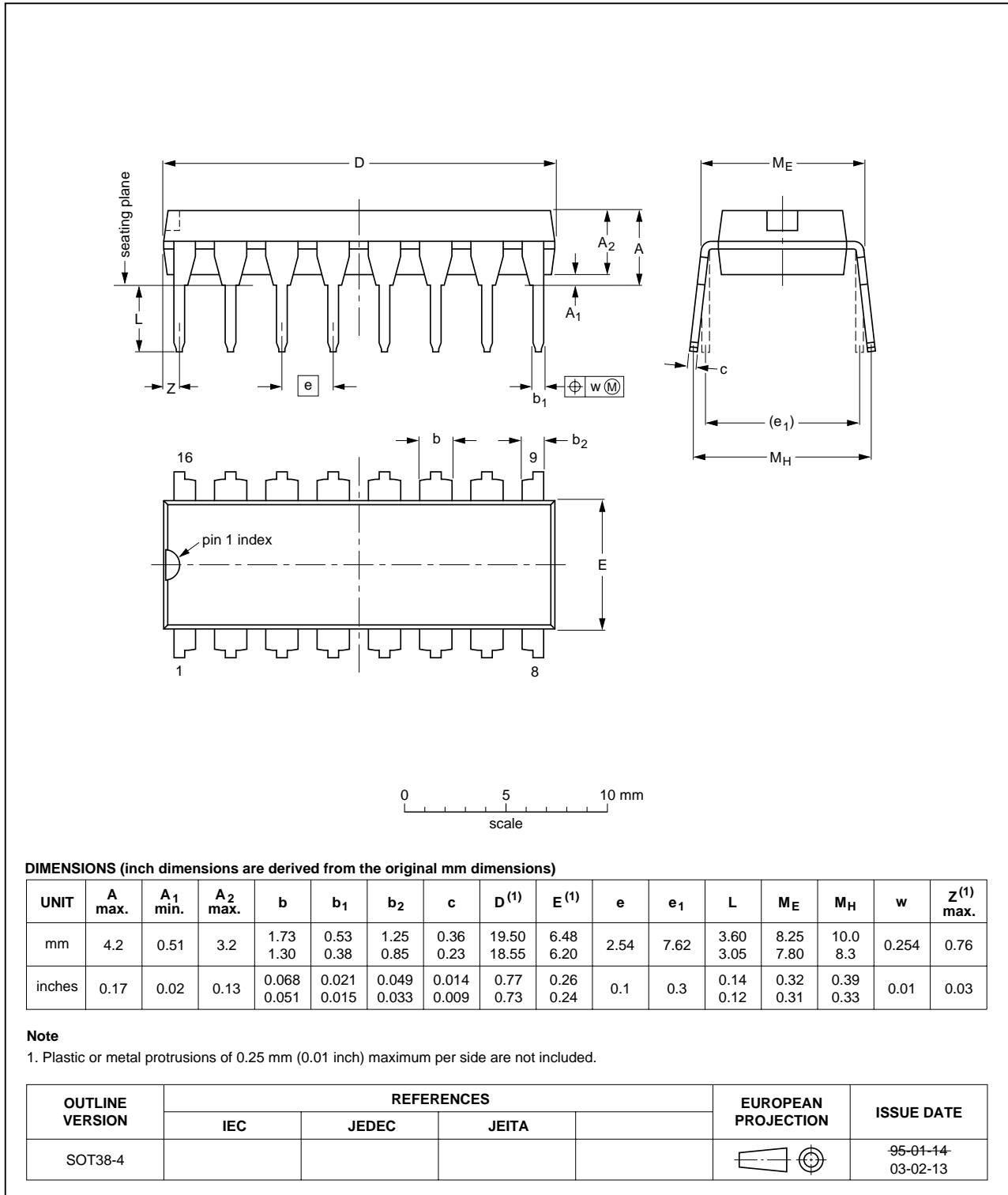


Fig 16. Package outline SOT38-4 (DIP16)

