

HEF4043B-Q100

Quad R/S latch with 3-state outputs

Rev. 2 — 30 January 2020

Product

1. General description

The HEF4043B-Q100 is a quad R/S latch with 3-state outputs with a common output enable input (OE). Each latch has an active HIGH set input (1S to 4S), an active HIGH reset input (1R to 4R) and an active HIGH 3-state output (1Q to 4Q).

When OE is HIGH, the latch output (nQ) is determined by the nR and nS inputs (see [Table 3](#)). When OE is LOW, the latch outputs are in the high impedance OFF-state. OE does not affect the state of the latch. The high impedance off-state feature allows common bussing of the outputs.

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
- 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. Applications

- Four-bit storage with output enable

4. Ordering information

Table 1. Ordering information

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

Type number	Package		
	Name	Description	Version
HEF4043BT-Q100	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram

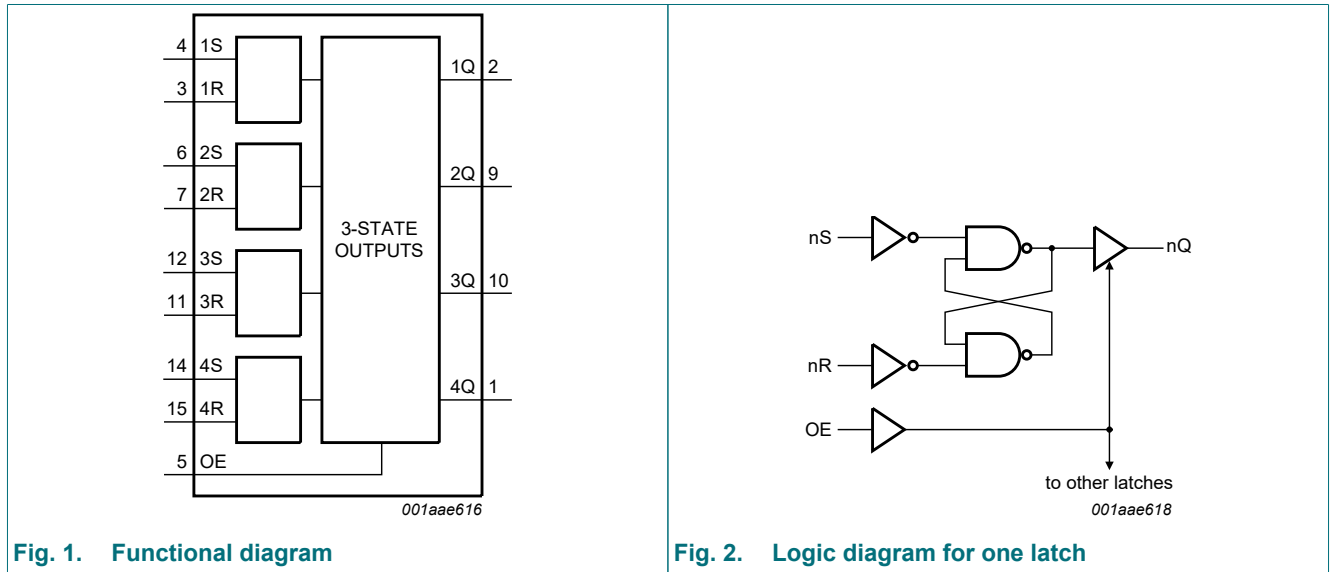


Fig. 1. Functional diagram

Fig. 2. Logic diagram for one latch

6. Pinning information

6.1. Pinning

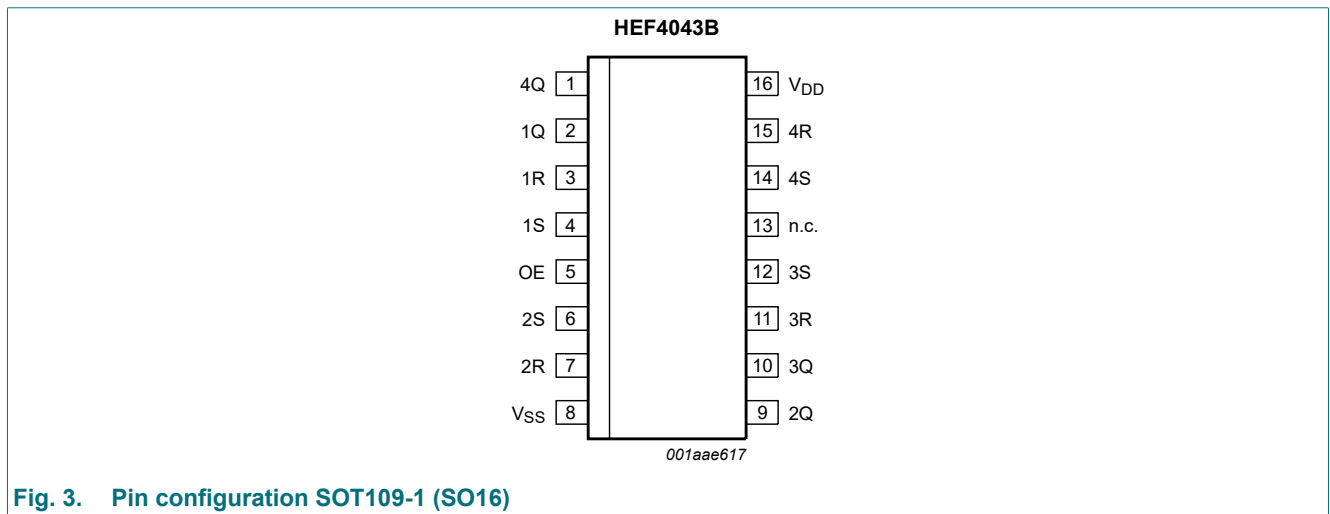


Fig. 3. Pin configuration SOT109-1 (SO16)

6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1Q to 4Q	2, 9, 10, 1	3-state buffered latch output
1R to 4R	3, 7, 11, 15	reset input (active HIGH)
1S to 4S	4, 6, 12, 14	set input (active HIGH)
OE	5	common output enable input
V _{SS}	8	ground supply voltage
n.c.	13	not connected
V _{DD}	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 _{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	-	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	-	± 0.3	-	± 0.3	-	± 1.0	μA
