# HEF4528B

## Dual monostable multivibrator

Rev. 10 — 14 March 2017 Product data sheet

## 1 General description

The HEF4528B is a dual retriggerable-resetable monostable multivibrator. Each multivibrator has an active LOW input ($n\overline{A}$), and active HIGH input (nB), an active LOW clear direct input ($n\overline{CD}$), an output (nQ) and its complement ($n\overline{Q}$), 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 $n\overline{A}$ when nB is LOW or a LOW-to-HIGH transition on nB when $n\overline{A}$ is HIGH produces a positive pulse (LOW-HIGH-LOW) on nQ and a negative pulse (HIGH-LOW-HIGH) on $n\overline{Q}$ if the $n\overline{CD}$ is HIGH. A LOW on $n\overline{CD}$ forces nQ LOW, $n\overline{Q}$ HIGH and inhibits any further pulses until $n\overline{CD}$ 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 |

nexperia

# 4 Functional diagram

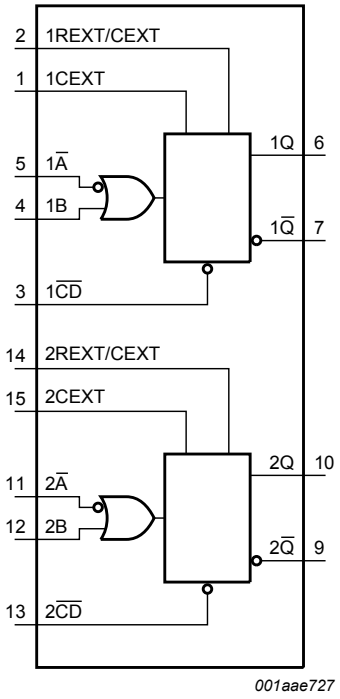



**Figure 1. Functional diagram**

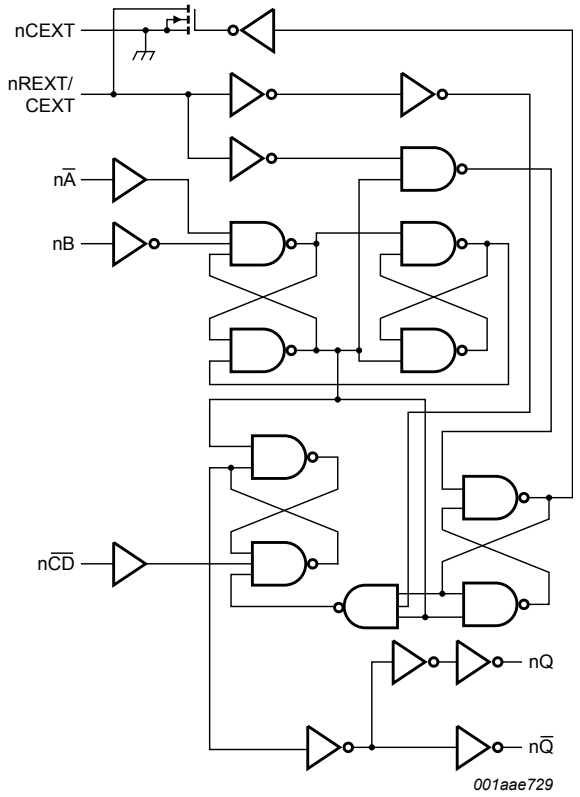



**Figure 2. Logic diagram for one monostable multivibrator**

# 5 Pinning information

## 5.1 Pinning

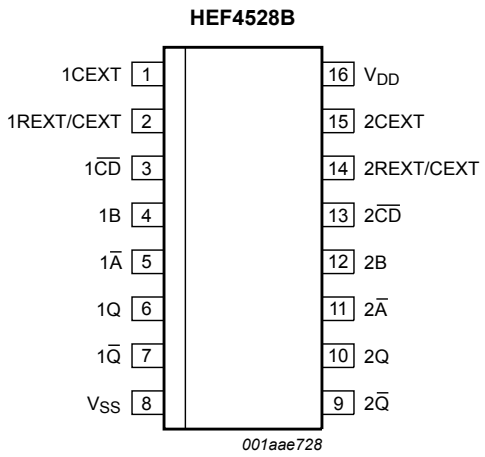



**Figure 3. Pin configuration (SO16)**

### 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) |
| $V_{SS}$ | 8 | ground supply voltage |
| $V_{DD}$ | 16 | supply voltage |

