

74VHC08; 74VHCT08

Quad 2-input AND gate

Rev. 01 — 30 June 2009

Product data sheet

1. General description

The 74VHC08; 74VHCT08 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard JESD7-A.

The 74VHC08; 74VHCT08 provide the quad 2-input AND function.

2. Features

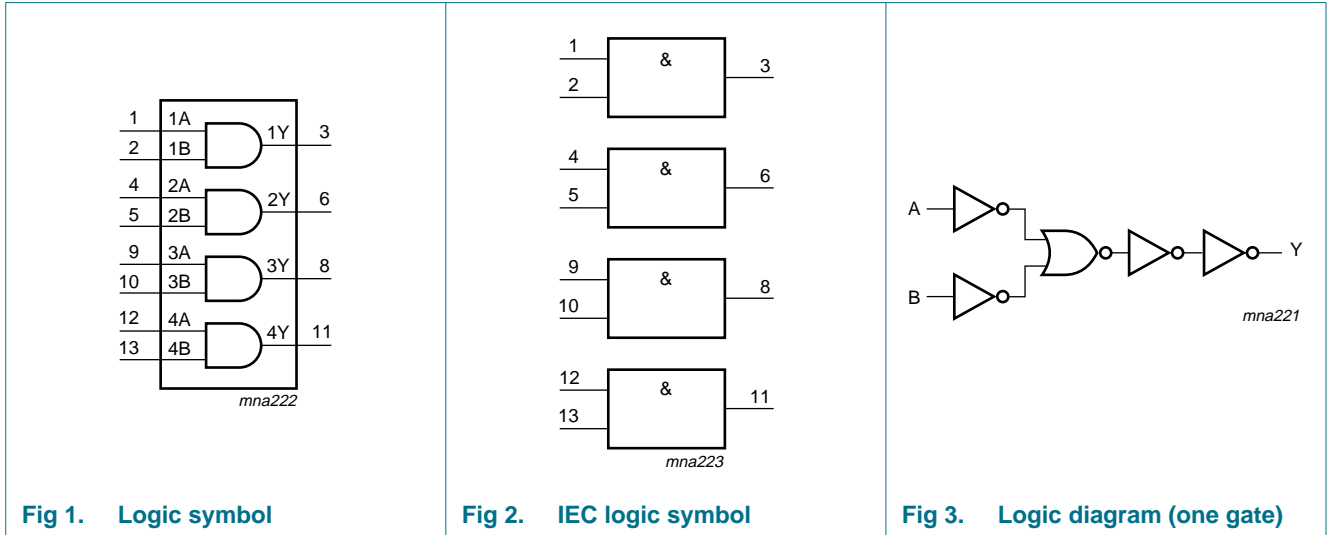
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than V_{CC}
- Input levels:
 - ◆ The 74VHC08 operates with CMOS logic levels
 - ◆ The 74VHCT08 operates with TTL logic levels
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
 - ◆ CDM JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from -40 °C to $+85\text{ °C}$ and from -40 °C to $+125\text{ °C}$

