

# HEF4043B

## Quad R/S latch with 3-state outputs

Rev. 13 — 8 December 2021

Product data sheet

### 1. General description

The HEF4043B is a quad R/S latch with 3-state outputs and common output enable input (OE). Each latch has set (nS), and reset (nR) inputs and a 3-state output (nQ). When OE is LOW, the latch outputs are in the high impedance OFF-state. OE does not affect the state of the latch. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{DD}$ .

### 2. Features and benefits

- Wide supply voltage range from 3.0 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 JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0  $\Omega$ )
- Specified from -40 °C to +85 °C

### 3. Applications

- Four-bit storage with output enable

### 4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
HEF4043BT	-40 °C to +85 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

## 5. Functional diagram

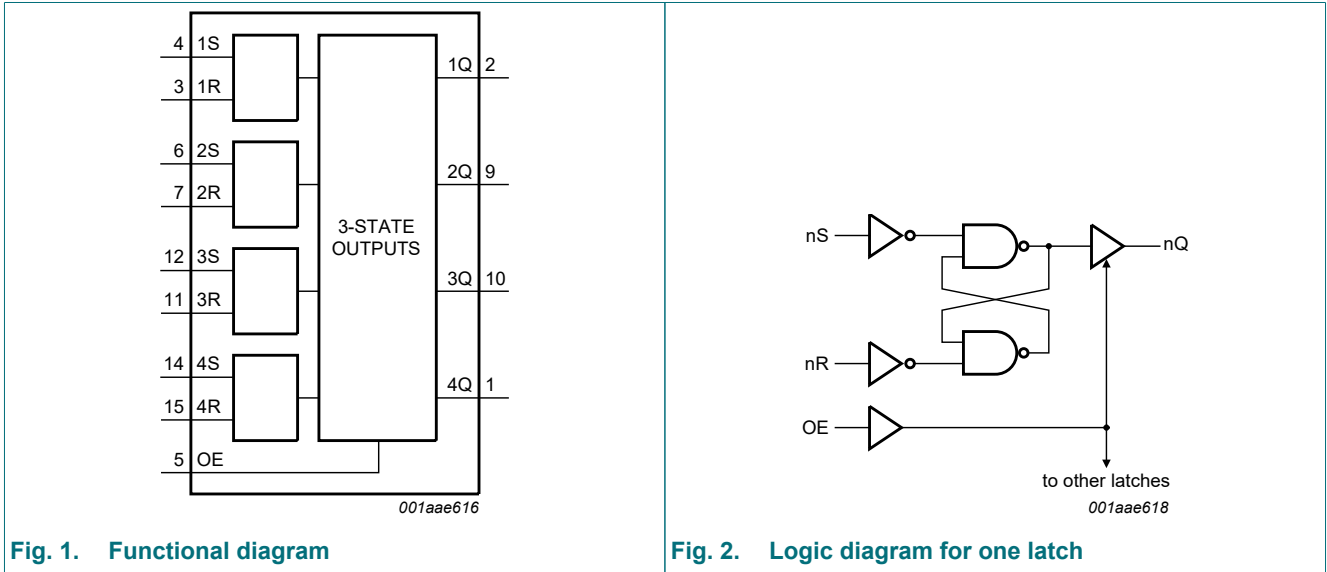


Fig. 1. Functional diagram

Fig. 2. Logic diagram for one latch

## 6. Pinning information

### 6.1. Pinning

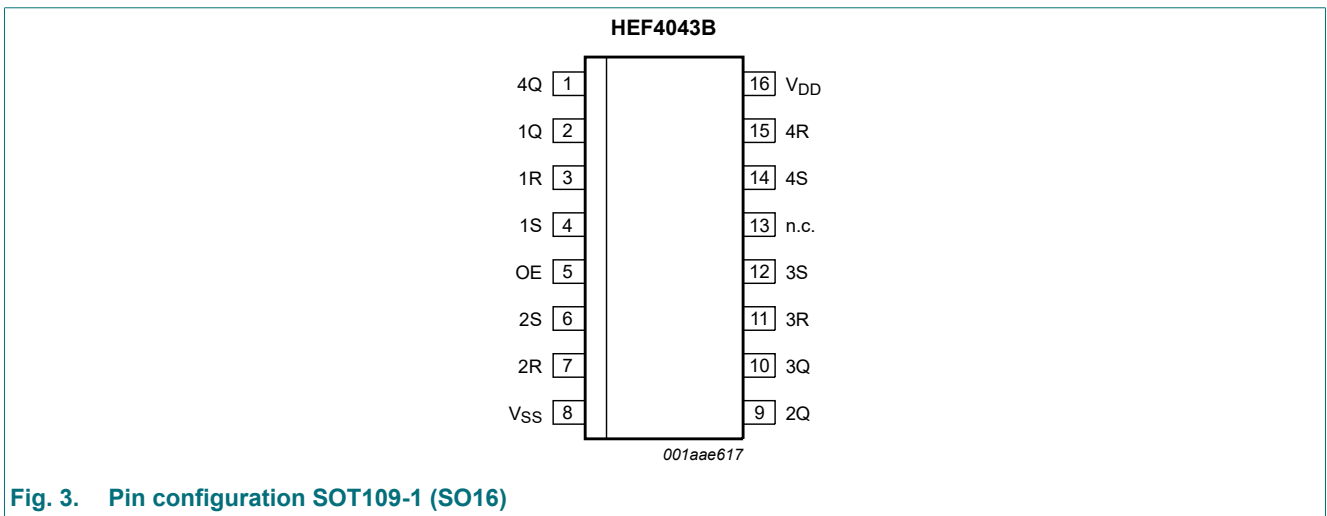


Fig. 3. Pin configuration SOT109-1 (SO16)

## 6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1Q, 2Q, 3Q, 4Q	2, 9, 10, 1	3-state buffered latch output
1R, 2R, 3R, 4R	3, 7, 11, 15	reset input (active HIGH)
1S, 2S, 3S, 4S	4, 6, 12, 14	set input (active HIGH)
OE	5	common output enable input
V <sub>SS</sub>	8	ground supply voltage
n.c.	13	not connected
V <sub>DD</sub>	16	supply voltage

## 7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high impedance state.

Inputs			Output
OE	nS	nR	nQ
L	X	X	Z
H	L	H	L
H	H	X	H
H	L	L	latched

## 8. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DD</sub>	supply voltage		-0.5	+18	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
V <sub>I</sub>	input voltage		-0.5	V <sub>DD</sub> + 0.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
I <sub>I/O</sub>	input/output current		-	±10	mA
I <sub>DD</sub>	supply current		-	50	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>amb</sub>	ambient temperature		-40	+85	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> -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	-	$V_{DD}$	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	$\mu\text{s/V}$

## 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	$V_{DD}$	$T_{amb} = -40\text{ °C}$		$T_{amb} = +25\text{ °C}$		$T_{amb} = +85\text{ °C}$		Unit
				Min	Max	Min	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$ I_O  < 1\ \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\ \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\ \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\ \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	-	$\pm 0.3$	-	$\pm 0.3$	-	$\pm 1.0$	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	nQ output HIGH; returned to $V_{DD}$	15 V	-	1.6	-	1.6	-	12.0	$\mu\text{A}$
		nQ output LOW; returned to $V_{SS}$	15 V	-	1.6	-	1.6	-	12.0	$\mu\text{A}$
$I_{DD}$	supply current	$I_O = 0\text{ A}$	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

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

$V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$  unless otherwise specified; for waveforms and test circuit see [Section 11.1](#).

