HEF4938B

Dual precision monostable multivibrator

Rev. 05 — 6 January 2010 **Product data sheet**

1. General description

The HEF4938B is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has an active LOW trigger/retrigger input ($n\overline{A}$), an active HIGH trigger/retrigger input (nB), an overriding active LOW direct reset input ($n\overline{CD}$), an output (nQ) and its complement ($n\overline{Q}$), and two pins (CEXT, always connected to ground, and nREXT/CEXT) for connecting the external timing components C_{EXT} and R_{EXT}. The typical pulse width variation over the specified temperature range is ±0.2 %.

The multivibrator may be triggered by either the positive or the negative edges of the input pulse and will produce an accurate output pulse with a pulse width range of 10 μs to infinity. The duration and accuracy of the output pulse are determined by the external timing components C_{EXT} and R_{EXT}. The output pulse width (t_W) is equal to $R_{EXT} \times C_{EXT}$. The linear design techniques in LOCMOS (Local Oxide CMOS) guarantee precise control of the output pulse width. A LOW level at $n\overline{CD}$ terminates the output pulse immediately. The trigger inputs' Schmitt trigger action makes the circuit highly tolerant of slower rise and fall times.

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 suitable for use over the full industrial (–40 °C to +85 °C) temperature range.

2. Features

- Separate reset inputs
- Triggering from leading or trailing edge
- Tolerant of slow trigger rise and fall times
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Operates across the full industrial temperature range –40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

3. Applications

- Industrial

founded by Philips

4. Ordering information

Table 1. Ordering information

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

Type number	Package		
	Name	Description	Version
HEF4938BP	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
HEF4938BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram

