

HEF4528B

Dual monostable multivibrator

Rev. 04 — 9 February 2009

Product data sheet

1. General description

The HEF4528B is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has an active LOW input ($n\bar{A}$), and active HIGH input (nB), an active LOW clear direct input ($n\bar{CD}$), an output (nQ) and its complement ($n\bar{Q}$), and two external timing component connecting pins (nC_{EXT} , always connected to ground, and nR_{EXT}/C_{EXT}).

An external timing capacitor (C_{EXT}) must be connected between nC_{EXT} and nR_{EXT}/C_{EXT} and an external resistor (R_{EXT}) must be connected between nR_{EXT}/C_{EXT} and V_{DD} . The output pulse duration is determined by the external timing components C_{EXT} and R_{EXT} . A HIGH-to-LOW transition on $n\bar{A}$ when nB is LOW or a LOW-to-HIGH transition on nB when $n\bar{A}$ is HIGH produces a positive pulse (LOW-HIGH-LOW) on nQ and a negative pulse (HIGH-LOW-HIGH) on $n\bar{Q}$ if the $n\bar{CD}$ is HIGH. A LOW on $n\bar{CD}$ forces nQ LOW, $n\bar{Q}$ HIGH and inhibits any further pulses until $n\bar{CD}$ is HIGH.

It operates over a recommended V_{DD} power supply range of 3 V to 15 V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD} , V_{SS} , or another input. It is also suitable for use over the full industrial ($-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$) temperature range.

2. Features

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Operates across the full industrial temperature range $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V