I_{OZ}	OFF-state output current	nQ output HIGH; returned to V_{DD}	15 V	-	1.6	-	1.6	-	12.0	μA
		nQ output LOW; returned to V_{SS}	15 V	-	1.6	-	1.6	-	12.0	μA
I_{DD}	supply current	$I_O = 0\text{ A}$	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

11. Dynamic characteristics

Table 7. Dynamic characteristics

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

Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	nR → nQ; see Fig. 4	5 V	[1] $63\text{ ns} + (0.55\text{ ns/pF})C_L$	-	90	180	ns
			10 V	$24\text{ ns} + (0.23\text{ ns/pF})C_L$	-	35	70	ns
			15 V	$17\text{ ns} + (0.16\text{ ns/pF})C_L$	-	25	50	ns
t_{PLH}	LOW to HIGH propagation delay	nS → nQ; see Fig. 4	5 V	[1] $38\text{ ns} + (0.55\text{ ns/pF})C_L$	-	65	135	ns
			10 V	$14\text{ ns} + (0.23\text{ ns/pF})C_L$	-	25	50	ns
			15 V	$7\text{ ns} + (0.16\text{ ns/pF})C_L$	-	15	35	ns
t_t	transition time	nQ output; see Fig. 4	5 V	[1] [2] $10\text{ ns} + (1.00\text{ ns/pF})C_L$	-	60	120	ns
			10 V	$9\text{ ns} + (0.42\text{ ns/pF})C_L$	-	30	60	ns
			15 V	$6\text{ ns} + (0.28\text{ ns/pF})C_L$	-	20	40	ns
t_{PHZ}	HIGH to OFF-state propagation delay	OE → nQ; see Fig. 5	5 V		-	45	90	ns
			10 V		-	20	35	ns
			15 V		-	10	25	ns
t_{PLZ}	LOW to OFF-state propagation delay	OE → nQ; see Fig. 5	5 V		-	50	100	ns
			10 V		-	20	40	ns
			15 V		-	10	25	ns
t_{PZH}	OFF-state to HIGH propagation delay	OE → nQ; see Fig. 5	5 V		-	25	50	ns
			10 V		-	15	30	ns
			15 V		-	10	25	ns
t_{PZL}	OFF-state to LOW propagation delay	OE → nQ; see Fig. 5	5 V		-	40	80	ns
			10 V		-	20	45	ns
			15 V		-	15	35	ns
t_w	pulse width	nS input HIGH; minimum width; see Fig. 4	5 V		30	15	-	ns
			10 V		20	10	-	ns
			15 V		16	8	-	ns
		nR input HIGH; minimum width; see Fig. 4	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_L in pF).

