74HC03; 74HCT03

Quad 2-input NAND gate; open-drain output

Rev. 6 — 10 August 2021   **Product data sheet**

1. General description

The 74HC03; 74HCT03 is a quad 2-input NAND gate with open-drain outputs. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Input levels:
    - For 74HC03: CMOS level
    - For 74HCT03: TTL level
- Complies with JEDEC standards:
    - JESD8C (2.7 V to 3.6 V)
    - JESD7A (2.0 V to 6.0 V)
- ESD protection:
    - HBM JESD22-A114F exceeds 2000 V
    - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC03D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT03D				
74HC03PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT03PW				

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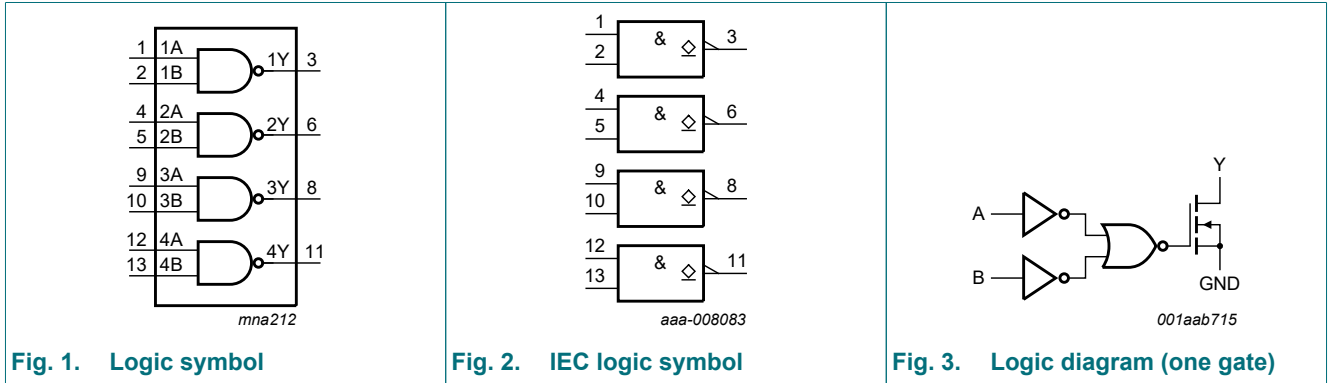## 4. Functional diagram

Fig. 1.   Logic symbol

Fig. 2.   IEC logic symbol

Fig. 3.   Logic diagram (one gate)

