

# HEF4528B

## Dual monostable multivibrator

Rev. 10 — 14 March 2017

Product data sheet

## 1 General description

The HEF4528B is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has an active LOW input ( $n\bar{A}$ ), an 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 ( $nCEXT$ , always connected to ground, and  $nREXT/CEXT$ ).

An external timing capacitor ( $C_{EXT}$ ) must be connected between  $nCEXT$  and  $nREXT/CEXT$  and an external resistor ( $R_{EXT}$ ) must be connected between  $nREXT/CEXT$  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.

## 2 Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from -40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

## 3 Ordering information

Table 1. Ordering information

All types operate from -40 °C to +85 °C.

Type number	Package		
	Name	Description	Version
HEF4528BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

### 4 Functional diagram

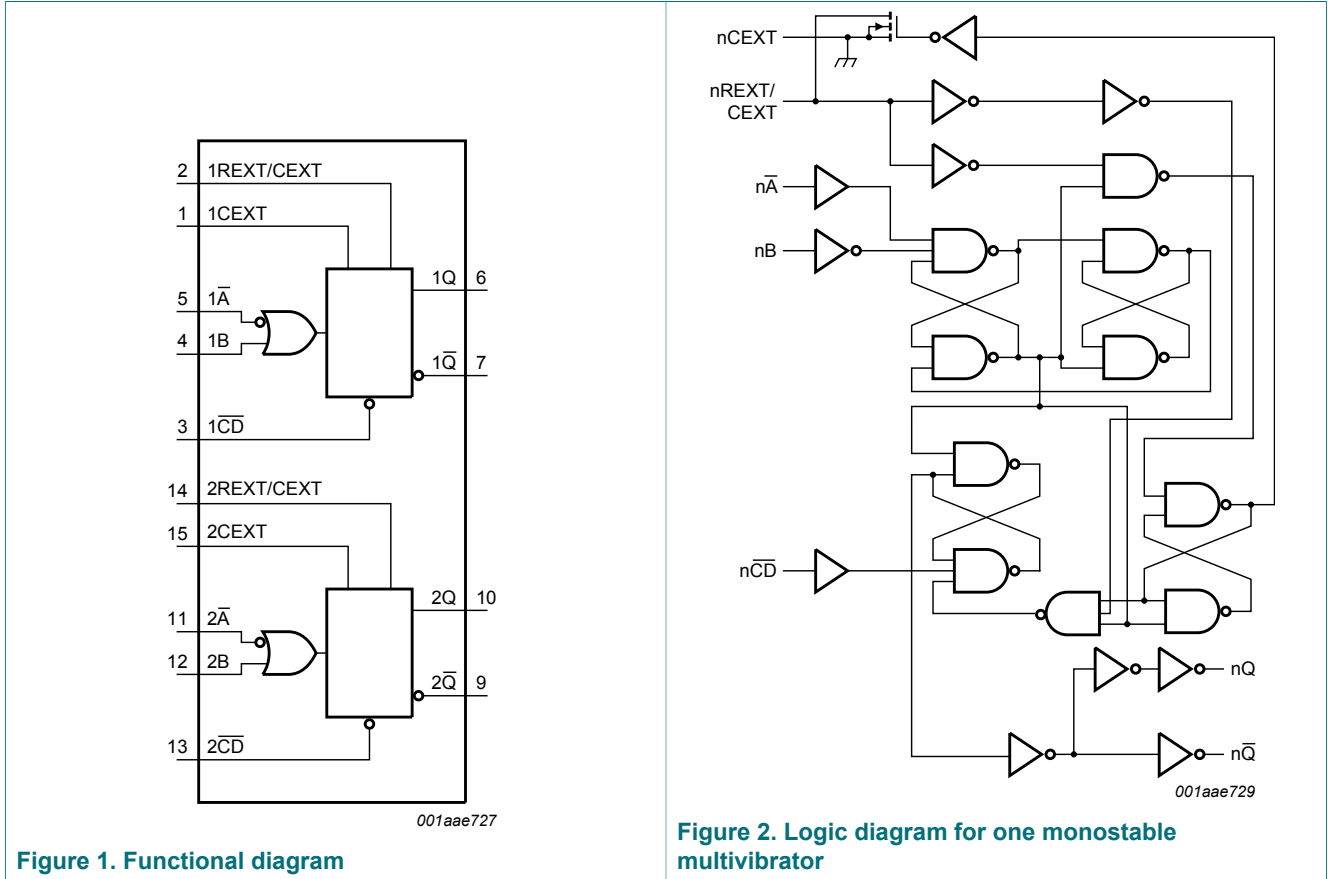


