

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

- C_{PD} is used to determine the dynamic power dissipation (P_D in μ 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.

- 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

- 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 _{CC}	supply voltage

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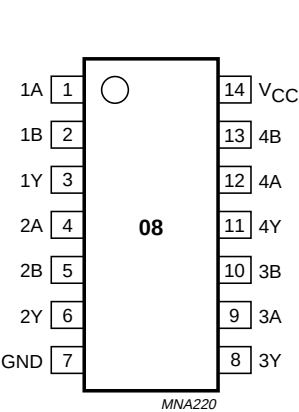
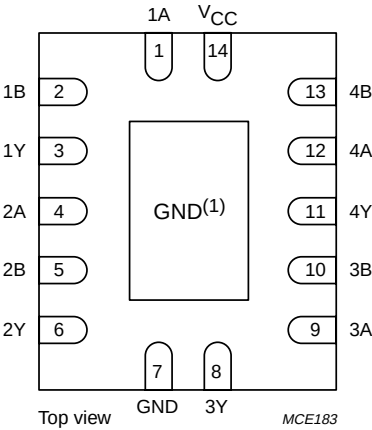


Fig.1 Pin configuration DIP14, SO14 and (T)SSOP14.



(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin or input.

Fig.2 Pin configuration DHVQFN14.

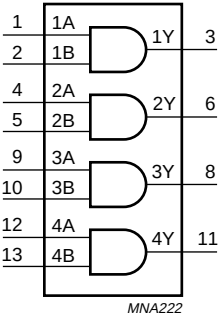


Fig.3 Logic symbol.

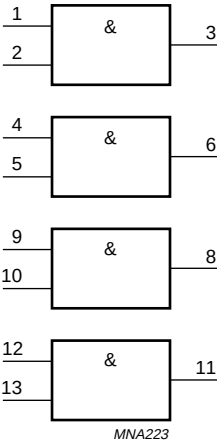
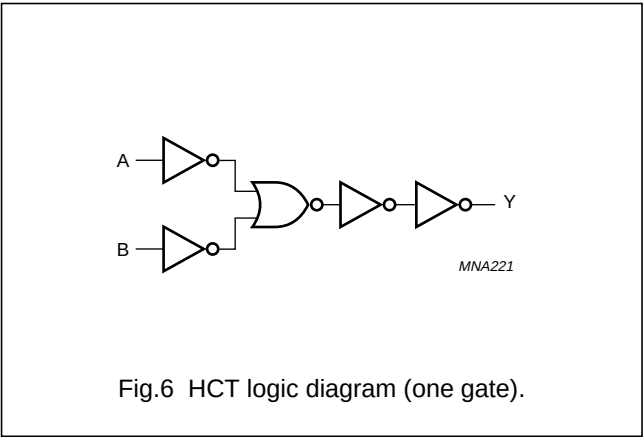
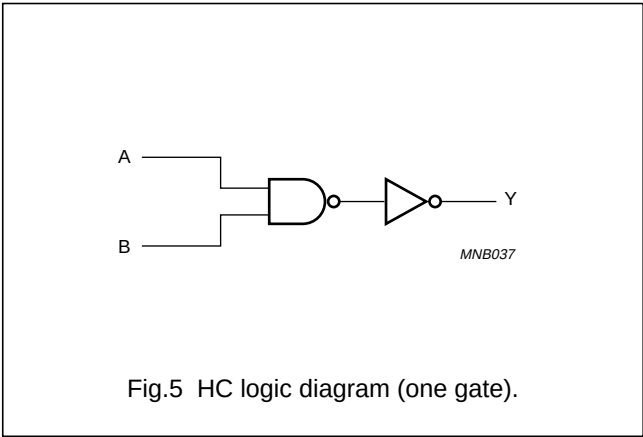


Fig.4 IEC logic symbol.

