HEF4528-Q100B

Dual monostable multivibrator

Rev. 2 — 4 March 2022 **Product data sheet**

1. General description

The HEF4528B-Q100 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 3) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 3)
  - Specified from -40 °C to +85 °C
- Fully static operation
- Wide supply voltage range from 3.0 V to 15.0 V
- CMOS low power dissipation
- High noise immunity
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Complies with JEDEC standard JESD 13-B

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
HEF4528BT-Q100	40 °C to +85 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

4. Functional diagram

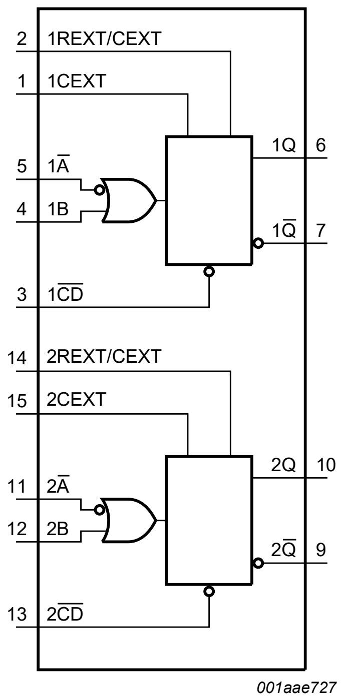


Fig. 1. Functional diagram

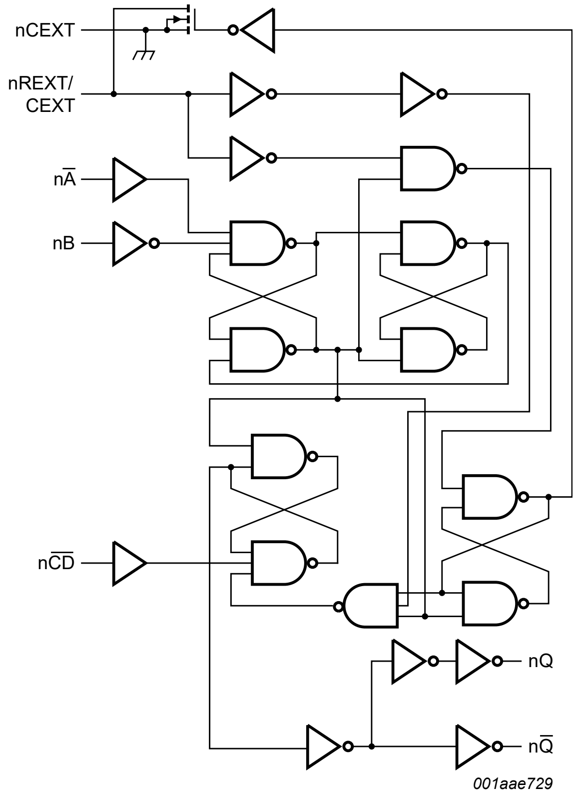


Fig. 2. Logic diagram for one monostable multivibrator

5. Pinning information

5.1. Pinning

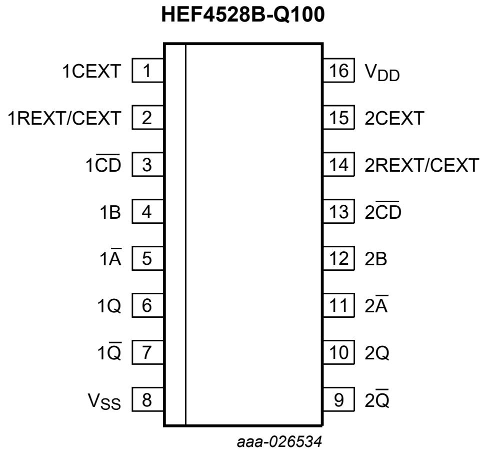


Fig. 3. Pin configuration SOT109-1 (SO16)

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

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}.*

Inputs			Outputs	
$\overline{A}$	B	$\overline{CD}$	Q	$\overline{Q}$
↓	L	H	⊓	⊔
H	↑	H	⊓	⊔
X	X	L	L	H

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	-	500	mW
P	power dissipation	per output	-	100	mW