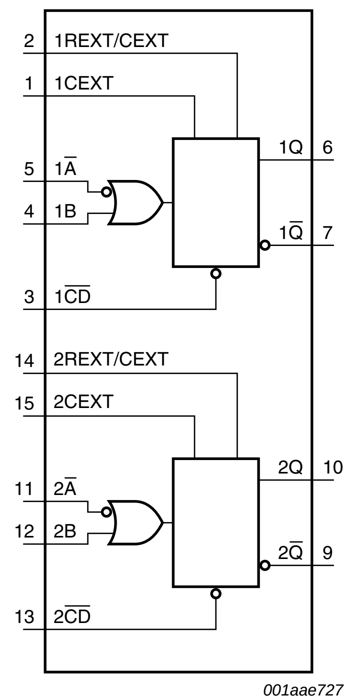


Fig 1. Functional diagram

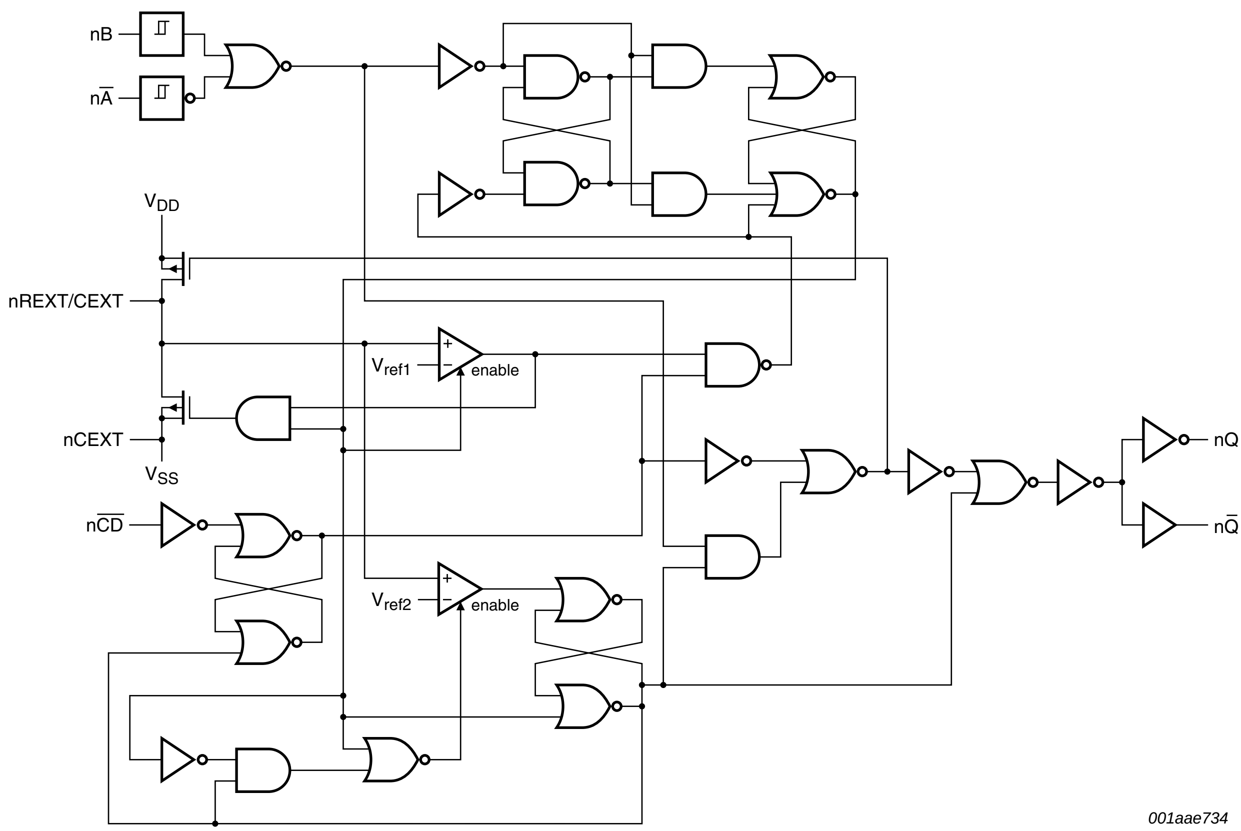


Fig 2. Logic diagram

6. Pinning information

6.1 Pinning

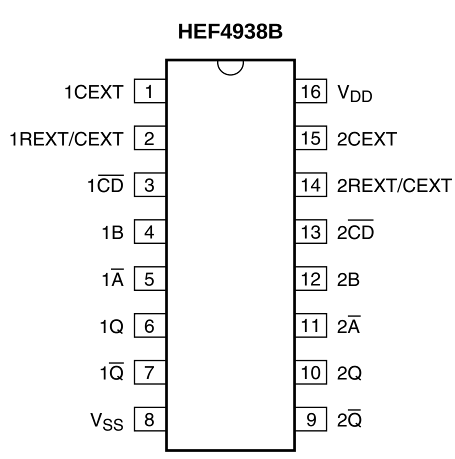


Fig 3. Pin configuration

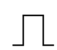
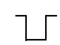
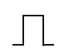
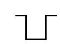
6.2 Pin description

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	direct reset 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

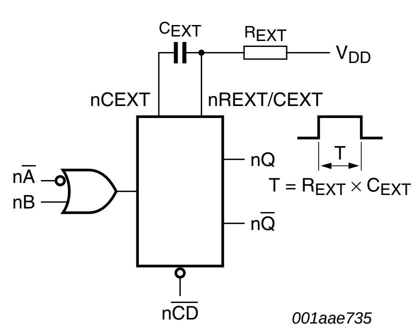
Table 3. Function table

Inputs			Outputs	
n$\overline{A}$	**nB**	**n$\overline{CD}$**	**nQ**	**n$\overline{Q}$**
↓	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_{EXT} and R_{EXT};