Symbol	Parameter	Conditions	V <sub>DD</sub>	Extrapolation formula [1]	Min	Typ	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	nR → nQ; see <a href="#">Fig. 4</a>	5 V	63 ns + (0.55 ns/pF)C <sub>L</sub>	-	90	180	ns
			10 V	24 ns + (0.23 ns/pF)C <sub>L</sub>	-	35	70	ns
			15 V	17 ns + (0.16 ns/pF)C <sub>L</sub>	-	25	50	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	nS → nQ; see <a href="#">Fig. 4</a>	5 V	38 ns + (0.55 ns/pF)C <sub>L</sub>	-	65	135	ns
			10 V	14 ns + (0.23 ns/pF)C <sub>L</sub>	-	25	50	ns
			15 V	7 ns + (0.16 ns/pF)C <sub>L</sub>	-	15	35	ns
t <sub>t</sub>	transition time	nQ output; see <a href="#">Fig. 4</a>	5 V [2]	10 ns + (1.00 ns/pF)C <sub>L</sub>	-	60	120	ns
			10 V	9 ns + (0.42 ns/pF)C <sub>L</sub>	-	30	60	ns
			15 V	6 ns + (0.28 ns/pF)C <sub>L</sub>	-	20	40	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	OE → nQ; see <a href="#">Fig. 5</a>	5 V		-	45	90	ns
			10 V		-	20	35	ns
			15 V		-	10	25	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	OE → nQ; see <a href="#">Fig. 5</a>	5 V		-	50	100	ns
			10 V		-	20	40	ns
			15 V		-	10	25	ns
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	OE → nQ; see <a href="#">Fig. 5</a>	5 V		-	25	50	ns
			10 V		-	15	30	ns
			15 V		-	10	25	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay	OE → nQ; see <a href="#">Fig. 5</a>	5 V		-	40	80	ns
			10 V		-	20	45	ns
			15 V		-	15	35	ns
t <sub>w</sub>	pulse width	nS input HIGH; minimum width; see <a href="#">Fig. 4</a>	5 V		30	15	-	ns
			10 V		20	10	-	ns
			15 V		16	8	-	ns
		nR input HIGH; minimum width; see <a href="#">Fig. 4</a>	5 V		30	15	-	ns
			10 V		20	10	-	ns
			15 V		16	8	-	ns

[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown (C<sub>L</sub> in pF).

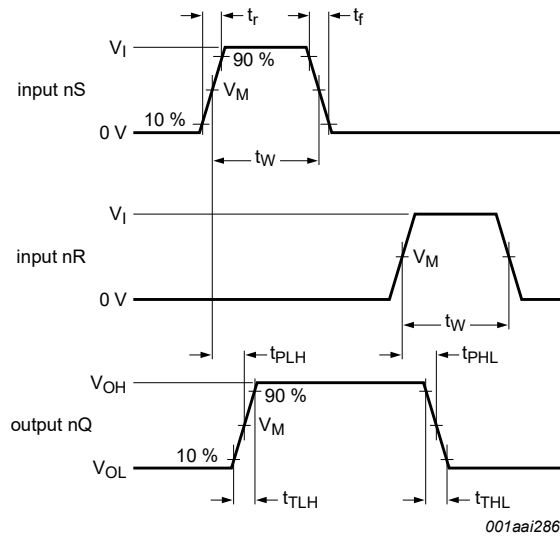
[2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

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

P<sub>D</sub> 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 <sub>DD</sub>	Typical formula for P <sub>D</sub> (μW)	where:
P <sub>D</sub>	dynamic power dissipation	5 V	$P_D = 1100 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	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	$P_D = 4400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 11400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

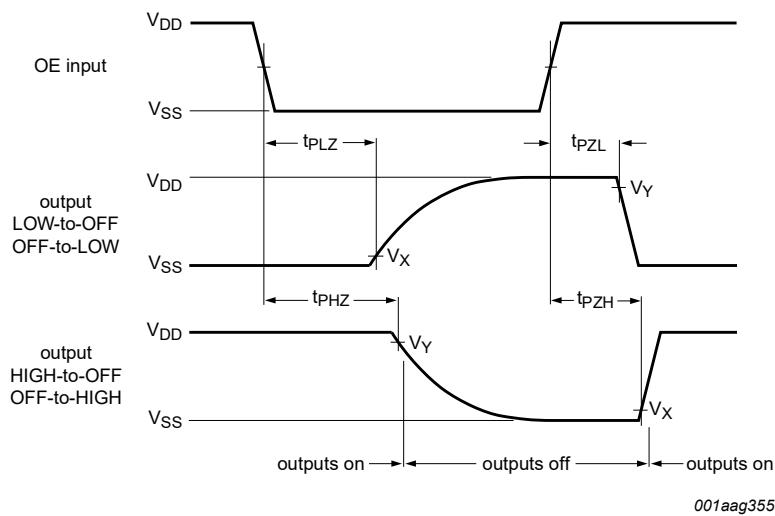
11.1. Waveforms and test circuit



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

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

**Fig. 4.** Input minimum set (nS) and reset (nR) pulse widths, inputs nS or nR to latch output (nQ) propagation delay and nQ transition time

