

# DATA SHEET

## **74HC08; 74HCT08** Quad 2-input AND gate

Product specification  
Supersedes data of 1990 Dec 01

2003 Jul 25

## Quad 2-input AND gate

## 74HC08; 74HCT08

## FEATURES

- Complies with JEDEC standard no. 8-1A
- ESD protection:  
HBM EIA/JESD22-A114-A exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from  $-40$  to  $+85$  °C and  $-40$  to  $+125$  °C.

## DESCRIPTION

The 74HC/HCT08 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 no. 7A. The 74HC/HCT08 provide the 2-input AND function.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25$  °C;  $t_r = t_f = 6$  ns.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			74HC08	74HCT08	
$t_{PHL}/t_{PLH}$	propagation delay nA, nB to nY	$C_L = 15$ pF; $V_{CC} = 5$ V	7	11	ns
$C_I$	input capacitance		3.5	3.5	pF
$C_{PD}$	power dissipation capacitance per gate	notes 1 and 2	10	20	pF

## Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts;

$N$  = total load switching outputs;

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

2. For 74HC08: the condition is  $V_I = \text{GND}$  to  $V_{CC}$ .  
For 74HCT08: the condition is  $V_I = \text{GND}$  to  $V_{CC} - 1.5$  V.

## FUNCTION TABLE

INPUT		OUTPUT
nA	nB	nY
L	L	L
L	H	L
H	L	L
H	H	H

## Note

1. H = HIGH voltage level;  
L = LOW voltage level.

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## ORDERING INFORMATION

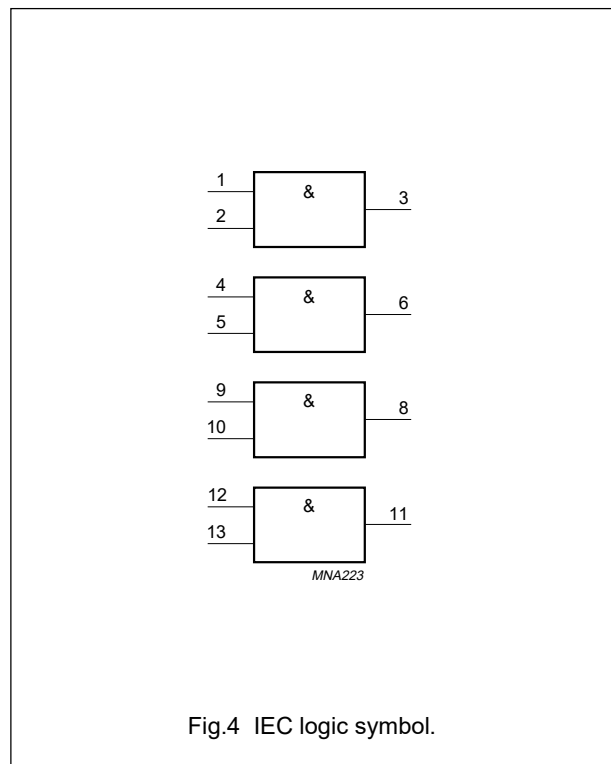
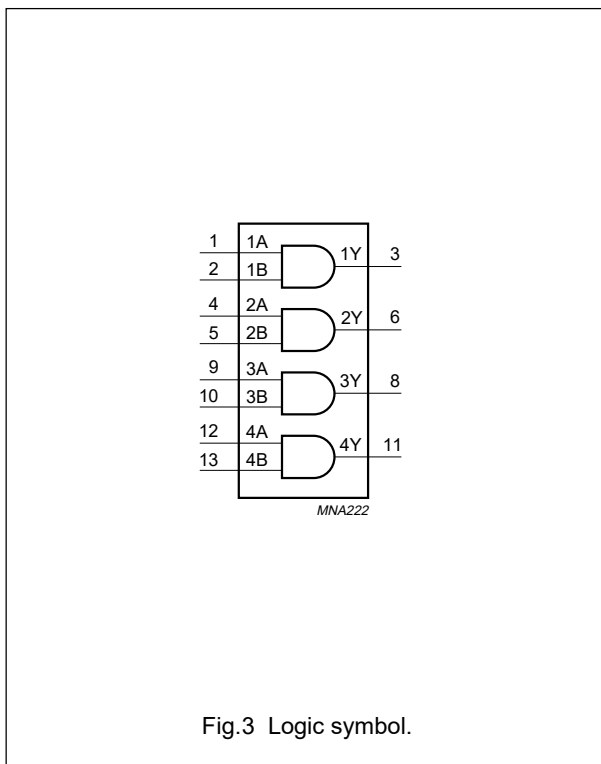
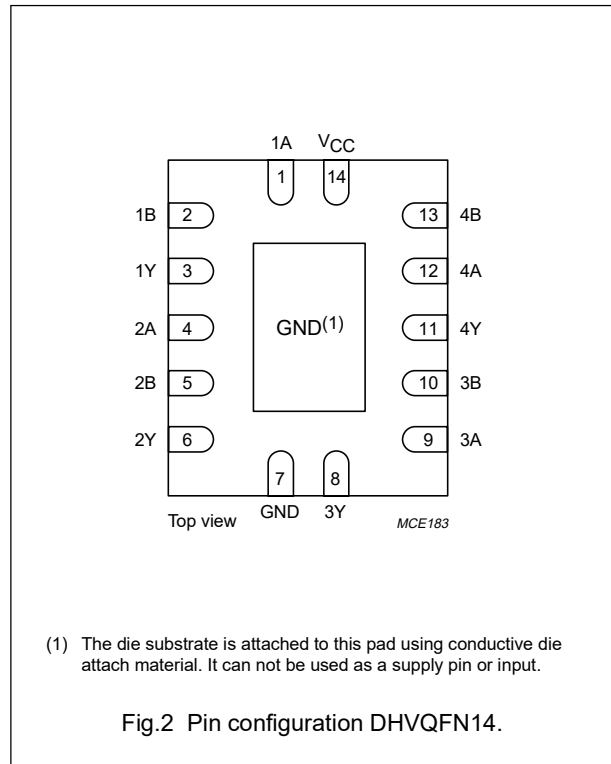
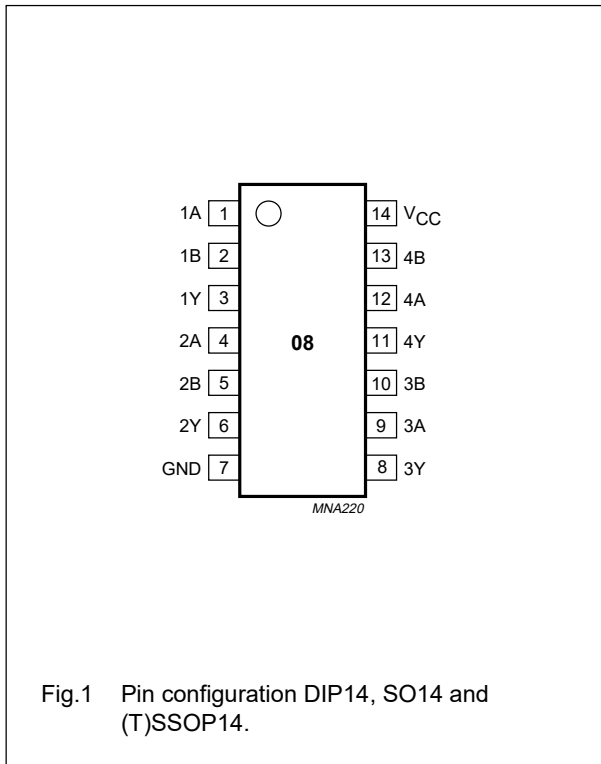
TYPE NUMBER	PACKAGE				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74HC08N	-40 to +125 °C	14	DIP14	plastic	SOT27-1
74HCT08N	-40 to +125 °C	14	DIP14	plastic	SOT27-1
74HC08D	-40 to +125 °C	14	SO14	plastic	SOT108-1
74HCT08D	-40 to +125 °C	14	SO14	plastic	SOT108-1
74HC08DB	-40 to +125 °C	14	SSOP14	plastic	SOT337-1
74HCT08DB	-40 to +125 °C	14	SSOP14	plastic	SOT337-1
74HC08PW	-40 to +125 °C	14	TSSOP14	plastic	SOT402-1
74HCT08PW	-40 to +125 °C	14	TSSOP14	plastic	SOT402-1
74HC08BQ	-40 to +125 °C	14	DHVQFN14	plastic	SOT762-1
74HCT08BQ	-40 to +125 °C	14	DHVQFN14	plastic	SOT762-1

