

HEF4049B

Hex inverting buffers

Rev. 12 — 3 September 2024

Product data sheet

1. General description

The HEF4049B is a hex inverter with overvoltage tolerant inputs. Inputs are overvoltage tolerant to 15.0 V. This enables the device to be used in HIGH-to-LOW level shifting applications.

2. Features and benefits

- Wide supply voltage range from 3.0 V to 15.0 V
- Overvoltage tolerant inputs to 15.0 V
- CMOS low power dissipation
- High noise immunity
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Complies with JEDEC standard JESD 13-B
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +85 °C

3. Applications

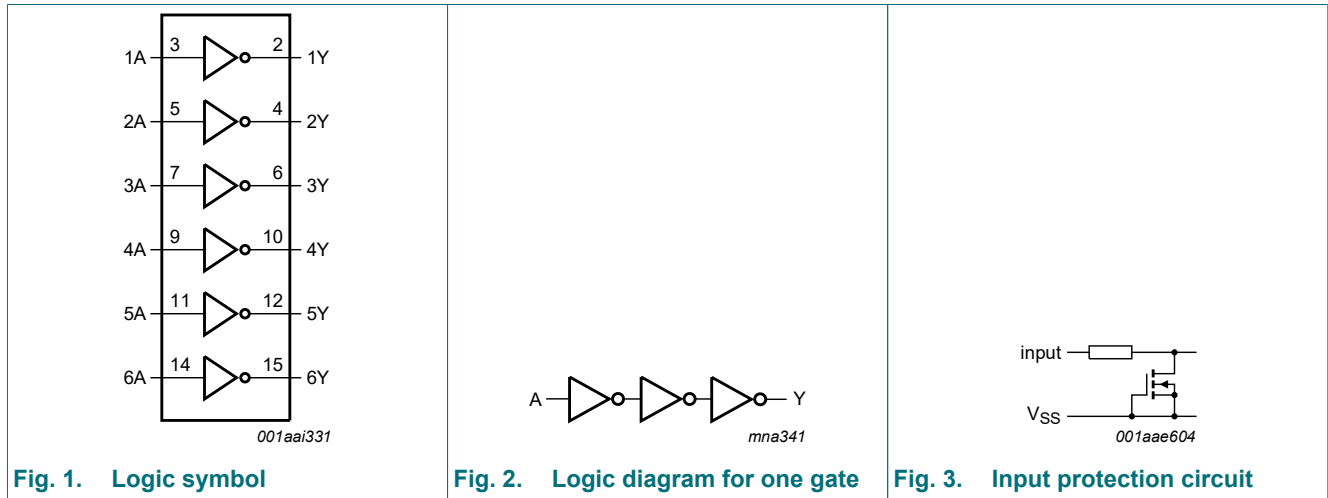
- LOCMOS (Local Oxidation CMOS) to DTL/TTL converter
- HIGH sink current for driving two TTL loads
- HIGH-to-LOW level logic conversion