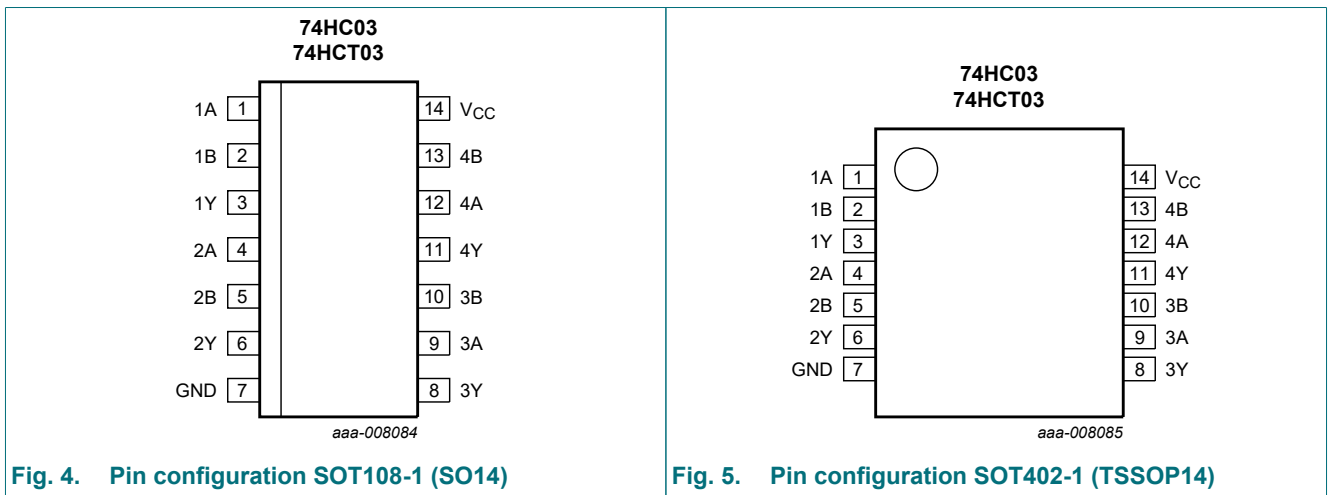## 5. Pinning information

5.1. Pinning

Fig. 4.   Pin configuration SOT108-1 (SO14)

Fig. 5.   Pin configuration SOT402-1 (TSSOP14)

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_{CC}	14	supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Input		Output
nA	**nB**	**nY**
L	L	Z
L	H	Z
H	L	Z
H	H	L

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
V_O	output voltage		[1]	-0.5	+7	V
I_{IK}	input clamping current	V_I < -0.5 V or V_I > V_{CC} + 0.5 V	[1]	-	±20	mA
I_{OK}	output clamping current	V_O < -0.5 V	[1]	-	-20	mA
I_O	output current	-0.5 V < V_O		-	-25	mA
I_{CC}	supply current			-	50	mA
I_{GND}	ground current			-50	-	mA
T_{stg}	storage temperature			-65	+150	°C
P_{tot}	total power dissipation		[2]	-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.
For SOT402-1 (TSSOP14) package: P_{tot} derates linearly with 7.3 mW/K above 81 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC03			74HCT03			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		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V_{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V_{CC} = 6.0 V	-	-	83	-	-	-	ns/V

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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 +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC03										
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V_{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V_{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V_{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V_{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}								
		I_O = 20 µA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	0.1	-	-	±1	-	±1	µA
I_{OZ}	OFF-state output current	$V_I = V_{IL}$; V_{CC} = 6.0 V; $V_O = V_{CC}$ or GND	-	-	±0.5	-	±5.0	-	±10	µA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	2.0	-	-	20	-	40	µA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT03										
V_{IH}	HIGH-level input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V								
		I_O = 20 µA	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I_{OZ}	OFF-state output current	$V_I = V_{IL}$; V_{CC} = 5.5 V; $V_O = V_{CC}$ or GND	-	-	±0.5	-	±5.0	-	±10	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 inputs at V_{CC} or GND; V_{CC} = 4.5 V to 5.5 V	-	100	360	-	450	-	490	µA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

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10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; C_L = 50 pF; for test circuit, see Fig. 7.

Symbol	Parameter	Conditions		25 °C			-40 °C to +85 °C	-40 °C to +125 °C	Unit
				Min	Typ	Max	Max	Max	
74HC03									
t_{pd}	propagation delay	nA, nB to nY; see Fig. 6	[1]						
		V_{CC} = 2.0 V		-	28	95	120	145	ns
		V_{CC} = 4.5 V		-	10	19	24	29	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	8	-	-	-	ns
		V_{CC} = 6.0 V		-	8	16	20	25	ns
t_t	transition time	see Fig. 6	[2]						
		V_{CC} = 2.0 V		-	19	75	95	110	ns
		V_{CC} = 4.5 V		-	7	15	19	22	ns
		V_{CC} = 6.0 V		-	6	13	16	19	ns
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC}	[3]	-	4	-	-	-	pF
74HCT03									
t_{pd}	propagation delay	nA, nB to nY; see Fig. 6	[1]						
		V_{CC} = 4.5 V		-	12	24	30	36	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	10	-	-	-	ns
t_t	transition time	V_{CC} = 4.5 V; see Fig. 6	[2]	-	7	15	19	22	ns
C_{PD}	power dissipation capacitance	per package; V_I = GND to V_{CC} - 1.5 V	[3]	-	4	-	-	-	pF

[1] t_{pd} is the same as t_{PLZ} and t_{PZL}.

