

74AHC02; 74AHCT02

Quad 2-input NOR gate

Rev. 03 — 7 January 2008

Product data sheet

1. General description

The 74AHC02; 74AHCT02 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard JESD7-A.

The 74AHC02; 74AHCT02 provides the quad 2-input NOR function.

2. Features

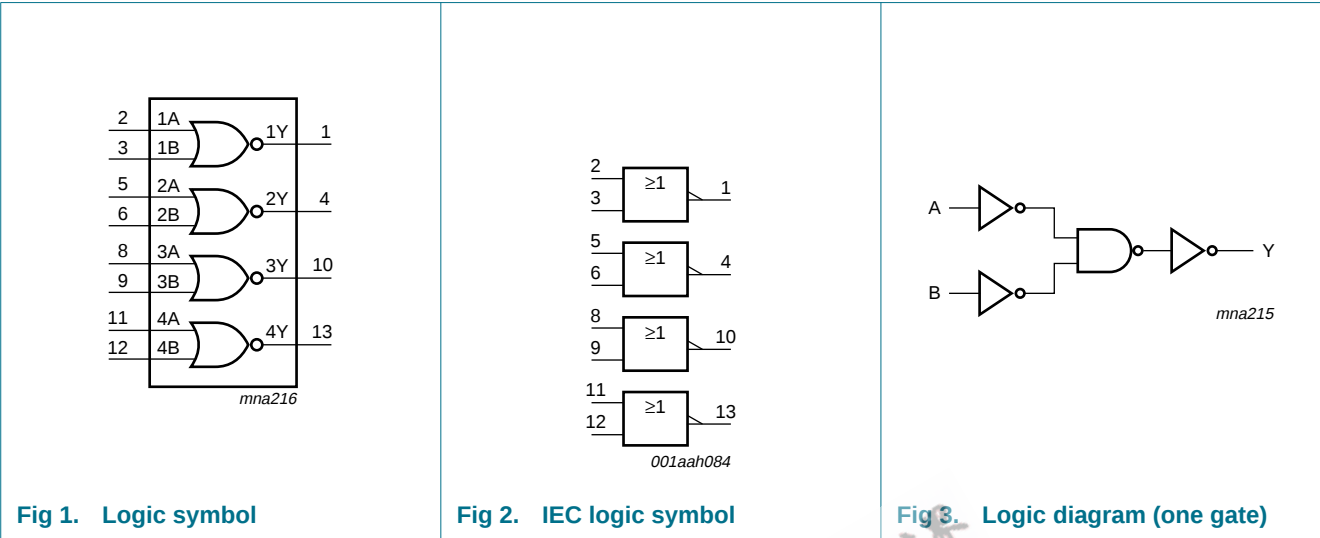
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than V_{CC}
- For 74AHC02 only: operates with CMOS input levels
- For 74AHCT02 only: operates with TTL input levels
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
 - ◆ CDM JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

