

74HC4002; 74HCT4002

Dual 4-input NOR gate

Rev. 4 — 17 September 2012

Product data sheet

1. General description

The 74HC4002; 74HCT4002 is a dual 4-input NOR gate. Inputs also include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- Complies with JEDEC standard JESD7A
- Low-power dissipation
- Input levels:
 - ◆ For 74HC4002: CMOS level
 - ◆ For 74HCT4002: TTL level
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to $+80\text{ °C}$ and from -40 °C to $+125\text{ °C}$.

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC4002N 74HCT4002N	-40 °C to $+125\text{ °C}$	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC4002D 74HCT4002D	-40 °C to $+125\text{ °C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC4002DB 74HCT4002DB	-40 °C to $+125\text{ °C}$	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HC4002PW	-40 °C to $+125\text{ °C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1



4. Functional diagram

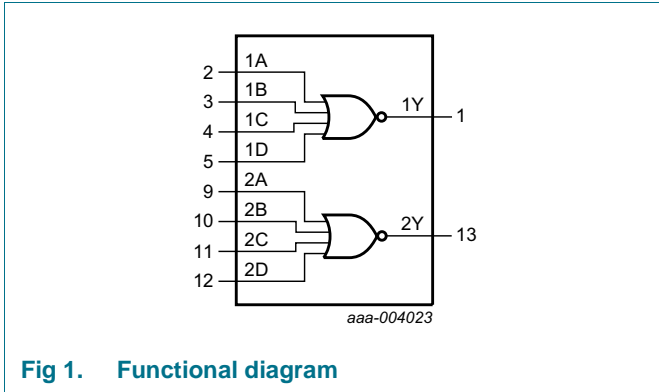


Fig 1. Functional diagram

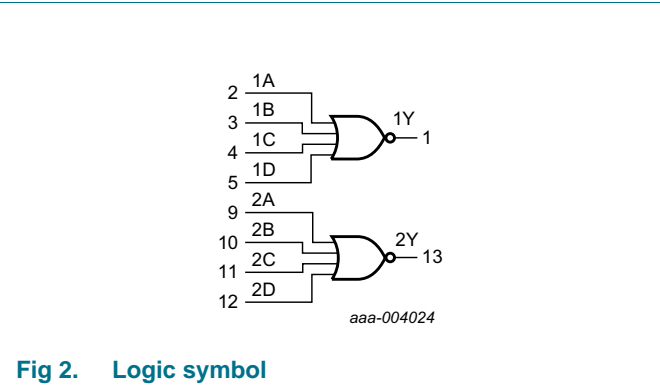


Fig 2. Logic symbol

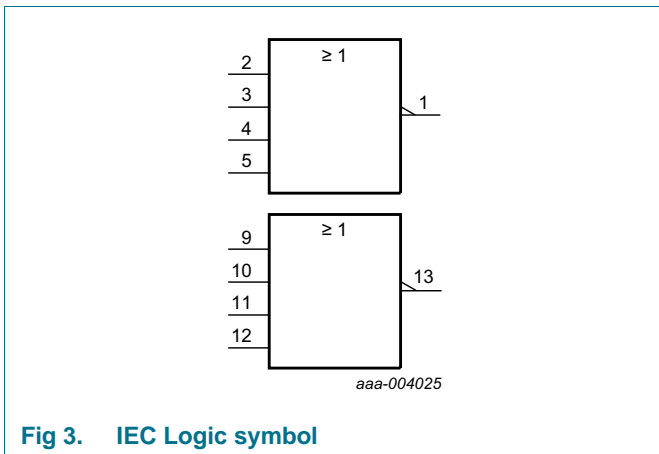


Fig 3. IEC Logic symbol

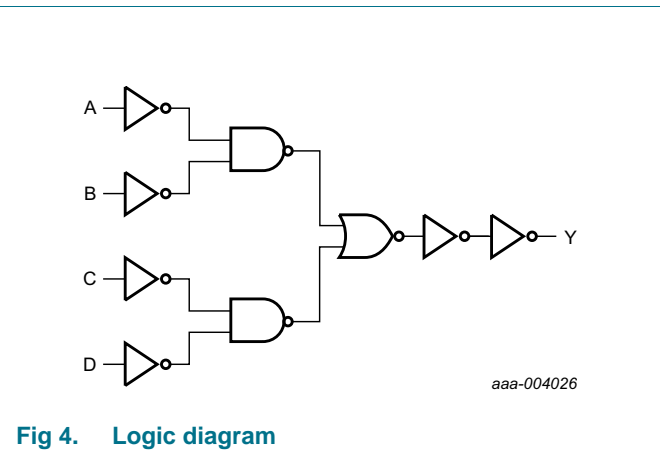


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning

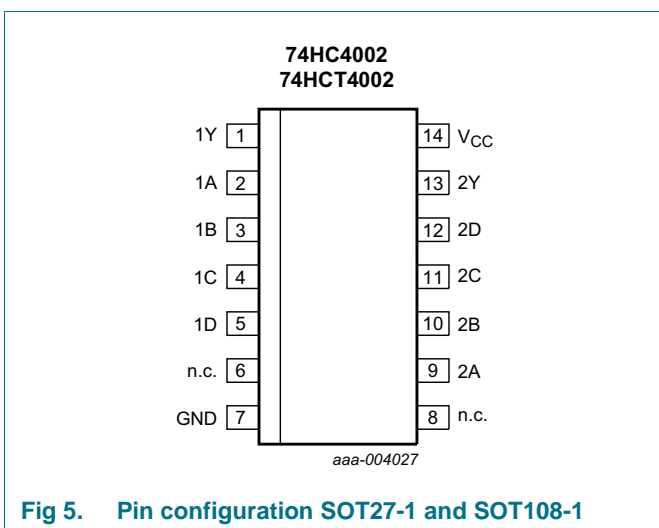


Fig 5. Pin configuration SOT27-1 and SOT108-1