4. Ordering information

Table 1. Ordering information

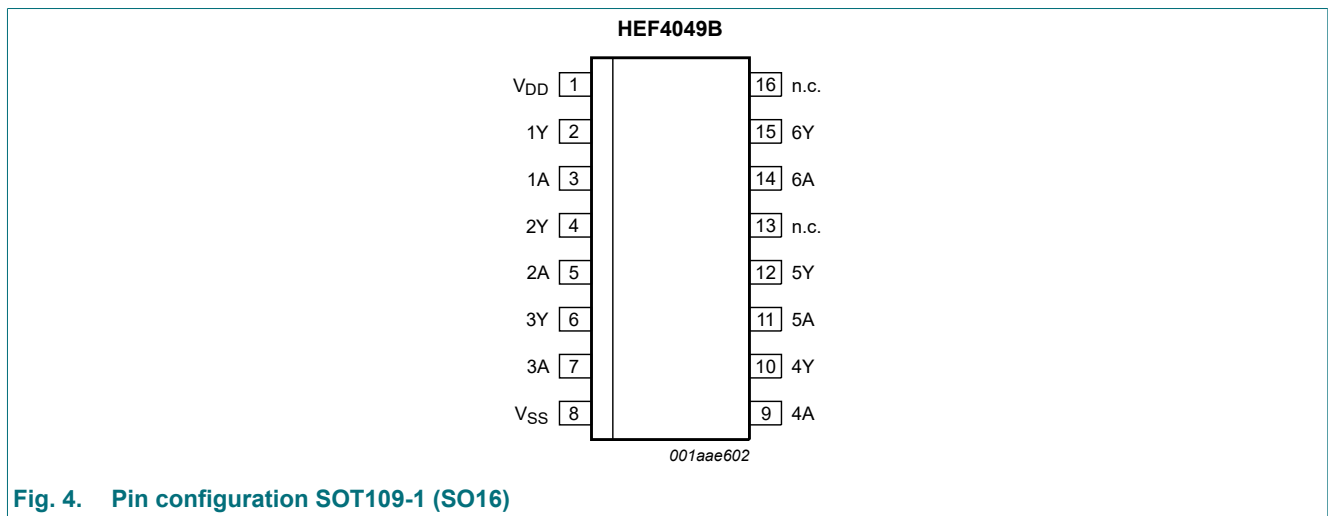
Type number	Package			
	Temperature range	Name	Description	Version
HEF4049BT	-40 °C to +85 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
V _{DD}	1	supply voltage
1Y, 2Y, 3Y, 4Y, 5Y, 6Y	2, 4, 6, 10, 12, 15	output
1A, 2A, 3A, 4A, 5A, 6A	3, 5, 7, 9, 11, 14	input
V _{SS}	8	ground supply voltage
n.c.	13, 16	not connected

7. Functional description

Table 3. Guaranteed fan-out

Driven element	Guaranteed fan-out
Standard TTL	2
74 LS	9
74 L	16

8. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage		-0.5	+18	V
I_{IK}	input clamping current	$V_I < -0.5$ V	-10	-	mA
V_I	input voltage		-0.5	+18	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

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	-	15	V
T_{amb}	ambient temperature	in free air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD} = 5$ V	-	-	3.75	$\mu\text{s/V}$
		$V_{DD} = 10$ V	-	-	0.5	$\mu\text{s/V}$
		$V_{DD} = 15$ V	-	-	0.08	$\mu\text{s/V}$

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 °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	4.75 V	3.5	-	2.9	-	2.3	-	mA
		V _O = 0.5 V	10 V	12.0	-	10.0	-	8.0	-	mA
		V _O = 1.5 V	15 V	24.0	-	20.0	-	16.0	-	mA
I _I	input leakage current	V _{DD} = 15 V	15 V	-	±0.3	-	±0.3	-	±1.0	μA
I _{DD}	supply current	I _O = 0 A	5 V	-	4.0	-	4.0	-	30	μA
			10 V	-	8.0	-	8.0	-	60	μA
			15 V	-	16.0	-	16.0	-	120	μA
C _I	input capacitance			-	-	-	7.5	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

$V_{SS} = 0\text{ V}$; $C_L = 50\text{ pF}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ °C}$; unless otherwise specified.

Symbol	Parameter	Conditions	V _{DD}	Extrapolation formula [1]	Min	Typ	Max	Unit
t _{PHL}	HIGH to LOW propagation delay	nA to nY; see Fig. 5	5 V	26 ns + (0.18 ns/pF)C _L	-	35	70	ns
			10 V	11 ns + (0.08 ns/pF)C _L	-	15	30	ns
			15 V	9 ns + (0.05 ns/pF)C _L	-	12	25	ns
t _{PLH}	LOW to HIGH propagation delay	nA to nY; see Fig. 5	5 V	23 ns + (0.55 ns/pF)C _L	-	50	100	ns
			10 V	14 ns + (0.23 ns/pF)C _L	-	25	50	ns
			15 V	12 ns + (0.16 ns/pF)C _L	-	20	40	ns
t _{THL}	HIGH to LOW output transition time	see Fig. 5	5 V	3 ns + (0.35 ns/pF)C _L	-	20	40	ns
			10 V	3 ns + (0.14 ns/pF)C _L	-	10	20	ns
			15 V	2 ns + (0.09 ns/pF)C _L	-	7	14	ns
t _{TLH}	LOW to HIGH output transition time	see Fig. 5	5 V	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