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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 V	–	–	1000	–	–	–	ns
		V _{CC} = 4.5 V	–	6.0	500	–	6.0	500	ns
		V _{CC} = 6.0 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 V or V _I > V _{CC} + 0.5 V	–	±20	mA
I _{OK}	output diode current	V _O < –0.5 V or V _O > V _{CC} + 0.5 V	–	±20	mA
I _O	output source or sink current	–0.5 V < V _O < V _{CC} + 0.5 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 other packages	T _{amb} = –40 to +125 °C; note 1 T _{amb} = –40 to +125 °C; note 2	–	750 500	mW mW

Notes

1. For DIP14 packages: above 70 °C derate linearly with 12 mW/K.
2. 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.

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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 _{CC} (V)				
T _{amb} = 25 °C							
V _{IH}	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 _{IL}	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 _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = –20 μA	2.0	1.9	2.0	–	V
		I _O = –20 μA	4.5	4.4	4.5	–	V
		I _O = –4.0 mA	4.5	3.98	4.32	–	V
		I _O = –20 μA	6.0	5.9	6.0	–	V
		I _O = –5.2 mA	6.0	5.48	5.81	–	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = 20 μA	2.0	–	0	0.1	V
		I _O = 20 μA	4.5	–	0	0.1	V
		I _O = 4.0 mA	4.5	–	0.15	0.26	V
		I _O = 20 μA	6.0	–	0	0.1	V
		I _O = 5.2 mA	6.0	–	0.16	0.26	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	6.0	–	0.1	±0.1	μA
I _{OZ}	3-state output OFF current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND	6.0	–	–	±0.5	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0	6.0	–	–	2	μA

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

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

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Family 74HCT08

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V _{CC} (V)				
T _{amb} = 25 °C							
V _{IH}	HIGH-level input voltage		4.5 to 5.5	2.0	1.6	–	V
V _{IL}	LOW-level input voltage		4.5 to 5.5	–	1.2	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = –20 μA	4.5	4.4	4.5	–	V
		I _O = –4.0 mA	4.5	3.84	4.32	–	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = 20 μA	4.5	–	0	0.1	V
		I _O = 4.0 mA	4.5	–	0.15	0.26	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	5.5	–	–	±0.1	μA
I _{OZ}	3-state output OFF current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; I _O = 0	5.5	–	–	±0.5	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0	5.5	–	–	2	μA
ΔI _{CC}	additional supply current per input	V _I = V _{CC} – 2.1 V; I _O = 0	4.5 to 5.5	–	60	216	μA
T _{amb} = –40 to +85 °C							
V _{IH}	HIGH-level input voltage		4.5 to 5.5	2.0	–	–	V
V _{IL}	LOW-level input voltage		4.5 to 5.5	–	–	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = –20 μA	4.5	4.4	–	–	V
		I _O = –4.0 mA	4.5	3.84	–	–	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = 20 μA	4.5	–	–	0.1	V
		I _O = 4.0 mA	4.5	–	–	0.33	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	5.5	–	–	±1.0	μA
I _{OZ}	3-state output OFF current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; I _O = 0	5.5	–	–	±5.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0	5.5	–	–	20	μA
ΔI _{CC}	additional supply current per input	V _I = V _{CC} – 2.1 V; I _O = 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 _{CC} (V)				
T _{amb} = −40 to +125 °C							
V _{IH}	HIGH-level input voltage		4.5 to 5.5	2.0	–	–	V
V _{IL}	LOW-level input voltage		4.5 to 5.5	–	–	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = −20 μA	4.5	4.4	–	–	V
		I _O = −4.0 mA	4.5	3.7	–	–	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}					
		I _O = 20 μA	4.5	–	–	0.1	V
		I _O = 4.0 mA	4.5	–	–	0.4	V
I _{LI}	input leakage current	V _I = V _{CC} or GND	5.5	–	–	±1.0	μA
I _{OZ}	3-state output OFF current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; I _O = 0	5.5	–	–	±10	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0	5.5	–	–	40	μA
ΔI _{CC}	additional supply current per input	V _I = V _{CC} − 2.1 V; I _O = 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 _{CC} (V)				
T _{amb} = 25 °C							
t _{PHL} /t _{PLH}	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 _{THL} /t _{TLH}	output transition time	see Figs 7 and 8	2.0	–	19	75	ns
			4.5	–	7	15	ns
			6.0	–	6	13	ns
T _{amb} = –40 to +85 °C							
t _{PHL} /t _{PLH}	propagation delay nA, nB to nY	see Figs 7 and 8	2.0	–	–	115	ns
			4.5	–	–	23	ns
			6.0	–	–	20	ns
t _{THL} /t _{TLH}	output transition time	see Figs 7 and 8	2.0	–	–	95	ns
			4.5	–	–	19	ns
			6.0	–	–	16	ns
T _{amb} = –40 to +125 °C							
t _{PHL} /t _{PLH}	propagation delay nA, nB to nY	see Figs 7 and 8	2.0	–	–	135	ns
			4.5	–	–	27	ns
			6.0	–	–	23	ns
t _{THL} /t _{TLH}	output transition time	see Figs 7 and 8	2.0	–	–	110	ns
			4.5	–	–	22	ns
			6.0	–	–	19	ns