3. Applications

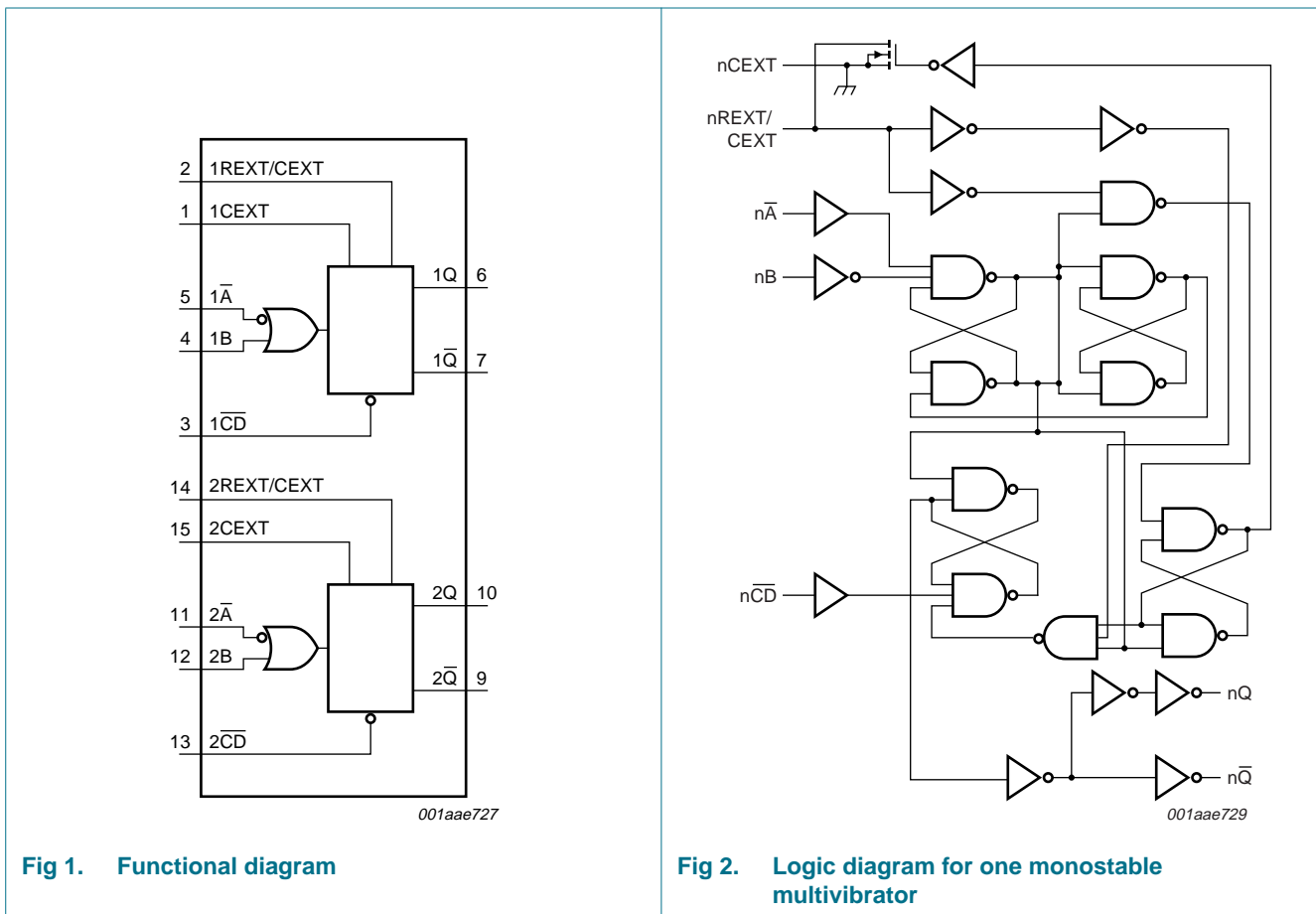
- Industrial

4. Ordering information

Table 1. Ordering information
All types operate from -40 °C to +85 °C

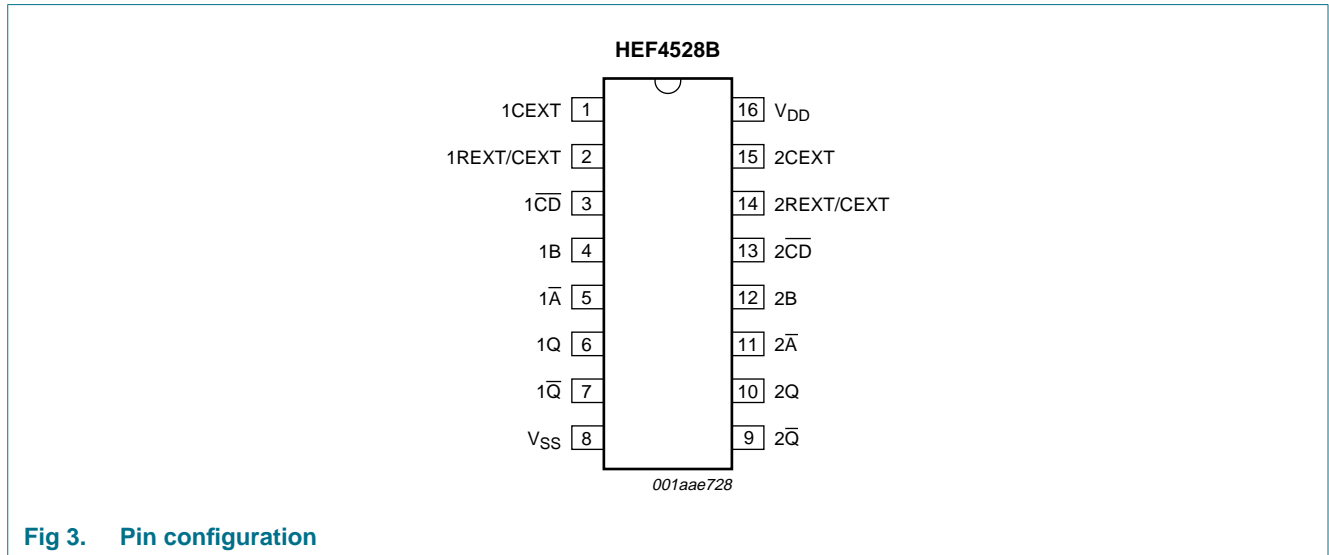
Type number	Package		Version
	Name	Description	
HEF4528BP	DIP16	plastic dual in-line package; 16-leads (300 mil)	SOT38-4
HEF4528BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram



6. Pinning information

6.1 Pinning







6.2 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	clear direct 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)
V _{SS}	8	ground supply voltage
V _{DD}	16	supply voltage


7. Functional description

Table 3. Function table^[1]

Inputs			Outputs	
\bar{A}	B	\bar{CD}	Q	\bar{Q}
↓	L	H		
H	↑	H		
X	X	L	L	H

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

 = one HIGH level output pulse, with the pulse width determined by C_{EXT} and R_{EXT};

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

8. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V _{DD}	supply voltage		-0.5	+18	V
I _{IK}	input clamping current	V _I < 0.5 V or V _I > V _{DD} + 0.5 V	-	±10	mA
V _I	input voltage		-0.5	V _{DD} + 0.5	V
I _{OK}	output clamping current	V _I < 0.5 V or V _I > V _{DD} + 0.5 V		±10	mA
I _{I/O}	input/output current		-	±10	mA
I _{DD}	supply current			50	mA
T _{stg}	storage temperature		-65	+150	°C
T _{amb}	ambient temperature		-40	+85	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +85 °C			
		DIP16 package	[1] -	750	mW
		SO16 package	[2] -	500	mW
P	power dissipation	per output	-	100	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.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{DD}	supply voltage		3	-	15	V
V _I	input voltage		0	-	V _{DD}	V
T _{amb}	ambient temperature	in free air	-40	-	+85	°C