## PINNING

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

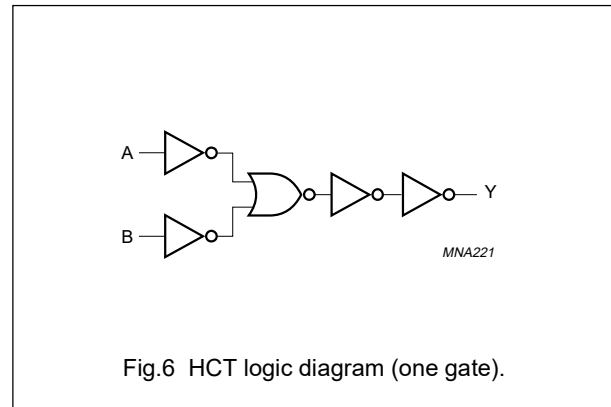
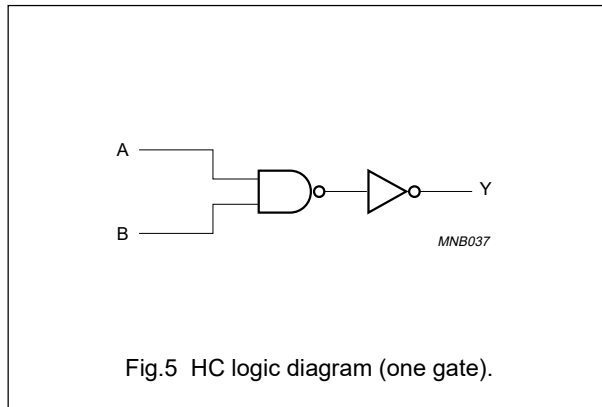
Quad 2-input AND gate

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## Quad 2-input AND gate

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## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	74HC08			74HCT08			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	see DC and AC characteristics per device	–40	+25	+125	–40	+25	+125	°C
$t_r, t_f$	input rise and fall times	$V_{CC} = 2.0\text{ V}$	–	–	1000	–	–	–	ns
		$V_{CC} = 4.5\text{ V}$	–	6.0	500	–	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	–	–	400	–	–	–	ns

## 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
$I_{IK}$	input diode current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	–	±20	mA
$I_{OK}$	output diode current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	–	±20	mA
$I_O$	output source or sink current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	–	±25	mA
$I_{CC}, I_{GND}$	$V_{CC}$ or GND current		–	±50	mA
$T_{stg}$	storage temperature		–65	+150	°C
$P_{tot}$	power dissipation				
	DIP14 package	$T_{amb} = -40\text{ to }+125\text{ °C}$ ; note 1	–	750	mW
	other packages	$T_{amb} = -40\text{ to }+125\text{ °C}$ ; note 2	–	500	mW

## Notes

- For DIP14 packages: above 70 °C derate linearly with 12 mW/K.
- For SO14 packages: above 70 °C derate linearly with 8 mW/K.  
For SSOP14 and TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.  
For DHVQFN14 packages: above 60 °C derate linearly with 4.5 mW/K.