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 Fig. 4 to Fig. 6; for test circuit see Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 6	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		nB HIGH; minimum width; see Fig. 6	5 V		50	25	-	ns
			10 V		30	15	-	ns
			15 V		20	10	-	ns
		$n\overline{CD}$ LOW; minimum width; see Fig. 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 Fig. 6	5 V [3]		-	235	-	ns
			10 V		-	155	-	ns
			15 V		-	140	-	ns
		nQ or $n\overline{Q}$; R_{EXT} = 10 kΩ; C_{EXT} = 1 nF; see Fig. 6	5 V [4]		-	5.45	-	μs
			10 V		-	4.95	-	μs
			15 V		-	4.85	-	μs

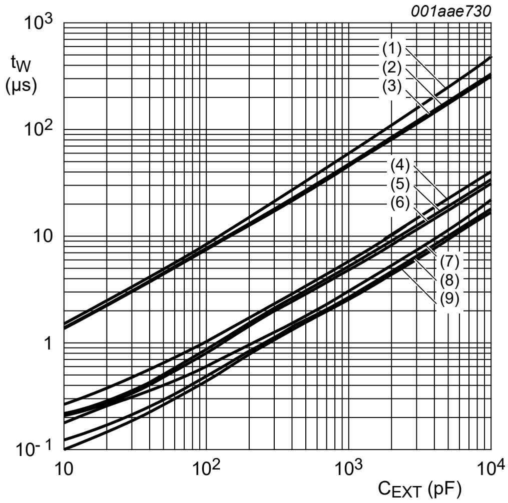
Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula [1]	Min	Typ	Max	Unit
Δt_W	pulse width variation	nQ output variation over temperature range	5 V [5]		-	±3	-	%
			10 V		-	±2	-	%
			15 V		-	±2	-	%
		nQ output variation over voltage range V_{DD} ± 5 %	5 V		-	±2	-	%
			10 V		-	±1	-	%
			15 V		-	±1	-	%
R_{EXT}	external timing resistor	see Fig. 4	5 V		5	-	2	MΩ
			10 V		5	-	2	MΩ
			15 V		5	-	2	MΩ
C_{EXT}	external timing capacitor	see Fig. 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 Fig. 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; Δt_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.

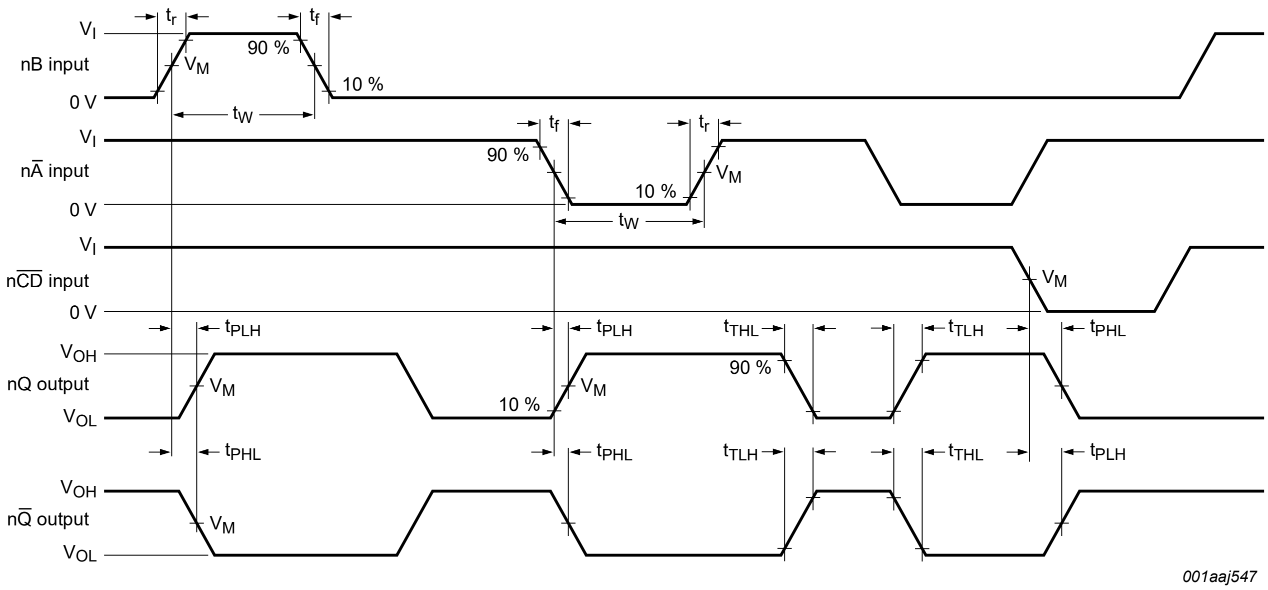
Symbol	Parameter	V_{DD}	Typical formula for P_D (μW)	where:
P_D	dynamic power dissipation	5 V	$P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}{}^2$	f_i = input frequency in MHz; f_o = output frequency in MHz; C_L = output load capacitance in pF; V_{DD} = supply voltage in V; $\Sigma(f_o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

