



**THE DATASHEET OF
HEF40098BP,652**



HEF40098B

Hex inverting buffer; 3-state

Rev. 9 — 18 March 2016

Product data sheet

1. General description

The HEF40098B is a hex inverting buffer with 3-state outputs. The 3-state outputs are controlled by two active LOW enable inputs ($\overline{1OE}$ and $\overline{2OE}$). A HIGH on $\overline{1OE}$ causes four of the six active LOW buffer elements ($\overline{1Y0}$ to $\overline{1Y3}$) to assume a high-impedance or OFF-state regardless of the other input conditions and a HIGH on $\overline{2OE}$ causes the outputs of the remaining two buffer elements ($\overline{2Y0}$ and $\overline{2Y1}$) to assume a high-impedance or OFF-state regardless of the other input conditions.

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.

2. Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

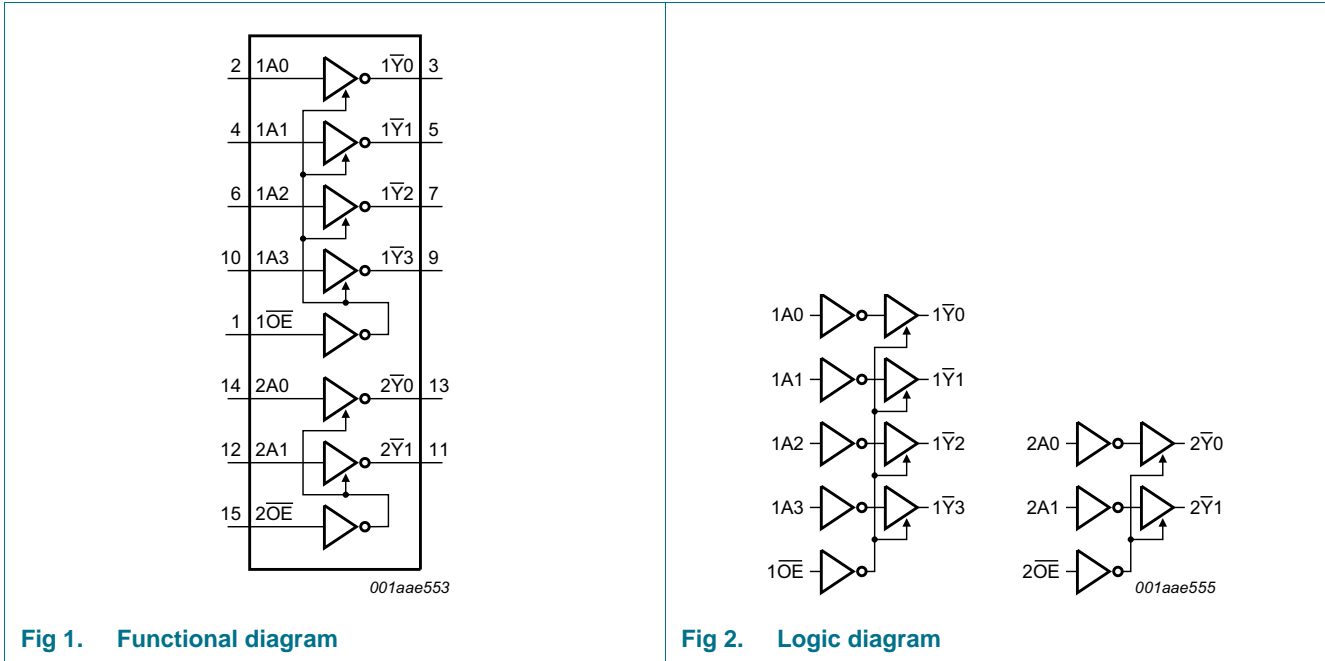
3. Ordering information

Table 1. Ordering information

All types operate from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$

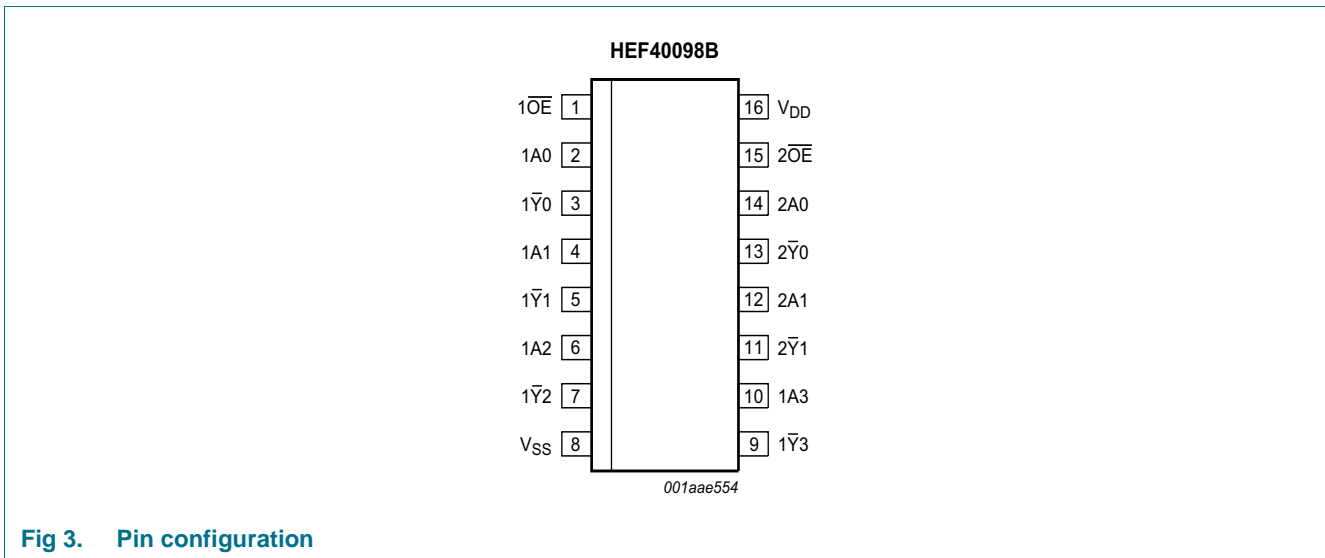
Type number	Package		
	Name	Description	Version