Table 5. Recommended operating conditions ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD} = 5\text{ V}$	-	-	3.75	ns/V
		$V_{DD} = 10\text{ V}$	-	-	0.5	ns/V
		$V_{DD} = 15\text{ V}$	-	-	0.08	ns/V

10. Static characteristics

Table 6. Static characteristics

$V_{SS} = 0\text{ V}$; $V_I = V_{SS}$ or V_{DD} ; unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	$T_{amb} = -40\text{ }^\circ\text{C}$		$T_{amb} = +25\text{ }^\circ\text{C}$		$T_{amb} = +85\text{ }^\circ\text{C}$		Unit
				Min	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	V
V_{IL}	LOW-level input voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	V
V_{OH}	HIGH-level output voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	V
V_{OL}	LOW-level output voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	V
I_{OH}	HIGH-level output current	$V_O = 2.5\text{ V}$	5 V	-1.7	-	-1.4	-	-1.1	-	mA
		$V_O = 4.6\text{ V}$	5 V	-0.52	-	-0.44	-	-0.36	-	mA
		$V_O = 9.5\text{ V}$	10 V	-1.3	-	-1.1	-	-0.9	-	mA
		$V_O = 13.5\text{ V}$	15 V	-3.6	-	-3.0	-	-2.4	-	mA
I_{OL}	LOW-level output current	$V_O = 0.4\text{ V}$	5 V	0.52	-	0.44	-	0.36	-	mA
		$V_O = 0.5\text{ V}$	10 V	1.3	-	1.1	-	0.9	-	mA
		$V_O = 1.5\text{ V}$	15 V	3.6	-	3.0	-	2.4	-	mA
I_I	input leakage current		15 V	-	± 0.3	-	± 0.3	-	± 1.0	μA
I_{DD}	supply current	all valid input combinations; $I_O = 0\text{ A}$	5 V	-	20	-	20	-	150	μA
			10 V	-	40	-	40	-	300	μA
			15 V	-	80	-	80	-	600	μA
C_I	input capacitance		-	-	-	-	7.5	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; for waveforms see [Figure 6](#); for test circuit see [Figure 7](#); unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula ^[1]	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	$n\bar{A}$ or nB to $n\bar{Q}$; see Figure 5	5 V	$113\text{ ns} + (0.55\text{ ns/pF}) C_L$	-	140	280	ns
			10 V	$39\text{ ns} + (0.23\text{ ns/pF}) C_L$	-	50	100	ns
			15 V	$27\text{ ns} + (0.16\text{ ns/pF}) C_L$	-	35	70	ns
		$n\bar{CD}$ to $n\bar{Q}$; see Figure 5	5 V	$78\text{ ns} + (0.55\text{ ns/pF}) C_L$	-	105	210	ns
			10 V	$29\text{ ns} + (0.23\text{ ns/pF}) C_L$	-	40	85	ns
			15 V	$22\text{ ns} + (0.16\text{ ns/pF}) C_L$	-	30	60	ns
t_{PLH}	LOW to HIGH propagation delay	$n\bar{A}$ or nB to $n\bar{Q}$; see Figure 5	5 V	$128\text{ ns} + (0.55\text{ ns/pF}) C_L$	-	155	305	ns
			10 V	$49\text{ ns} + (0.23\text{ ns/pF}) C_L$	-	60	115	ns
			15 V	$32\text{ ns} + (0.16\text{ ns/pF}) C_L$	-	40	80	ns
		$n\bar{CD}$ to $n\bar{Q}$; see Figure 5	5 V	$93\text{ ns} + (0.55\text{ ns/pF}) C_L$	-	120	240	ns
			10 V	$39\text{ ns} + (0.23\text{ ns/pF}) C_L$	-	50	105	ns
			15 V	$27\text{ ns} + (0.16\text{ ns/pF}) C_L$	-	35	70	ns
t_t	transition time	$n\bar{Q}$, $n\bar{Q}$; see Figure 6	5 V ^[2]	$10\text{ ns} + (1.00\text{ ns/pF}) C_L$	-	60	120	ns
			10 V	$9\text{ ns} + (0.42\text{ ns/pF}) C_L$	-	30	60	ns
			15 V	$6\text{ ns} + (0.28\text{ ns/pF}) C_L$	-	20	40	ns
t_{rec}	recovery time	$n\bar{CD}$ to $n\bar{A}$ or nB ; see Figure 6	5 V		0	-75	-	ns
			10 V		0	-30	-	ns
			15 V		0	-25	-	ns
t_{su}	set-up time	$n\bar{CD}$ to $n\bar{A}$ or nB ; see Figure 6	5 V		0	-105	-	ns
			10 V		0	-40	-	ns
			15 V		0	-25	-	ns
t_W	pulse width	$n\bar{A}$ LOW; minimum width; see Figure 6	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		nB HIGH; minimum width; see Figure 6	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		$n\bar{CD}$ LOW; minimum width; see Figure 6	5 V		60	30	-	ns
			10 V		35	15	-	ns
			15 V		25	10	-	ns
		$n\bar{Q}$ or $n\bar{Q}$; $R_{EXT} = 5\text{ k}\Omega$; $C_{EXT} = 15\text{ pF}$; see Figure 6	5 V ^[3]		-	235	-	ns
			10 V		-	155	-	ns
			15 V		-	140	-	ns
$n\bar{Q}$ or $n\bar{Q}$; $R_{EXT} = 10\text{ k}\Omega$; $C_{EXT} = 1000\text{ pF}$; see Figure 6	5 V ^[4]		-	5.45	-	μs		
	10 V		-	4.95	-	μs		
	15 V		-	4.85	-	μs		