Figure 1. Functional diagram

Figure 2. Logic diagram for one monostable multivibrator

### 5 Pinning information

#### 5.1 Pinning

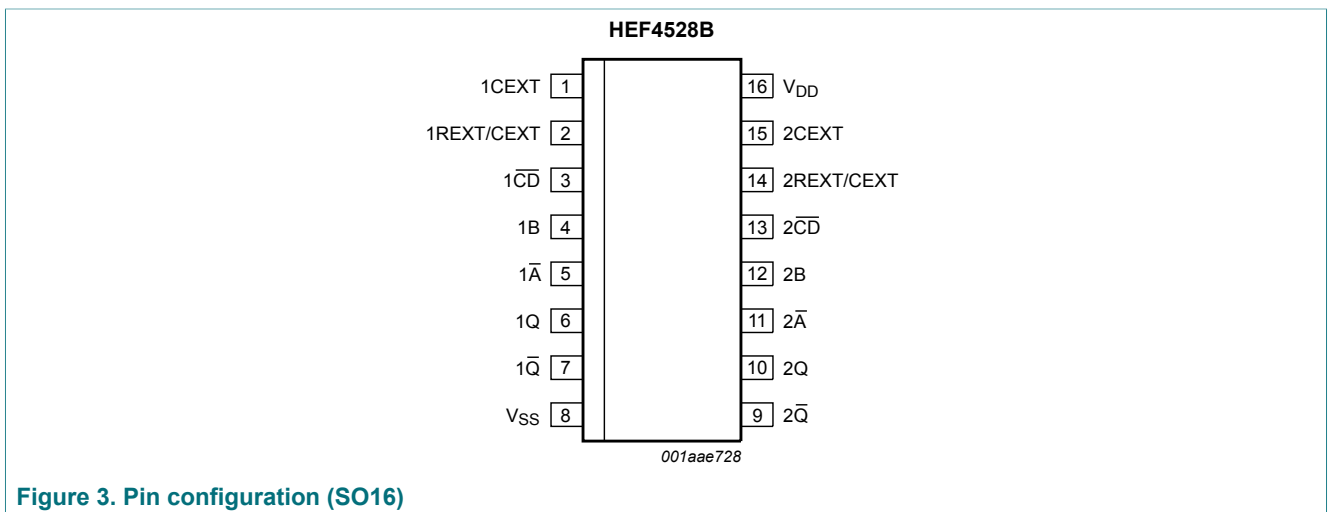


Figure 3. Pin configuration (SO16)





## 5.2 Pin description

Table 2. Pin description


Symbol	Pin	Description
1CEXT, 2CEXT	1, 15	external capacitor connection (always connected to ground)
1REXT/CEXT, 2REXT/CEXT	2, 14	external capacitor/resistor connection
1 $\overline{CD}$ , 2 $\overline{CD}$	3, 13	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 <sub>SS</sub>	8	ground supply voltage
V <sub>DD</sub>	16	supply voltage


## 6 Functional description

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

Inputs			Outputs	
A	B	$\overline{CD}$	Q	$\overline{Q}$
↓	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 pulse width determined by C<sub>EXT</sub> and R<sub>EXT</sub>;

 = one LOW level output pulse, with the pulse width determined by C<sub>EXT</sub> and R<sub>EXT</sub>.