[2] t_t is the same as t_{THL}.

[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;

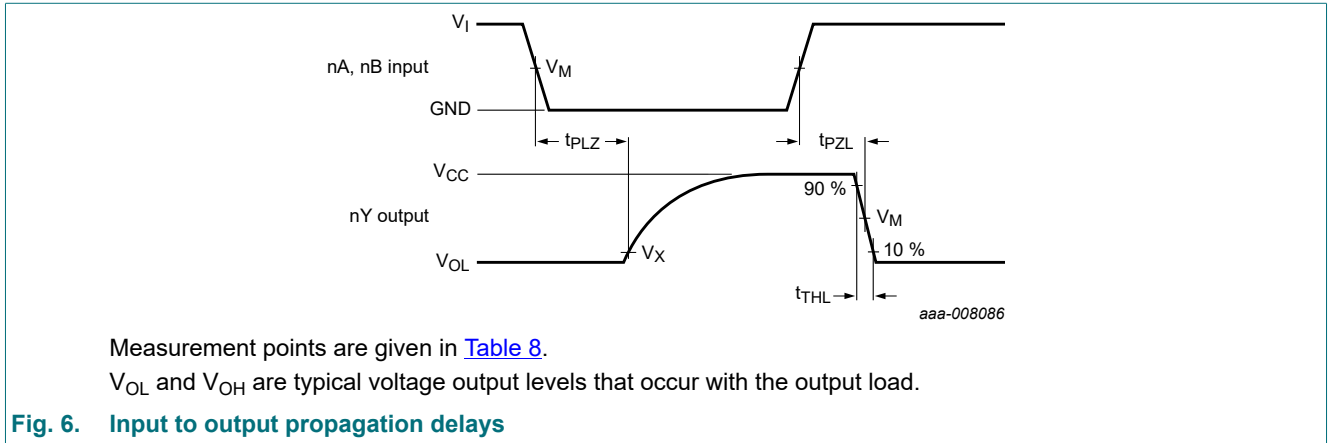$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

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10.1. Waveforms and test circuit

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.   Input to output propagation delays

Table 8. Measurement points

Type	Input	Output	
	V_M	V_M	V_X
74HC03	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$
74HCT03	1.3 V	1.3 V	$0.1V_{CC}$

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.