HEF40098BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\overline{OE}$	1	output enable input (active LOW)
1A0, 1A1, 1A2, 1A3	2, 4, 6, 10	buffer input
$1\overline{Y}0, 1\overline{Y}1, 1\overline{Y}2, 1\overline{Y}3$	3, 5, 7, 9	buffer output (active LOW)
V_{SS}	8	supply voltage
$2\overline{Y}0, 2\overline{Y}1$	13, 11	buffer output (active LOW)
2A0, 2A1	14, 12	buffer input
$2\overline{OE}$	15	output enable input (active LOW)
V_{DD}	16	supply voltage

6. Functional description

Table 3. Function table^[1]

Inputs		Output
nAn	$n\overline{OE}$	$n\overline{Y}n$
H	L	L
L	L	H
X	H	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

7. 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	$V_I < -0.5\text{ V}$ or $V_I > V_{DD} + 0.5\text{ V}$	-	± 10	mA
V_I	input voltage		-0.5	$V_{DD} + 0.5$	V
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{DD} + 0.5\text{ V}$	-	± 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	$T_{amb} = -40\text{ to }+85\text{ °C}$			
		SO16 package ^[1]	-	500	mW
P	power dissipation		-	100	mW

[1] For SO16 package: P_{tot} derates linearly with 8 mW/K above 70 °C.