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

SOT109-1

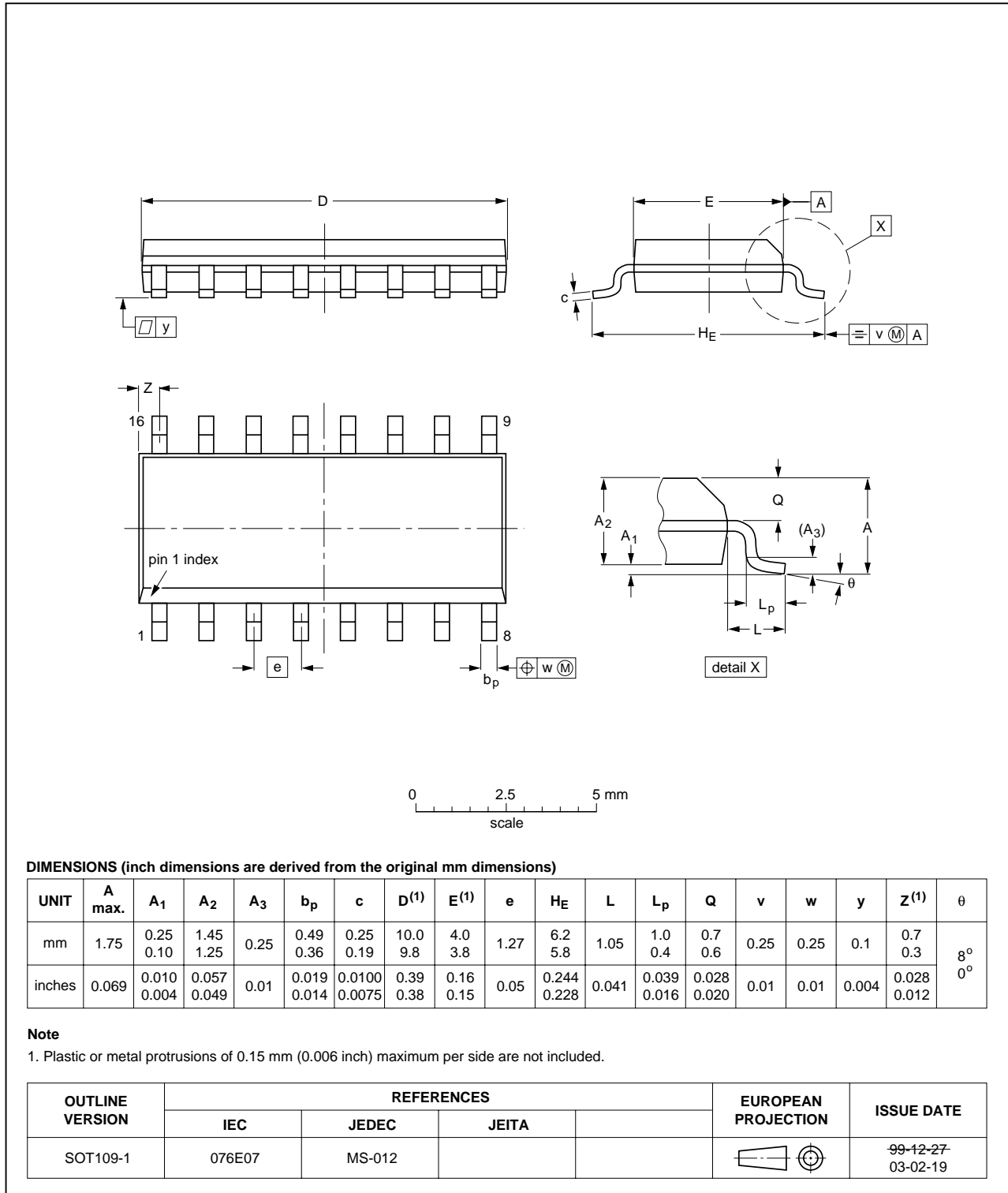


Fig 17. Package outline SOT109-1 (SO16)

