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# 74HC02; 74HCT02

## Quad 2-input NOR gate

Rev. 8 — 9 February 2023

Product data sheet

## 1. General description

The 74HC02; 74HCT02 is a quad 2-input NOR gate. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

## 2. Features and benefits

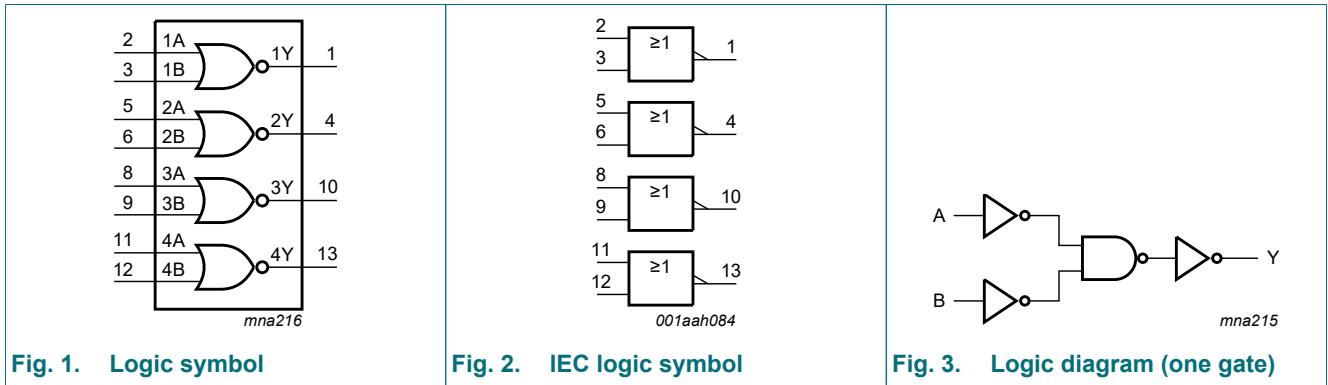
- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Input levels:
  - For 74HC02: CMOS level
  - For 74HCT02: TTL level
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