## Quad 2-input AND gate

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## DC CHARACTERISTICS

## Family 74HC08

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = 25 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		2.0	1.5	1.2	–	V
			4.5	3.15	2.4	–	V
			6.0	4.2	3.2	–	V
V <sub>IL</sub>	LOW-level input voltage		2.0	–	0.8	0.5	V
			4.5	–	2.1	1.35	V
			6.0	–	2.8	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = –20 µA	2.0	1.9	2.0	–	V
		I <sub>O</sub> = –20 µA	4.5	4.4	4.5	–	V
		I <sub>O</sub> = –4.0 mA	4.5	3.98	4.32	–	V
		I <sub>O</sub> = –20 µA	6.0	5.9	6.0	–	V
		I <sub>O</sub> = –5.2 mA	6.0	5.48	5.81	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	2.0	–	0	0.1	V
		I <sub>O</sub> = 20 µA	4.5	–	0	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	0.15	0.26	V
		I <sub>O</sub> = 20 µA	6.0	–	0	0.1	V
		I <sub>O</sub> = 5.2 mA	6.0	–	0.16	0.26	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	6.0	–	0.1	±0.1	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND	6.0	–	–	±0.5	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	6.0	–	–	2	µA

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SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 to +85 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		2.0	1.5	–	–	V
			4.5	3.15	–	–	V
			6.0	4.2	–	–	V
V <sub>IL</sub>	LOW-level input voltage		2.0	–	–	0.5	V
			4.5	–	–	1.35	V
			6.0	–	–	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = -20 µA	2.0	1.9	–	–	V
		I <sub>O</sub> = -20 µA	4.5	4.4	–	–	V
		I <sub>O</sub> = -4.0 mA	4.5	3.84	–	–	V
		I <sub>O</sub> = -20 µA	6.0	5.9	–	–	V
		I <sub>O</sub> = -5.2 mA	6.0	5.34	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	2.0	–	–	0.1	V
		I <sub>O</sub> = 20 µA	4.5	–	–	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	–	0.33	V
		I <sub>O</sub> = 20 µA	6.0	–	–	0.1	V
		I <sub>O</sub> = 5.2 mA	6.0	–	–	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	6.0	–	–	±1.0	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND	6.0	–	–	±5.0	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	6.0	–	–	20	µA

## Quad 2-input AND gate

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SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 to +125 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		2.0	1.5	–	–	V
			4.5	3.15	–	–	V
			6.0	4.2	–	–	V
V <sub>IL</sub>	LOW-level input voltage		2.0	–	–	0.5	V
			4.5	–	–	1.35	V
			6.0	–	–	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = -20 µA	2.0	1.9	–	–	V
		I <sub>O</sub> = -20 µA	4.5	4.4	–	–	V
		I <sub>O</sub> = -4.0 mA	4.5	3.7	–	–	V
		I <sub>O</sub> = -20 µA	6.0	5.9	–	–	V
		I <sub>O</sub> = -5.2 mA	6.0	5.2	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	2.0	–	–	0.1	V
		I <sub>O</sub> = 20 µA	4.5	–	–	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	–	0.4	V
		I <sub>O</sub> = 20 µA	6.0	–	–	0.1	V
		I <sub>O</sub> = 5.2 mA	6.0	–	–	0.4	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	6.0	–	–	±1.0	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND	6.0	–	–	±10.0	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	6.0	–	–	40	µA



## Quad 2-input AND gate

## 74HC08; 74HCT08

**Family 74HCT08**

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = 25 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		4.5 to 5.5	2.0	1.6	–	V
V <sub>IL</sub>	LOW-level input voltage		4.5 to 5.5	–	1.2	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = –20 µA	4.5	4.4	4.5	–	V
		I <sub>O</sub> = –4.0 mA	4.5	3.84	4.32	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	4.5	–	0	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	0.15	0.26	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5	–	–	±0.1	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	±0.5	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	2	µA
ΔI <sub>CC</sub>	additional supply current per input	V <sub>I</sub> = V <sub>CC</sub> – 2.1 V; I <sub>O</sub> = 0	4.5 to 5.5	–	60	216	µA
<b>T<sub>amb</sub> = –40 to +85 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		4.5 to 5.5	2.0	–	–	V
V <sub>IL</sub>	LOW-level input voltage		4.5 to 5.5	–	–	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = –20 µA	4.5	4.4	–	–	V
		I <sub>O</sub> = –4.0 mA	4.5	3.84	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	4.5	–	–	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	–	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5	–	–	±1.0	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	±5.0	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	20	µA
ΔI <sub>CC</sub>	additional supply current per input	V <sub>I</sub> = V <sub>CC</sub> – 2.1 V; I <sub>O</sub> = 0	4.5 to 5.5	–	–	270	µA