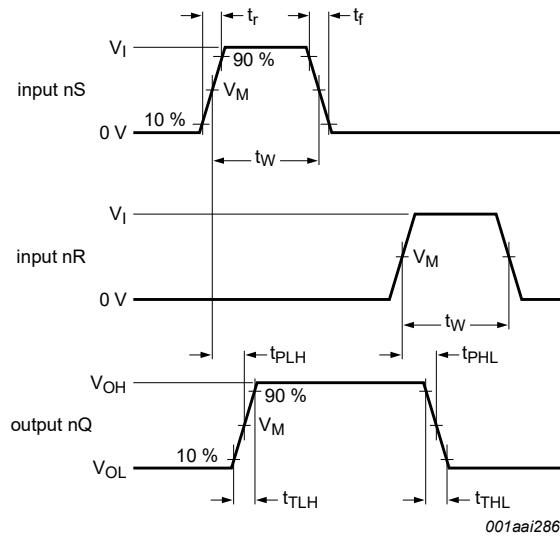
[2] t_t is the same as t_{THL} and t_{TLH} .

Table 8. Dynamic power dissipation P_D

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

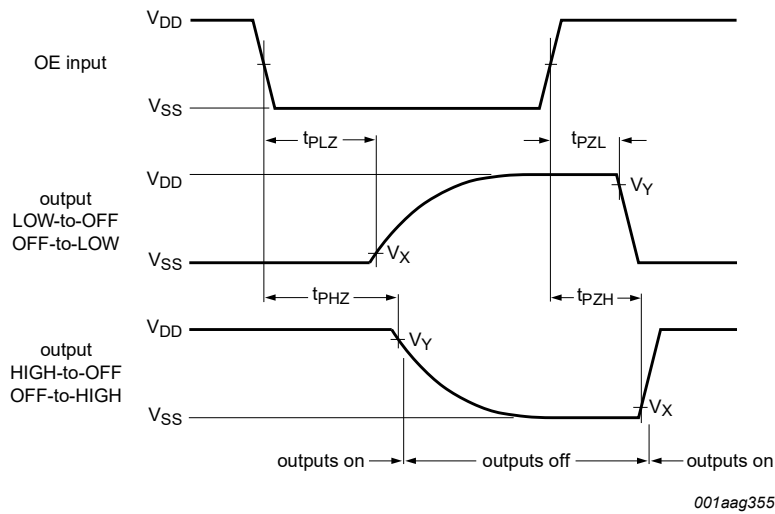
Symbol	Parameter	V_{DD}	Typical formula for P_D (μW)	where:
P_D	dynamic power dissipation	5 V	$P_D = 1100 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz; f_o = output frequency in MHz; C_L = output load capacitance in pF; V_{DD} = supply voltage in V; $\Sigma(f_o \times C_L)$ = sum of the outputs.
		10 V	$P_D = 4400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 11400 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

11.1. Waveforms



t_r and t_f are the input rise and fall times.
 Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.
 Transition times: transition time (t_t) = HIGH LOW (t_{THL}) or LOW HIGH (t_{TLH}) transition times.
 Measurement points are given in [Table 9](#) and test data is given in [Table 10](#).

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

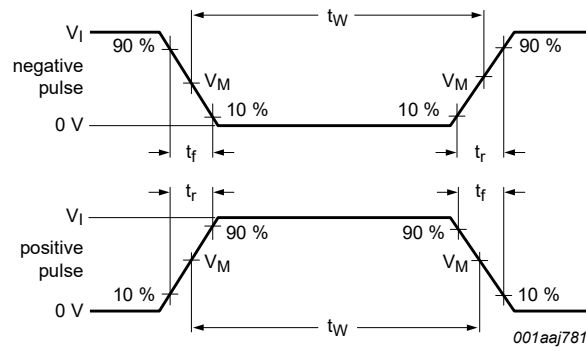


Measurement points are given in [Table 9](#).

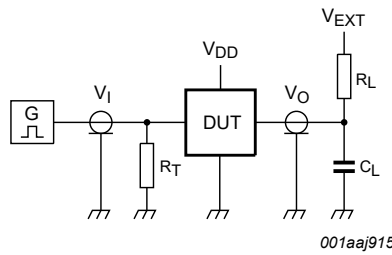
Fig. 5. Output enable (OE) to latch output (nQ) enable time (t_{PZL} and t_{PZH}) and disable time (t_{PLZ} and t_{PHZ})

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 test circuit:

DUT = Device Under Test.