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

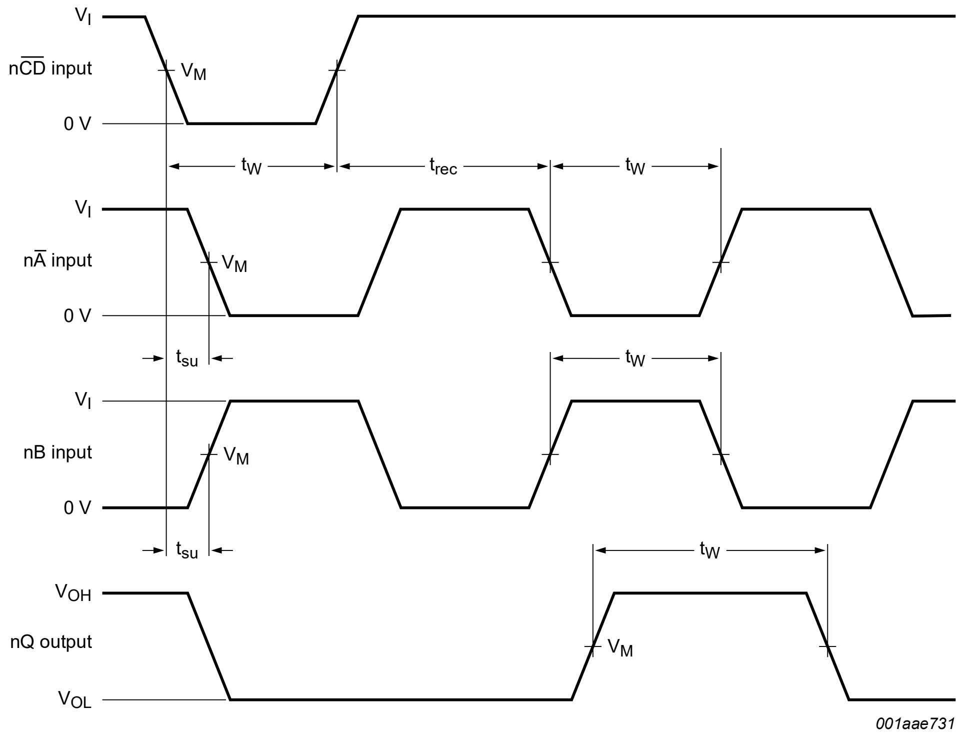
10.1. Waveforms and test circuit



Measurement points are given in Table 9.

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

Fig. 5. Waveforms showing propagation delays and transition times



Measurement points are given in Table 9.

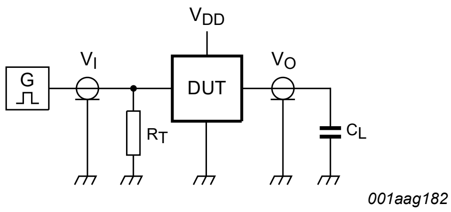
Set-up and recovery times are shown as positive values but may be specified as negative values.

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

Fig. 6. Waveforms showing minimum n$\overline{A}$, 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	0.5 × V_{DD}	0.5 × V_{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.