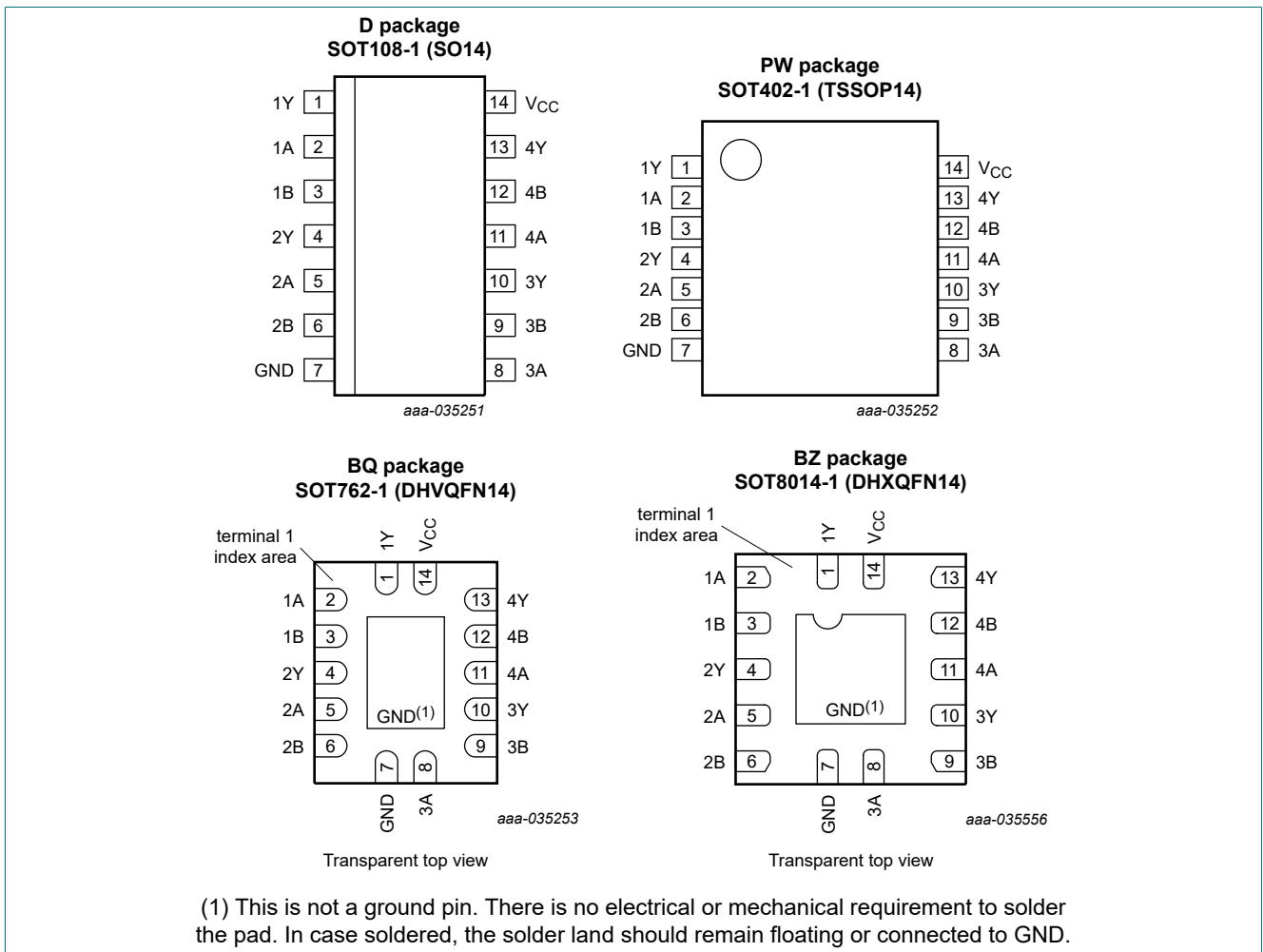
Type number	Package			
	Temperature range	Name	Description	Version
<a href="#">74HC02D</a> <a href="#">74HCT02D</a>	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	<a href="#">SOT108-1</a>
<a href="#">74HC02PW</a> <a href="#">74HCT02PW</a>	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	<a href="#">SOT402-1</a>
<a href="#">74HC02BQ</a> <a href="#">74HCT02BQ</a>	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm	<a href="#">SOT762-1</a>
<a href="#">74HC02BZ</a> <a href="#">74HCT02BZ</a>	-40 °C to +125 °C	DHXQFN14	plastic, leadless dual in-line compatible thermal enhanced extreme thin quad flat package; no leads; 14 terminals; 0.4 mm pitch; body 2 mm × 2 mm × 0.48 mm	<a href="#">SOT8014-1</a>

### 4. Functional diagram



### 5. Pinning information

#### 5.1. Pinning



## 5.2. Pin description

Table 2. Pin description

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

## 6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

Input		Output
nA	nB	nY
L	L	H
X	H	L
H	X	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 <sub>CC</sub>	supply voltage		-0.5	+7	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V [1]	-	±20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V [1]	-	±20	mA
I <sub>O</sub>	output current	-0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 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	SOT108-1 SOT402-1 SOT762-1 [2]	-	500	mW
		SOT8016-1	-	250	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<sub>tot</sub> derates linearly with 10.1 mW/K above 100 °C.  
 For SOT402-1 (TSSOP14) package: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.  
 For SOT762-1 (DHVQFN14) package: P<sub>tot</sub> derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC02			74HCT02			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	-	+125	-40	-	+125	°C
$\Delta t/\Delta V$	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 +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC02</b>										
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	1.2	-	1.5	-	1.5	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	2.4	-	3.15	-	3.15	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	3.2	-	4.2	-	4.2	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	0.8	0.5	-	0.5	-	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	2.1	1.35	-	1.35	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	2.8	1.8	-	1.8	-	1.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	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 output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	-	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
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$	-	-	2.0	-	20	-	40	$\mu\text{A}$
$C_I$	input capacitance		-	3.5	-	-	-	-	-	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT02</b>										
V <sub>IH</sub>	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 <sub>IL</sub>	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 output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 µA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 5.2 mA	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	2.0	-	20	-	40	µA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V	-	150	540	-	675	-	735	µA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10. Dynamic characteristics