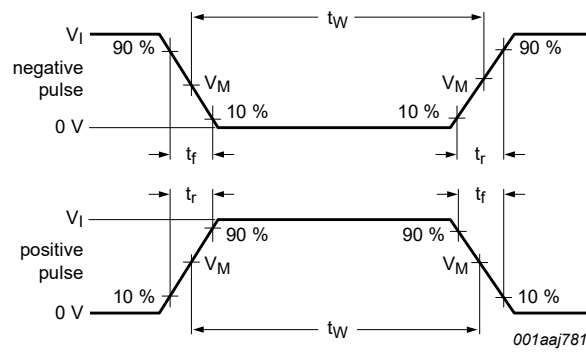


Measurement points are given in [Table 9](#).

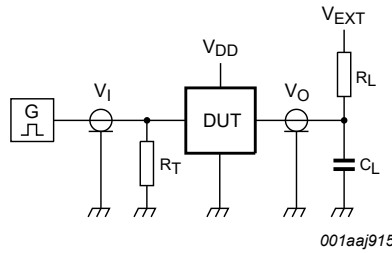
**Fig. 5.** Output enable (OE) to latch output (nQ) enable time ( $t_{PZL}$  and  $t_{PZH}$ ) and disable time ( $t_{PLZ}$  and  $t_{PHZ}$ )

**Table 9. Measurement points**

Supply voltage	Input		Output		
$V_{DD}$	$V_i$	$V_M$	$V_M$	$V_X$	$V_Y$
5 V to 15 V	$V_{DD}$ or 0 V	$0.5V_{DD}$	$0.5V_{DD}$	$0.1V_{DD}$	$0.9V_{DD}$



a. Input waveform



b. Test circuit

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

Definitions for test circuit:

$R_L$  = Load resistance;

$C_L$  = Load capacitance including jig and probe capacitance;

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator;

$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 6. Test circuit for measuring switching times**

**Table 10. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
$V_{DD}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
5 V to 15 V	$V_{DD}$	$\leq 20$ ns	50 pF	1 k $\Omega$	open	$V_{DD}$	GND