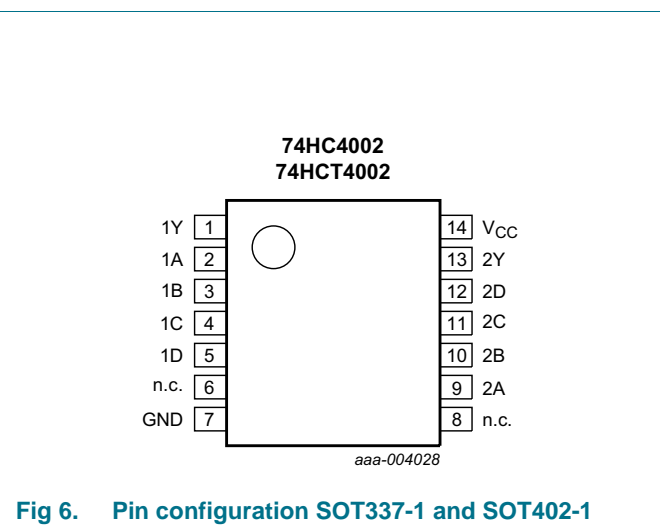


Fig 6. Pin configuration SOT337-1 and SOT402-1

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1Y	1	data output
1A, 1B, 1C, 1D	2, 3, 4, 5	data input
n.c.	6, 8	not connected
GND	7	ground (0 V)
2Y	13	data output
2A, 2B, 2C, 2D	9, 10, 11, 12	data input
V _{CC}	14	supply voltage

6. Functional description

Table 3. Function table^[1]

Input				Output
nA	nB	nC	nD	nY
L	L	L	L	H
H	X	X	X	L
X	H	X	X	L
X	X	H	X	L
X	X	X	H	L

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+7	V
I _{IK}	input clamping current	V _I < -0.5 V or V _I > V _{CC} + 0.5 V	[1]	±20	mA
I _{OK}	output clamping current	V _O < -0.5 V or V _O > V _{CC} + 0.5 V	[1]	±20	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 V	-	±25	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation		[2]		
	DIP14 package		-	750	mW
	SO14, and (T)SSOP14 packages		-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For DIP14 package: P_{tot} derates linearly with 12 mW/K above 70 °C.
 For SO14 package: P_{tot} derates linearly with 8 mW/K above 70 °C.
 For (T)SSOP14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC4002			74HCT4002			Unit
			Min	Typ	Max	Min	Typ	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V _I	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V _{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V _{CC} = 6.0 V	-	-	83	-	-	-	ns/V