Table 7. Dynamic characteristics

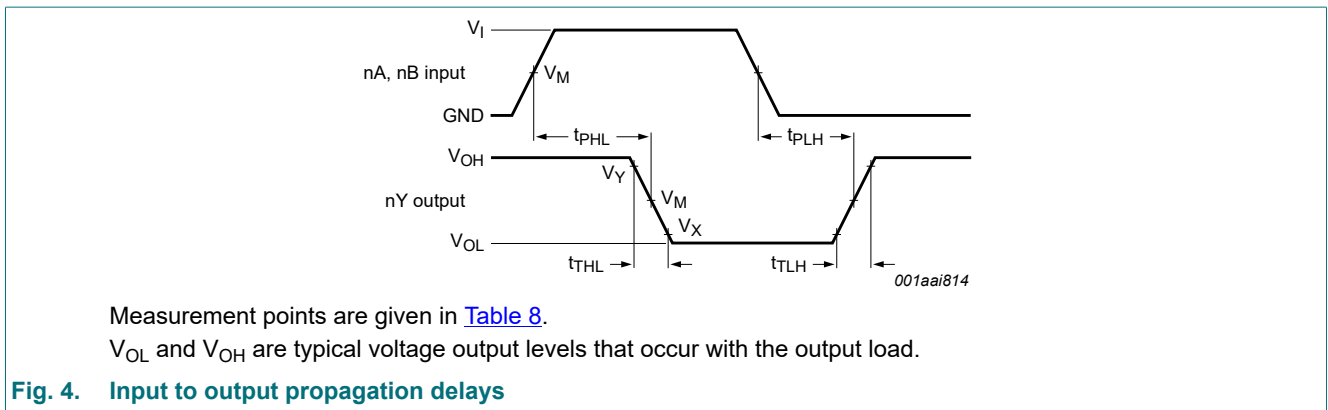
GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see Fig. 5.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC02</b>										
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Fig. 4 [1]								
		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 <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	7	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	7	15	-	20	-	23	ns
t <sub>t</sub>	transition time	see Fig. 4 [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
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	22	-	-	-	-	-	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT02</b>										
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Fig. 4 [1]								
		V <sub>CC</sub> = 4.5 V	-	11	19	-	24	-	29	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	9	-	-	-	-	-	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see Fig. 4 [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]	-	24	-	-	-	-	-	pF

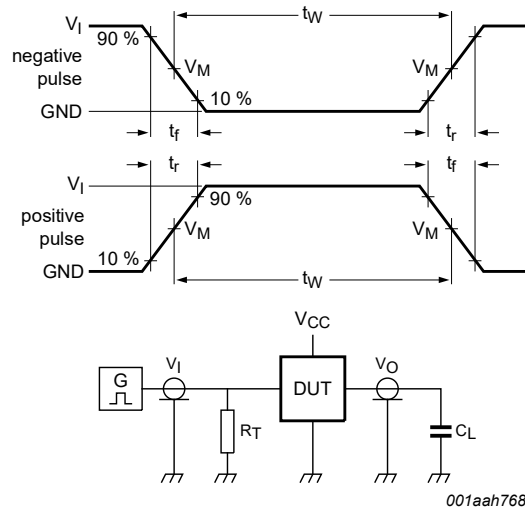
- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = 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.

### 10.1. Waveforms and test circuit



**Table 8. Measurement points**

Type	Input	Output		
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>
74HC02	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>
74HCT02	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>



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. 5. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74HC02	$V_{CC}$	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74HCT02	3.0 V	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$