8. 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	ns/V
		$V_{DD} = 10\text{ V}$	-	-	0.5	ns/V
		$V_{DD} = 15\text{ V}$	-	-	0.08	ns/V

9. 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\text{ }\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\text{ }\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\text{ }\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\text{ }\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	-	-3.8	-	-3.2	-	-2.5	mA
		$V_O = 4.6\text{ V}$	5 V	-	-1.2	-	-1.0	-	-0.8	mA
		$V_O = 9.5\text{ V}$	10 V	-	-3.8	-	-3.2	-	-2.5	mA
		$V_O = 13.5\text{ V}$	15 V	-	-12.0	-	-10.0	-	-8.0	mA
I_{OL}	LOW-level output current	$V_O = 0.4\text{ V}$;	4.75 V	3.5	-	2.9	-	2.3	-	mA
		$V_O = 0.5\text{ V}$;	10 V	12.0	-	10.0	-	8.0	-	mA
		$V_O = 1.5\text{ V}$;	15 V	24.0	-	20.0	-	16.0	-	mA
I_I	input leakage current	$V_I = 0\text{ V}$ or 15 V	15 V	-	0.3	-	0.3	-	1.0	μA
I_{DD}	supply current	$I_O = 0\text{ A}$	5 V	-	4	-	4	-	30	μA
			10 V	-	8	-	8	-	60	μA
			15 V	-	16	-	16	-	120	μA
I_{OZ}	OFF-state output current		15 V	-	1.6	-	1.6	-	12.0	μA
C_I	input capacitance			-	-	-	7.5	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; for test circuit see [Figure 6](#); unless otherwise specified.

Symbol	Parameter	Conditions	V _{DD}	Extrapolation formula ^[1]	Min	Typ	Max	Unit
t _{PHL}	HIGH to LOW propagation delay	nAn to nȳn; see Figure 4	5 V	70 ns + (0.20 ns/pF)C _L	-	80	160	ns
			10 V	31 ns + (0.08 ns/pF)C _L	-	35	70	ns
			15 V	22 ns + (0.06 ns/pF)C _L	-	25	50	ns
t _{PLH}	LOW to HIGH propagation delay	nAn to nȳn; see Figure 4	5 V	50 ns + (0.30 ns/pF)C _L	-	65	130	ns
			10 V	24 ns + (0.13 ns/pF)C _L	-	30	60	ns
			15 V	23 ns + (0.05 ns/pF)C _L	-	25	50	ns
t _{THL}	HIGH to LOW output transition time	see Figure 4	5 V	15 ns + (0.30 ns/pF)C _L	-	30	60	ns
			10 V	10 ns + (0.11 ns/pF)C _L	-	15	30	ns
			15 V	7 ns + (0.07 ns/pF)C _L	-	10	20	ns
t _{TLH}	LOW to HIGH output transition time	see Figure 4	5 V	10 ns + (0.50 ns/pF)C _L	-	35	70	ns
			10 V	8 ns + (0.24 ns/pF)C _L	-	20	40	ns
			15 V	6 ns + (0.18 ns/pF)C _L	-	15	30	ns
t _{PHZ}	HiGH to OFF-state propagation delay	nȳOE, to nȳn; see Figure 5	5 V		-	45	85	ns
			10 V		-	35	65	ns
			15 V		-	30	60	ns
t _{PLZ}	LOW to OFF-state propagation delay	nȳOE, to nȳn; see Figure 5	5 V		-	65	135	ns
			10 V		-	40	80	ns
			15 V		-	35	70	ns
t _{PZH}	OFF-state to HIGH propagation delay	nȳOE, to nȳn; see Figure 5	5 V		-	70	140	ns
			10 V		-	35	75	ns
			15 V		-	30	65	ns
t _{PZL}	OFF-state to LOW propagation delay	nȳOE, to nȳn; see Figure 5	5 V		-	90	185	ns
			10 V		-	40	85	ns
			15 V		-	35	70	ns

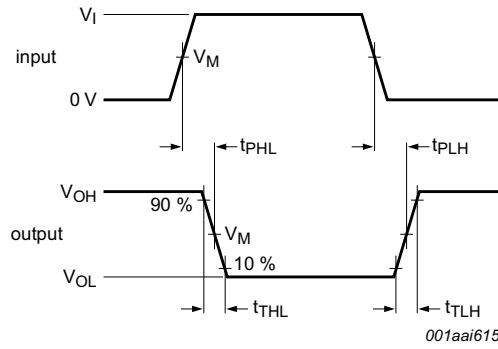
[1] The typical value of the propagation delay and transition times are calculated from the extrapolation formula as shown (C_L in pF).