3. Ordering information

Table 1. Ordering information

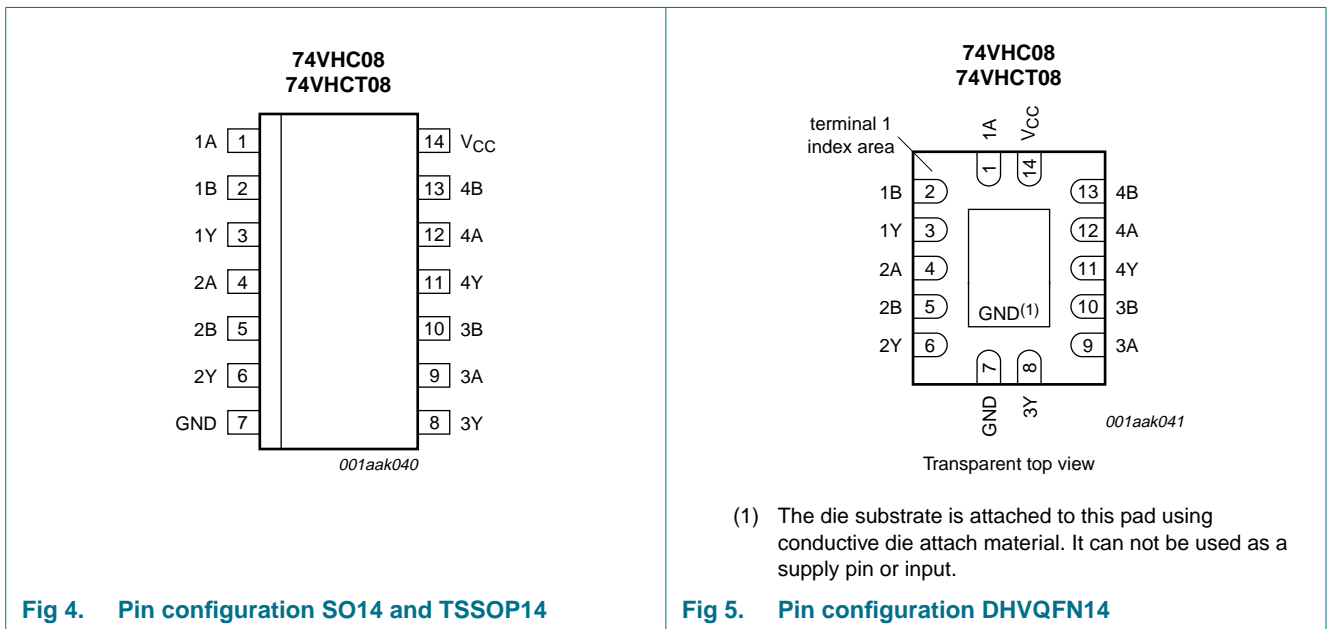
Type number	Package			
	Temperature range	Name	Description	Version
74VHC08D 74VHCT08D	-40 °C to $+125\text{ °C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74VHC08PW 74VHCT08PW	-40 °C to $+125\text{ °C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74VHC08BQ 74VHCT08BQ	-40 °C to $+125\text{ °C}$	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

Table 2. Pin description

Symbol	Pin	Description
1A	1	data input
1B	2	data input
1Y	3	data output
2A	4	data input
2B	5	data input
2Y	6	data output
GND	7	ground (0 V)
3Y	8	data output
3A	9	data input
3B	10	data input
4Y	11	data output
4A	12	data input
4B	13	data input
V _{CC}	14	supply voltage

6. Functional description

Table 3. Function selection^[1]

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

[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

Table 4. Limiting values ...continued

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

Symbol	Parameter	Conditions	Min	Max	Unit
P_{tot}	total power dissipation	$T_{\text{amb}} = -40\text{ °C to }+125\text{ °C}$			
	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	74VHC08			74VHCT08			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	$V_{\text{CC}} = 3.3\text{ V} \pm 0.3\text{ V}$	-	-	100	-	-	-	ns/V
		$V_{\text{CC}} = 5.0\text{ V} \pm 0.5\text{ V}$	-	-	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 74VHC08

V_{IH}	HIGH-level input voltage	$V_{\text{CC}} = 2.0\text{ V}$	1.5	-	-	1.5	-	1.5	-	V
		$V_{\text{CC}} = 3.0\text{ V}$	2.1	-	-	2.1	-	2.1	-	V
		$V_{\text{CC}} = 5.5\text{ V}$	3.85	-	-	3.85	-	3.85	-	V
V_{IL}	LOW-level input voltage	$V_{\text{CC}} = 2.0\text{ V}$	-	-	0.5	-	0.5	-	0.5	V
		$V_{\text{CC}} = 3.0\text{ V}$	-	-	0.9	-	0.9	-	0.9	V
		$V_{\text{CC}} = 5.5\text{ V}$	-	-	1.65	-	1.65	-	1.65	V
V_{OH}	HIGH-level output voltage	$V_{\text{I}} = V_{\text{IH}}$ or V_{IL}								
		$I_{\text{O}} = -50\text{ }\mu\text{A}; V_{\text{CC}} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_{\text{O}} = -50\text{ }\mu\text{A}; V_{\text{CC}} = 3.0\text{ V}$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_{\text{O}} = -50\text{ }\mu\text{A}; V_{\text{CC}} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{\text{O}} = -4.0\text{ mA}; V_{\text{CC}} = 3.0\text{ V}$	2.58	-	-	2.48	-	2.4	-	V
	$I_{\text{O}} = -8.0\text{ mA}; V_{\text{CC}} = 4.5\text{ V}$	3.94	-	-	3.8	-	3.7	-	V	