### 11. Package outline

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

SOT108-1

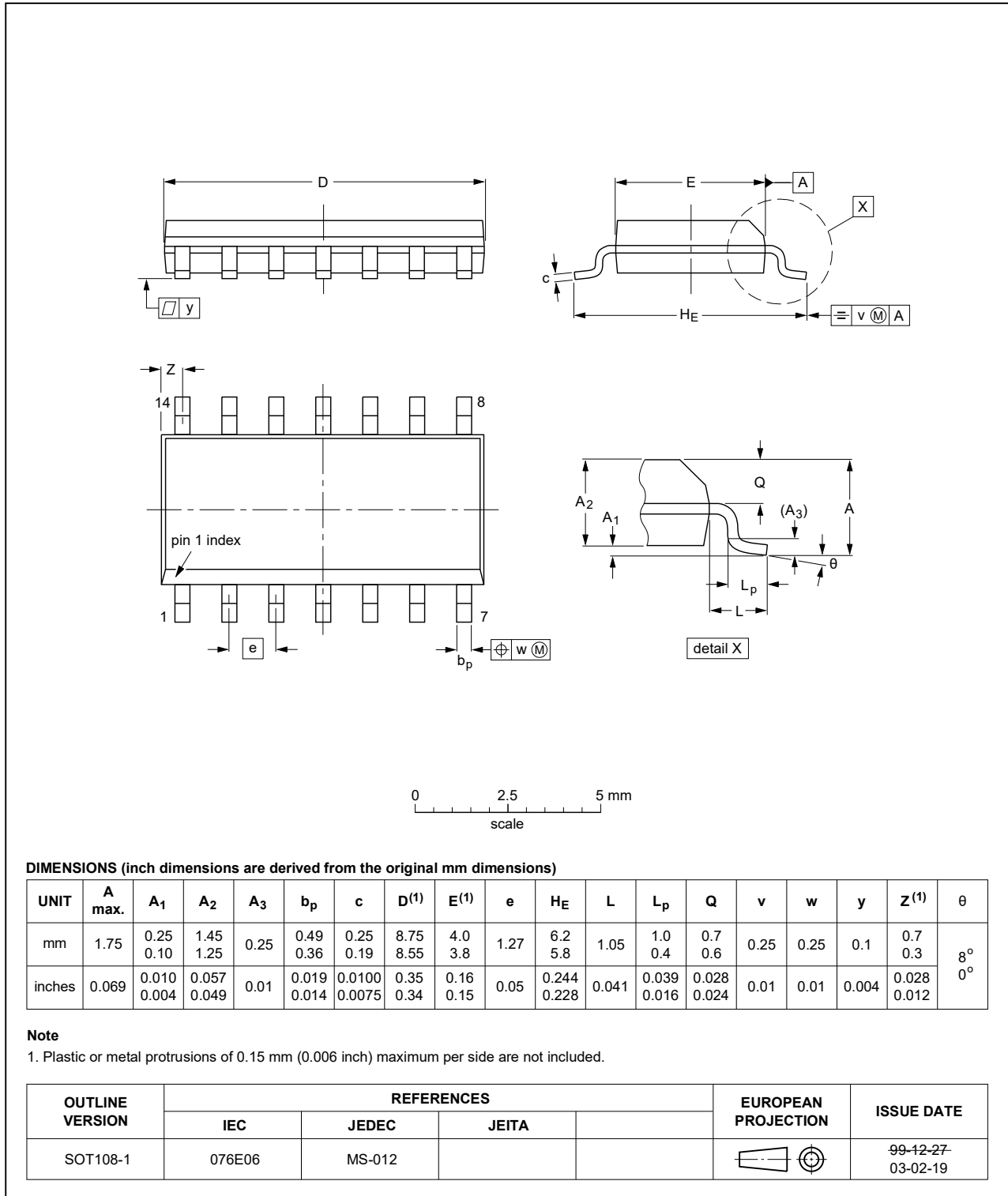


Fig. 6. Package outline SOT108-1 (SO14)