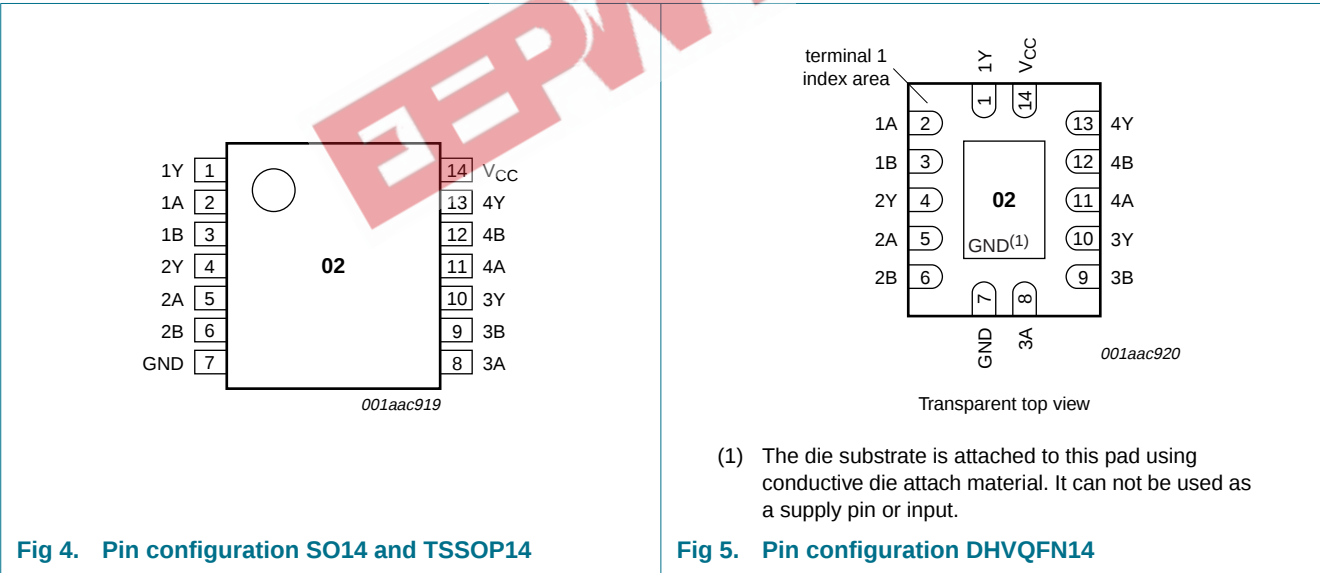
Type number	Package			
	Temperature range	Name	Description	Version
74AHC02D 74AHCT02D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHC02PW 74AHCT02PW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHC02BQ 74AHCT02BQ	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85\text{ mm}$	SOT762-1

4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Symbol	Pin	Description
1Y	1	data output
1A	2	data input
1B	3	data input
2Y	4	data output

Table 2. Pin description ...continued

Symbol	Pin	Description
2A	5	data input
2B	6	data input
GND	7	ground (0 V)
3A	8	data input
3B	9	data input
3Y	10	data output
4A	11	data input
4B	12	data input
4Y	13	data output
V _{CC}	14	supply voltage

6. Functional description

Table 3. Function table^[1]

Input nA	Input nB	Output nY
L	L	H
X	H	L
H	X	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	+7.0	V
V _I	input voltage		-0.5	+7.0	V
I _{IK}	input clamping current	V _I < -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	V _O = -0.5 V to (V _{CC} + 0.5 V)	-	±25	mA
I _{CC}	supply current		-	75	mA
I _{GND}	ground current		-75	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C			
	SO14 package		^[2] -	500	mW
	TSSOP14 package		^[3] -	500	mW
	DHVQFN14 package		^[4] -	500	mW

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

[2] P_{tot} derates linearly with 8 mW/K above 70 °C.

[3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

[4] P_{tot} derates linearly with 4.5 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	74AHC02			74AHCT02			Unit
			Min	Typ	Max	Min	Typ	Max	
V _{CC}	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V _I	input voltage		0	-	5.5	0	-	5.5	V
V _O	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V _{CC} = 3.3 V ± 0.3 V	-	-	100	-	-	-	ns/V
		V _{CC} = 5.0 V ± 0.5 V	-	-	20	-	-	20	ns/V

9. Static characteristics

Table 6. Static characteristics

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	
For type 74AHC02										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V _{CC} = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V _{CC} = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V _{CC} = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V _{CC} = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -50 µA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -50 µA; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = -50 µA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA; V _{CC} = 3.0 V	2.58	-	-	2.48	-	2.4	-	V
V _{OL}	LOW-level output voltage	I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.8	-	3.7	-	V
		V _I = V _{IH} or V _{IL}								
		I _O = 50 µA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
I _I	input leakage current	I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	2.0	-	20	-	40	µA
C _I	input capacitance		-	3.0	10	-	10	-	10	pF