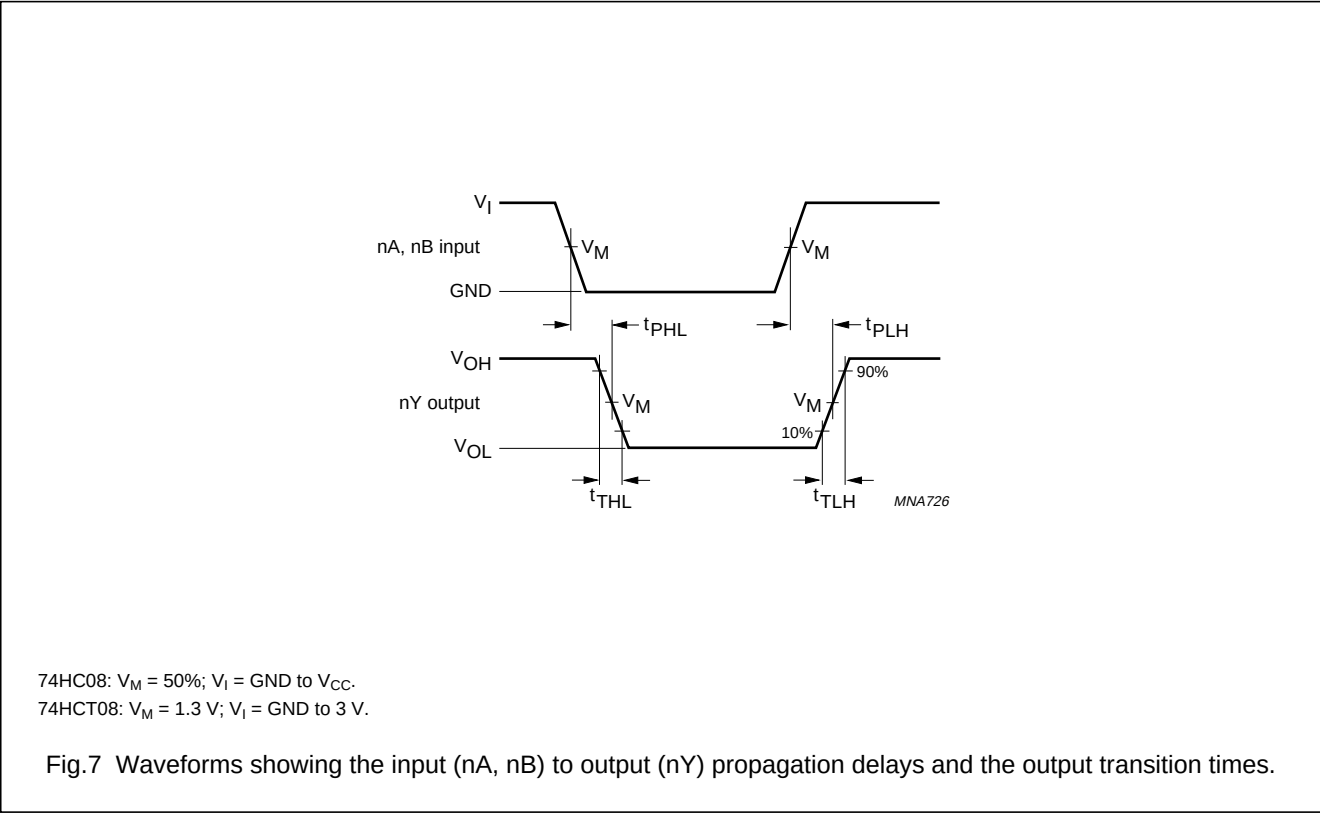
Quad 2-input AND gate

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Family 74HCT08
GND = 0 V; $t_f = t_r = 6\text{ ns}$; $C_L = 50\text{ pF}$.

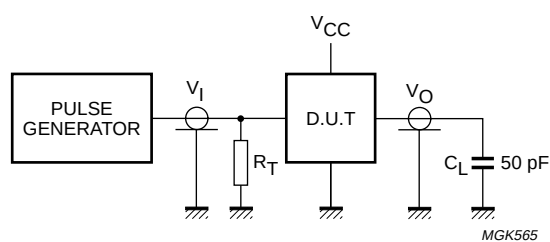
SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V _{CC} (V)				
T _{amb} = 25 °C							
t _{PHL} /t _{PLH}	propagation delay nA, nB to nY	see Figs 7 and 8	4.5	–	14	24	ns
t _{THL} /t _{TLH}	output transition time	see Figs 7 and 8	4.5	–	7	15	ns
T _{amb} = –40 to +85 °C							
t _{PHL} /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
T _{amb} = –40 to +125 °C							
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

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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.