Table 7. Dynamic characteristics ...continued

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; for waveforms see [Figure 6](#); for test circuit see [Figure 7](#); unless otherwise specified.

Symbol	Parameter	Conditions	V _{DD}	Extrapolation formula ^[1]	Min	Typ	Max	Unit
Δt_W	pulse width change	nQ output variation over temperature range; see Figure 4	5 V	[5]	-	±3	-	%
			10 V		-	±2	-	%
			15 V		-	±2	-	%
		nQ output variation over voltage range $V_{DD} \pm 5\%$; see Figure 4	5 V		-	±2	-	%
			10 V		-	±1	-	%
			15 V		-	±1	-	%
R_{EXT}	external timing resistor	see Figure 4	5 V		5	-	2000	kΩ
			10 V		5	-	2000	kΩ
			15 V		5	-	2000	kΩ
C_{EXT}	external timing capacitor	see Figure 4	5 V		no limits			
			10 V		no limits			
			15 V		no limits			

[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown (C_L in pF).

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

[3] For other R_{EXT} , C_{EXT} combinations and $C_{EXT} < 0.01\text{ }\mu\text{F}$ see [Figure 4](#).

[4] For other R_{EXT} , C_{EXT} combinations and $C_{EXT} > 0.01\text{ }\mu\text{F}$ use formula $t_W = K \times R_{EXT} \times C_{EXT}$.

where: t_W = output pulse width (s);

R_{EXT} = external timing resistor (Ω);

C_{EXT} = external timing capacitor (F);

$K = 0.42$ for $V_{DD} = 5\text{ V}$;

$K = 0.32$ for $V_{DD} = 10\text{ V}$;

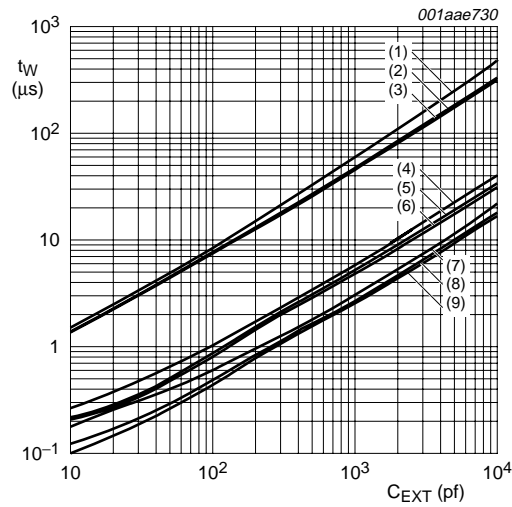
$K = 0.30$ for $V_{DD} = 15\text{ V}$.

[5] $T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$; Δt_W is referenced to t_W at $T_{amb} = 25\text{ °C}$.

Table 8. Dynamic power dissipation P_D

P_D can be calculated from the formulas shown. $V_{SS} = 0\text{ V}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ °C}$.

Symbol	Parameter	V _{DD}	Typical formula for P_D (μW)	where:
P_D	dynamic power dissipation	5 V	$P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz;
		10 V	$P_D = 20000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_o = output frequency in MHz;
		15 V	$P_D = 59000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	C_L = output load capacitance in pF;
				V_{DD} = supply voltage in V;
				$\Sigma(C_L \times f_o)$ = sum of the outputs.