Table 8. Dynamic power dissipation P_D

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

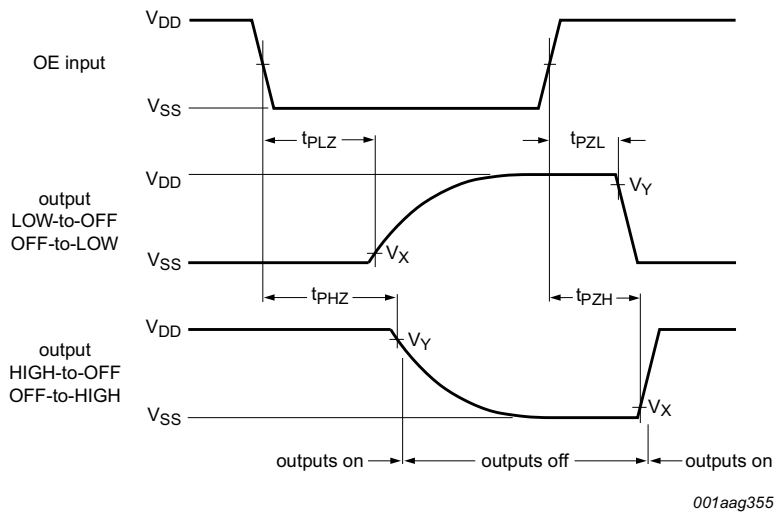
Symbol	Parameter	V _{DD}	Typical formula for P _D (μW)	where:
P _D	dynamic power dissipation	5 V	$P_D = 5000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f _i = input frequency in MHz, f _o = output frequency in MHz, C _L = output load capacitance in pF, V _{DD} = supply voltage in V, Σ(C _L × f _o) = sum of the outputs.
		10 V	$P_D = 22800 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 81000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

11. AC waveforms



Measurement points are given in Table 9, V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 4. Input (nAn) to output (nYn) propagation delays

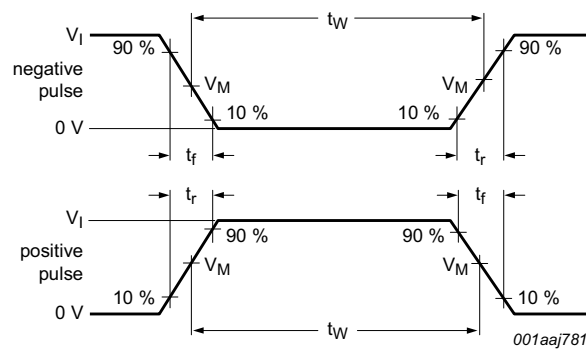


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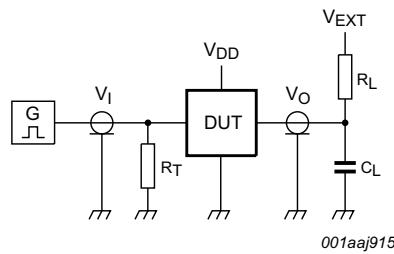
Fig 5. 3-state enable and disable times

Table 9. Measurement points

Supply voltage	Input	Output		
V_{DD}	V_M	V_M	V_X	V_Y
5 V to 15 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