Fig. 7.   Test circuit for measuring switching times
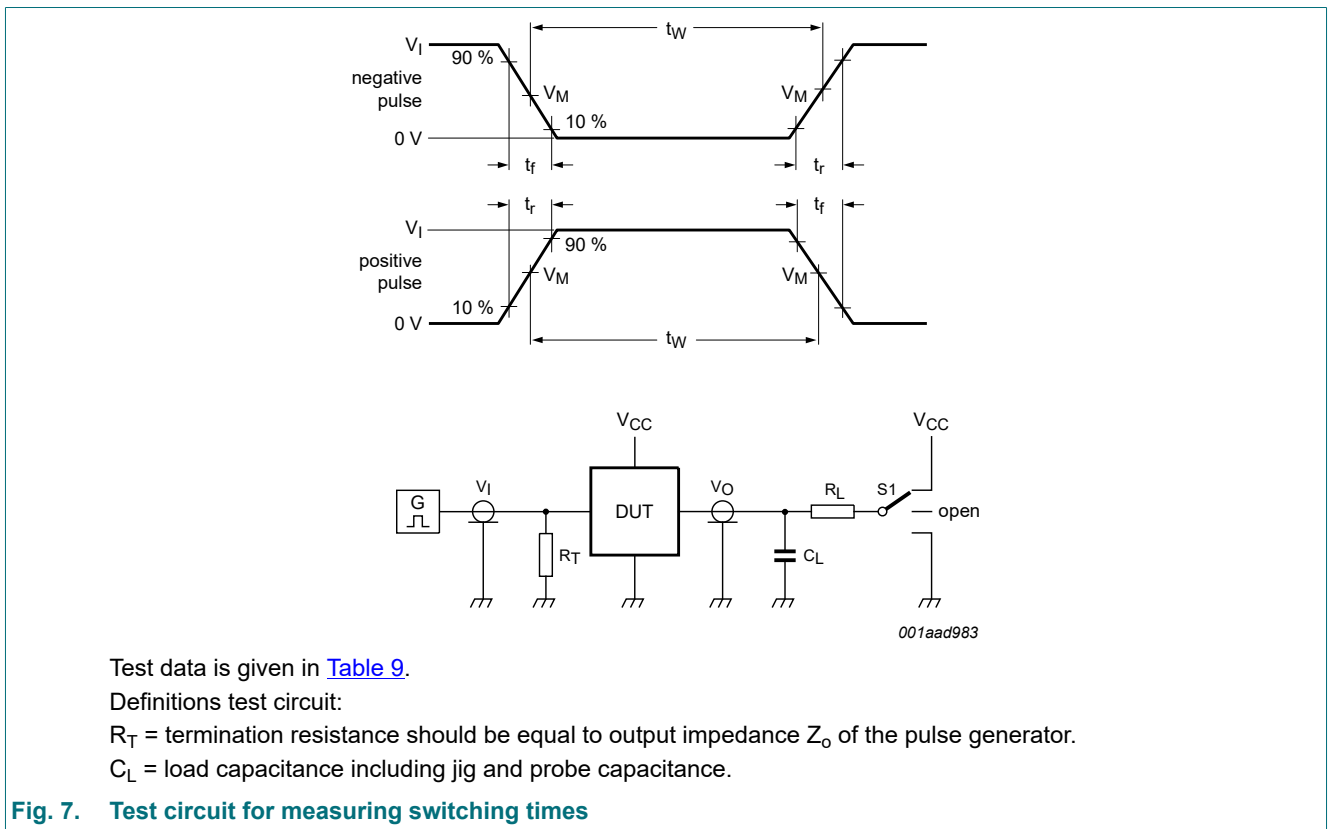
Table 9. Test data

Type	Input		Load		S1 position
	V_I	t_r, t_f	C_L	R_L	t_{PZL}, t_{PLZ}
74HC03	V_{CC}	6 ns	15 pF, 50 pF	1 kΩ	V_{CC}
74HCT03	3.0 V	6 ns	15 pF, 50 pF	1 kΩ	V_{CC}

