# 74HC08; 74HCT08

# Quad 2-input AND gate Rev. 5 — 30 November 2015

Product data sheet

#### 1. **General description**

The 74HC08; 74HCT08 is a quad 2-input AND gate. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

#### **Features and benefits** 2.

- Complies with JEDEC standard JESD7A
- Input levels:
  - ◆ For 74HC08: CMOS level ◆ For 74HCT08: 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 +85 °C and from -40 °C to +125 °C

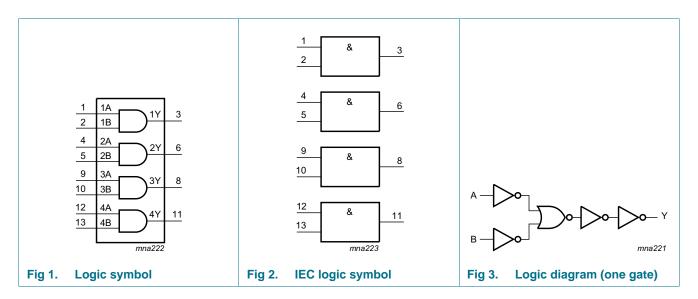
#### **Ordering information** 3.

Table 1. **Ordering information** 

Type number	Package				
	Temperature range	Name	Description	Version	
74HC08D	−40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width	SOT108-1	
74HCT08D			3.9 mm		
74HC08DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body	SOT337-1	
74HCT08DB			width 5.3 mm		
74HC08PW	−40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads;	SOT402-1	
74HCT08PW			body width 4.4 mm		
74HC08BQ	−40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very	SOT762-1	
74HCT08BQ			thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85$ mm		

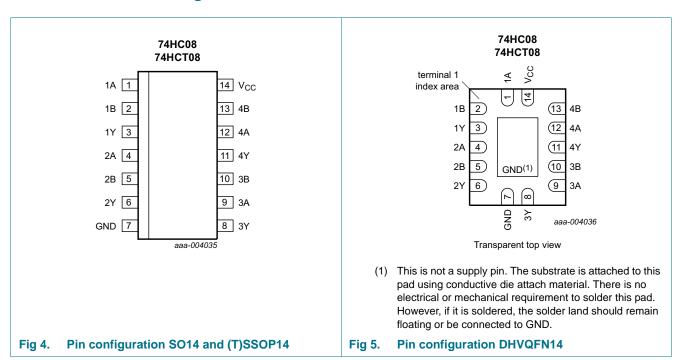


## 4. Functional diagram



## 5. Pinning information

## 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1A to 4A	1, 4, 9, 12	data input
1B to 4B	2, 5, 10,13	data input
1Y to 4Y	3, 6, 8, 11	data output
GND	7	ground (0 V)
V <sub>CC</sub>	14	supply voltage

## 6. Functional description

Table 3. Function table[1]

Input		Output
nA	nB	nY
L	L	L
L	Н	L
Н	L	L
Н	Н	Н

<sup>[1]</sup> 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 <sub>IK</sub>	input clamping current	$V_{I} < -0.5 \text{ V or } V_{I} > V_{CC} + 0.5 \text{ V}$	<u>[1]</u>	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$	<u>[1]</u>	-	±20	mA
Io	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$		-	±25	mA
I <sub>CC</sub>	supply current			-	50	mA
I <sub>GND</sub>	ground current			-50	-	mA
T <sub>stg</sub>	storage temperature			-65	+150	°C
P <sub>tot</sub>	total power dissipation	SO14, (T)SSOP14 and DHVQFN14 packages	[2]	-	500	mW

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

For (T)SSOP14 packages: Ptot derates linearly with 5.5 mW/K above 60 °C.