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}	≤ 20 ns	50 pF	1 k Ω	open	V_{DD}	GND

12. Package outline

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

SOT109-1

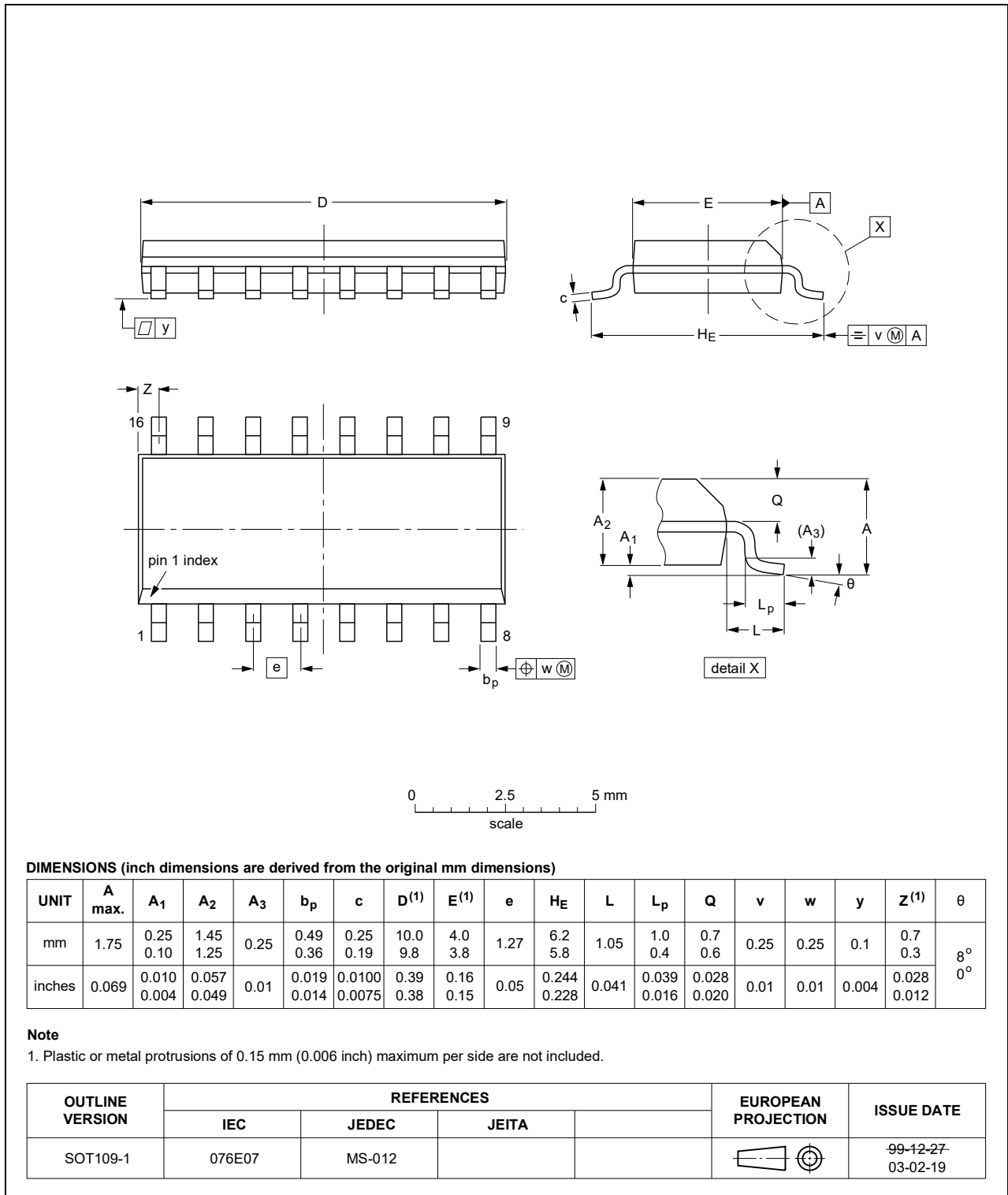


Fig. 7. Package outline SOT109-1 (SO16)

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4043B_Q100 v.2	20200130	Product data sheet	-	HEF4043B_Q100 v.1
Modifications:	<ul style="list-style-type: none">• 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.• Fig. 2: Typo corrected.			
HEF4043B_Q100 v.1	20130715	Product specification	-	-

14. 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.
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Date of release: 30 January 2020