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

SOT338-1

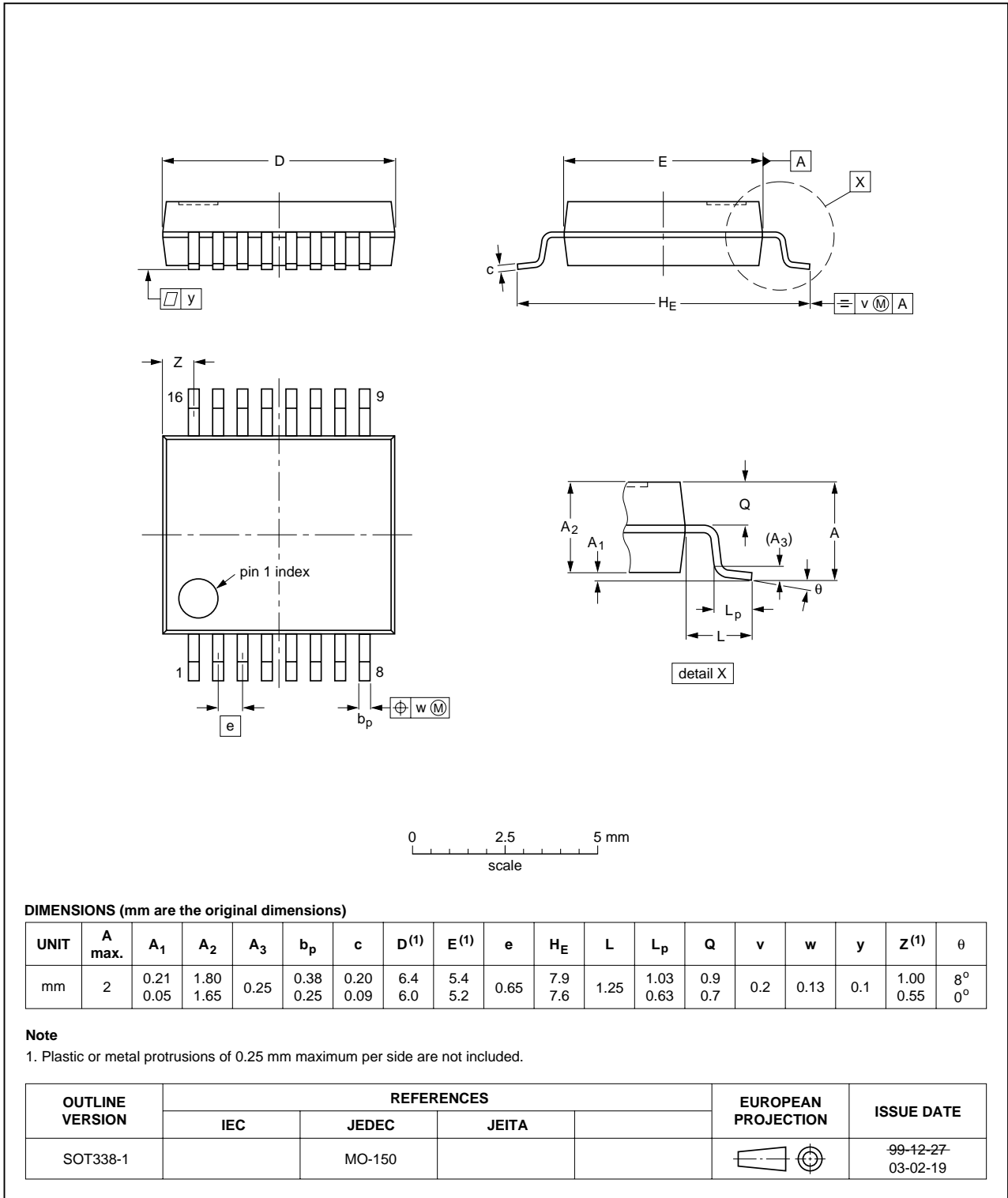


Fig 18. Package outline SOT338-1 (SSOP16)