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4002										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1	-	±1	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	2	-	20	-	40	μA

Table 6. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
C _I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT4002										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA	3.84	4.32	-	3.84	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 20 µA	-	0	0.1	-	0.1	-	0.1	V
		I _O = 5.2 mA	-	0.15	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	2	-	20	-	40	µA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V	-	45	162	-	203	-	221	µA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; $C_L = 50\text{ pF}$; for load circuit see [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C		Unit	
			Min	Typ	Max	Max (85 °C)	Max (125 °C)		
74HC4002									
t_{pd}	propagation delay	nA, nB, nC or nD to nY; see Figure 7	[1]						
		$V_{CC} = 2.0\text{ V}$	-	30	100	125	150	ns	
		$V_{CC} = 4.5\text{ V}$	-	11	20	25	30	ns	
		$V_{CC} = 6.0\text{ V}$	-	9	17	21	26	ns	
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	9	-	-	-	ns	
t_t	transition time	see Figure 7	[2]						
		$V_{CC} = 2.0\text{ V}$	-	19	75	95	110	ns	
		$V_{CC} = 4.5\text{ V}$	-	7	15	19	22	ns	
		$V_{CC} = 6.0\text{ V}$	-	6	13	16	19	ns	
C_{PD}	power dissipation capacitance	per package; $V_I = GND$ to V_{CC}	[3]	-	16	-	-	-	pF
74HCT4002									
t_{pd}	propagation delay	nA, nB, nC or nD to nY; see Figure 7	[1]						
		$V_{CC} = 4.5\text{ V}$	-	13	22	28	33	ns	
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	11	-	-	-	ns	
t_t	transition time	$V_{CC} = 4.5\text{ V}$; see Figure 7	[2]	-	7	15	19	22	ns
C_{PD}	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC} - 1.5\text{ V}$	[3]	-	22	-	-	-	pF

[1] t_{pd} is the same as t_{PHL} and t_{PLH} .

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

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$$

where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

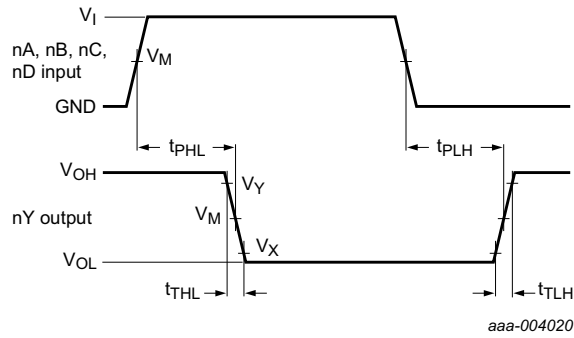
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms

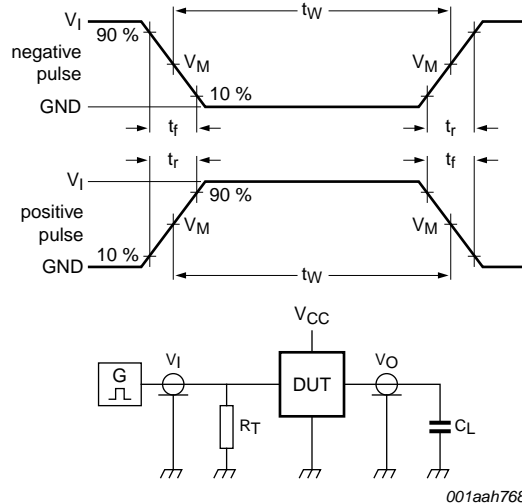


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 7. Waveforms showing the input (nA, nB, nC, nD) to output (nY) propagation delays and the output transition times

Table 8. Measurement points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
74HC4002	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$
74HCT4002	1.3 V	1.3 V	$0.1V_{CC}$	$0.9V_{CC}$



Test data is given in [Table 9](#).
 Definitions test circuit:
 R_T = termination resistance should be equal to output impedance Z_o of the pulse generator.
 C_L = load capacitance including jig and probe capacitance.