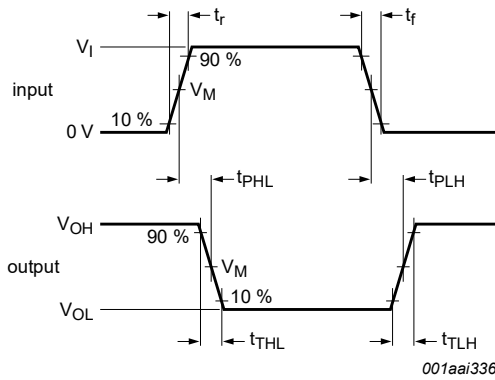
[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown (C_L in pF).

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	$P_D = 2500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	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; Σ(f _o × C _L) = sum of the outputs.
		10 V	$P_D = 11000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 35000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

11.1. Waveforms and test circuit

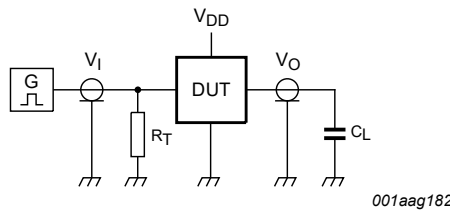


Measurement points are given in [Table 9](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 5. Input (nA) to output (nY) propagation delays and transition times

Table 9. Measurement points

Input		Output		
V_M	V_I	V_M	V_X	V_Y
$0.5 \times V_{DD}$	0 V to V_{DD}	$0.5 \times V_{DD}$	$0.1 \times V_{DD}$	$0.9 \times V_{DD}$



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

Fig. 6. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Input			Load
V_{DD}	V_I	V_M	t_r, t_f	C_L
5 V to 15 V	V_{DD}	$0.5V_I$	≤ 20 ns	50 pF