Table 6. Static characteristics ...continued
 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	
For type 74AHCT02										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	-	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 = –50 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = –8.0 mA	3.94	-	-	3.8	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 50 μA	-	0	0.1	-	0.1	-	0.1	V
		I _O = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	2.0	-	20	-	40	μA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} – 2.1 V; I _O = 0 A; other pins at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C _I	input capacitance		-	3.0	10	-	10	-	10	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics
 GND = 0 V; For test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
For type 74AHC02										
t _{pd}	propagation delay	nA, nB to nY; see Figure 6 ^[2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	3.9	7.9	1.0	9.5	1.0	10.0	ns
		C _L = 50 pF	-	5.5	11.4	1.0	13	1.0	14.5	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	2.9	5.5	1.0	6.5	1.0	7.0	ns
		C _L = 50 pF		4.2	7.5	1.0	8.5	1.0	9.5	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} ^[3]	-	7.0	-	-	-	-	-	pF

Table 7. Dynamic characteristics ...continued
GND = 0 V; For test circuit see Figure 7.

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
For type 74AHCT02										
t _{pd}	propagation delay	nA, nB to nY; see Figure 6 ^[2]								
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.8	5.5	1.0	6.5	1.0	7.0	ns
		C _L = 50 pF	-	5.1	7.5	1.0	8.5	1.0	9.5	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} ^[3]	-	8.0	-	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage ($V_{CC} = 3.3 \text{ V}$ and $V_{CC} = 5.0 \text{ V}$).

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

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

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

f_i = input frequency in MHz, f_o = output frequency in MHz

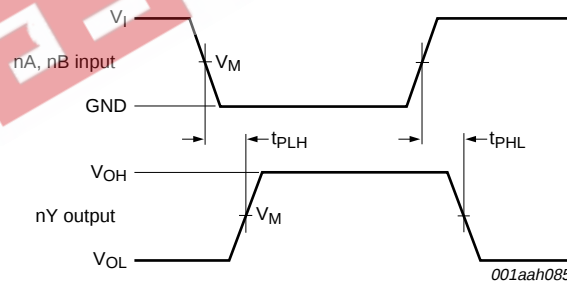
C_L = output load capacitance in pF

V_{CC} = supply voltage in V

N = number of inputs switching

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

11. Waveforms



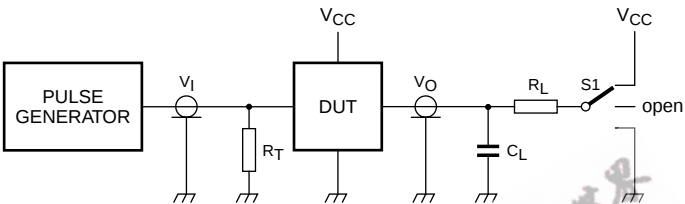
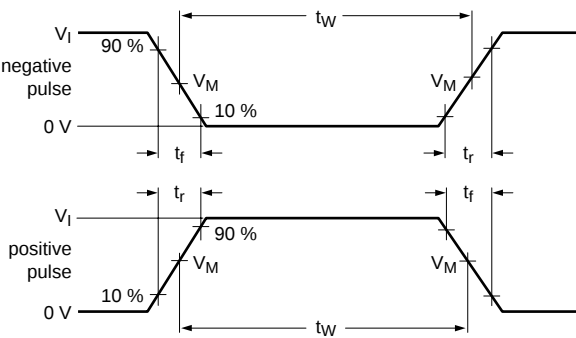
Measurement points are given in Table 8.

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

Fig 6. The input (nA, nB) to output (nY) propagation delays

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74AHC02	$0.5V_{CC}$	$0.5V_{CC}$
74AHCT02	1.5 V	$0.5V_{CC}$



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.
 R_L = Load resistance.
 $S1$ = Test selection switch.