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

SOT402-1

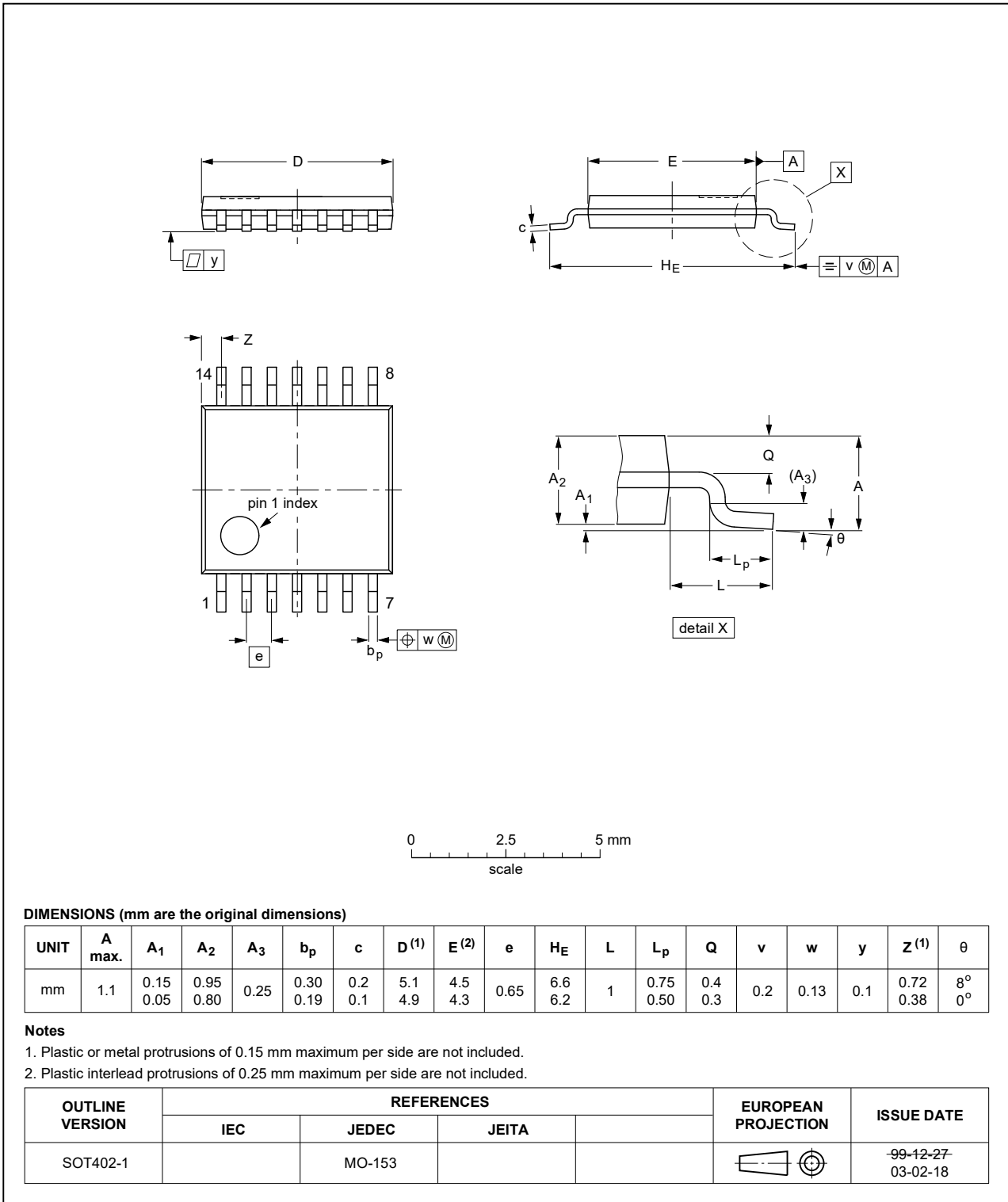


Fig. 7. Package outline SOT402-1 (TSSOP14)