## 6 Functional description

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

| Inputs | | | Outputs | |
|---|---|---|---|---|
| $\overline{A}$ | 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 pule width determined by $C_{EXT}$ and $R_{EXT}$;
⎎ = one LOW level output pulse, with the pulse width determined by $C_{EXT}$ and $R_{EXT}$.

# 7 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 | $V_O$ < -0.5 V or $V_O$ > $V_{DD}$ + 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 | | | |
| | | 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 |
| Δt/ΔV | input transition rise and fall rate | $V_{DD}$ = 5 V | - | 3.75 | µs/V |
| | | $V_{DD}$ = 10 V | - | 0.5 | µs/V |
| | | $V_{DD}$ = 15 V | - | 0.08 | µs/V |

# 9 Static characteristics

**Table 6. Static characteristics**

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

| Symbol | Parameter | Conditions | $V_{DD}$ | $T_{amb}$ = -40 °C | | $T_{amb}$ = 25 °C | | $T_{amb}$ = 85 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Max | Min | Max | Min | Max | |
| $V_{IH}$ | HIGH-level input voltage | $\|I_O\|$ < 1 µA | 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 µA | 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 µA | 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 µA | 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 V | 5 V | - | -1.7 | - | -1.4 | - | -1.1 | mA |
| | | $V_O$ = 4.6 V | 5 V | - | -0.52 | - | -0.44 | - | -0.36 | mA |
| | | $V_O$ = 9.5 V | 10 V | - | -1.3 | - | -1.1 | - | -0.9 | mA |
| | | $V_O$ = 13.5 V | 15 V | - | -3.6 | - | -3.0 | - | -2.4 | mA |
| $I_{OL}$ | LOW-level output current | $V_O$ = 0.4 V | 5 V | 0.52 | - | 0.44 | - | 0.36 | - | mA |
| | | $V_O$ = 0.5 V | 10 V | 1.3 | - | 1.1 | - | 0.9 | - | mA |
| | | $V_O$ = 1.5 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 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 |