Fig 7. Load circuit for switching times

Table 9. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74AHC02	V_{CC}	$\leq 3.0 \text{ ns}$	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74AHCT02	3.0 V	$\leq 3.0 \text{ ns}$	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

12. Package outline

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

SOT108-1

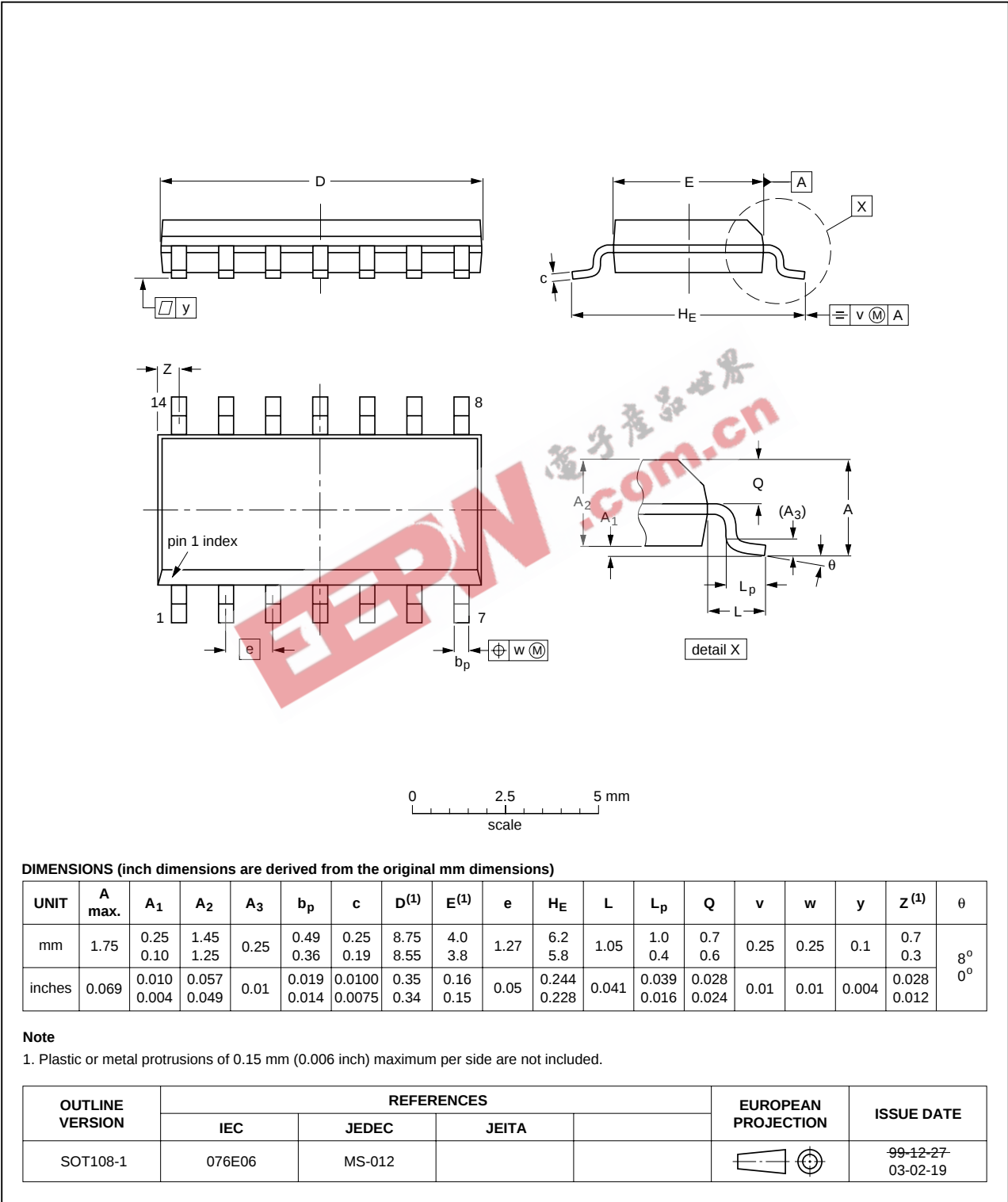


Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1

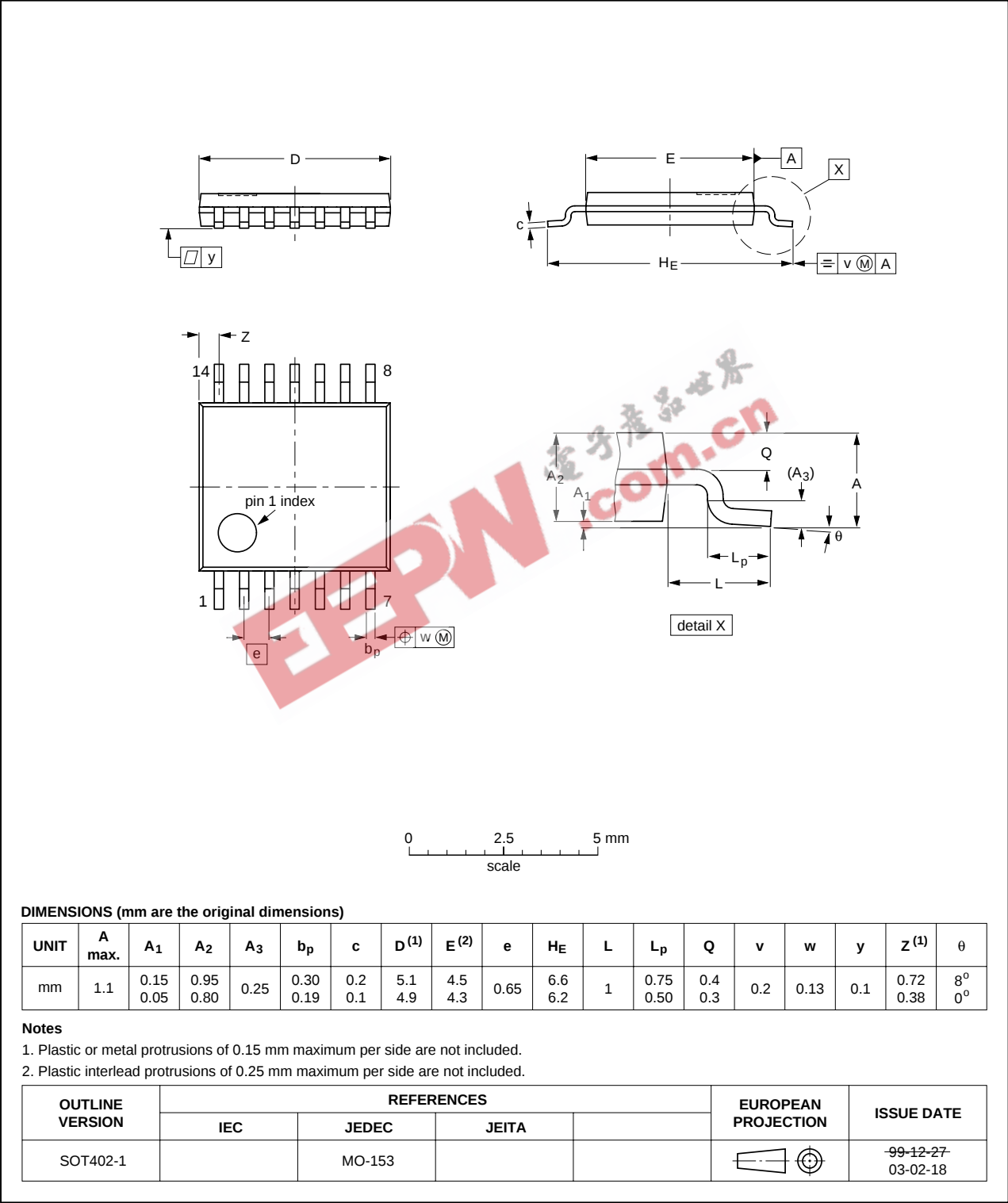


Fig 9. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;
14 terminals; body 2.5 x 3 x 0.85 mm SOT762-1