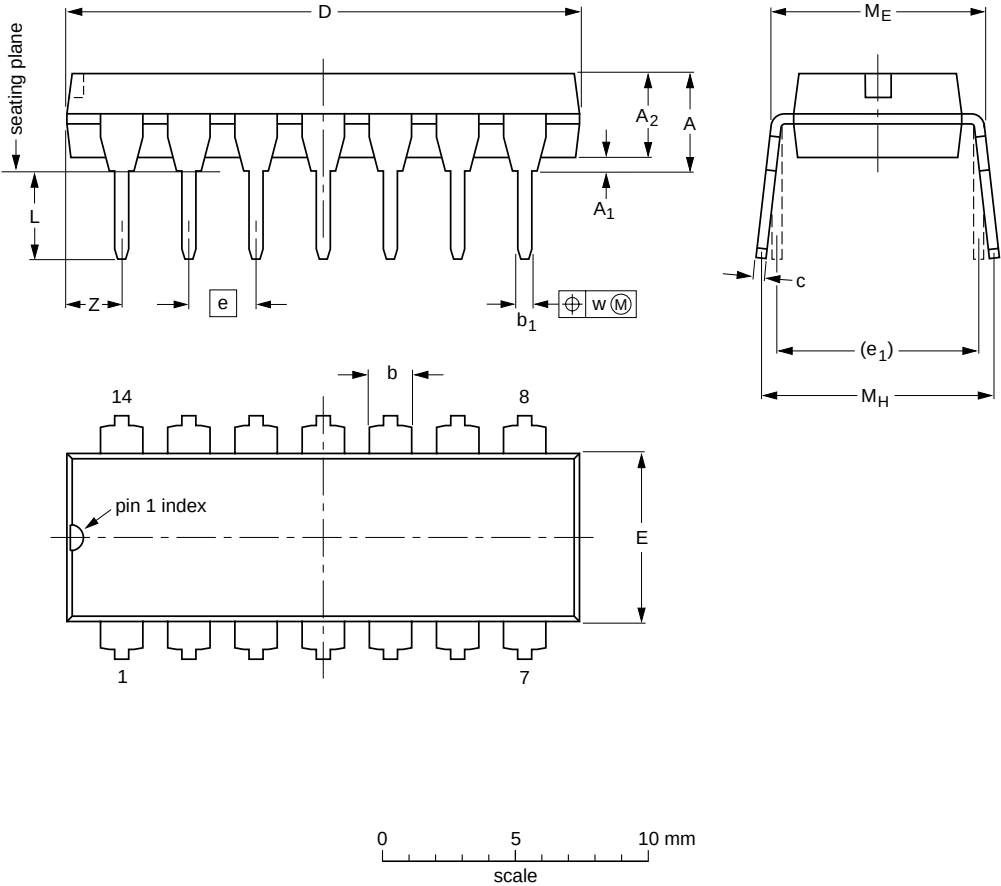
Quad 2-input AND gate

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PACKAGE OUTLINES

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

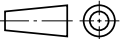
SOT27-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.02	