Fig 8. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V _I	t _r , t _f	C _L	
74HC4002	V _{CC}	6.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}
74HCT4002	3.0 V	6.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}

12. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

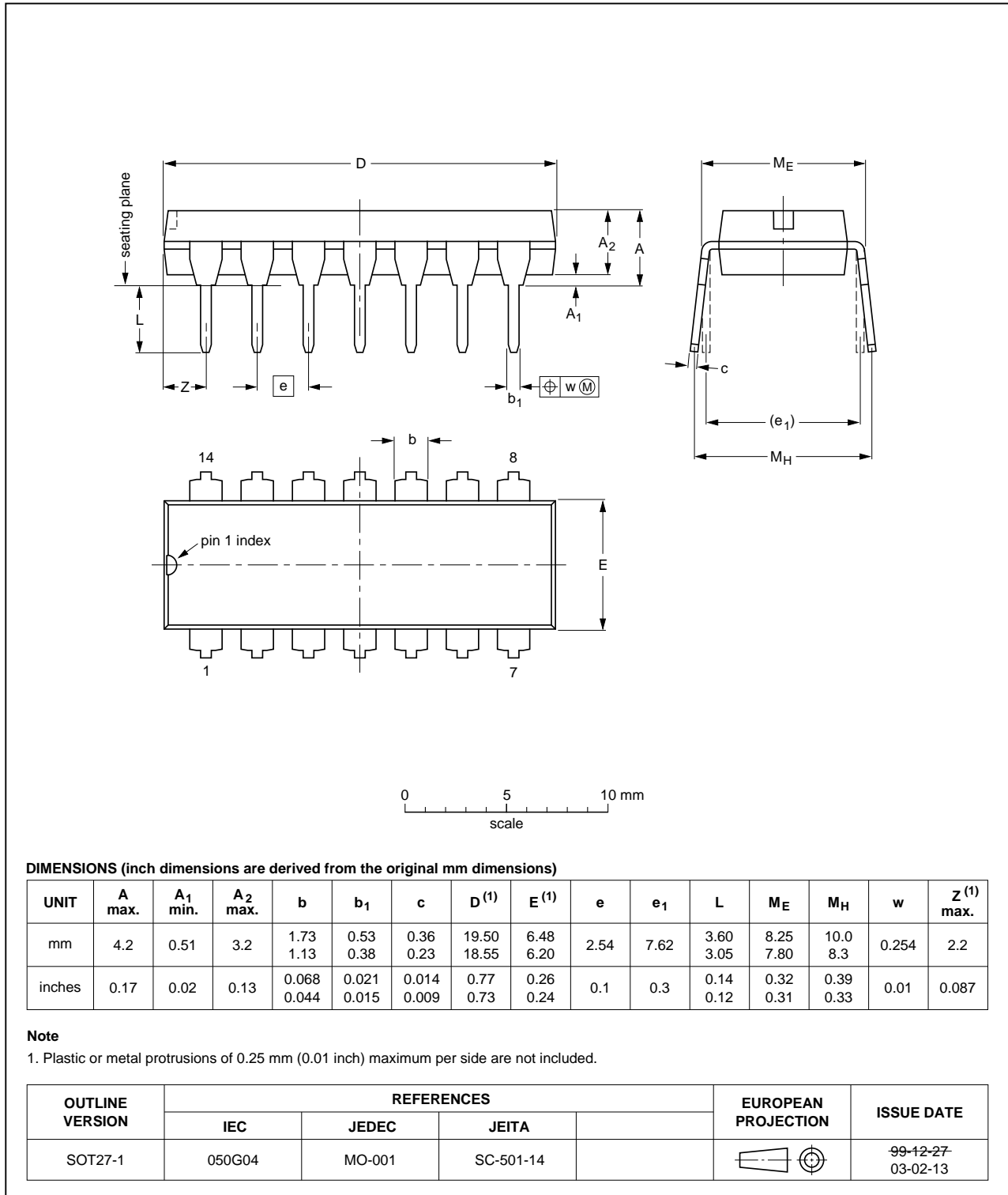


Fig 9. Package outline SOT27-1 (DIP14)