11. Package outline

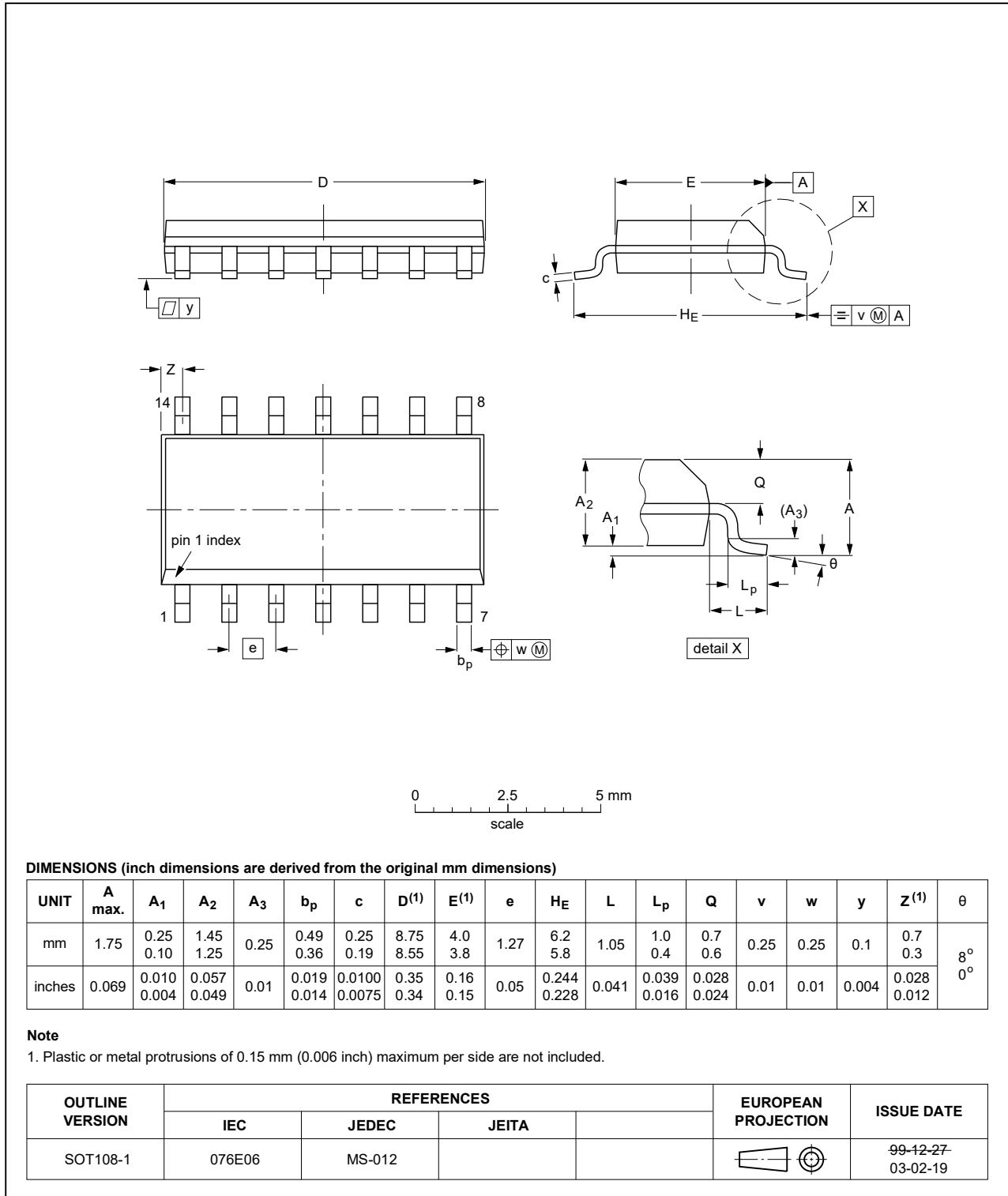**SO14: plastic small outline package; 14 leads; body width 3.9 mm** **SOT108-1**

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

UNIT	A max.	A₁	A₂	A₃	bₚ	c	D[1]	E[1]	e	Hₑ	L	Lₚ	Q	v	w	y	Z[1]	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT108-1	076E06	MS-012				~~99-12-27~~ 03-02-19

Fig. 8. Package outline SOT108-1 (SO14)

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.	A₁	A₂	A₃	bₚ	c	D(1)	E(2)	e	H_E	L	Lₚ	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

Fig. 9. Package outline SOT402-1 (TSSOP14)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT03 v.6	20210810	Product data sheet	-	74HC_HCT03 v.5
Modifications:	• Section 2 updated. • Type number 74HC03DB (SOT337-1/SSOP14) removed.			
74HC_HCT03 v.5	20210107	Product data sheet	-	74HC_HCT03 v.4
Modifications:	• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Type number 74HCT03DB (SOT337-1 / SSOP14) removed. • Section 7: Derating values for P_{tot} total power dissipation have been updated.			
74HC_HCT03 v.4	20151127	Product data sheet	-	74HC_HCT03 v.3
Modifications:	• Type numbers 74HC03N and 74HCT03N (SOT27-1) removed.			
74HC_HCT03 v.3	20130627	Product data sheet	-	74HC_HCT03_CNV v.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.			
74HC_HCT03_CNV v.2	19970827	Product specification	-	-

14. Legal information

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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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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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