## 7 Limiting values

**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DD}$	supply voltage		-0.5	+18	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{DD} + 0.5\text{ V}$	-	$\pm 10$	mA
$V_I$	input voltage		-0.5	$V_{DD} + 0.5$	V
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{DD} + 0.5\text{ V}$	-	$\pm 10$	mA
$I_{I/O}$	input/output current		-	$\pm 10$	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	$T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$			
		SO16 package [1]	-	500	mW
$P$	power dissipation	per output	-	100	mW

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

## 8 Recommended operating conditions

**Table 5. Recommended operating conditions**

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

## 9 Static characteristics

**Table 6. Static characteristics**
 $V_{SS} = 0\text{ V}$ ;  $V_I = V_{SS}$  or  $V_{DD}$  unless otherwise specified.

Symbol	Parameter	Conditions	$V_{DD}$	$T_{amb} = -40\text{ °C}$		$T_{amb} = 25\text{ °C}$		$T_{amb} = 85\text{ °C}$		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	-	$\pm 0.3$	-	$\pm 0.3$	-	$\pm 1.0$	$\mu\text{A}$
$I_{DD}$	supply current	all valid input combinations; $I_O = 0\text{ A}$	5 V	-	20	-	20	-	150	$\mu\text{A}$
			10 V	-	40	-	40	-	300	$\mu\text{A}$
			15 V	-	80	-	80	-	600	$\mu\text{A}$
$C_I$	input capacitance		-	-	-	-	7.5	-	-	pF

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

$V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; unless otherwise specified; for waveforms see [Figure 4](#) to [Figure 6](#); for test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	$V_{DD}$	Extrapolation formula <sup>[1]</sup>	Min	Typ	Max	Unit
$t_{PHL}$	HIGH to LOW propagation delay	$n\bar{A}$ or $nB$ to $n\bar{Q}$ ; see <a href="#">Figure 5</a>	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
		$n\bar{C}\bar{D}$ to $nQ$ ; see <a href="#">Figure 5</a>	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 $nQ$ ; see <a href="#">Figure 5</a>	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
		$n\bar{C}\bar{D}$ to $n\bar{Q}$ ; see <a href="#">Figure 5</a>	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	$nQ$ , $n\bar{Q}$ ; see <a href="#">Figure 5</a>	5 V <sup>[2]</sup>	$10\text{ ns} + (1.00\text{ ns/pF})C_L$	-	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	$n\bar{C}\bar{D}$ to $n\bar{A}$ or $nB$ ; see <a href="#">Figure 6</a>	5 V		0	-75	-	ns
			10 V		0	-30	-	ns
			15 V		0	-25	-	ns
$t_{su}$	set-up time	$n\bar{C}\bar{D}$ to $n\bar{A}$ or $nB$ ; see <a href="#">Figure 6</a>	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 <a href="#">Figure 6</a>	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		$nB$ HIGH; minimum width; see <a href="#">Figure 6</a>	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		$n\bar{C}\bar{D}$ LOW; minimum width; see <a href="#">Figure 6</a>	5 V		60	30	-	ns
			10 V		35	15	-	ns
			15 V		25	10	-	ns
		$nQ$ or $n\bar{Q}$ ; $R_{EXT} = 5\text{ k}\Omega$ ; $C_{EXT} = 15\text{ pF}$ ; see <a href="#">Figure 6</a>	5 V <sup>[3]</sup>		-	235	-	ns
			10 V		-	155	-	ns
			15 V		-	140	-	ns