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

*$V_{SS}$ = 0 V; $T_{amb}$ = 25 °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 [1] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| $t_{PHL}$ | HIGH to LOW propagation delay | $n\overline{A}$ or nB to $n\overline{Q}$; see Figure 5 | 5 V | 113 ns + (0.55 ns/pF)$C_L$ | - | 140 | 280 | ns |
| | | | 10 V | 39 ns + (0.23 ns/pF)$C_L$ | - | 50 | 100 | ns |
| | | | 15 V | 27 ns + (0.16 ns/pF)$C_L$ | - | 35 | 70 | ns |
| | | $n\overline{CD}$ to nQ; see Figure 5 | 5 V | 78 ns + (0.55 ns/pF)$C_L$ | - | 105 | 210 | ns |
| | | | 10 V | 29 ns + (0.23 ns/pF)$C_L$ | - | 40 | 85 | ns |
| | | | 15 V | 22 ns + (0.16 ns/pF)$C_L$ | - | 30 | 60 | ns |
| $t_{PLH}$ | LOW to HIGH propagation delay | $n\overline{A}$ or nB to nQ; see Figure 5 | 5 V | 128 ns + (0.55 ns/pF)$C_L$ | - | 155 | 305 | ns |
| | | | 10 V | 49 ns + (0.23 ns/pF)$C_L$ | - | 60 | 115 | ns |
| | | | 15 V | 32 ns + (0.16 ns/pF)$C_L$ | - | 40 | 80 | ns |
| | | $n\overline{CD}$ to $n\overline{Q}$; see Figure 5 | 5 V | 93 ns + (0.55 ns/pF)$C_L$ | - | 120 | 240 | ns |
| | | | 10 V | 39 ns + (0.23 ns/pF)$C_L$ | - | 50 | 105 | ns |
| | | | 15 V | 27 ns + (0.16 ns/pF)$C_L$ | - | 35 | 70 | ns |
| $t_t$ | transition time | nQ, $n\overline{Q}$; see Figure 5 | 5 V [2] | 10 ns + (1.00 ns/pF)$C_L$ | - | 60 | 120 | ns |
| | | | 10 V | 9 ns + (0.42 ns/pF)$C_L$ | - | 30 | 60 | ns |
| | | | 15 V | 6 ns + (0.28 ns/pF)$C_L$ | - | 20 | 40 | ns |
| $t_{rec}$ | recovery time | $n\overline{CD}$ to $n\overline{A}$ 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 | $n\overline{CD}$ to $n\overline{A}$ or nB; see Figure 6 | 5 V | | 0 | -105 | - | ns |
| | | | 10 V | | 0 | -40 | - | ns |
| | | | 15 V | | 0 | -25 | - | ns |
| $t_W$ | pulse width | $n\overline{A}$ 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 |
| | | $n\overline{CD}$ LOW; minimum width; see Figure 6 | 5 V | | 60 | 30 | - | ns |
| | | | 10 V | | 35 | 15 | - | ns |
| | | | 15 V | | 25 | 10 | - | ns |
| | | nQ or $n\overline{Q}$; $R_{EXT}$ = 5 kΩ; $C_{EXT}$ = 15 pF; see Figure 6 | 5 V [3] | | - | 235 | - | ns |
| | | | 10 V | | - | 155 | - | ns |
| | | | 15 V | | - | 140 | - | ns |

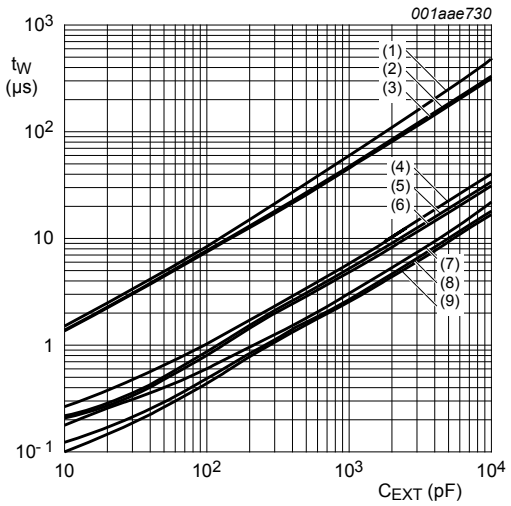
| Symbol | Parameter | Conditions | $V_{DD}$ | Extrapolation formula [1] | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| | | nQ or $n\overline{Q}$; $R_{EXT}$ = 10 kΩ; $C_{EXT}$ = 1 nF; see Figure 6 | 5 V [4] | | - | 5.45 | - | µs |
| | | | 10 V | | - | 4.95 | - | µs |
| | | | 15 V | | - | 4.85 | - | µs |
| $\Delta t_W$ | pulse width variation | nQ output variation over temperature range | 5 V [5] | | - | ±3 | - | % |
| | | | 10 V | | - | ±2 | - | % |
| | | | 15 V | | - | ±2 | - | % |
| | | nQ output variation over voltage range $V_{DD}$ ± 5 % | 5 V | | - | ±2 | - | % |
| | | | 10 V | | - | ±1 | - | % |
| | | | 15 V | | - | ±1 | - | % |
| $R_{EXT}$ | external timing resistor | see Figure 4 | 5 V | | 5 | - | 2 | MΩ |
| | | | 10 V | | 5 | - | 2 | MΩ |
| | | | 15 V | | 5 | - | 2 | MΩ |
| $C_{EXT}$ | 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 µF see Figure 4.
[4] For other $R_{EXT}$, $C_{EXT}$ combinations and $C_{EXT}$ > 0.01 µF 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 V;
K = 0.32 for $V_{DD}$ = 10 V;
K = 0.30 for $V_{DD}$ = 15 V.
[5] $T_{amb}$ = -40 °C to +85 °C; $\Delta t_W$ is referenced to $t_W$ at $T_{amb}$ = 25 °C.