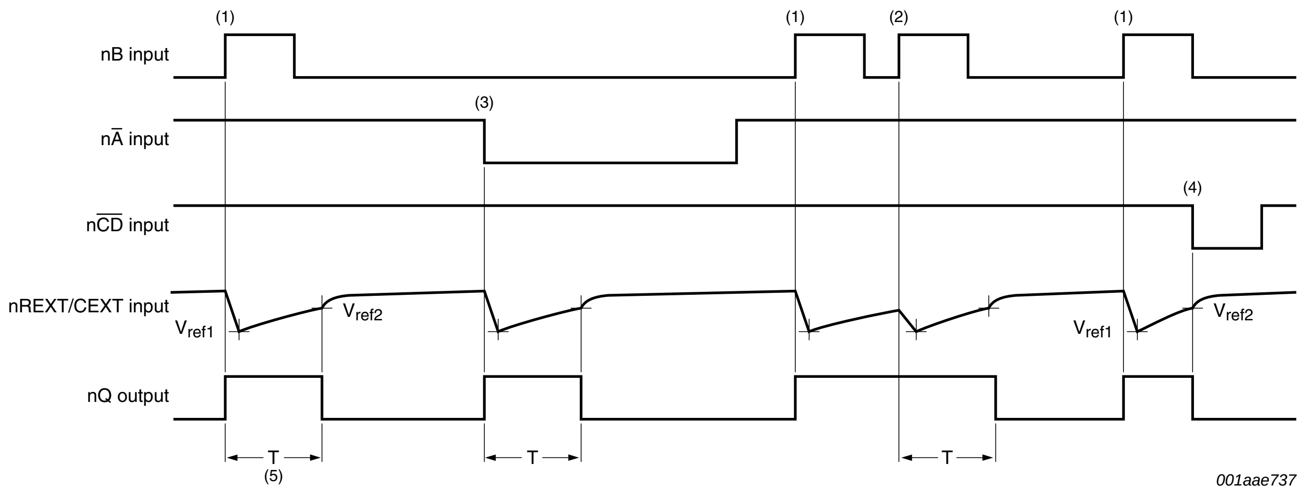
 = one LOW level output pulse, with the pulse width determined by C_{EXT} and R_{EXT}.



(1) The external timing resistor R_{EXT} minimum value is 5 kΩ. Its maximum permissible resistance, which holds the specified accuracy of t_W (nQ, n$\overline{Q}$ output), depends on the leakage current of the capacitor C_{EXT} and the leakage of the HEF4938B

(2) The external timing capacitor C_{EXT} minimum value is 2000 pF with no upper limit

Fig 4. Connection of the external timing components R_{EXT} and C_{EXT}



(1) Positive edge triggering.

(2) Positive edge re-triggering (pulse lengthening).

(3) Negative edge triggering.

(4) Reset (pulse shortening).

(5) $T = R_{EXT} \times C_{EXT}$.

Fig 5. Timing diagram

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	+125	°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	-	+125	°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

10. 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	$\lvert I_O \rvert$ < 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	$\lvert I_O \rvert$ < 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	$\lvert I_O \rvert$ < 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	$\lvert I_O \rvert$ < 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	−0.64	-	−0.5	-	−0.36	-	mA
		V_O = 9.5 V	10 V	−1.6	-	−1.3	-	−0.9	-	mA
		V_O = 13.5 V	15 V	−4.2	-	−3.4	-	−2.4	-	mA
I_{OL}	LOW-level output current	V_O = 0.4 V	5 V	0.64	-	0.5	-	0.36	-	mA
		V_O = 0.5 V	10 V	1.6	-	1.3	-	0.9	-	mA
		V_O = 1.5 V	15 V	4.2	-	3.4	-	2.4	-	mA
I_I	input leakage current	pins 2 and 14	15 V	-	±0.1	-	±0.1	-	±1.0	μA
I_{DD}	supply current	active state	5 V [1]	-	-	(Typical = 55)		-	-	μA
			10 V	-	-	(Typical = 150)		-	-	μA
			15 V	-	-	(Typical = 220)		-	-	μA

Table 6. Static characteristics *…continued*

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	
I_{DD}	supply current	I_O = 0 A	5 V	-	5	-	5	-	150	μA
			10 V	-	10	-	10	-	300	μA
			15 V	-	20	-	20	-	600	μA
C_I	input capacitance		-	-	-	-	7.5	-	-	pF

[1] Only one monostable is switching: current present during output pulse (output Q is HIGH).