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

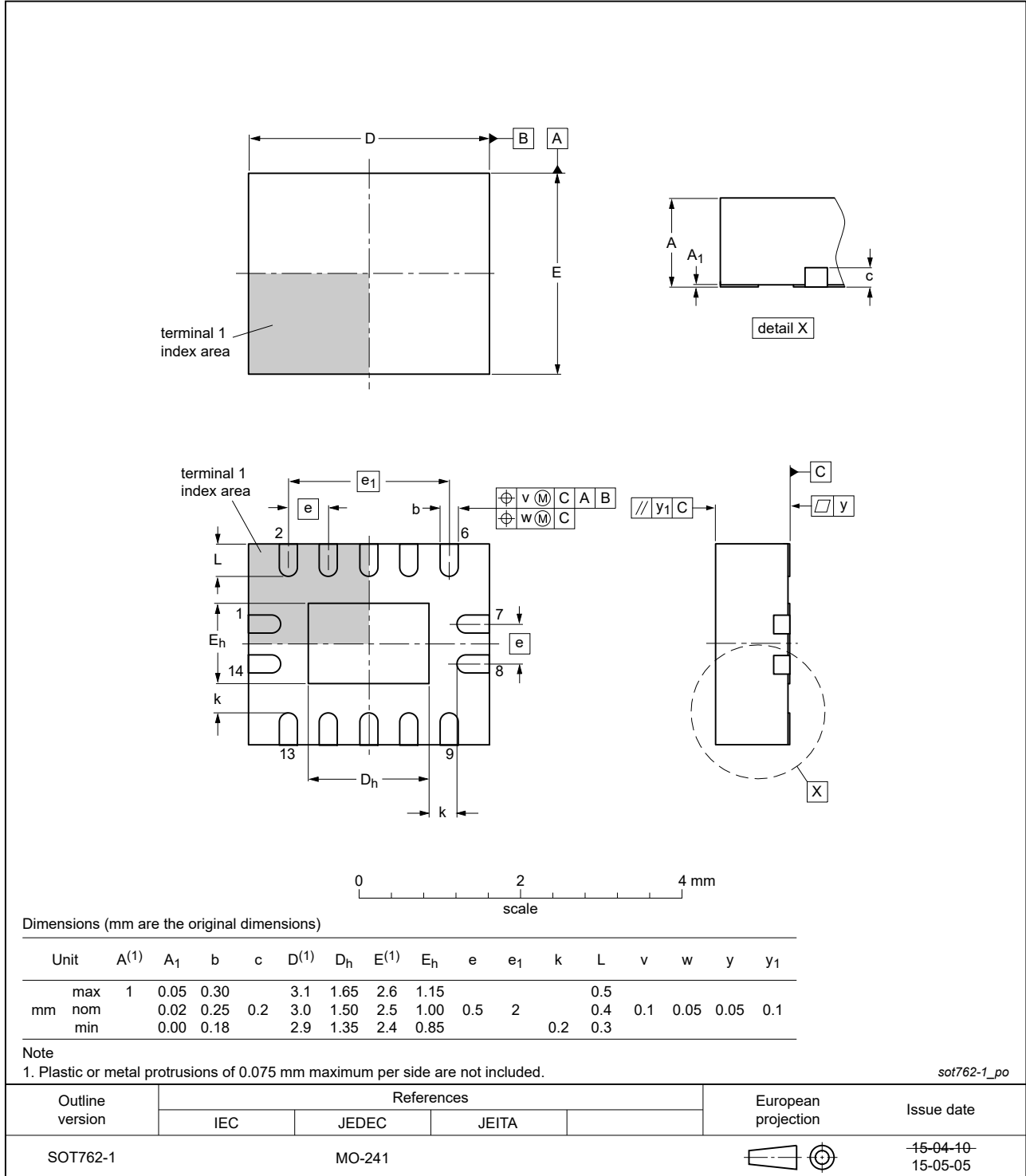


Fig. 8. Package outline SOT762-1 (DHVQFN14)

DHXQFN14: plastic, leadless dual in-line compatible thermal enhanced extreme thin quad flat package; no leads; 14 terminals; 0.4 mm pitch; body 2 mm x 2 mm x 0.48 mm