For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

<sup>[2]</sup> For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70  $^{\circ}\text{C}.$ 

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		74HC08			74HCT08		
			Min	Тур	Max	Min	Тур	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	-	+125	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC} = 2.0 \text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5 \text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0 \text{ V}$	-	-	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	o +85 °C	-40 °C t	o +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC08										
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
$V_{IL}$	LOW-level	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
011	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_{O} = -20 \mu A; V_{CC} = 2.0 V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20 \mu A; V_{CC} = 4.5 V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -20 \mu A; V_{CC} = 6.0 \text{ V}$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_O = -4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
		$I_{O} = -5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V
$V_{OL}$	LOW-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_O = 20 \mu A; V_{CC} = 2.0 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20 \mu A; V_{CC} = 6.0 \text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
		$I_O = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	2.0	-	20	-	40	μΑ

 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions		25 °C		-40 °C t	o +85 °C	-40 °C to	o +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
Cı	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT0	8		1	1						
$V_{IH}$	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
$V_{IL}$	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_{O} = -20 \mu A$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -4.0 \text{ mA}$	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
		I <sub>O</sub> = 20 μA	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 5.2 \text{ mA}$	-	0.15	0.26	-	0.33	-	0.4	V
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	2.0	-	20	-	40	μΑ
Δl <sub>CC</sub>	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V; } I_O = 0 \text{ A;}$ other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	60	216	-	270	-	294	μΑ
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

# 10. Dynamic characteristics

#### Table 7. Dynamic characteristics

 $GND = 0 \ V; \ C_L = 50 \ pF;$  for test circuit see <u>Figure 7</u>.

Symbol	Parameter	Conditions			25 °C		-40 °C to	+125 °C	Unit
				Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC08			,						
t <sub>pd</sub> propagation delay		nA, nB to nY; see Figure 6	<u>[1]</u>						
		V <sub>CC</sub> = 2.0 V		-	25	90	115	135	ns
		V <sub>CC</sub> = 4.5 V		-	9	18	23	27	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	7	-	-	-	ns
		V <sub>CC</sub> = 6.0 V		-	7	15	20	23	ns
t <sub>t</sub>	transition time	see Figure 6	[2]						
		V <sub>CC</sub> = 2.0 V		-	19	75	95	110	ns
		V <sub>CC</sub> = 4.5 V		-	7	15	19	22	ns
		V <sub>CC</sub> = 6.0 V		-	6	13	16	19	ns

Table 7. Dynamic characteristics

 $GND = 0 \ V; \ C_L = 50 \ pF;$  for test circuit see <u>Figure 7</u>.

Symbol	Parameter	Conditions			25 °C		-40 °C to	+125 °C	Unit
				Min	Тур	Max	Max (85 °C)	Max (125 °C)	
C <sub>PD</sub>	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC}$	[3]	-	10	-	-	-	pF
74HCT02	2								
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Figure 6	<u>[1]</u>						
		V <sub>CC</sub> = 4.5 V		-	14	24	30	36	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF		-	11	-	-	-	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see <u>Figure 6</u>	[2]	-	7	15	19	22	ns
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> – 1.5 V	[3]	-	20	-	-	-	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  $\mu W$ ):

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

 $f_i$  = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

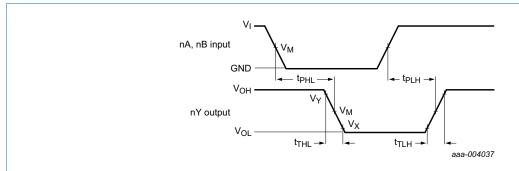
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = 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 <u>Table 9</u>.

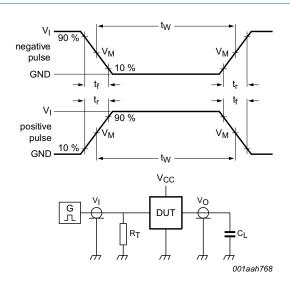
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 6. Input to output propagation delays

Table 8. Measurement points

Туре	Input	Output						
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>				
74HC08	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				
74HCT08	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				

74HC\_HCT08



Test data is given in Table 9.

Definitions test circuit:

 $R_T$  = termination resistance should be equal to output impedance  $Z_0$  of the pulse generator.

 $C_L$  = load capacitance including jig and probe capacitance.