11. Dynamic characteristics

Table 7. Dynamic characteristics

V_{SS} = 0 V; T_{amb} = 25 °C; for test circuit see Figure 11; unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula[1]	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	$n\overline{A}$, nB to $n\overline{Q}$; see Figure 6	5 V	193 ns + (0.55 ns/pF)C_L	-	220	440	ns
			10 V	74 ns + (0.23 ns/pF)C_L	-	85	190	ns
			15 V	52 ns + (0.16 ns/pF)C_L	-	60	120	ns
		$n\overline{CD}$ to nQ; see Figure 6	5 V	98 ns + (0.55 ns/pF)C_L	-	125	250	ns
			10 V	44 ns + (0.23 ns/pF)C_L	-	55	110	ns
			15 V	32 ns + (0.16 ns/pF)C_L	-	40	80	ns
t_{PLH}	LOW to HIGH propagation delay	$n\overline{A}$, nB to nQ; see Figure 6	5 V	173 ns + (0.55 ns/pF)C_L	-	200	460	ns
			10 V	79 ns + (0.23 ns/pF)C_L	-	90	180	ns
			15 V	52 ns + (0.16 ns/pF)C_L	-	60	120	ns
		$n\overline{CD}$ to $n\overline{Q}$; see Figure 6	5 V	98 ns + (0.55 ns/pF)C_L	-	125	250	ns
			10 V	44 ns + (0.23 ns/pF)C_L	-	55	110	ns
			15 V	32 ns + (0.16 ns/pF)C_L	-	40	80	ns
t_{rec}	recovery time	$n\overline{CD}$ to $n\overline{A}$, nB; see Figure 7	5 V		-	20	40	ns
			10 V		-	10	20	ns
			15 V		-	5	10	ns
t_{rtrig}	retrigger time	nQ, $n\overline{Q}$ to $n\overline{A}$, nB; see Figure 7	5 V		0	-	-	ns
			10 V		0	-	-	ns
			15 V		0	-	-	ns
t_W	pulse width	$\overline{A}$ input LOW; minimum width; see Figure 7	5 V		90	45	-	ns
			10 V		30	15	-	ns
			15 V		24	12	-	ns
		nB input HIGH; minimum width; see Figure 7	5 V		50	25	-	ns
			10 V		24	12	-	ns
			15 V		20	10	-	ns
		nQ or $n\overline{Q}$ output; R_{EXT} = 100 kΩ; C_{EXT} = 0.1 μF; see Figure 7	5 V		9.3	10.0	10.6	ms
			10 V		9.2	9.9	10.5	ms
			15 V		9.1	9.8	10.4	ms

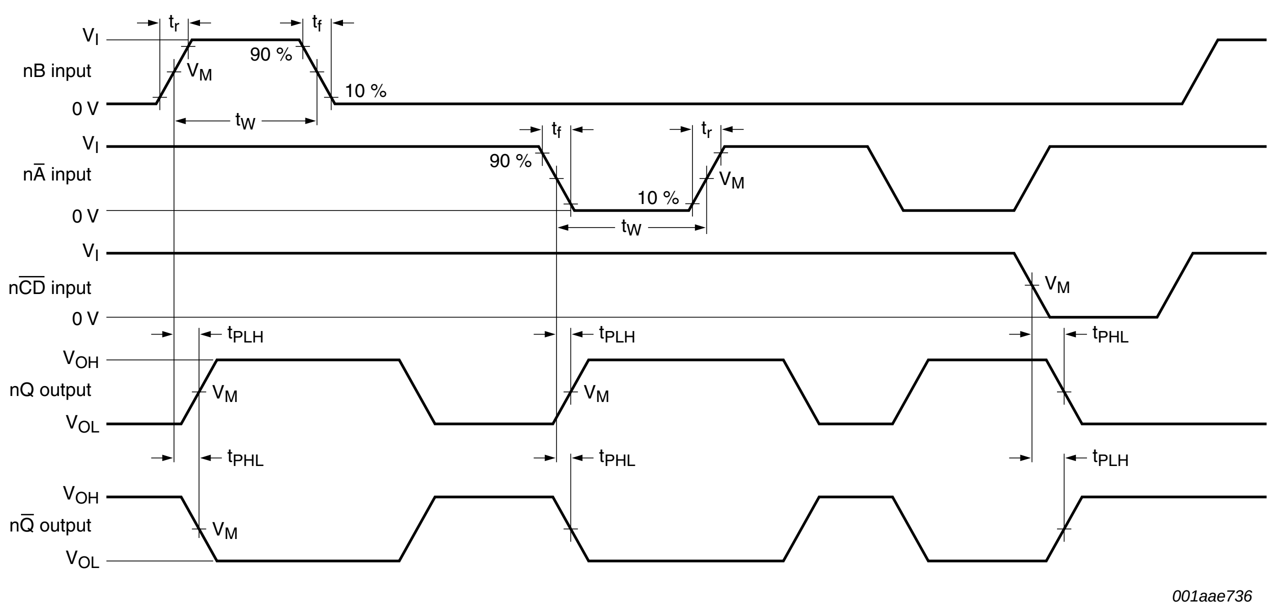
Table 7. Dynamic characteristics *...continued*