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note
1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

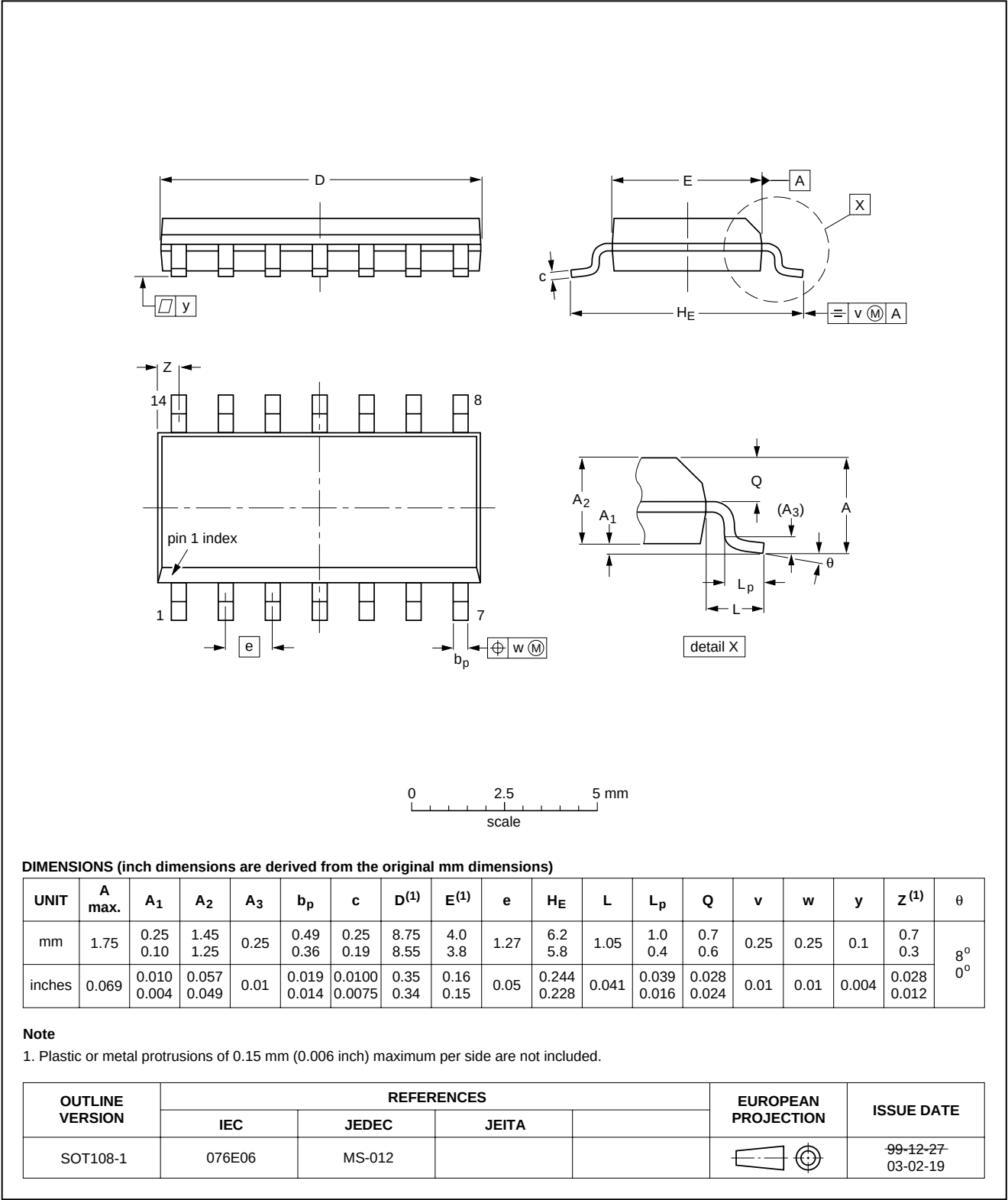
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT27-1	050G04	MO-001	SC-501-14			99-12-27- 03-02-13