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

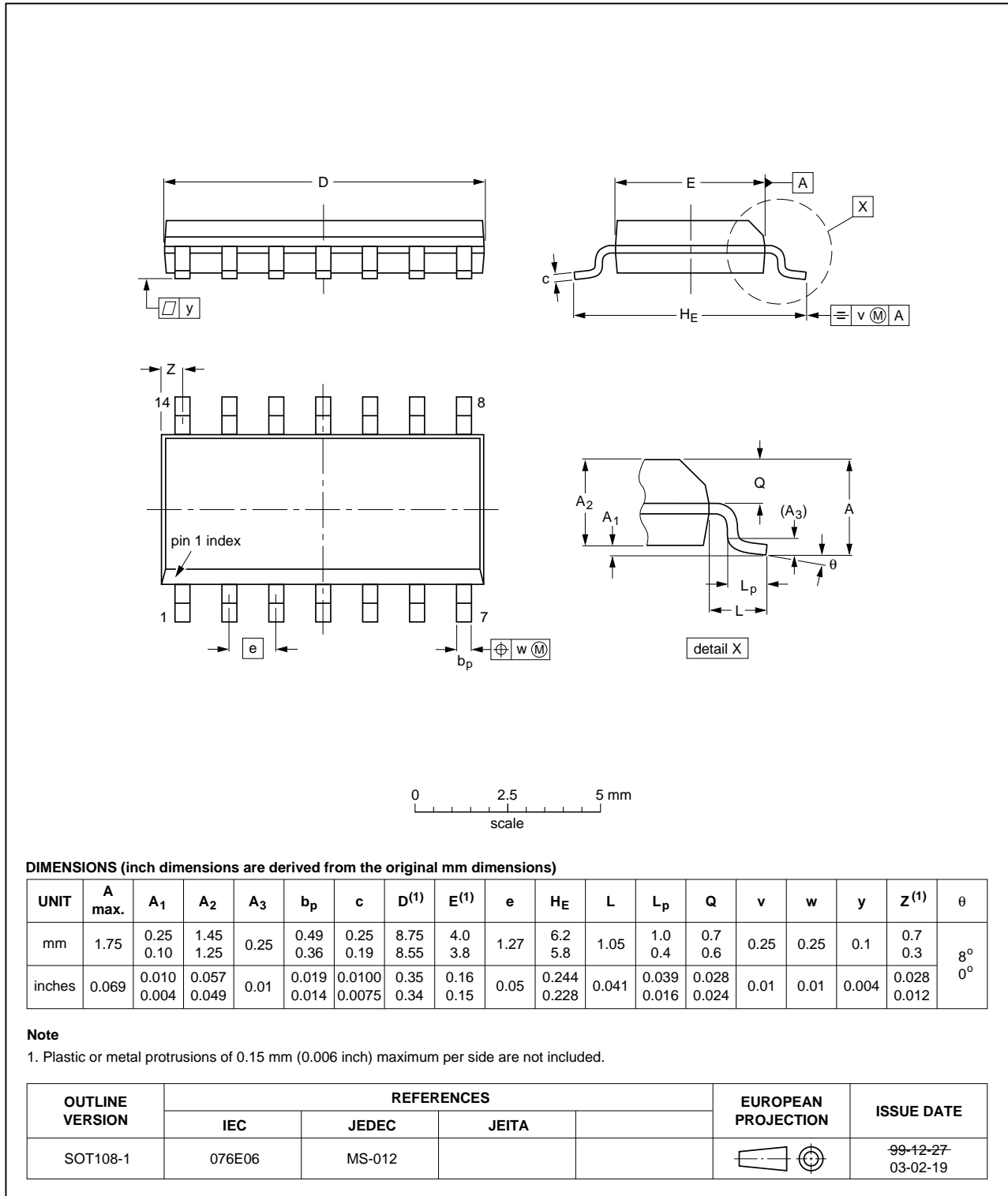


Fig 10. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