V_{SS} = 0 V; T_{amb} = 25 °C; for test circuit see Figure 11; unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula[1]	Min	Typ	Max	Unit
Δt_W	pulse width variation	nQ or $n\overline{Q}$ output variation over temperature (T_{amb}) range; see Figure 8	5 V		-	±0.2	-	%
			10 V		-	±0.2	-	%
			15 V		-	±0.2	-	%
		nQ or $n\overline{Q}$ output variation over V_{DD} voltage range 5 V to 15 V; see Figure 9			-	±1.5	-	%
		nQ or $n\overline{Q}$ output variation between same package devices; R_{EXT} = 100 kΩ; C_{EXT} = 2 nF to 10 μF	5 V		-	±1	-	%
			10 V		-	±1	-	%
			15 V		-	±1	-	%
C_I	input capacitance	nREXT/CEXT			-	15	-	pF

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

12. Waveforms



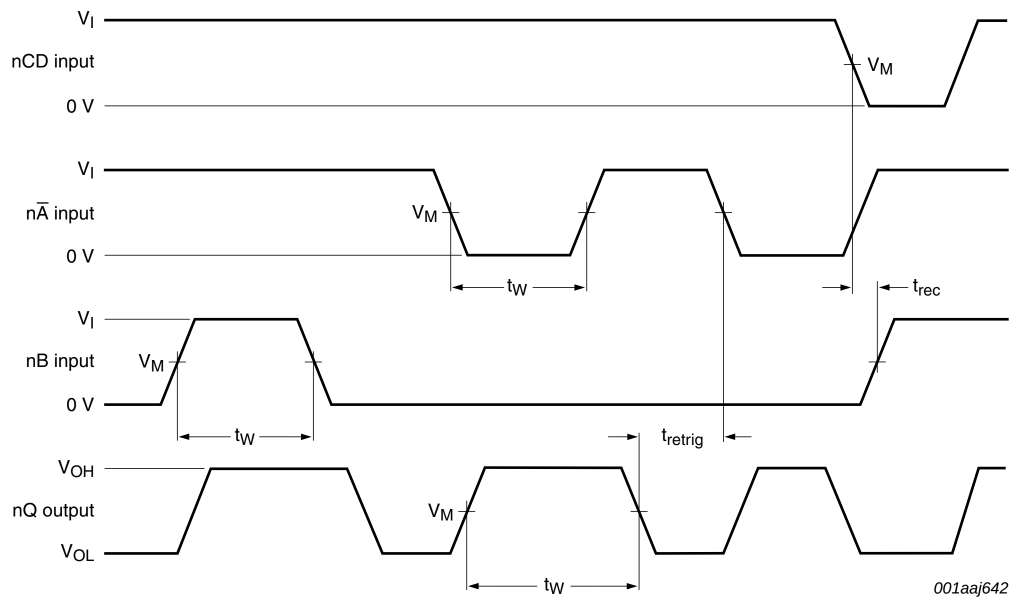
Measurement points are given in Table 8, the test circuit in Figure 11 and the test data in Table 9.