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	
V _{OL}	LOW-level output voltage	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 _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 _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
C _I	input capacitance		-	3.0	10	-	10	-	10	pF
For type 74VHCT08										
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 74VHC08										
t_{pd}	propagation delay	nA, nB to nY; see Figure 6 ^[2] $V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	4.0	8.8	1.0	10.5	1.0	11.0	ns
		$C_L = 50\text{ pF}$	-	5.6	12.3	1.0	14	1.0	15.5	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.0	5.9	1.0	7.0	1.0	7.5	ns
		$C_L = 50\text{ pF}$		4.2	7.9	1.0	9.0	1.0	10.0	ns
C_{PD}	power dissipation capacitance	$C_L = 50\text{ pF}; f_i = 1\text{ MHz}; V_i = \text{GND to }V_{CC}$	^[3]	-	10.0	-	-	-	-	pF
For type 74VHCT08										
t_{pd}	propagation delay	nA, nB to nY; see Figure 6 ^[2] $V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.2	6.9	1.0	8.0	1.0	9.0	ns
		$C_L = 50\text{ pF}$	-	4.2	7.9	1.0	9.0	1.0	10.0	ns
C_{PD}	power dissipation capacitance	$C_L = 50\text{ pF}; f_i = 1\text{ MHz}; V_i = \text{GND to }V_{CC}$	^[3]	-	12.0	-	-	-	-	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).

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

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

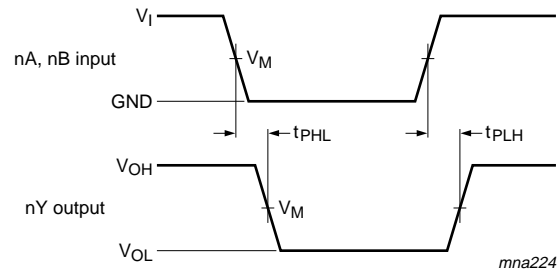
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

N = number of inputs switching

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

11. Waveforms



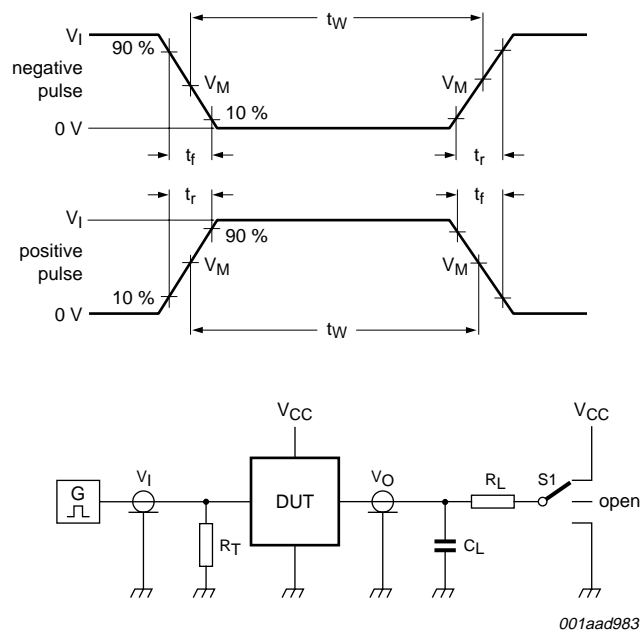
Measurement points are given in [Table 8](#).