## Quad 2-input AND gate

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SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 to +125 °C</b>							
V <sub>IH</sub>	HIGH-level input voltage		4.5 to 5.5	2.0	–	–	V
V <sub>IL</sub>	LOW-level input voltage		4.5 to 5.5	–	–	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = -20 µA	4.5	4.4	–	–	V
		I <sub>O</sub> = -4.0 mA	4.5	3.7	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 20 µA	4.5	–	–	0.1	V
		I <sub>O</sub> = 4.0 mA	4.5	–	–	0.4	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5	–	–	±1.0	µA
I <sub>OZ</sub>	3-state output OFF current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	±10	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	5.5	–	–	40	µA
ΔI <sub>CC</sub>	additional supply current per input	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0	4.5 to 5.5	–	–	294	µA

## Quad 2-input AND gate

## 74HC08; 74HCT08

## AC CHARACTERISTICS

## Family 74HC08

GND = 0 V;  $t_f = t_r = 6$  ns;  $C_L = 50$  pF.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = 25 °C</b>							
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay nA, nB to nY	see Figs 7 and 8	2.0	–	25	90	ns
			4.5	–	9	18	ns
			6.0	–	7	15	ns
t <sub>THL</sub> /t <sub>TLH</sub>	output transition time	see Figs 7 and 8	2.0	–	19	75	ns
			4.5	–	7	15	ns
			6.0	–	6	13	ns
<b>T<sub>amb</sub> = –40 to +85 °C</b>							
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay nA, nB to nY	see Figs 7 and 8	2.0	–	–	115	ns
			4.5	–	–	23	ns
			6.0	–	–	20	ns
t <sub>THL</sub> /t <sub>TLH</sub>	output transition time	see Figs 7 and 8	2.0	–	–	95	ns
			4.5	–	–	19	ns
			6.0	–	–	16	ns
<b>T<sub>amb</sub> = –40 to +125 °C</b>							
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay nA, nB to nY	see Figs 7 and 8	2.0	–	–	135	ns
			4.5	–	–	27	ns
			6.0	–	–	23	ns
t <sub>THL</sub> /t <sub>TLH</sub>	output transition time	see Figs 7 and 8	2.0	–	–	110	ns
			4.5	–	–	22	ns
			6.0	–	–	19	ns

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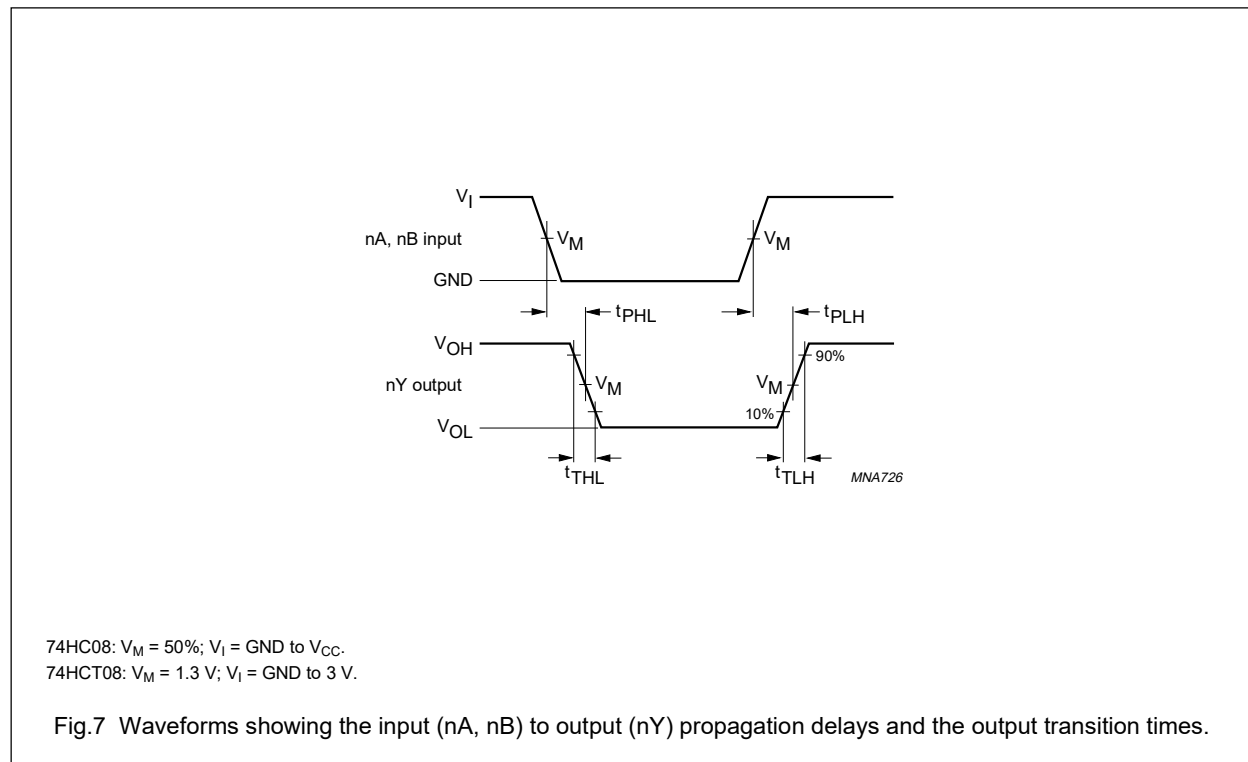
74HC08; 74HCT08

## Family 74HCT08

GND = 0 V;  $t_f = t_r = 6$  ns;  $C_L = 50$  pF.