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

Fig 6. Waveforms showing rise and fall times and propagation delays

Table 8. Measurement points

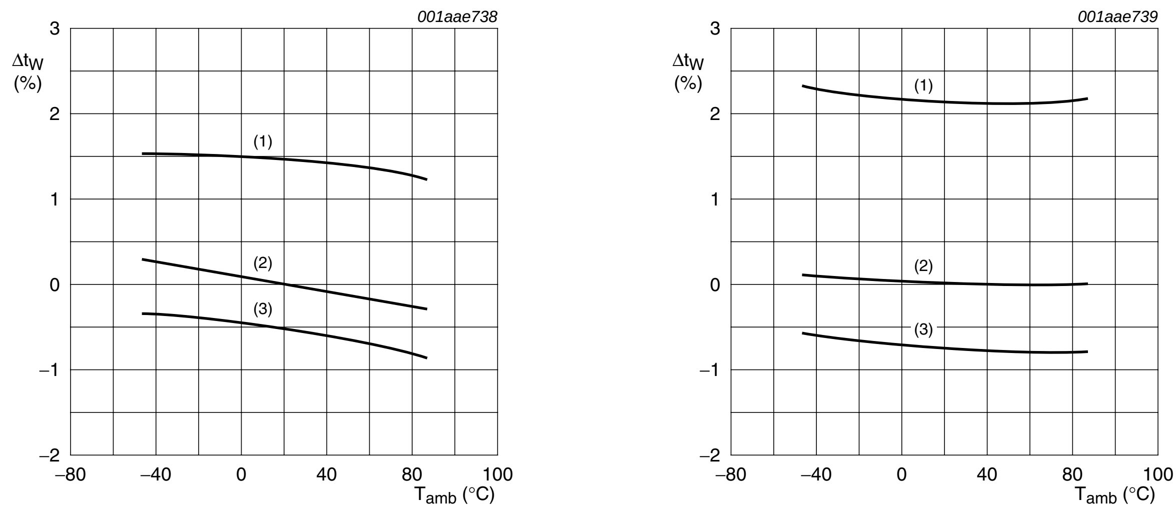
Supply voltage	Input	Output
V_{DD}	V_M	V_M
5 V to 15 V	$0.5V_{DD}$	$0.5V_{DD}$



Measurement points are given in Table 8, the test circuit in Figure 11 and the test data in Table 9.

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

Fig 7. Waveforms showing minimum n$\overline{A}$, nB, and nQ pulse widths and recovery and retrigger times



a. R_{EXT} = 100 kΩ; C_{EXT} = 100 nF

0 % at V_{DD} = 10 V and T_{amb} = 25 °C

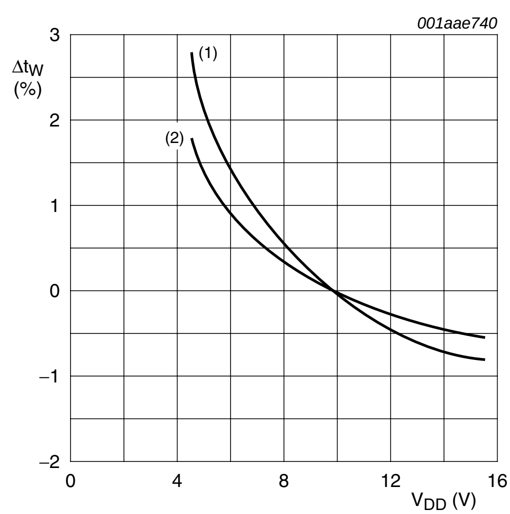
(1) V_{DD} = 5 V.

(2) V_{DD} = 10 V.