Symbol	Parameter	Conditions	V <sub>DD</sub>	Extrapolation formula <sup>[1]</sup>	Min	Typ	Max	Unit
		nQ or nQ̄; R <sub>EXT</sub> = 10 kΩ; C <sub>EXT</sub> = 1 nF; see <a href="#">Figure 6</a>	5 V <sup>[4]</sup>		-	5.45	-	μs
			10 V		-	4.95	-	μs
			15 V		-	4.85	-	μs
Δt <sub>W</sub>	pulse width variation	nQ output variation over temperature range	5 V <sup>[5]</sup>		-	±3	-	%
			10 V		-	±2	-	%
			15 V		-	±2	-	%
		nQ output variation over voltage range V <sub>DD</sub> ± 5 %	5 V		-	±2	-	%
			10 V		-	±1	-	%
			15 V		-	±1	-	%
R <sub>EXT</sub>	external timing resistor	see <a href="#">Figure 4</a>	5 V		5	-	2	MΩ
			10 V		5	-	2	MΩ
			15 V		5	-	2	MΩ
C <sub>EXT</sub>	external timing capacitor	see <a href="#">Figure 4</a>	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<sub>L</sub> in pF).

[2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[3] For other R<sub>EXT</sub>, C<sub>EXT</sub> combinations and C<sub>EXT</sub> < 0.01 μF see [Figure 4](#).

[4] For other R<sub>EXT</sub>, C<sub>EXT</sub> combinations and C<sub>EXT</sub> > 0.01 μF use formula t<sub>W</sub> = K × R<sub>EXT</sub> × C<sub>EXT</sub>.

where: t<sub>W</sub> = output pulse width (s);

R<sub>EXT</sub> = external timing resistor (Ω);

C<sub>EXT</sub> = external timing capacitor (F);

K = 0.42 for V<sub>DD</sub> = 5 V;

K = 0.32 for V<sub>DD</sub> = 10 V;

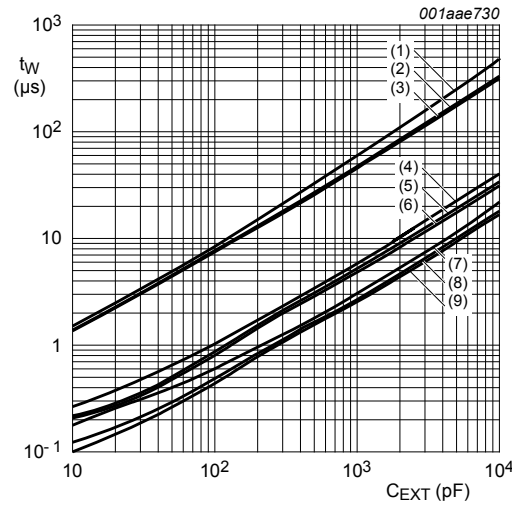
K = 0.30 for V<sub>DD</sub> = 15 V.

[5] T<sub>amb</sub> = -40 °C to +85 °C; Δt<sub>W</sub> is referenced to t<sub>W</sub> at T<sub>amb</sub> = 25 °C.

**Table 8. Dynamic power dissipation P<sub>D</sub>**

P<sub>D</sub> can be calculated from the formulas shown. V<sub>SS</sub> = 0 V; t<sub>r</sub> = t<sub>f</sub> ≤ 20 ns; T<sub>amb</sub> = 25 °C.