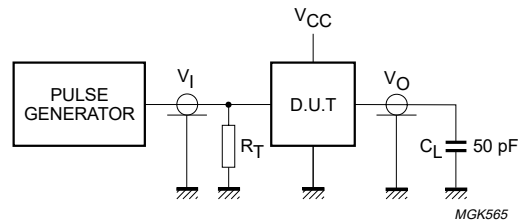
SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	$V_{CC}$ (V)				
<b><math>T_{amb} = 25</math> °C</b>							
$t_{PHL}/t_{PLH}$	propagation delay nA, nB to nY	see Figs 7 and 8	4.5	–	14	24	ns
$t_{THL}/t_{TLH}$	output transition time	see Figs 7 and 8	4.5	–	7	15	ns
<b><math>T_{amb} = -40</math> to <math>+85</math> °C</b>							
$t_{PHL}/t_{PLH}$	propagation delay nA, nB to nY	see Figs 7 and 8	4.5	–	–	30	ns
$t_{THL}/t_{TLH}$	output transition time	see Figs 7 and 8	4.5	–	–	19	ns
<b><math>T_{amb} = -40</math> to <math>+125</math> °C</b>							
$t_{PHL}/t_{PLH}$	propagation delay nA, nB to nY	see Figs 7 and 8	4.5	–	–	36	ns
$t_{THL}/t_{TLH}$	output transition time	see Figs 7 and 8	4.5	–	–	22	ns

## AC WAVEFORMS



## Quad 2-input AND gate

74HC08; 74HCT08



Definitions for test circuit:

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

$R_T$  = Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

Fig.8 Load circuitry for switching times.