(3) V_{DD} = 15 V.

b. R_{EXT} = 100 kΩ; C_{EXT} = 2 nF

Fig 8. Typical normalized change in output pulse width as a function of ambient temperature

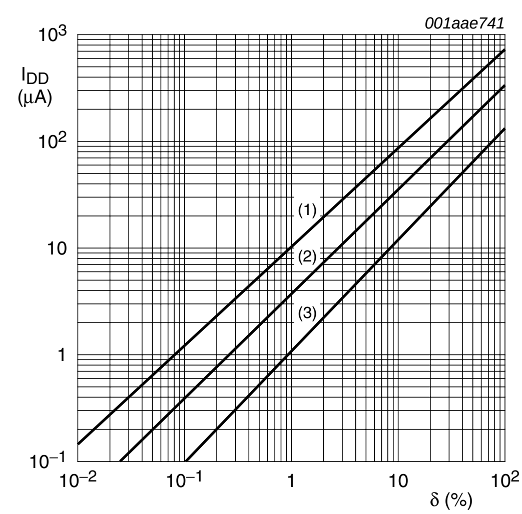


T_{amb} = 25 °C; 0 % at V_{DD} = 10 V; R_{EXT} = 100 kΩ

(1) C_{EXT} = 2 nF.

(2) C_{EXT} = 100 nF.

Fig 9. Typical normalized change in output pulse width as a function of the supply voltage



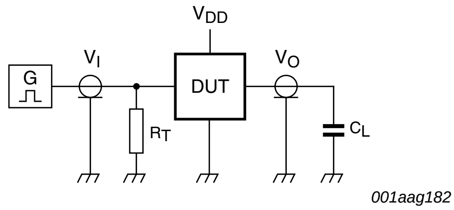
R_{EXT} = 100 kΩ; C_{EXT} = 100 nF; C_L = 50 pF; one monostable multivibrator switching only

(1) V_{DD} = 15 V.

(2) V_{DD} = 10 V.

(3) V_{DD} = 5 V.

Fig 10. Total supply current as a function of the output duty factor



Test data is given in Table 9.

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.

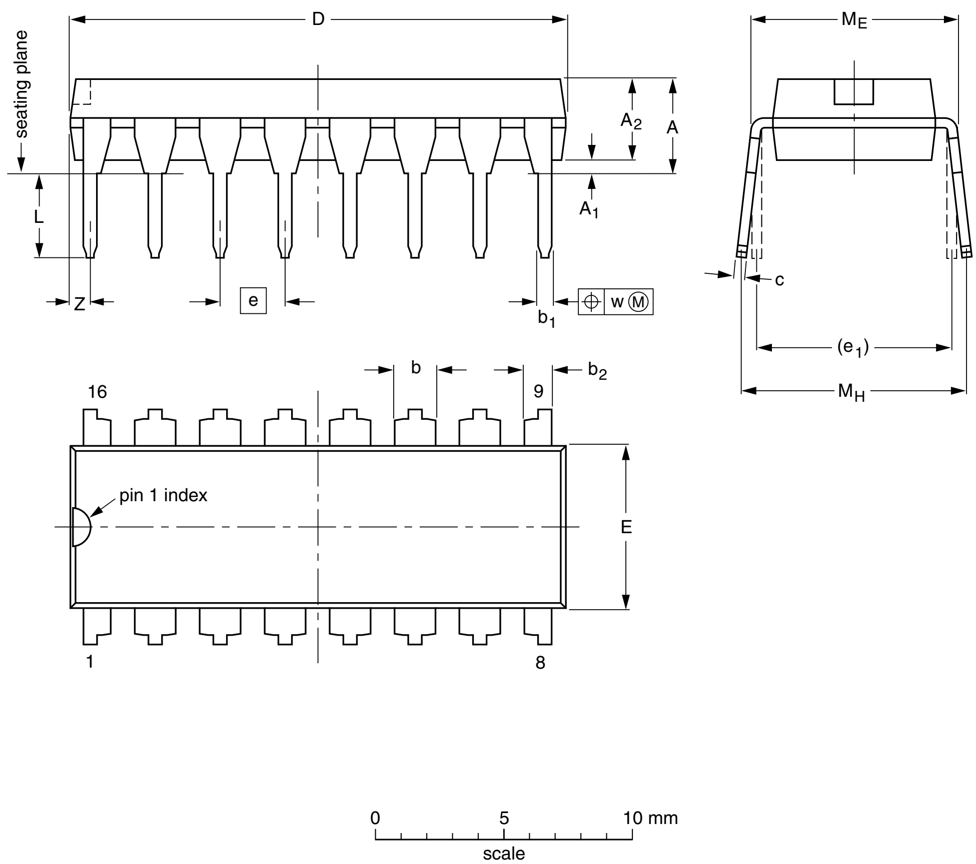
Fig 11. Test circuit

Table 9. 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

13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D [(1)]	E [(1)]	e	e_1	L	M_E	M_H	w	Z [(1)] max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.03