SOT8014-1

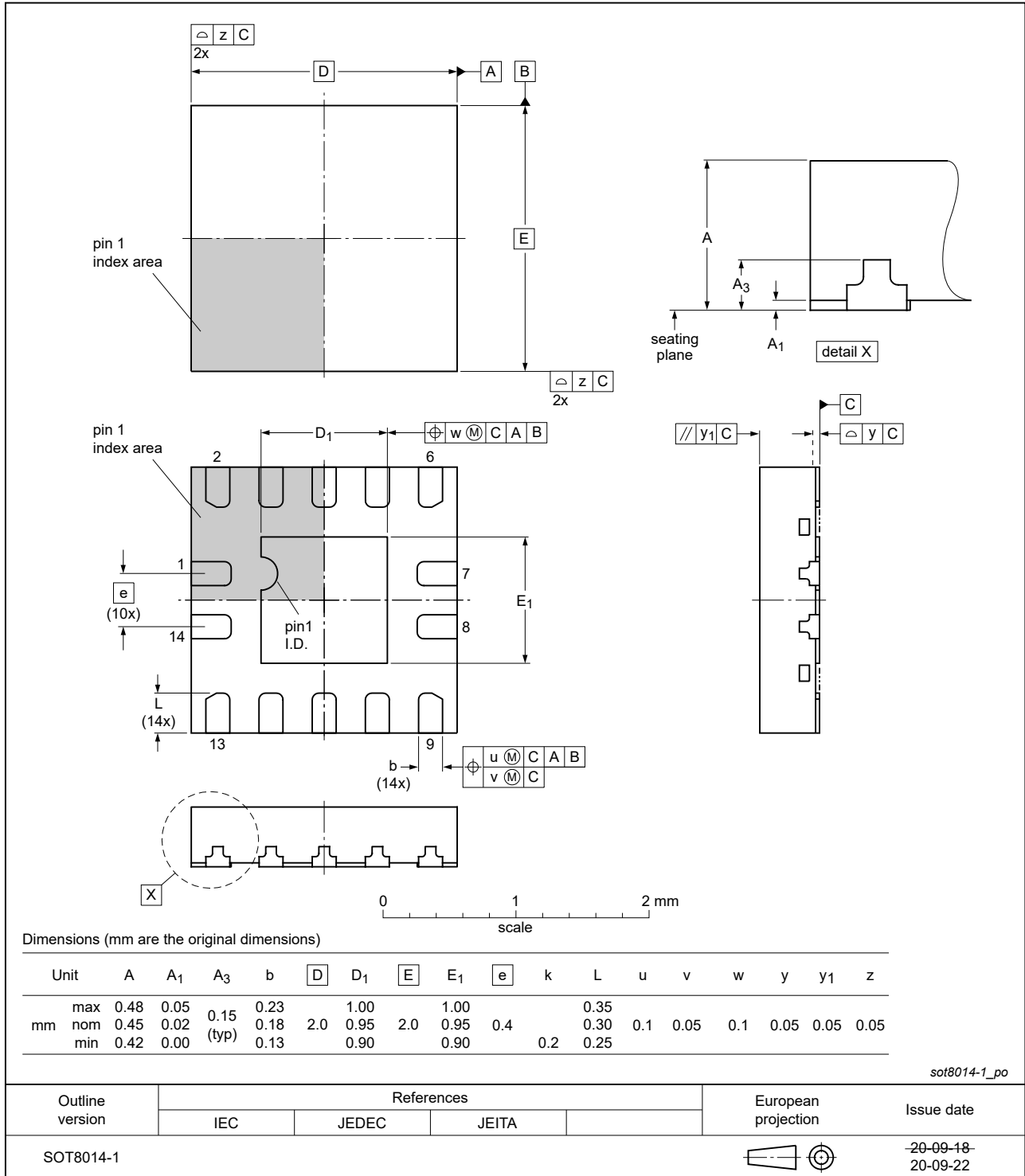


Fig. 9. Package outline SOT8014-1 (DHXQFN14)

## 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_HCT02 v.8	20230209	Product data sheet	-	74HC_HCT02 v.7
Modifications:	<ul style="list-style-type: none"> <li>Added type numbers 74HC02BZ and 74HCT02BZ (SOT8014-1/DHXQFN14).</li> </ul>			
74HC_HCT02 v.7	20210810	Product data sheet	-	74HC_HCT02 v.6
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 2</a> updated.</li> <li>Type numbers 74HC02DB and 74HCT02DB (SOT337-1/SSOP14) removed.</li> </ul>			
74HC_HCT02 v.6	20200407	Product data sheet	-	74HC_HCT02 v.5
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation have been updated.</li> </ul>			
74HC_HCT02 v.5	20151126	Product data sheet	-	74HC_HCT02 v.4
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC02N and 74HCT02N (SOT27-1) removed.</li> </ul>			
74HC_HCT02 v.4	20120904	Product data sheet	-	74HC_HCT02 v.3
Modifications:	<ul style="list-style-type: none"> <li>Conditions for <math>V_{OH}</math>, <math>I_I</math> and <math>I_{CC}</math> updated to the family specification (errata).</li> </ul>			
74HC_HCT02 v.3	20080918	Product data sheet	-	74HC_HCT02_CNV v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Added type numbers 74HC02BQ and 74HCT02BQ (DHVQFN14 package)</li> </ul>			
74HC_HCT02_CNV v.2	19970827	Product specification	-	-

## 14. Legal information

### 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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