- (1) $R_{EXT} = 100\text{ k}\Omega$, $V_{DD} = 5\text{ V}$.
- (2) $R_{EXT} = 100\text{ k}\Omega$, $V_{DD} = 10\text{ V}$.
- (3) $R_{EXT} = 100\text{ k}\Omega$, $V_{DD} = 15\text{ V}$.
- (4) $R_{EXT} = 10\text{ k}\Omega$, $V_{DD} = 5\text{ V}$.
- (5) $R_{EXT} = 10\text{ k}\Omega$, $V_{DD} = 10\text{ V}$.
- (6) $R_{EXT} = 10\text{ k}\Omega$, $V_{DD} = 15\text{ V}$.
- (7) $R_{EXT} = 5\text{ k}\Omega$, $V_{DD} = 5\text{ V}$.
- (8) $R_{EXT} = 5\text{ k}\Omega$, $V_{DD} = 10\text{ V}$.
- (9) $R_{EXT} = 5\text{ k}\Omega$, $V_{DD} = 15\text{ V}$.

Fig 4. Output pulse width (t_W) as a function of external timing capacitor (C_{EXT})

12. Waveforms

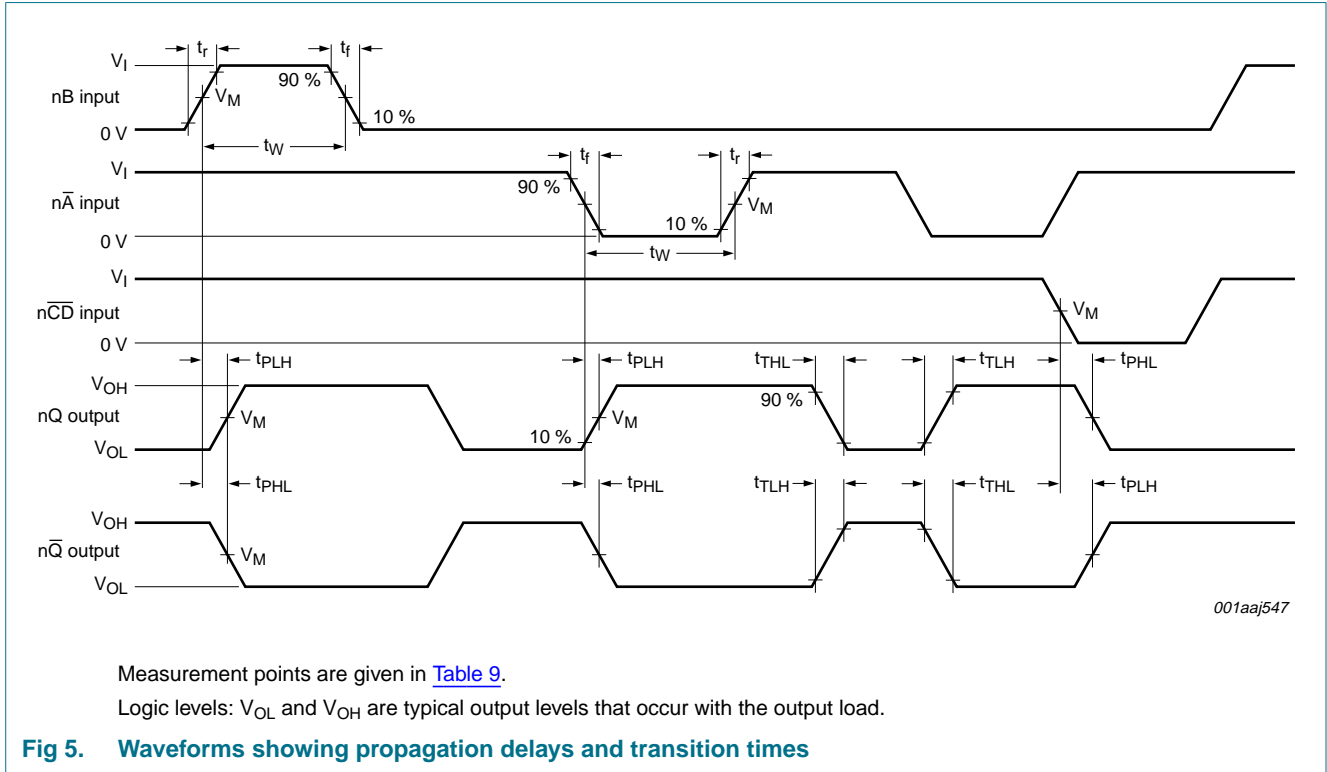
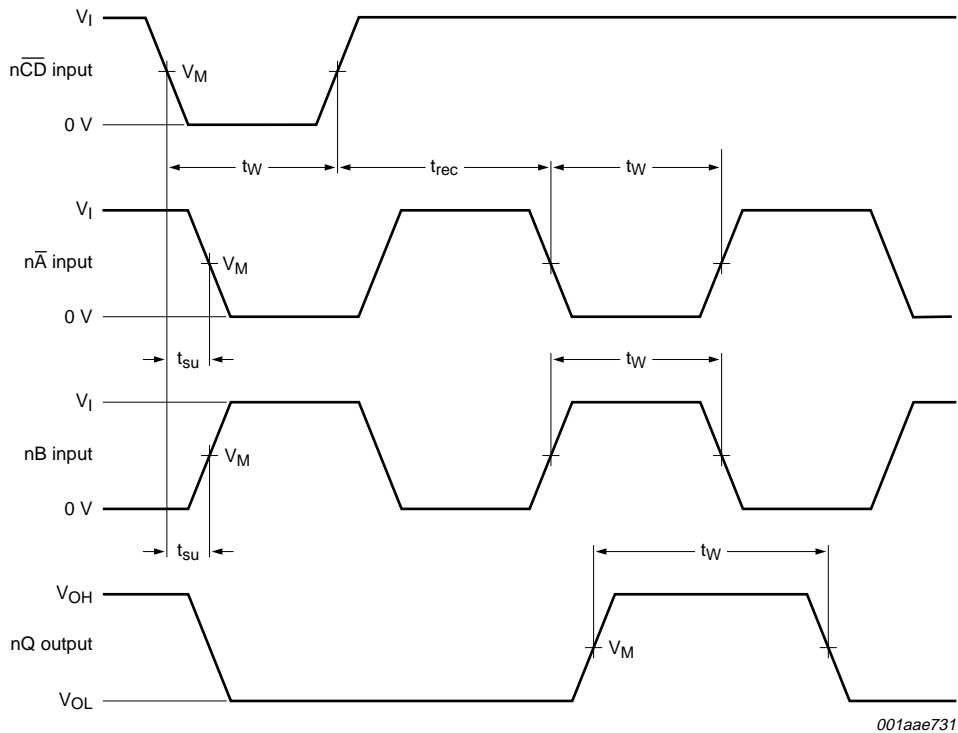