Fig. 7. Test circuit for measuring switching times

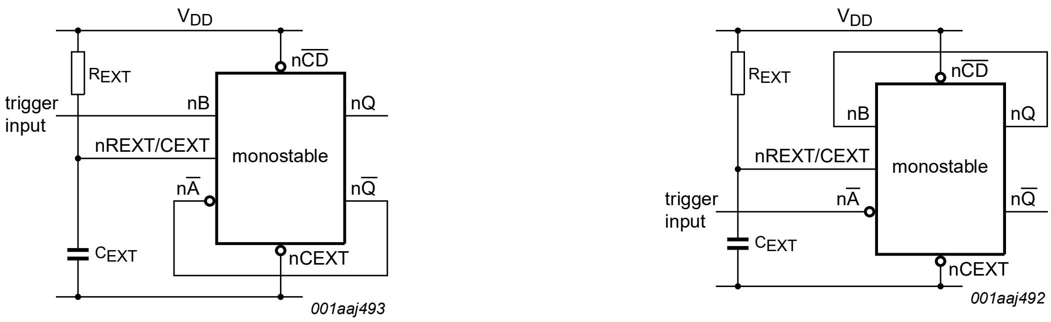
Table 10. Test data

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-Q100 application is:

- Non-retriggerable monostable multivibrator



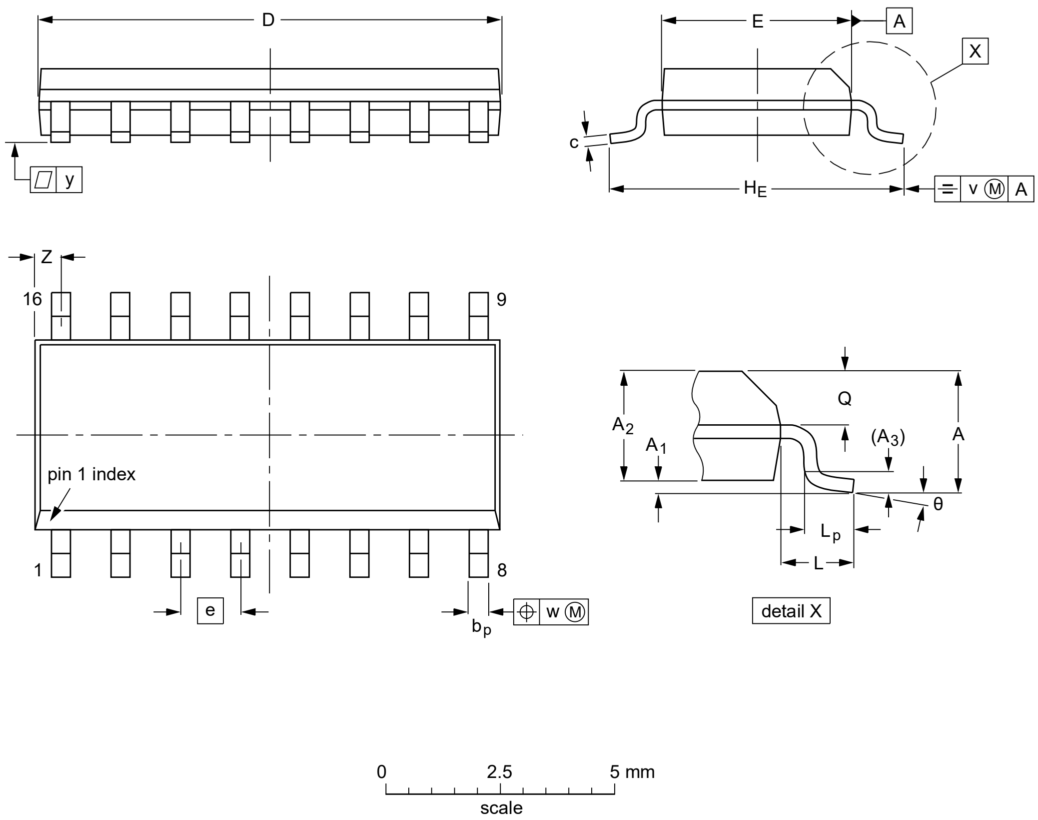
a. Rising edge triggered

b. Falling edge triggered

Fig. 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 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

Fig. 9. Package outline SOT109-1 (SO16)

13. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4528B_Q100 v.2	20220304	Product data sheet	-	HEF4528B_Q100 v.1
Modifications	• Section 2 updated.			
HEF4528B_Q100 v.1	20170314	Product data sheet	-	-

15. Legal information

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".
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