### Table 8. Dynamic power dissipation $P_D$

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

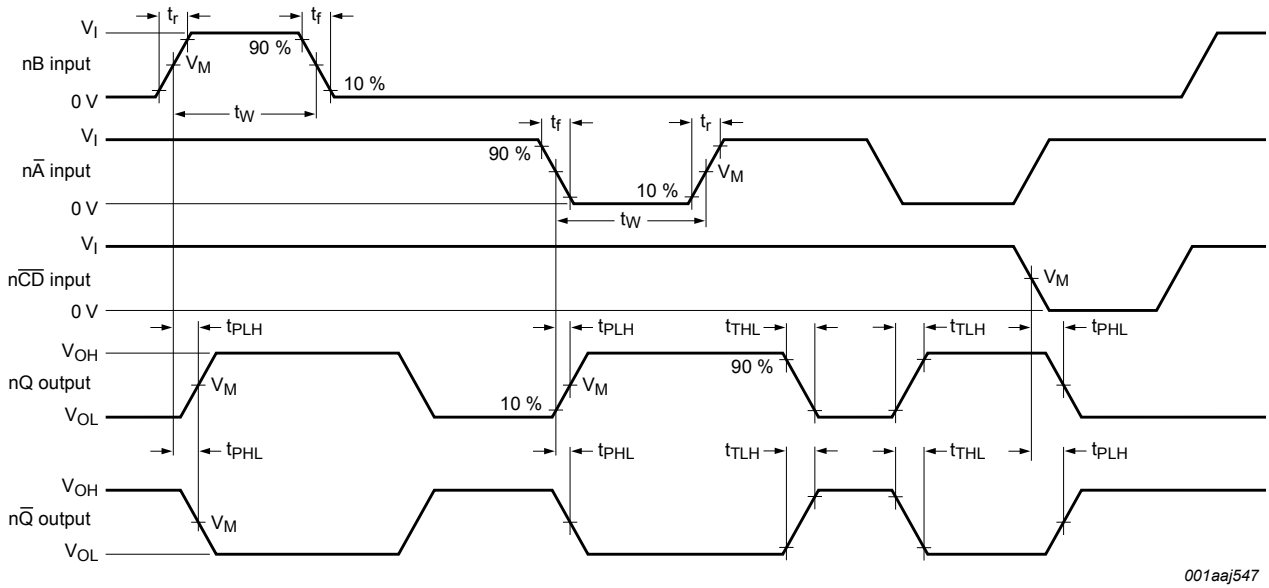
| Symbol | Parameter | $V_{DD}$ | Typical formula for $P_D$ (µW) | where: |
|---|---|---|---|---|
| $P_D$ | dynamic power dissipation | 5 V | $P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | $f_i$ = input frequency in MHz; $f_o$ = output frequency in MHz; $C_L$ = output load capacitance in pF; $V_{DD}$ = supply voltage in V; $\Sigma(f_o \times C_L)$ = 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 kΩ, $V_{DD}$ = 5 V.
(2) $R_{EXT}$ = 100 kΩ, $V_{DD}$ = 10 V.
(3) $R_{EXT}$ = 100 kΩ, $V_{DD}$ = 15 V.
(4) $R_{EXT}$ = 10 kΩ, $V_{DD}$ = 5 V.
(5) $R_{EXT}$ = 10 kΩ, $V_{DD}$ = 10 V.
(6) $R_{EXT}$ = 10 kΩ, $V_{DD}$ = 15 V.
(7) $R_{EXT}$ = 5 kΩ, $V_{DD}$ = 5 V.
(8) $R_{EXT}$ = 5 kΩ, $V_{DD}$ = 10 V.
(9) $R_{EXT}$ = 5 kΩ, $V_{DD}$ = 15 V.