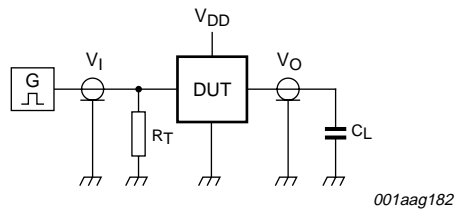
Table 9. Measurement points

Supply voltage	Input	Output
V_{DD}	V_M	V_M
5 V to 15 V	$0.5V_{DD}$	$0.5V_{DD}$



Measurement points are given in [Table 9](#).
 Set-up and recovery times are shown as positive values but may be specified as negative values.
 Logic levels: V_{OL} and V_{OH} are typical output levels that occur with the output load.

Fig 6. Waveforms showing minimum $n\overline{A}$, nB , and nQ pulse widths and set-up and recovery times



Test data is given in [Table 10](#).
 Definitions for test circuit:
 DUT = Device Under Test.
 C_L = load capacitance including jig and probe capacitance.
 R_T = termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig 7. Test circuit

Table 10. Test data

Supply voltage	Input	Load
V_{DD}	V_I	C_L
5 V to 15 V	V_{SS} or V_{DD}	50 pF
		t_r, t_f
		≤ 20 ns

13. Application information

An example of an application for the HEF4528B is:

- Non-retriggerable monostable multivibrator

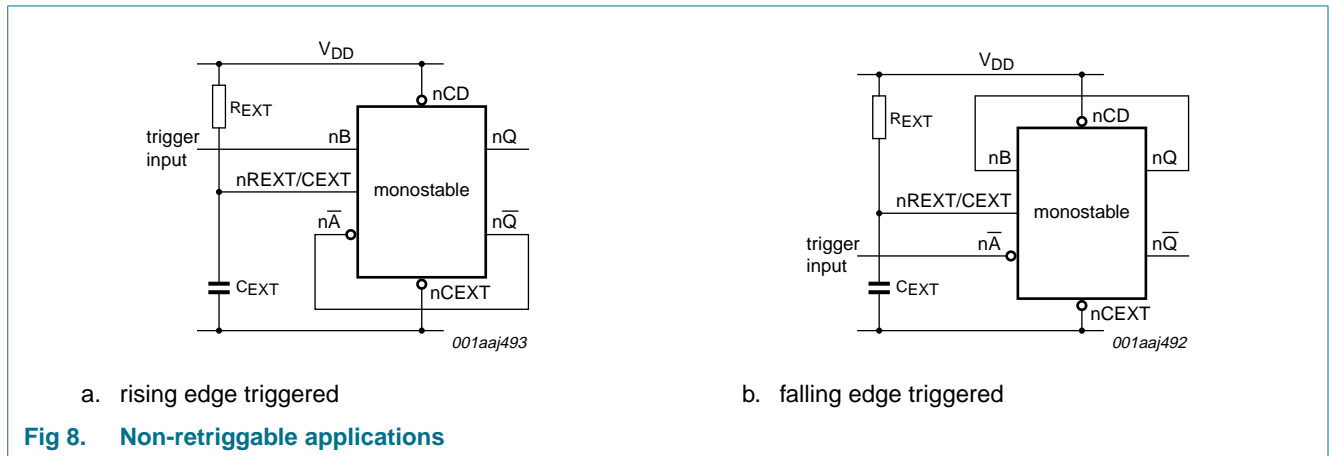


Fig 8. Non-retriggerable applications

14. Package outline

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

SOT38-4

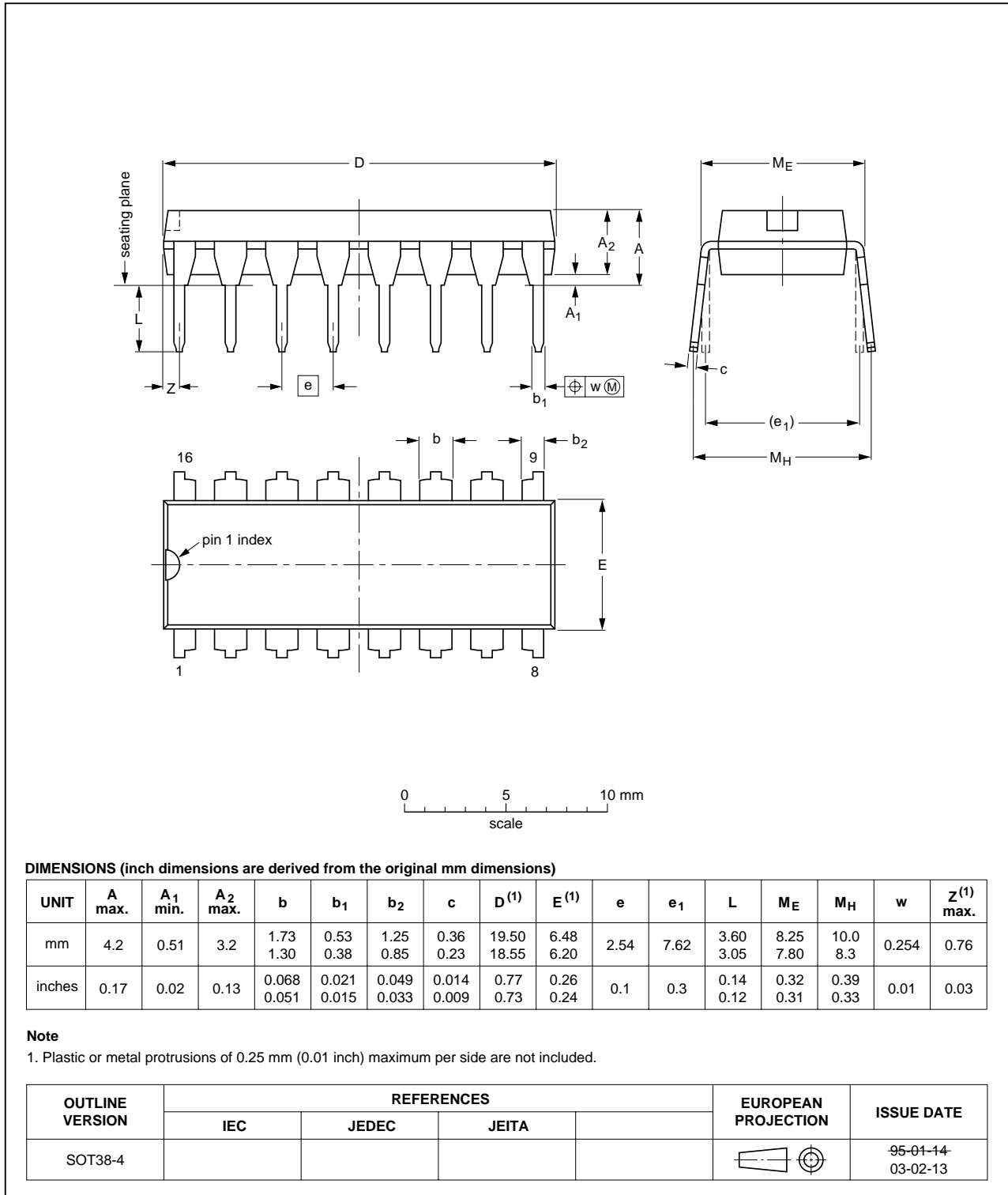


Fig 9. Package outline SOT38-4 (DIP16)