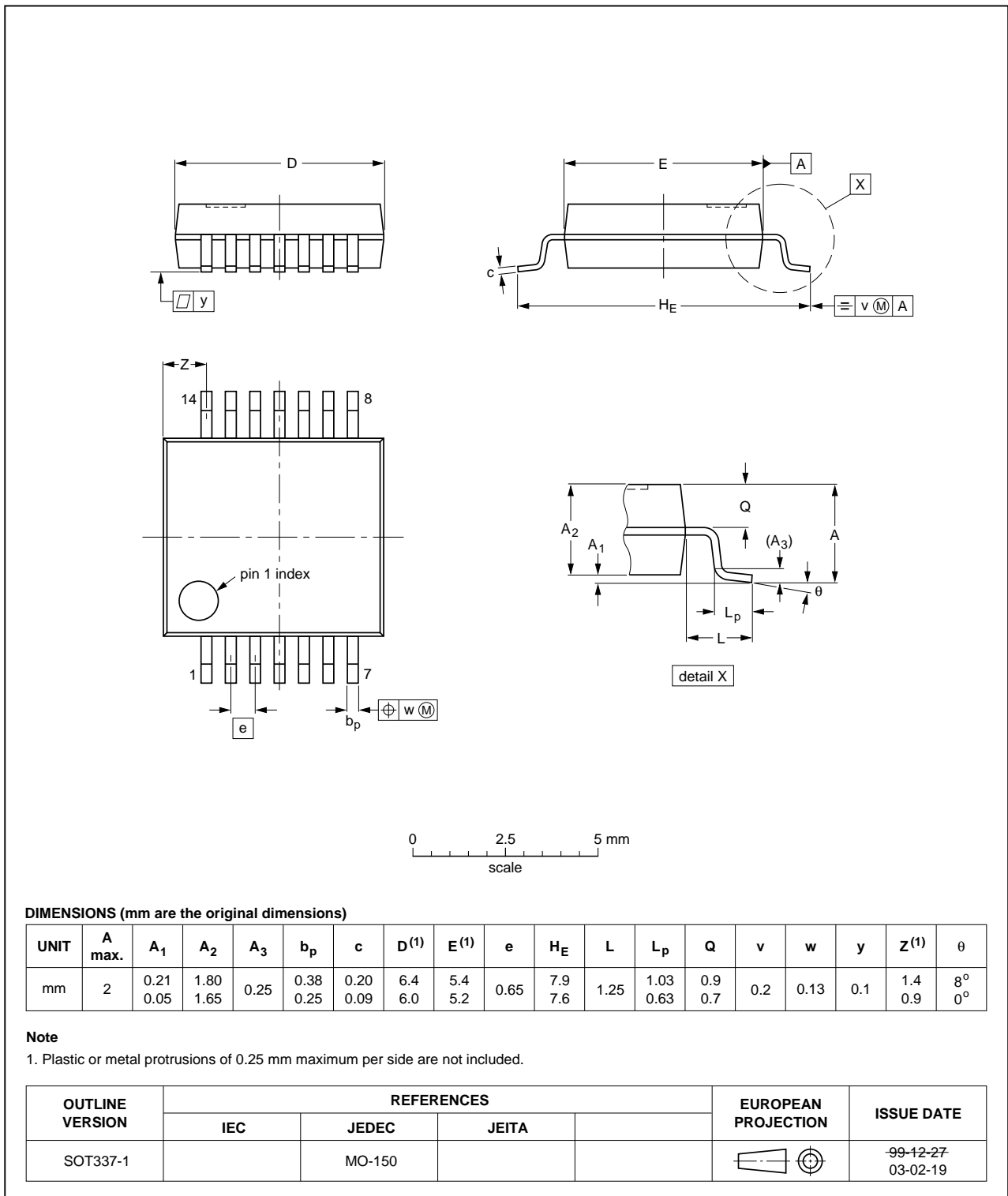


Fig 11. Package outline SOT337-1 (SSOP14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