12. Package outline

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

SOT109-1

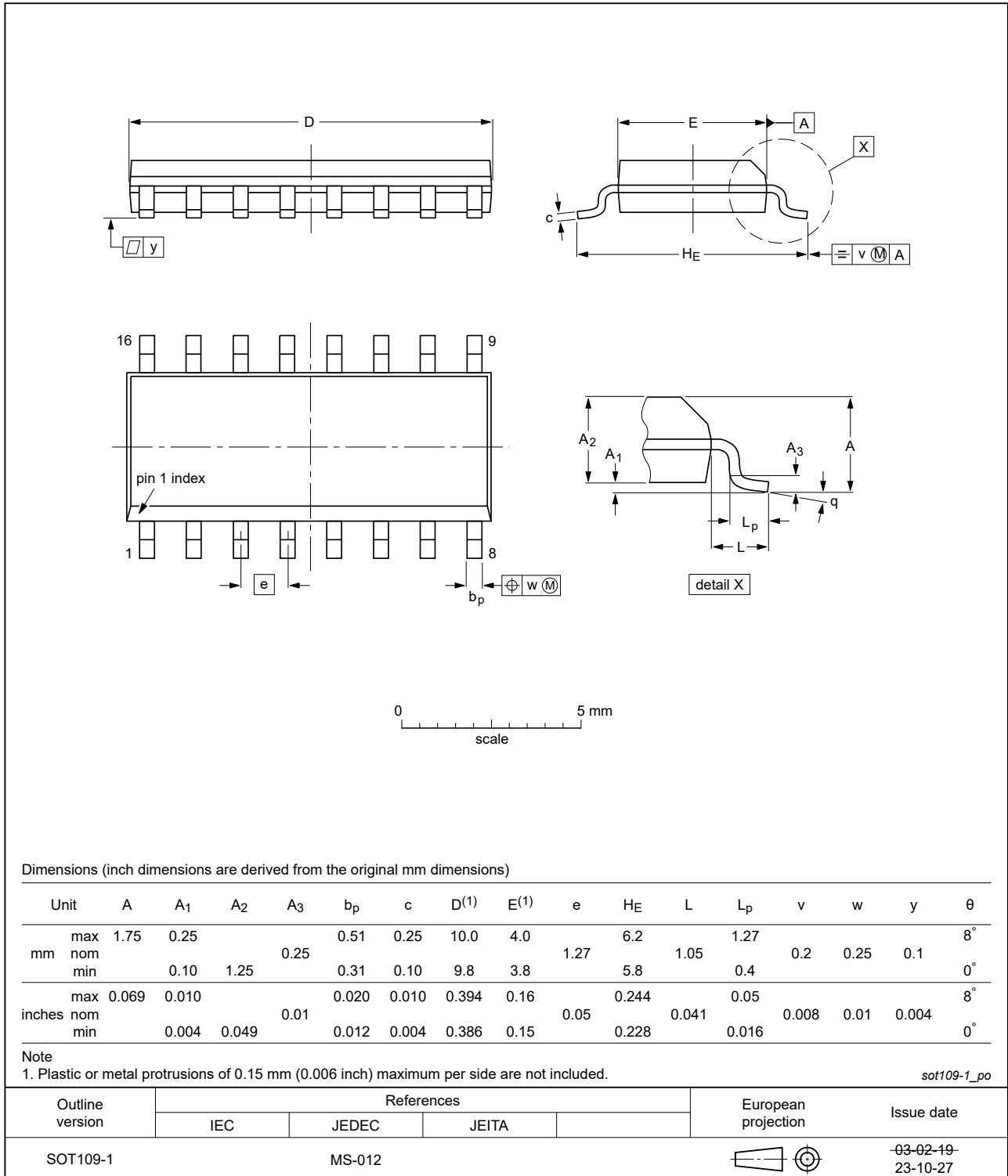


Fig. 7. Package outline SOT109-1 (SO16)

13. Abbreviations

Table 11. Abbreviations

Acronym	Description
ANSI	American National Standards Institute
CDM	Charged Device Model
CMOS	Complementary Metal Oxide Semiconductor
DTL	Diode Transistor Logic
DUT	Device Under Test
ESD	ElectroStatic Discharge
ESDA	ElectroStatic Discharge Association
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council
LOCMOS	Local Oxidation CMOS
TTL	Transistor-Transistor Logic

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4049B v.12	20240903	Product data sheet	-	HEF4049B v.11
Modifications:	<ul style="list-style-type: none"> • Section 2: ESD specification updated according to the latest JEDEC standard. • Fig. 7: Aligned SO package outline drawing to JEDEC MS-012 • The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Section 1 updated. 			
HEF4049B v.11	20160623	Product data sheet	-	HEF4049B v.10
Modifications:	<ul style="list-style-type: none"> • Table 4: condition for input clamping current changed (typo corrected). • Table 5: maximum value for input voltage changed (typo corrected). 			
HEF4049B v.10	20160324	Product data sheet	-	HEF4049B v.9
Modifications:	<ul style="list-style-type: none"> • Type number HEF4049BP (SOT38-4) removed. 			
HEF4049B v.9	20111118	Product data sheet	-	HEF4049B v.8
Modifications:	<ul style="list-style-type: none"> • Table 6: I_{OH} minimum values changed to maximum • Table 11: Added DUT 			
HEF4049B v.8	20091202	Product data sheet	-	HEF4049B v.7
HEF4049B v.7	20090721	Product data sheet	-	HEF4049B v.6
HEF4049B v.6	20090325	Product data sheet	-	HEF4049B v.5
HEF4049B v.5	20081111	Product data sheet	-	HEF4049B v.4
HEF4049B v.4	20080704	Product data sheet	-	HEF4049B_CNV v.3
HEF4049B_CNV v.3	19950101	Product specification	-	HEF4049B_CNV v.2
HEF4049B_CNV v.2	19950101	Product specification	-	-

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".
- [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 <https://www.nexperia.com>.

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