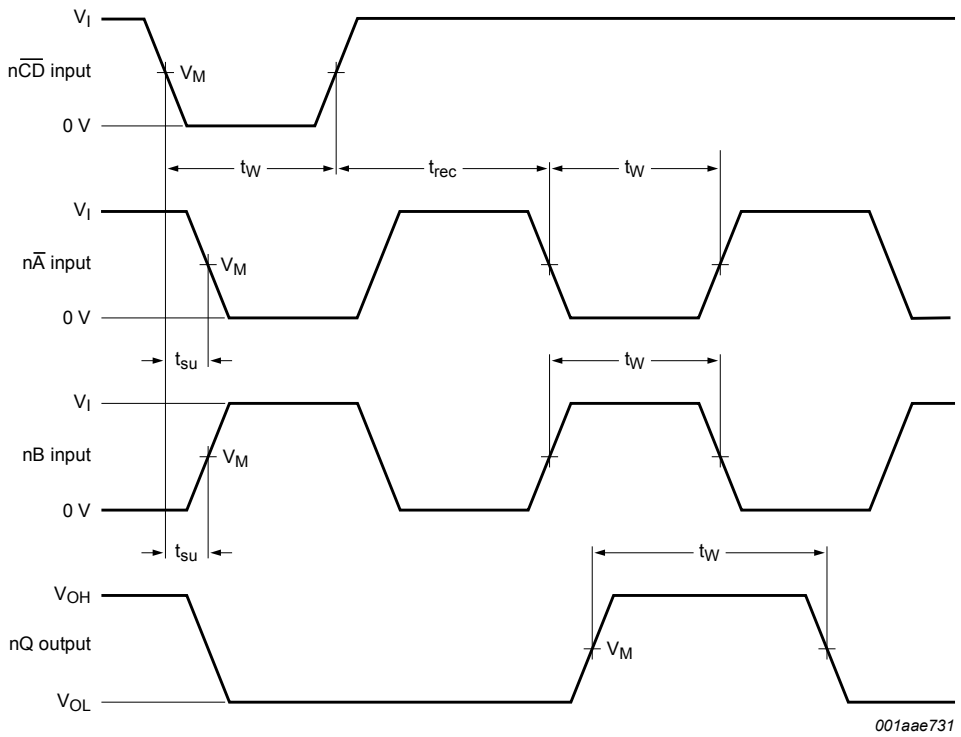
**Figure 4. Output pulse width ($t_W$) as a function of external timing capacitor ($C_{EXT}$)**

## 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.

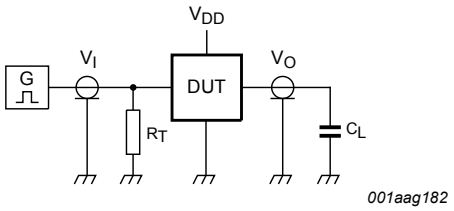
Set-up and recovery times are shown as positive values but may be specified as negative values.

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

**Figure 6. Waveforms showing minimum nA, 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**

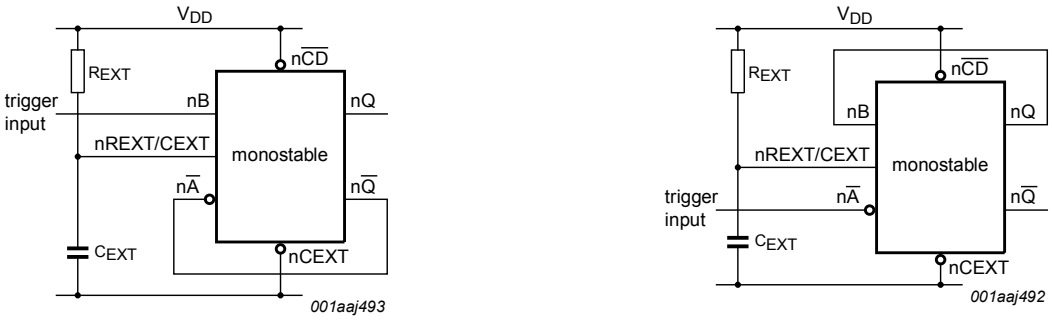
**Table 10. Test data**

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

# 11 Application information

An example of a HEF4528B application is:

- Non-retriggerable monostable multivibrator



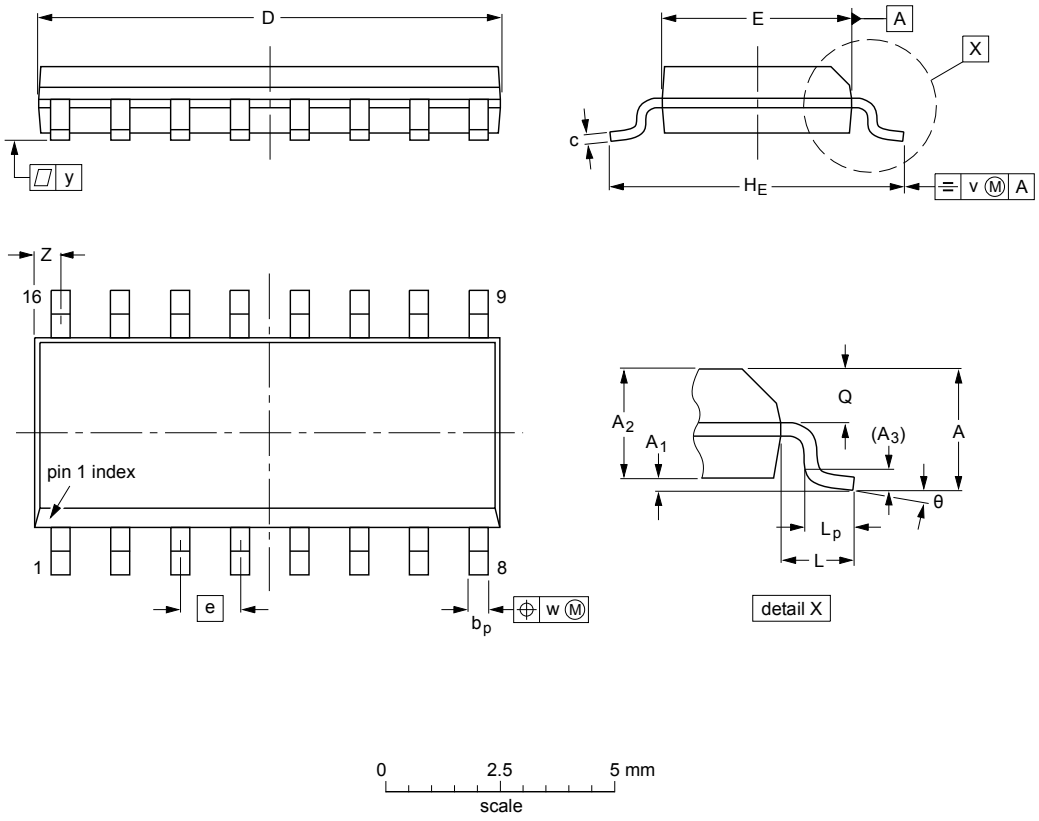

a. Rising edge triggered

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. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | 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 |

**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: | • The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| HEF4528B v.9 | 20160530 | Product data sheet | - | HEF4528B v.8 |
| Modifications: | • Figure 2: Logic diagram modified. | | | |
| HEF4528B v.8 | 20160331 | Product data sheet | - | HEF4528B v.7 |
| Modifications: | • Type number HEF4528BP (SOT38-4) removed. | | | |
| HEF4528B v.7 | 20111122 | Product data sheet | - | HEF4528B v.6 |
| Modifications: | • Section Applications removed<br>• Table 6: $I_{OH}$ minimum values changed to maximum | | | |
| 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[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.nexperia.com.

## 15.2 Definitions

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