Quad 2-input AND gate

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

SOT108-1

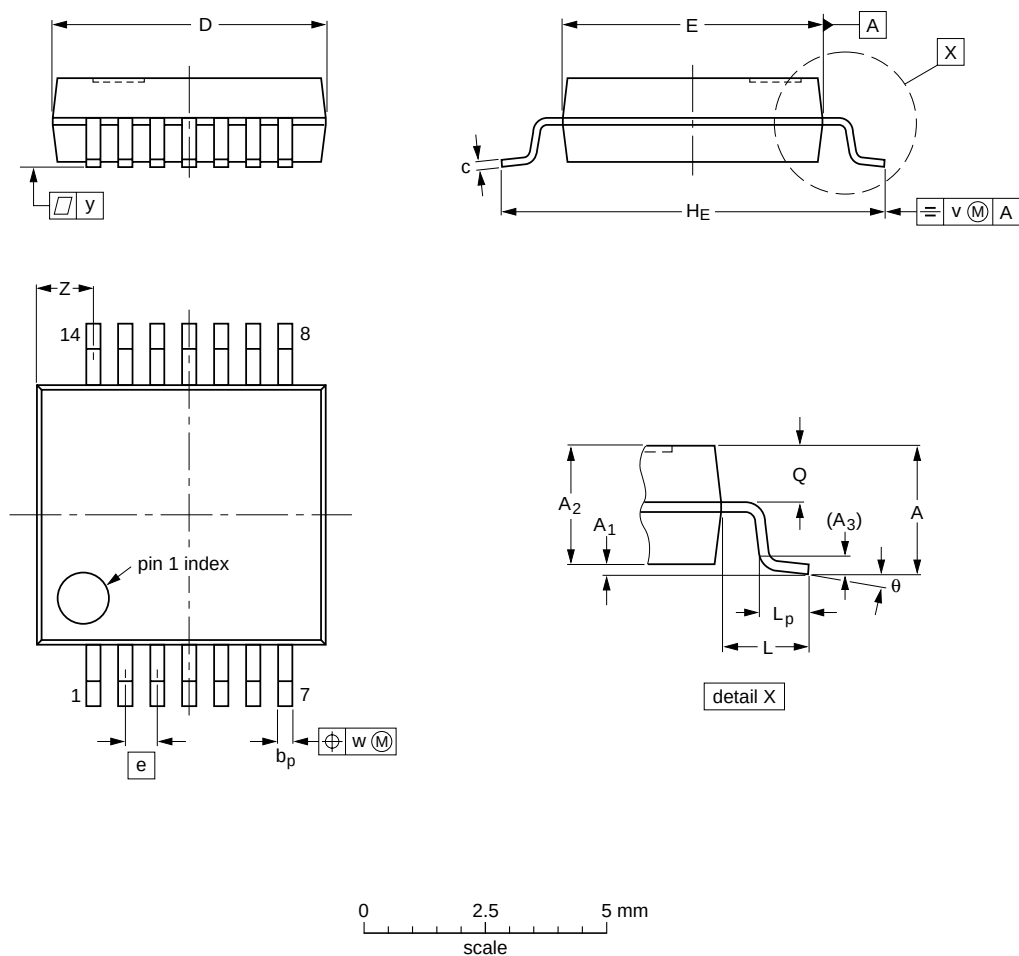


Quad 2-input AND gate

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

SOT337-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	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°