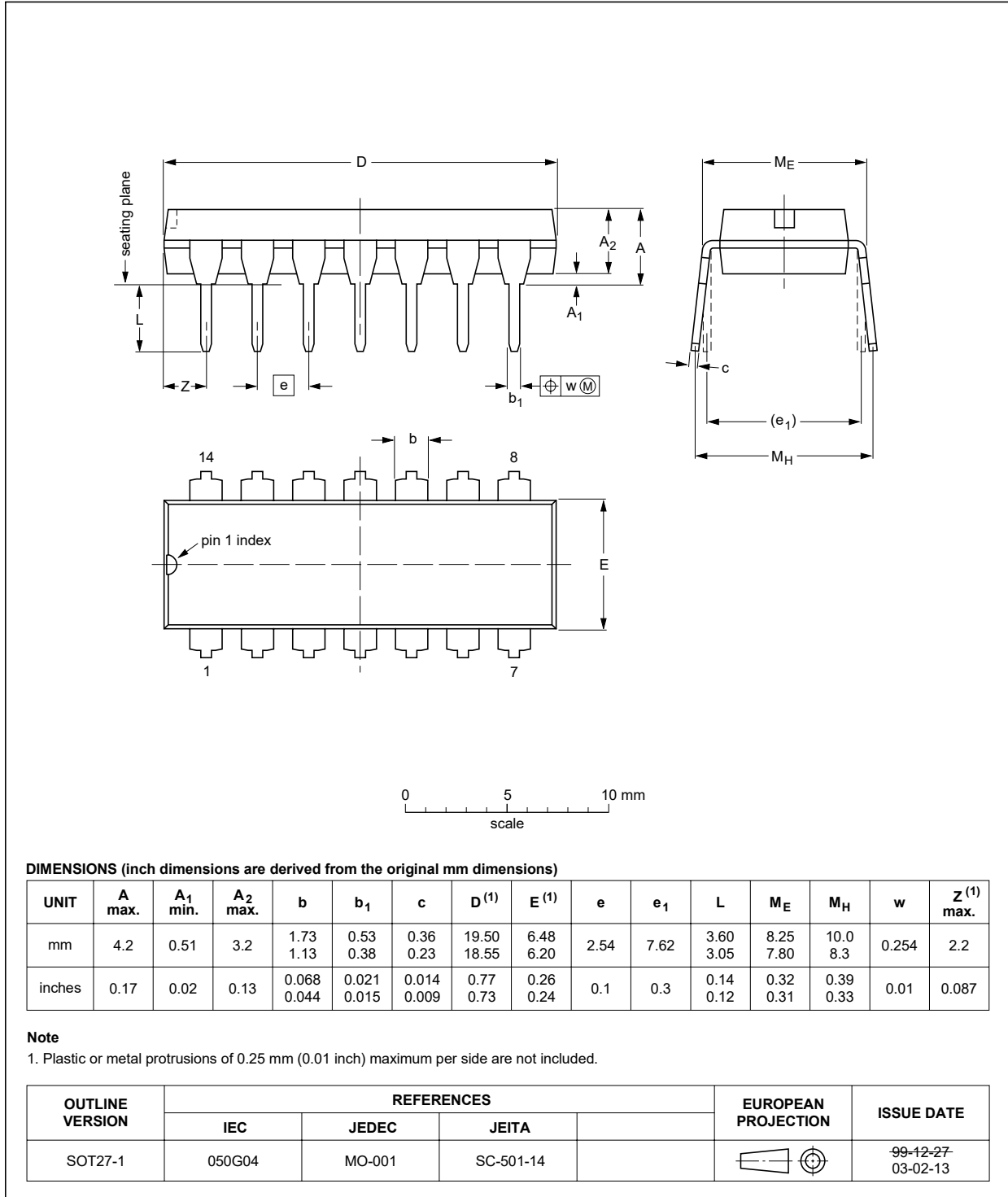
Quad 2-input AND gate

74HC08; 74HCT08

PACKAGE OUTLINES

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

SOT27-1

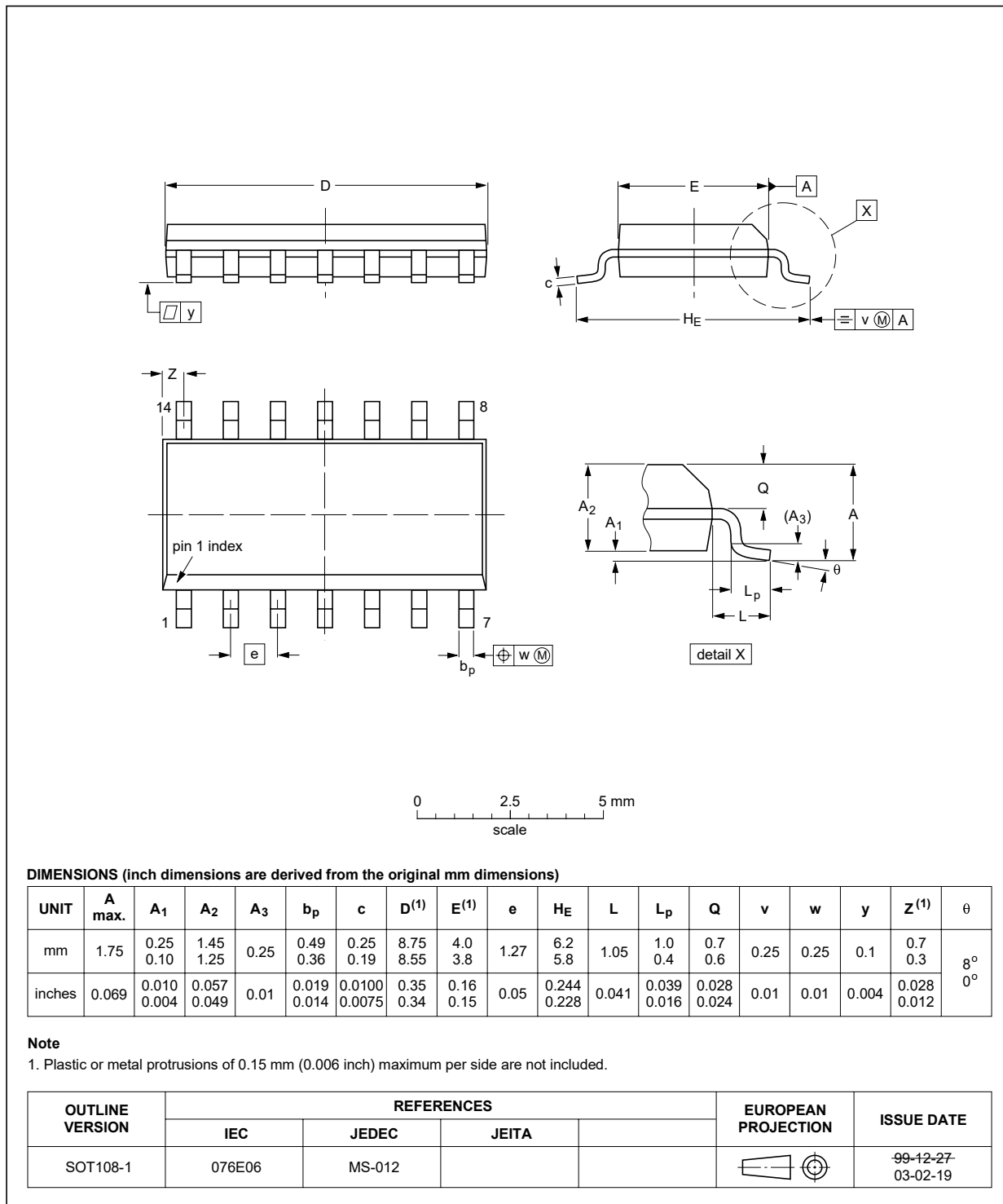


Quad 2-input AND gate

74HC08; 74HCT08

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

SOT108-1

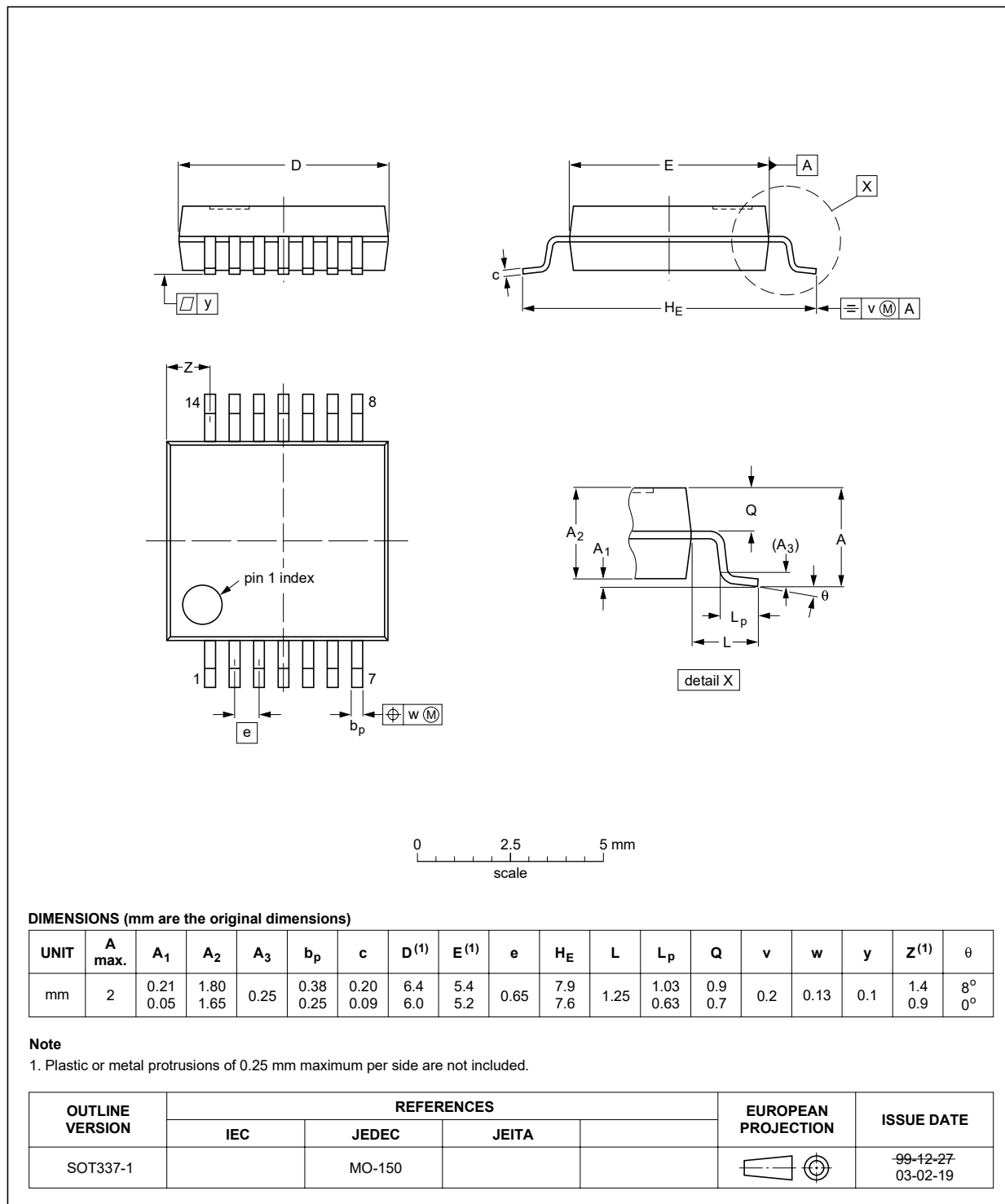