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

SOT403-1

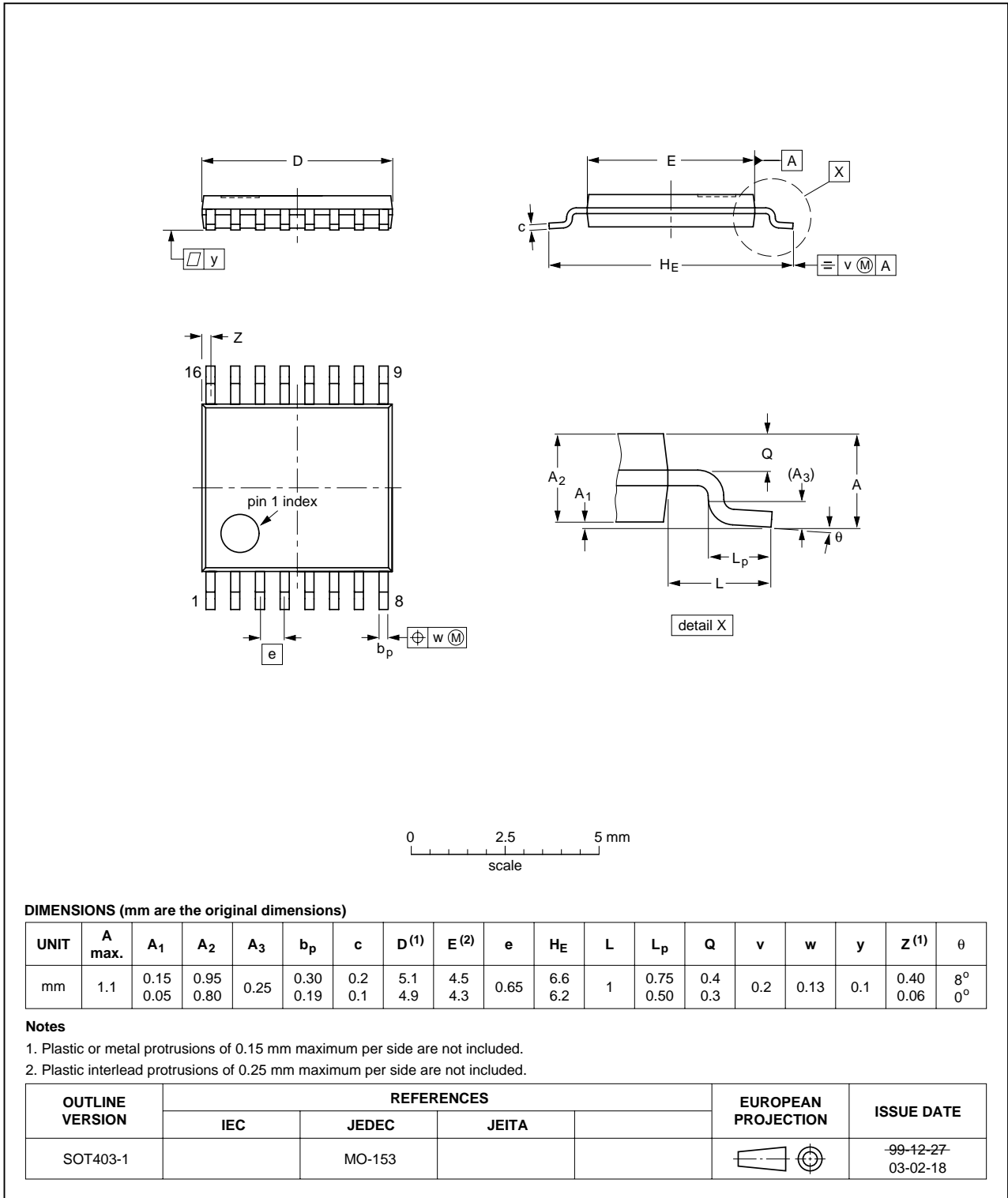


Fig 19. Package outline SOT403-1 (TSSOP16)