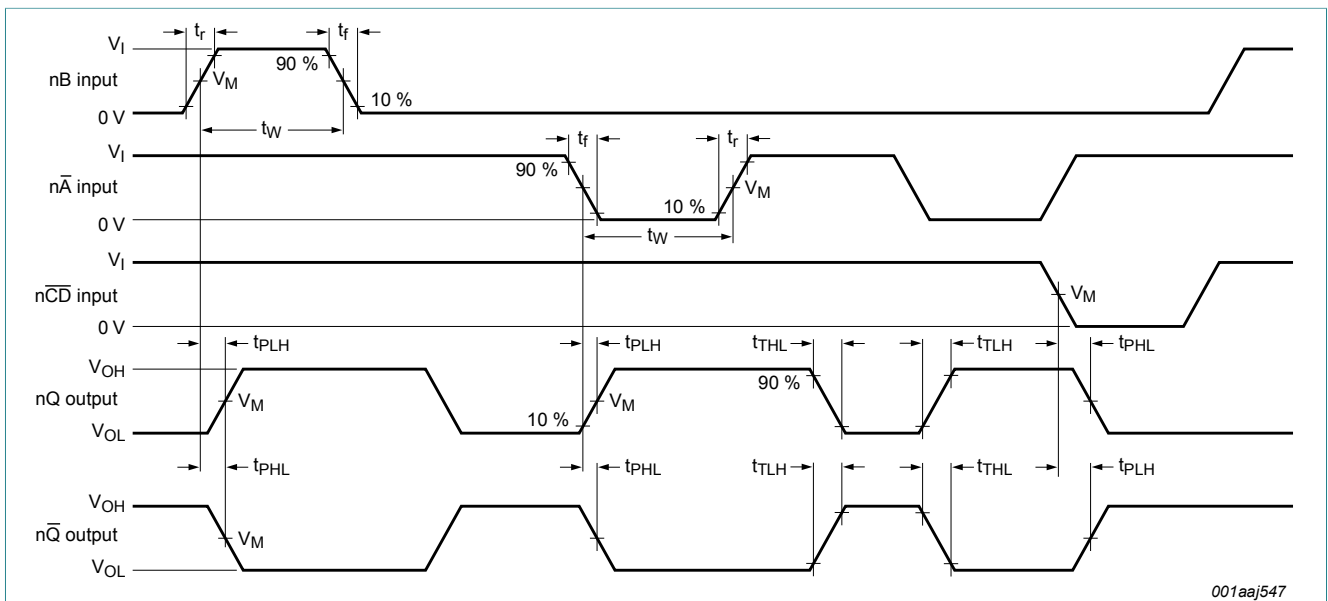
Symbol	Parameter	V <sub>DD</sub>	Typical formula for P <sub>D</sub> (μW)	where:
P <sub>D</sub>	dynamic power dissipation	5 V	$P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f <sub>i</sub> = input frequency in MHz; f <sub>o</sub> = output frequency in MHz; C <sub>L</sub> = output load capacitance in pF; V <sub>DD</sub> = supply voltage in V; Σ(f <sub>o</sub> × C <sub>L</sub> ) = sum of the outputs.
		10 V	$P_D = 20000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 59000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	



- (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)  $R_{EXT} = 5\text{ k}\Omega$ ,  $V_{DD} = 15\text{ V}$ .

Figure 4. Output pulse width ( $t_w$ ) as a function of external timing capacitor ( $C_{EXT}$ )