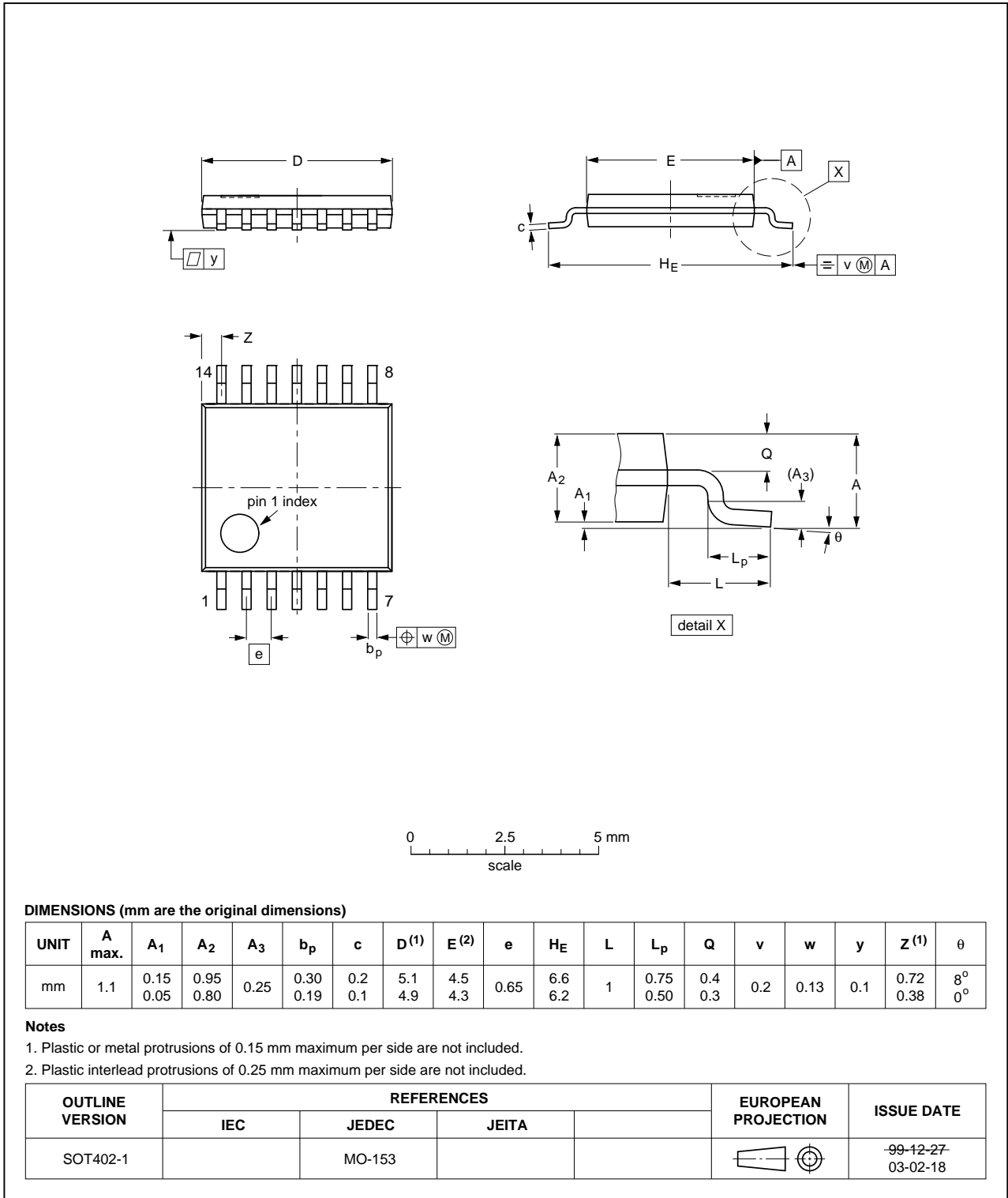


Fig 12. Package outline SOT402-1 (TSSOP14)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4002 v.4	20120917	Product data sheet	-	74HC_HCT4002 v.3
Modifications:	<ul style="list-style-type: none"> • Table 1: Type number 74HC20DB changed into 74HC4002DB. 			
74HC_HCT4002 v.3	20120904	Product data sheet	-	74HC_HCT4002_CNV v.2
Modifications:	<ul style="list-style-type: none"> • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. 			
74HC_HCT4002_CNV v.2	19970829	Product specification	-	-

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Document status ^{[1][2]}	Product status ^[3]	Definition
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[2] The term 'short data sheet' is explained in section "Definitions".

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