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

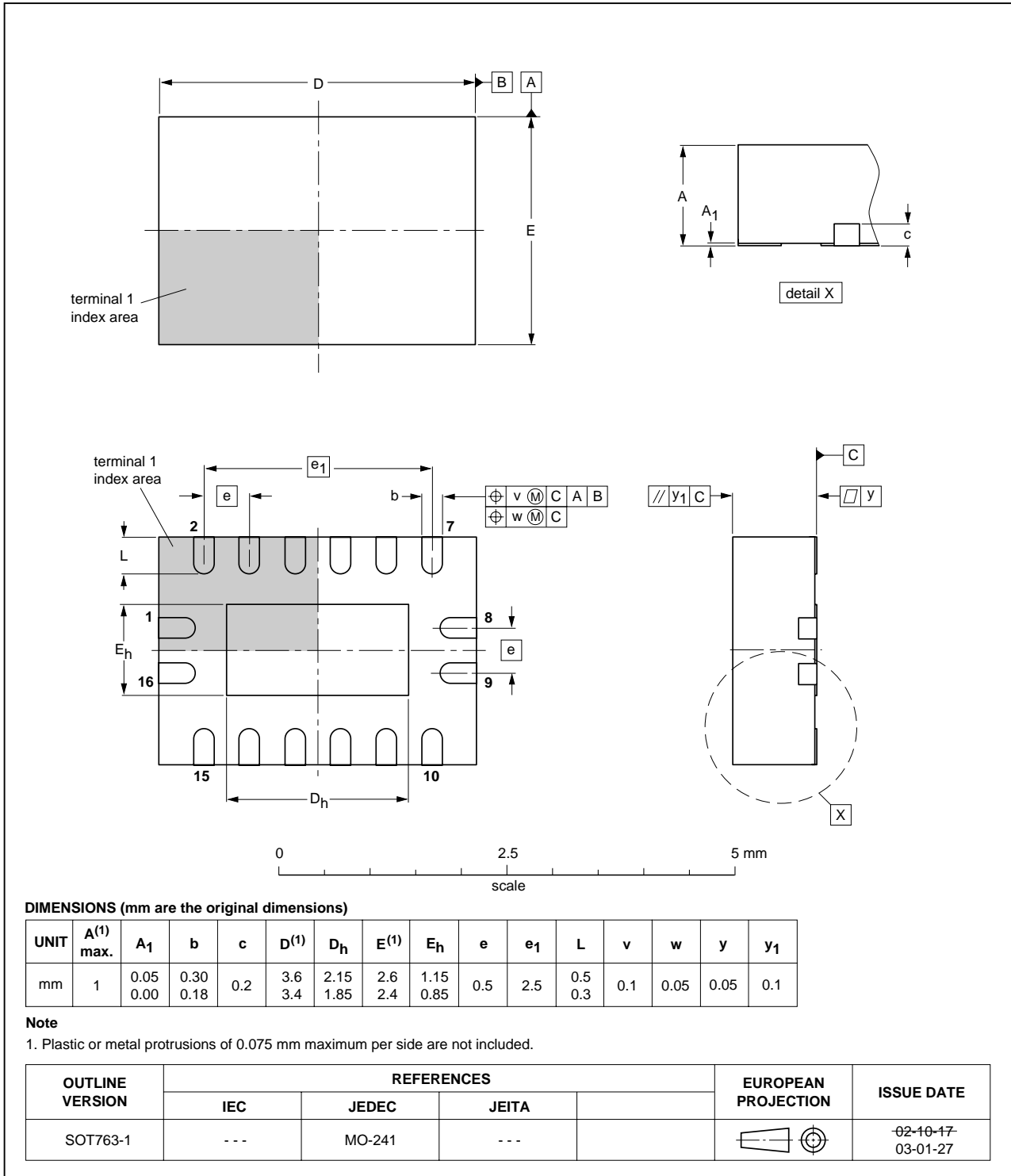


Fig 20. Package outline SOT763-1 (DHVQFN16)

## 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_5	20090713	Product data sheet	-	74HC_HCT123_4
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Section 3 "Ordering information"</a> and <a href="#">Section 13 "Package outline"</a>, package version SOT38-1 changed to SOT38-4</li> </ul>			
74HC_HCT123_4	20060616	Product data sheet	-	74HC_HCT123_3
74HC_HCT123_3	20040511	Product specification	-	74HC_HCT123_CNV_2
74HC_HCT123_CNV_2	19980708	Product specification	-	-

## 16. Legal information

### 16.1 Data sheet status

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

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

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

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

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