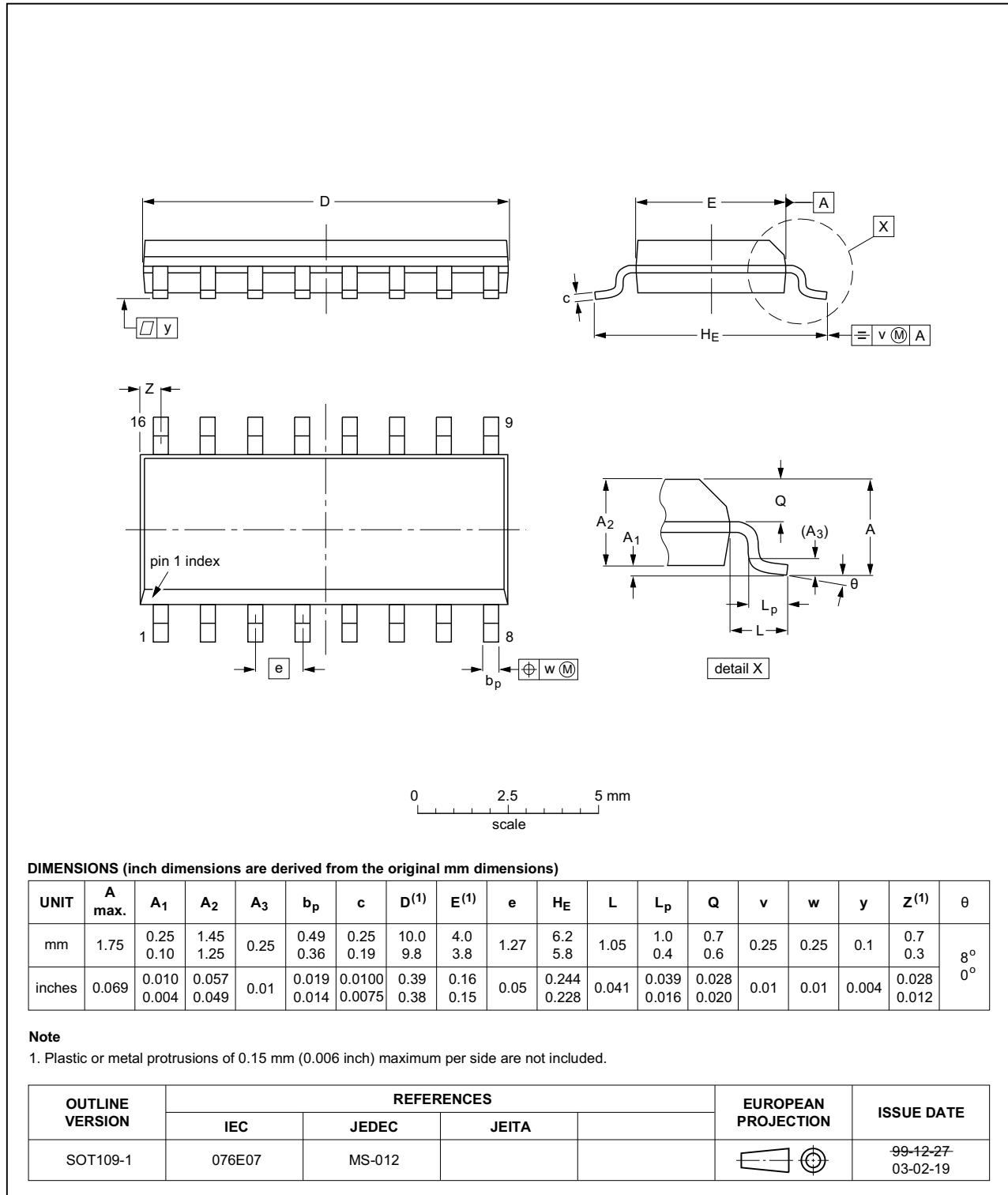


Fig 7. Package outline SOT109-1 (SO16)

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF40098B v.9	20160318	Product data sheet	-	HEF40098B v.8
Modifications:	<ul style="list-style-type: none"> Type number HEF40098BP (SOT38-4) removed. 			
HEF40098B v.8	20111121	Product data sheet	-	HEF40098B v.7
Modifications:	<ul style="list-style-type: none"> Legal pages updated. Changes in “General description” and “Features and benefits”. Section “Applications” removed. 			
HEF40098B v.7	20110914	Product data sheet	-	HEF40098B v.6
HEF40098B v.6	20090624	Product data sheet	-	HEF40098B v.5
HEF40098B v.5	20081031	Product data sheet	-	HEF40098B v.4
HEF40098B v.4	20080731	Product data sheet	-	HEF40098B_CNV v.3
HEF40098B_CNV v.3	19950101	Product specification	-	HEF40098B_CNV v.2
HEF40098B_CNV v.2	19950101	Product specification	-	-

14. Legal information

14.1 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".

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