12. Package outline

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

SOT109-1

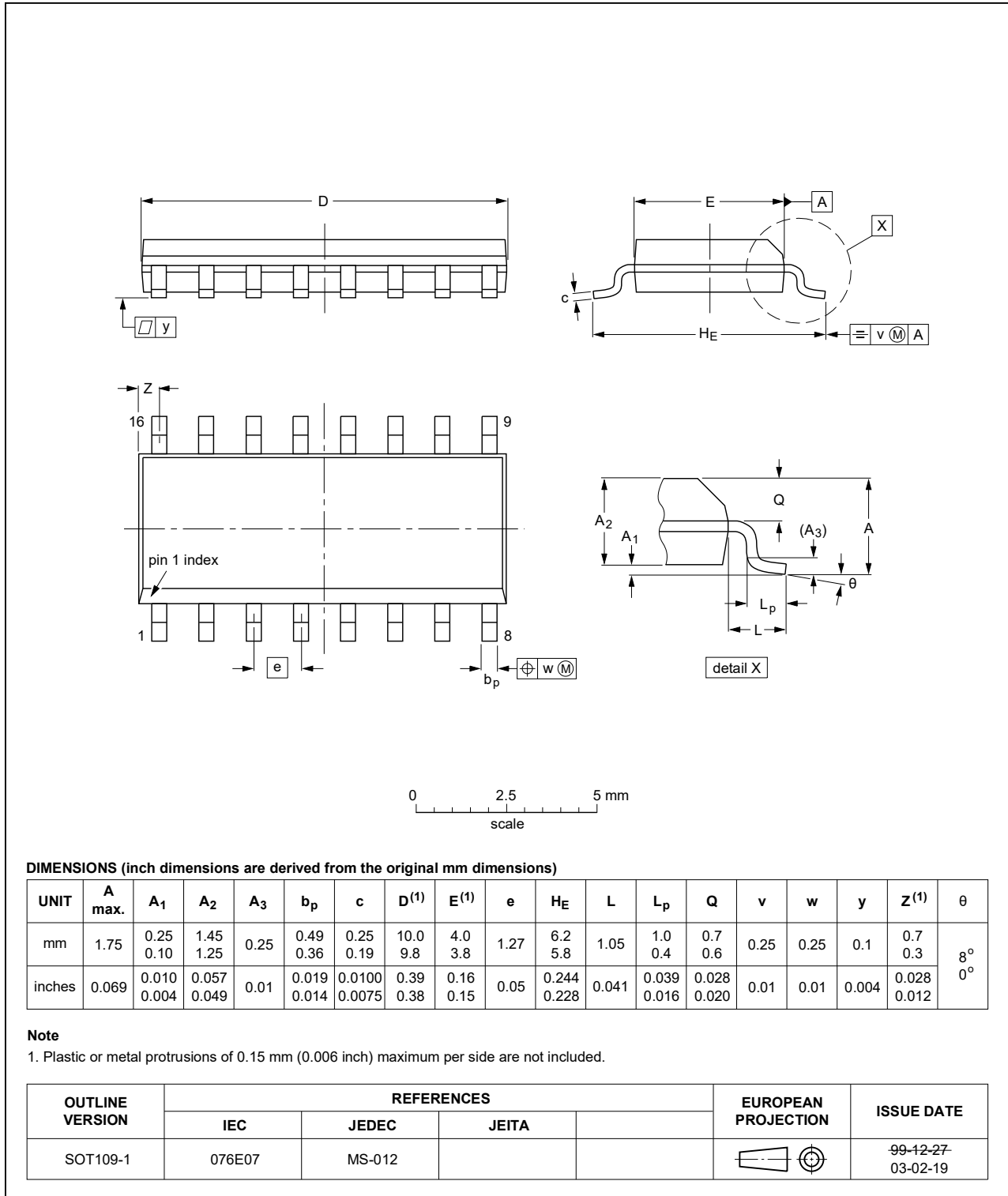


Fig. 7. Package outline SOT109-1 (SO16)



## 13. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4043B v.13	20211208	Product data sheet	-	HEF4043B v.12
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Section 1</a> and <a href="#">Section 14</a> updated.</li> <li>• <a href="#">Section 13</a> added.</li> </ul>			
HEF4043B v.12	20200130	Product data sheet	-	HEF4043B v.11
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> <li>• <a href="#">Fig. 2</a>: Typo corrected.</li> </ul>			
HEF4043B v.11	20160324	Product data sheet	-	HEF4043B v.10
Modifications:	<ul style="list-style-type: none"> <li>• Type number HEF4043BP (SOT38-4) removed.</li> </ul>			
HEF4043B v.10	20111118	Product data sheet	-	HEF4043B v.9
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Table 6</a>: <math>I_{OH}</math> minimum values changed to maximum</li> </ul>			
HEF4043B v.9	20091216	Product data sheet	-	HEF4043B v.8
HEF4043B v.8	20091127	Product data sheet	-	HEF4043B v.7
HEF4043B v.7	20090710	Product data sheet	-	HEF4043B v.6
HEF4043B v.6	20081111	Product data sheet	-	HEF4043B v.5
HEF4043B v.5	20080729	Product data sheet	-	HEF4043B v.4
HEF4043B v.4	20080710	Product data sheet	-	HEF4043B_CNV v.3
HEF4043B_CNV v.3	19950101	Product specification	-	HEF4043B_CNV v.2
HEF4043B_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.
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- [1] Please consult the most recently issued document before initiating or completing a design.
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