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
74VHC08	$0.5V_{CC}$	$0.5V_{CC}$
74VHCT08	1.5 V	$0.5V_{CC}$



001aad983

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}
74VHC08	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74VHCT08	3.0 V	≤ 3.0 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

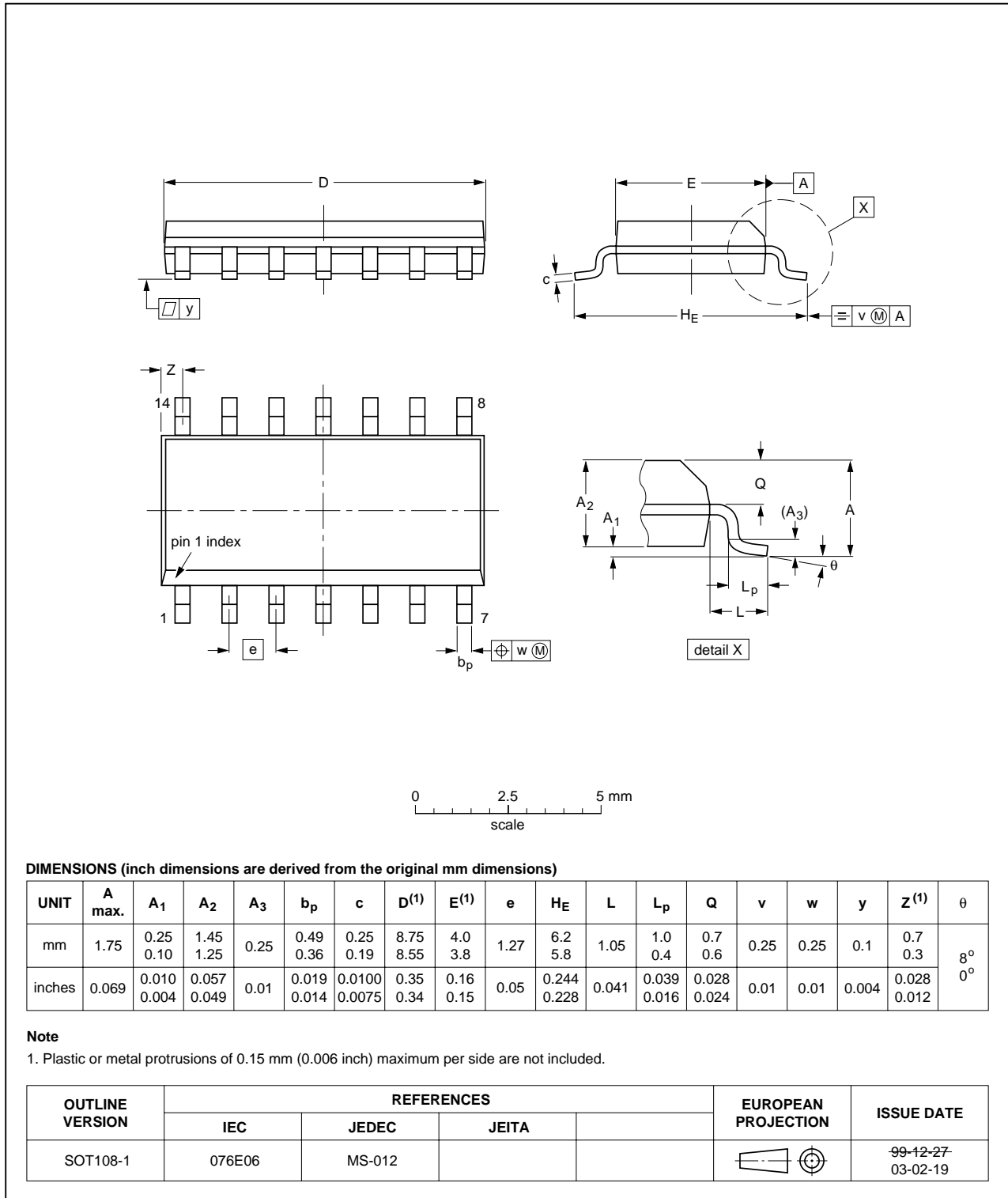


Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1

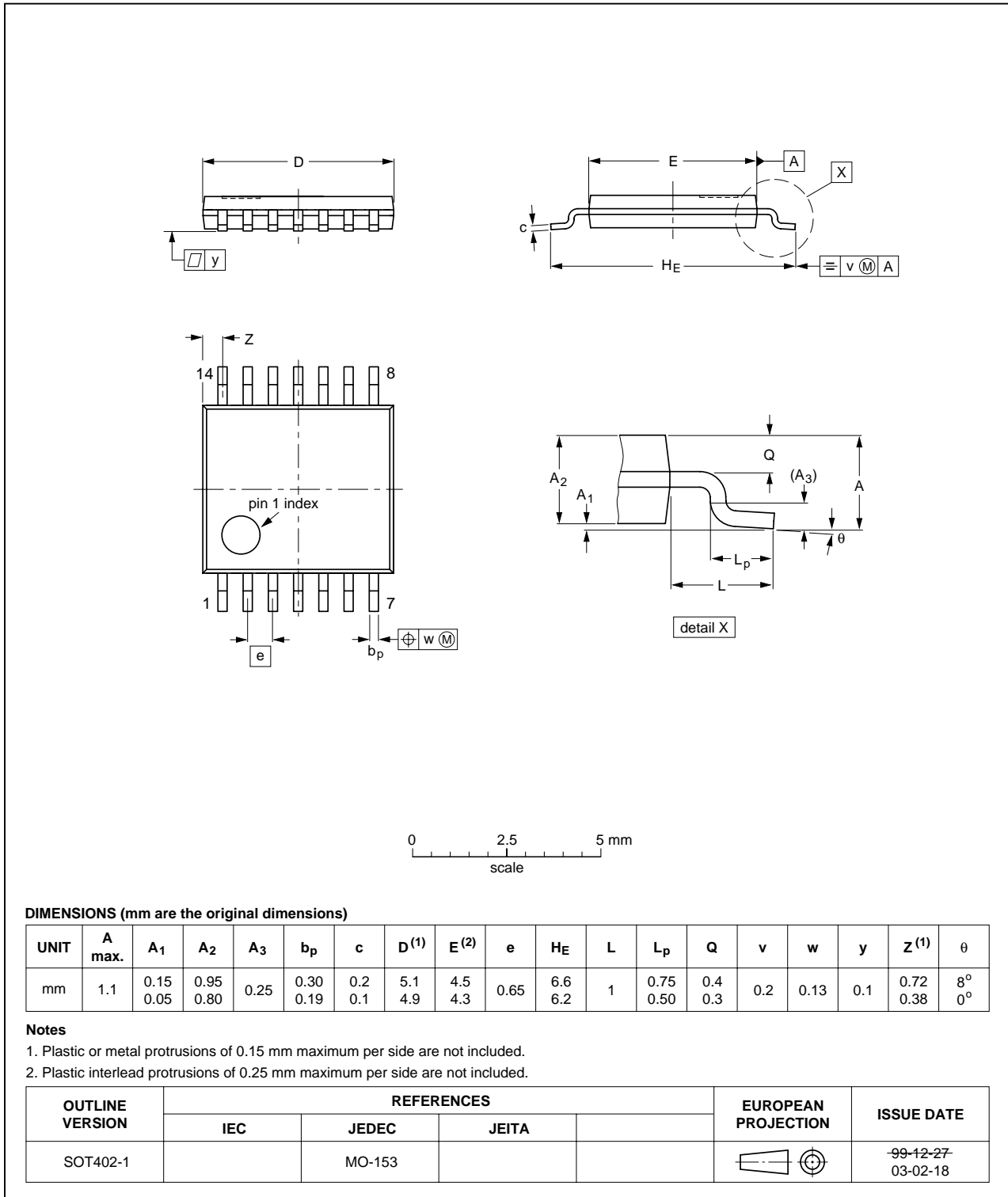


Fig 9. Package outline SOT402-1 (TSSOP14)