### 10.1 Waveforms and test circuit

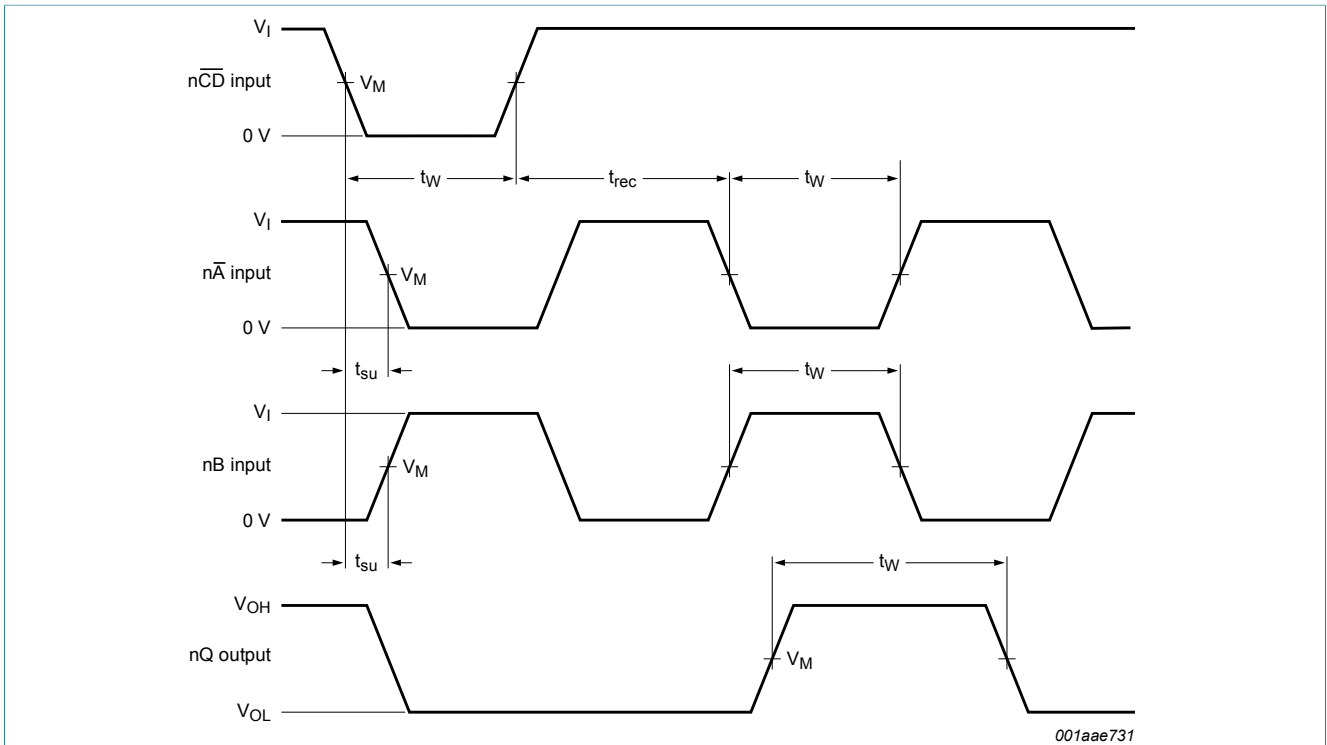


Measurement points are given in [Table 9](#).

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

Figure 5. Waveforms showing propagation delays and transition times





Measurement points are given in [Table 9](#).

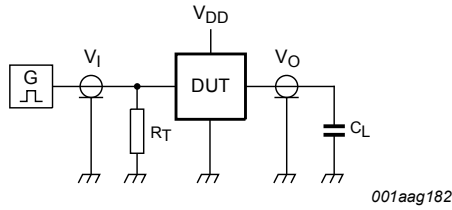
Set-up and recovery times are shown as positive values but may be specified as negative values.

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

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

**Table 9. Measurement points**

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



Test data is given in [Table 10](#).

Definitions for test circuit:

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

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

**Figure 7. Test circuit for measuring switching times**

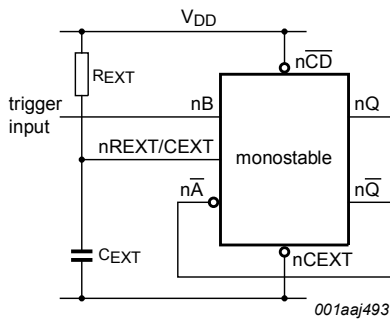
**Table 10. Test data**

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

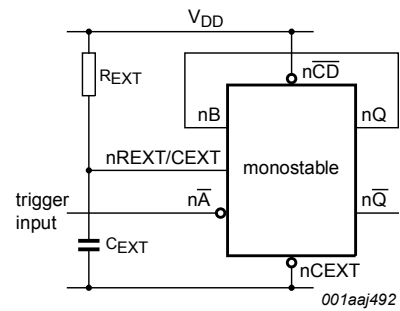
## 11 Application information

An example of a HEF4528B application is:

- Non-retriggerable monostable multivibrator



a. Rising edge triggered



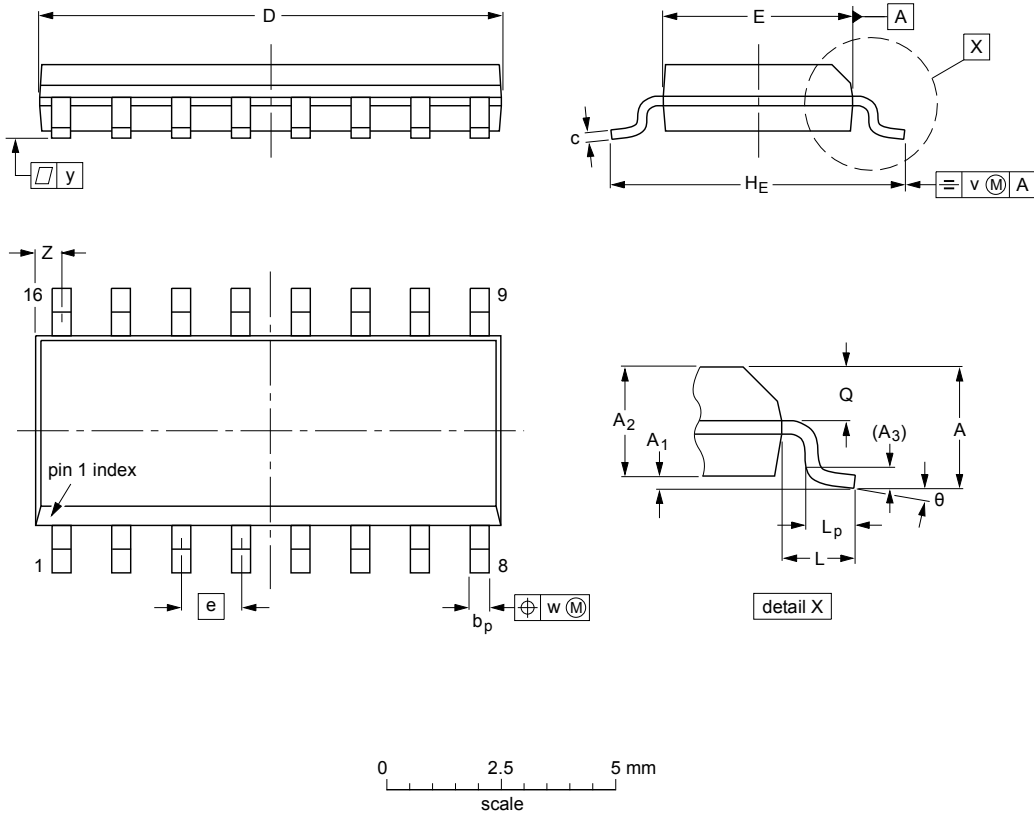
b. Falling edge triggered

**Figure 8. Non-retriggerable applications**

12 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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 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 03-02-19

Figure 9. Package outline SOT109-1 (SO16)

## 13 Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test

## 14 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4528B v.10	20170314	Product data sheet	-	HEF4528B v.9
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
HEF4528B v.9	20160530	Product data sheet	-	HEF4528B v.8
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Figure 2</a>: Logic diagram modified.</li> </ul>			
HEF4528B v.8	20160331	Product data sheet	-	HEF4528B v.7
Modifications:	<ul style="list-style-type: none"> <li>Type number HEF4528BP (SOT38-4) removed.</li> </ul>			
HEF4528B v.7	20111122	Product data sheet	-	HEF4528B v.6
Modifications:	<ul style="list-style-type: none"> <li>Section Applications removed</li> <li><a href="#">Table 6</a>: I<sub>OH</sub> minimum values changed to maximum</li> </ul>			
HEF4528B v.6	20091127	Product data sheet	-	HEF4528B v.5
HEF4528B v.5	20090813	Product data sheet	-	HEF4528B v.4
HEF4528B v.4	20090209	Product data sheet	-	HEF4528B_CNV v.3
HEF4528B_CNV v.3	19950101	Product specification	-	HEF4528B_CNV v.2
HEF4528B_CNV v.2	19950101	Product specification	-	-

## 15 Legal information

### 15.1 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.nexperia.com>.

### 15.2 Definitions

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