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

SOT109-1

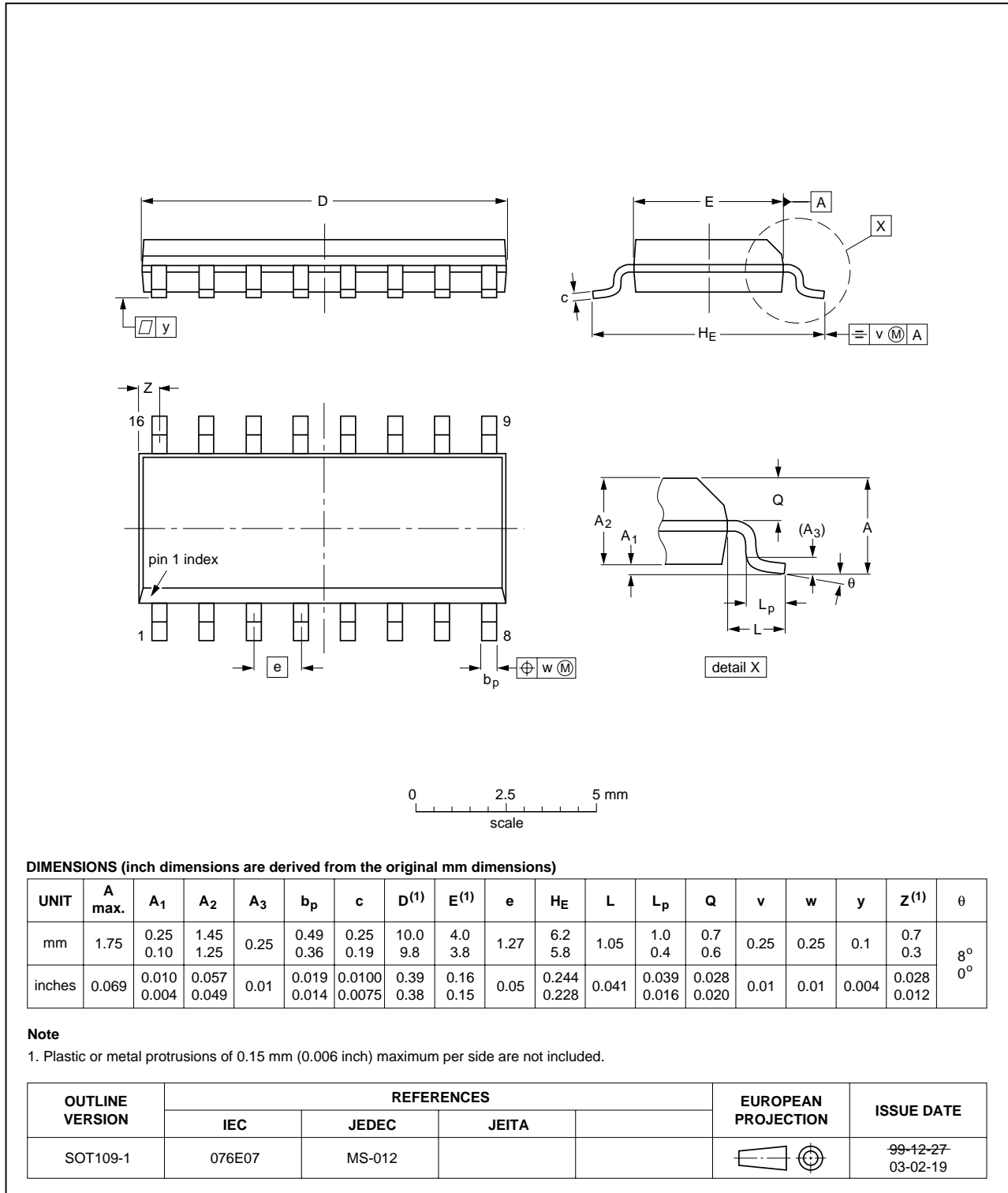


Fig 10. Package outline SOT109-1 (SO16)

15. Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4528B_4	20090209	Product data sheet	-	HEF4528B_CNV_3
Modifications:	<ul style="list-style-type: none"> • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Pin names changed throughout. • Section 2 “Features” added. • Section 3 “Applications” added. • Package version SOT38-1 changed to SOT38-4 in Section 4 and Figure 9. Package SOT74 removed from Section 4. • Table 1 “Ordering information” restructured. • Section 8 “Limiting values” and Section 10 “Static characteristics” added, taken from the HE4000B Family Specifications data sheet. • Table 5 “Recommended operating conditions” added. • Table 7 “Dynamic characteristics” restructured. • Figure 7 “Test circuit” added. • Section 15 “Abbreviations” added. 			
HEF4528B_CNV_3	19950101	Product specification	-	HEF4528B_CNV_2
HEF4528B_CNV_2	19950101	Product specification	-	-

17. Legal information

17.1 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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