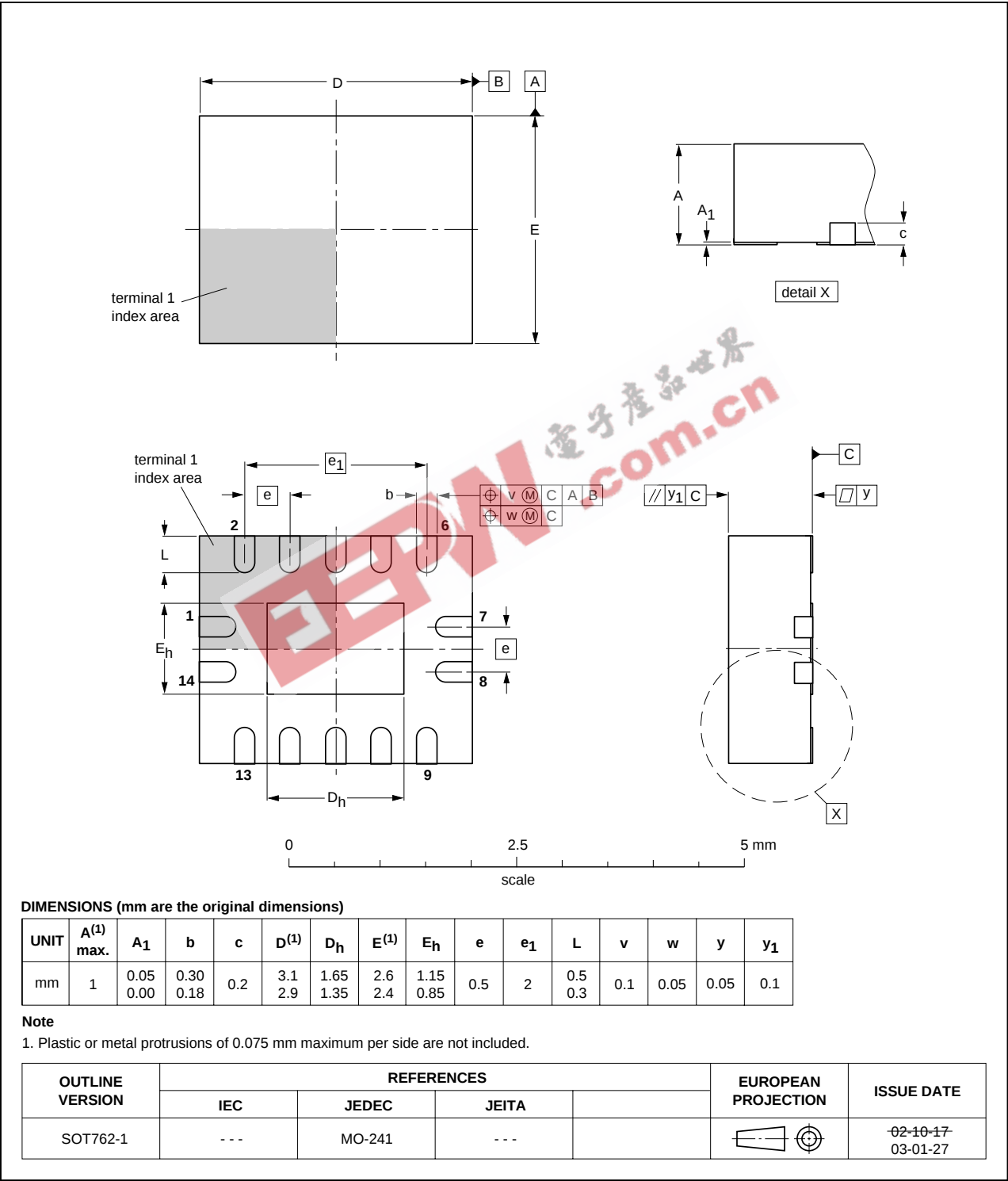


Fig 10. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
LSTTL	Low-power Schottky Transistor-Transistor Logic
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
CDM	Charge Device Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT02_3	20080107	Product data sheet	-	74AHC_AHCT02_2
Modifications:	• 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. • Section 3: DHVQFN14 package added. • Section 8: derating values added for DHVQFN14 package. • Section 12: outline drawing added for DHVQFN14 package.			
74AHC_AHCT02_2	19990923	Product specification	-	74AHC_AHCT02_1
74AHC_AHCT02_1	19981218	Product specification	-	-

15. Legal information

15.1 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.
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[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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