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

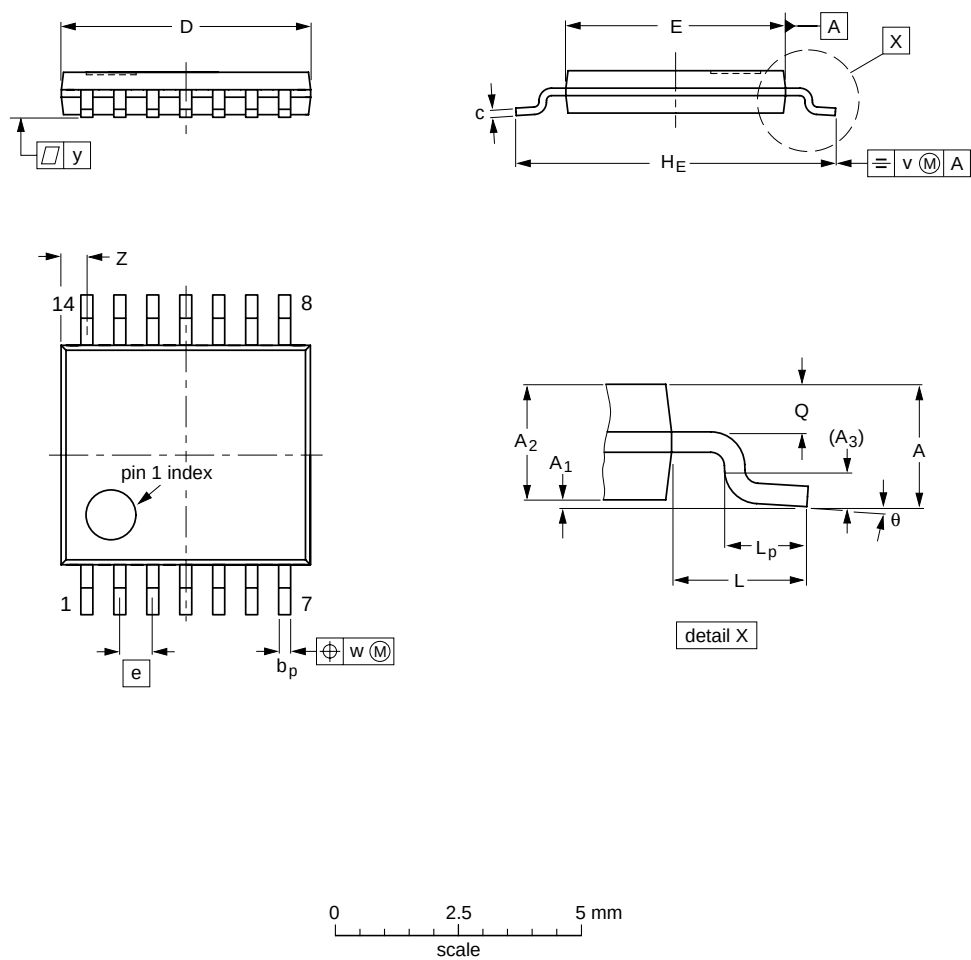
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT337-1		MO-150				99-12-27 03-02-19

Quad 2-input AND gate

74HC08; 74HCT08

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

SOT402-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	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