Fig 7. Test circuit for measuring switching times

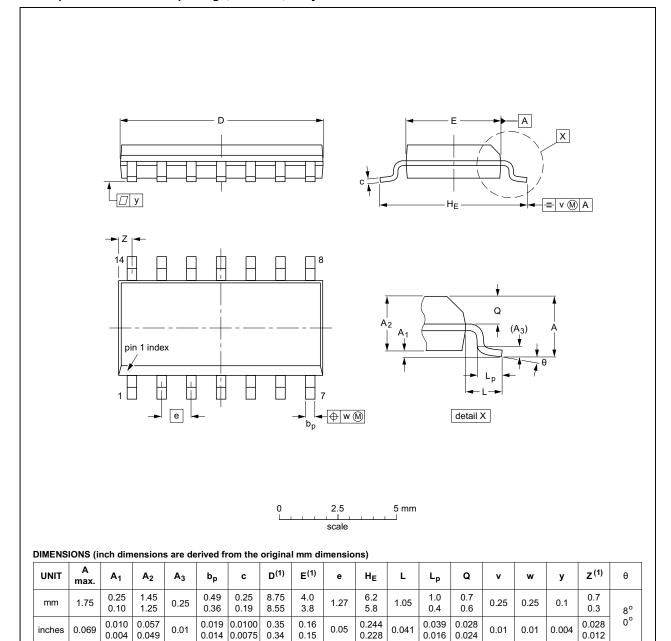
Table 9. Test data

Туре	Input L		Load	Test
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	
74HC08	V <sub>CC</sub>	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>
74HCT08	3.0 V	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>

## 12. Package outline

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

SOT108-1



#### Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION		REFER	EUROPEAN	ISSUE DATE	
	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE
SOT108-1	076E06	MS-012			<del>99-12-27</del> 03-02-19

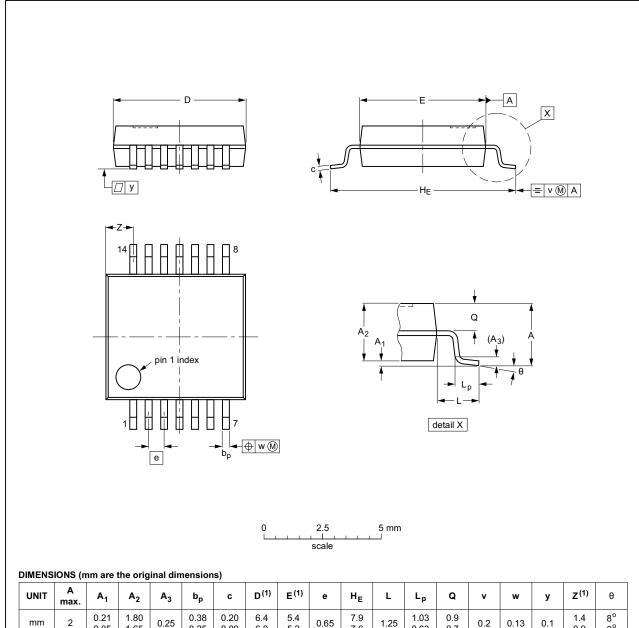
Fig 8. Package outline SOT108-1 (SO14)

74HC\_HCT08

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

SOT337-1



_							-,												
	UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ
	mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC JEDEC		JEITA			PROJECTION
SOT337-1		MO-150				<del>99-12-27</del> 03-02-19