Quad 2-input AND gate

74HC08; 74HCT08

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

SOT337-1



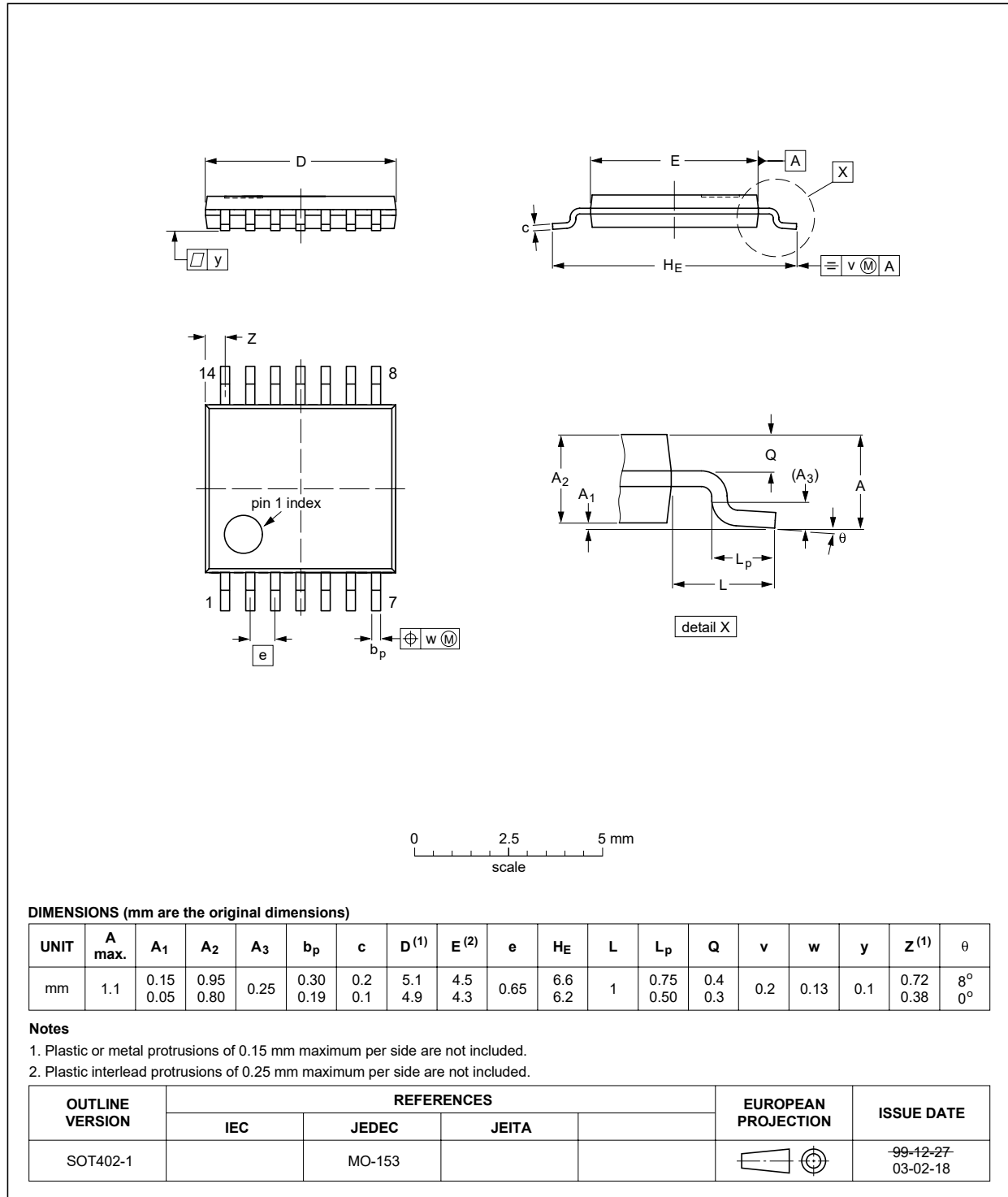


Quad 2-input AND gate

74HC08; 74HCT08

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

SOT402-1

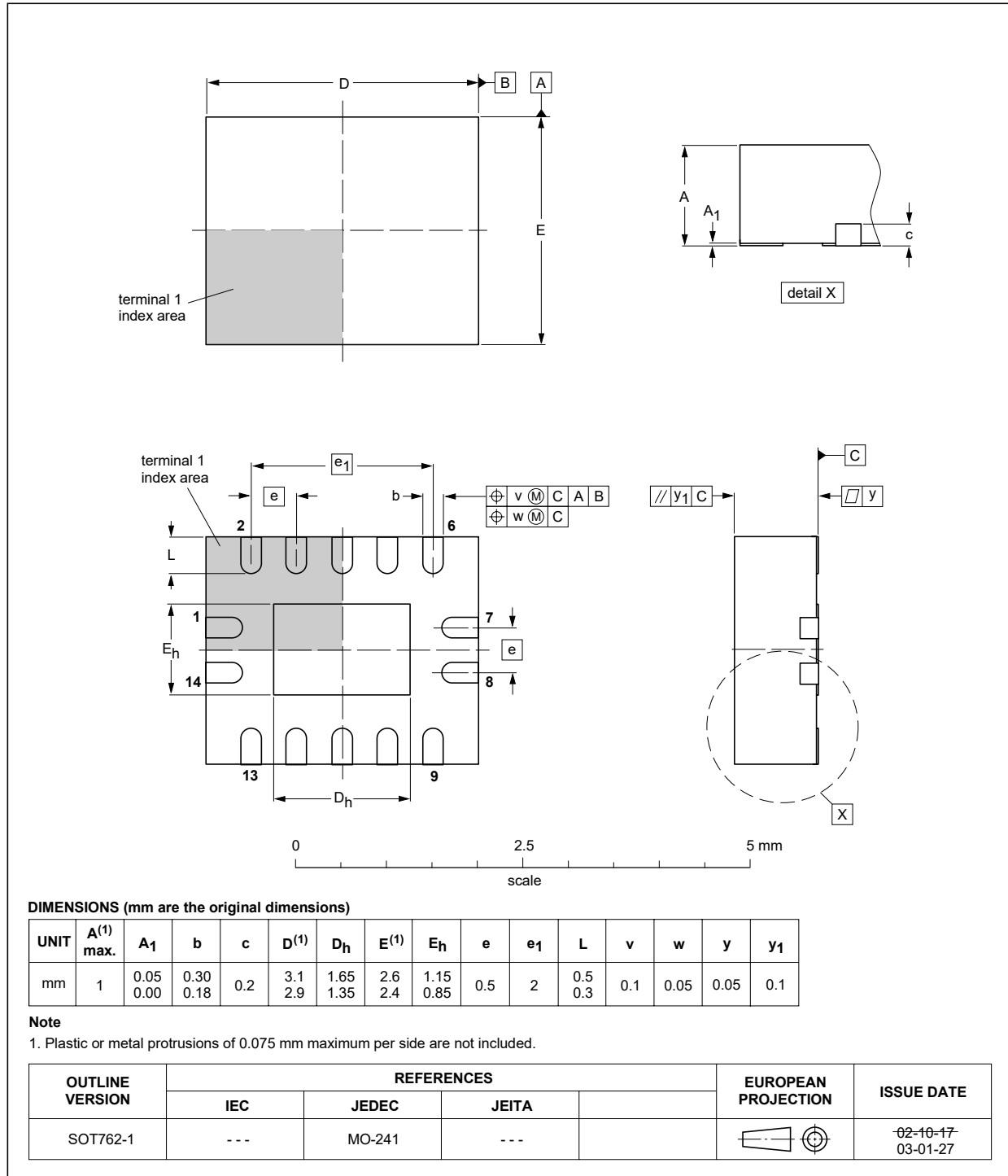


Quad 2-input AND gate

74HC08; 74HCT08

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



## Quad 2-input AND gate

74HC08; 74HCT08

## DATA SHEET STATUS

LEVEL	DATA SHEET STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)(3)</sup>	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device.

These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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