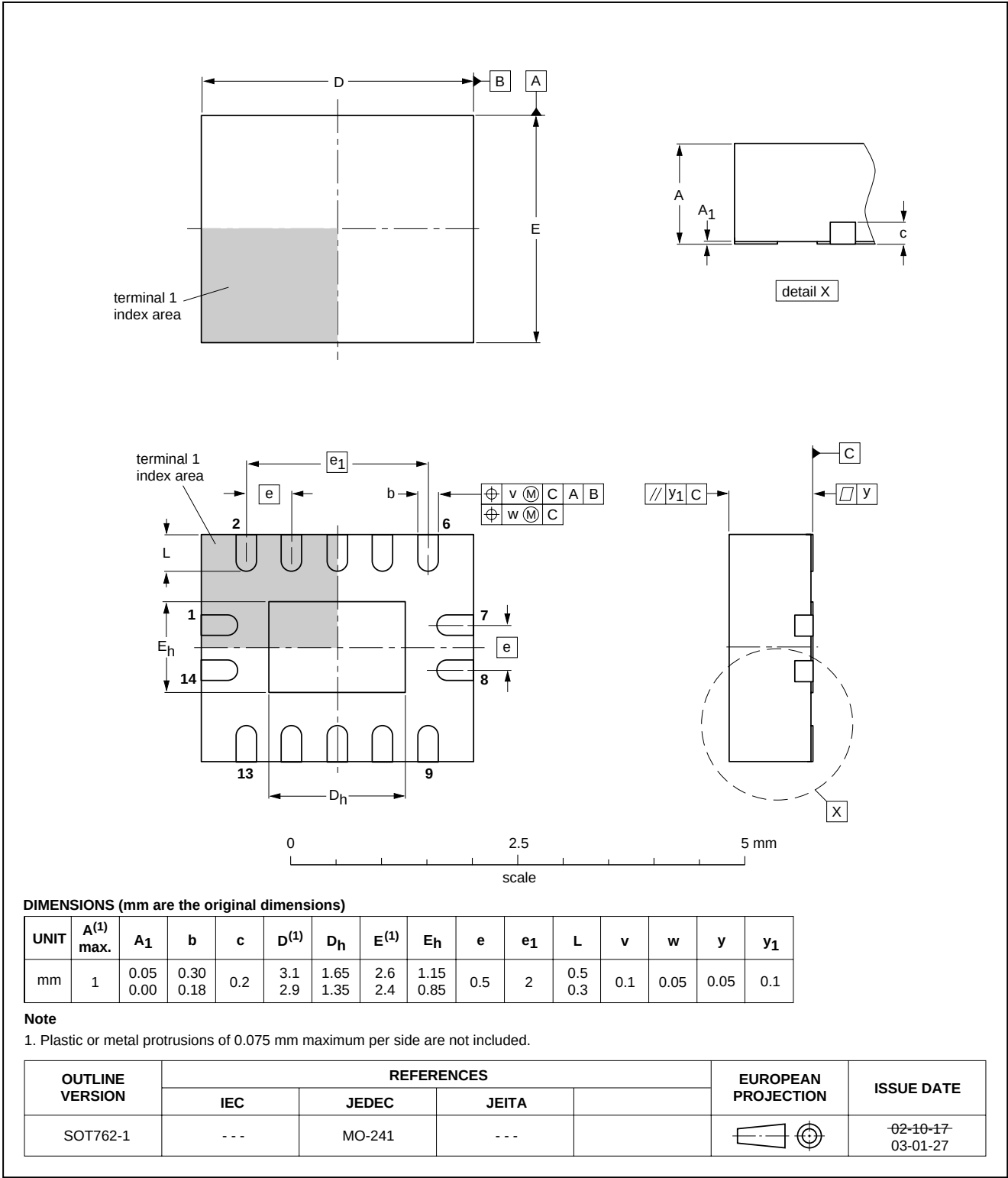
- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				99-12-27- 03-02-18

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 ⁽¹⁾	PRODUCT STATUS ⁽²⁾⁽³⁾	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.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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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