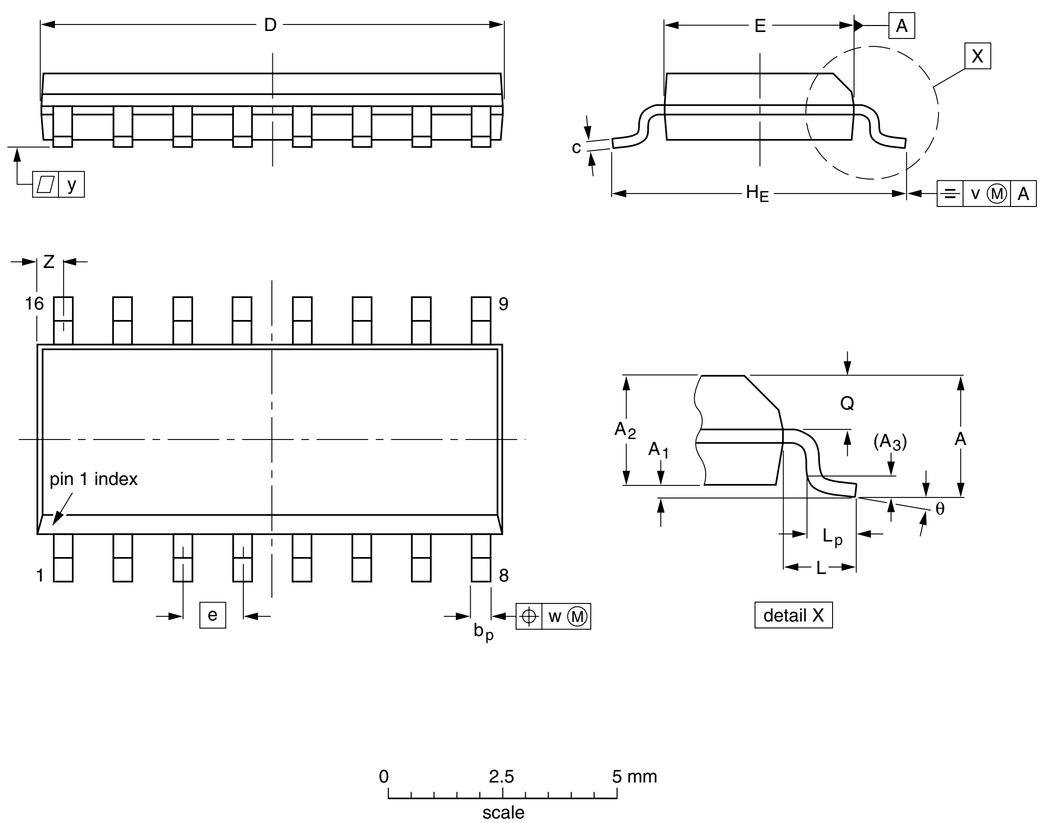
Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT38-4						~~95-01-14~~ 03-02-13

Fig 12. Package outline SOT38-4 (DIP16)

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 13. Package outline SOT109-1 (SO16)

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4938B_5	20100106	Product data sheet	-	HEF4938B_4
Modifications:	• Maximum temperature changed to 85 °C throughout. • Section 2 "Features" ESD data removed. • Section 9 "Recommended operating conditions" $\Delta t/\Delta V$ values updated. • Section 15 "Legal information" export control disclaimer added. • Abbreviations section removed.			
HEF4938B_4	20090309	Product data sheet	-	HEF4938B_CNV_3
HEF4938B_CNV_3	19950101	Product specification	-	HEF4938B_CNV_2
HEF4938B_CNV_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.nxp.com.

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