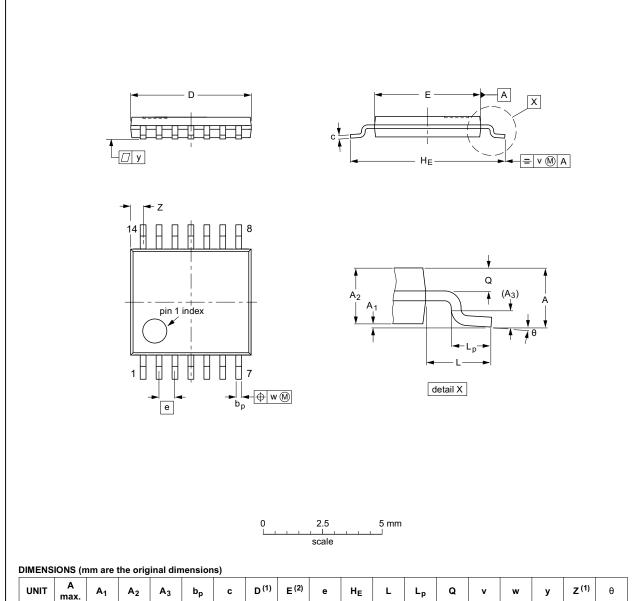
Package outline SOT337-1 (SSOP14)

74HC\_HCT08

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

SOT402-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	<b>A</b> <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(2)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

#### Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE			
VERSION	IEC	JEDEC JEIT			PROJECTION	ISSUE DATE	
SOT402-1		MO-153				<del>99-12-27</del> 03-02-18	

Fig 10. Package outline SOT402-1 (TSSOP14)

74HC\_HCT08

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

SOT762-1

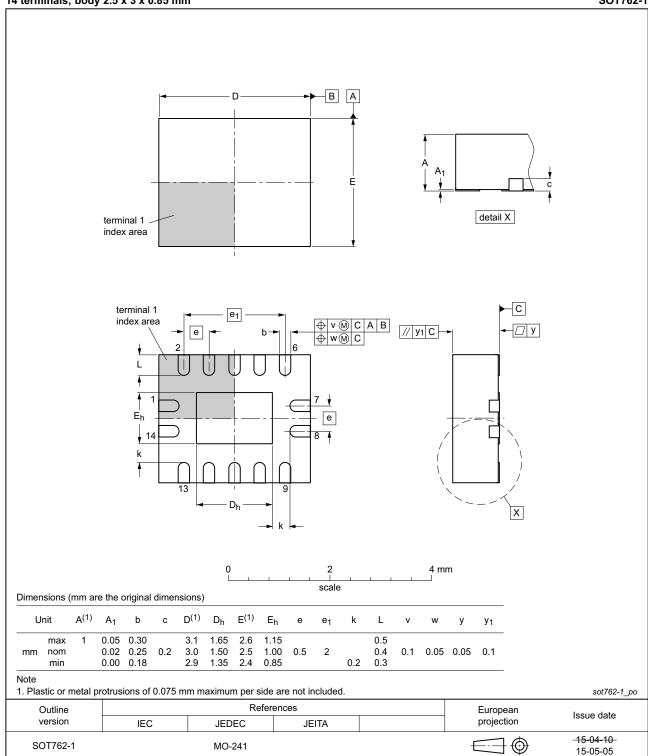


Fig 11. Package outline SOT762-1 (DHVQFN14)

74HC\_HCT08

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## 13. Abbreviations

#### Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	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_HCT08 v.5	20151130	Product data sheet	-	74HC_HCT08 v.4					
Modifications:	Type numbers 74H0	08N and 74HCT08N (SO	T27-1) removed.						
74HC_HCT08 v.4	20120906	Product data sheet	-	74HC_HCT08 v.3					
Modifications:	<ul> <li>The format of this data sheet has been redesigned to comply with the new identity g of NXP Semiconductors.</li> </ul>								
	<ul> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>								
74HC_HCT08 v.3	20030725	Product specification	-	74HC_HCT08_CNV v.2					
74HC_HCT08_CNV v.2	19970826	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.
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"
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <a href="http://www.nxp.com">http://www.nxp.com</a>.

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## 17. Contents

General description 1
Features and benefits
Ordering information 1
Functional diagram 2
Pinning information
Pinning
Pin description
Functional description 3
Limiting values
Recommended operating conditions 4
Static characteristics 4
Dynamic characteristics 5
Waveforms
Package outline 8
Abbreviations12
Revision history
Legal information
Data sheet status
Definitions
Disclaimers
Trademarks14
Contact information 14
Contents

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