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

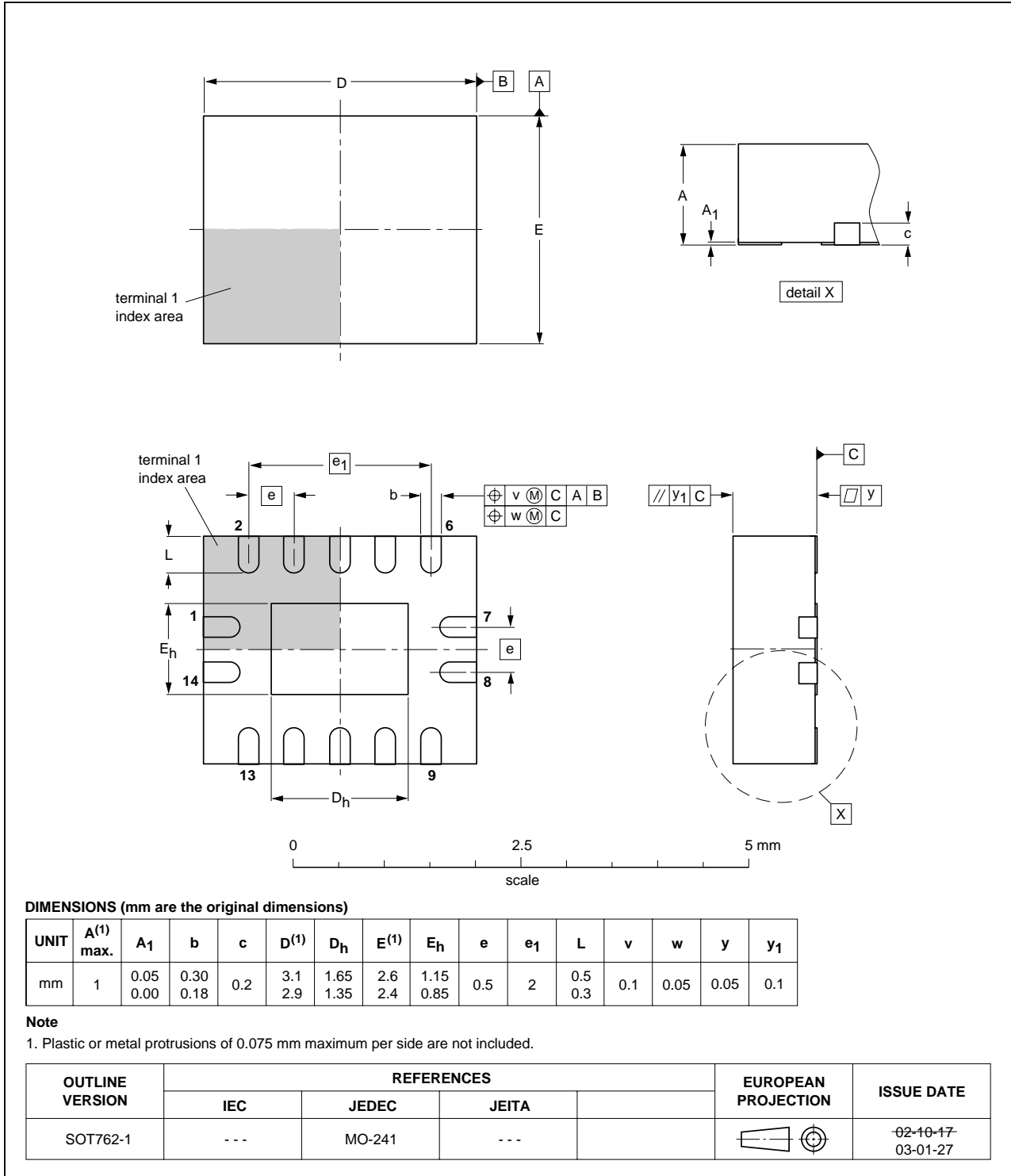


Fig 10. Package outline SOT762-1 (DHVQFN14)

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	Charged Device Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74VHC_VHCT08_1	20090630	Product data sheet	-	-

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.
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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17. Contents

1	General description	1
2	Features	1
3	Ordering information	1
4	Functional diagram	2
5	Pinning information	2
5.1	Pinning	2
5.2	Pin description	3
6	Functional description	3
7	Limiting values	3
8	Recommended operating conditions	4
9	Static characteristics	4
10	Dynamic characteristics	6
11	Waveforms	7
12	Package outline	9
13	Abbreviations	12
14	Revision history	12
15	Legal information	13
15.1	Data sheet status	13
15.2	Definitions	13
15.3	Disclaimers	13
15.4	Trademarks	13
16	Contact information	13
17	Contents	14