

# 74HC7014

## Hex non-inverting precision Schmitt-trigger

Rev. 3 — 30 April 2014

Product data sheet

### 1. General description

The 74HC7014 is a hex buffer with precision Schmitt-trigger inputs. The precisely defined trigger levels are lying in a window between  $0.55 \times V_{CC}$  and  $0.65 \times V_{CC}$ . It makes the circuit suitable to operate in a highly noisy environment. Input shorts are allowed to  $-1.5$  V and  $+16$  V without disturbing other channels. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

### 2. Features and benefits

- Operating voltage 3.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115A exceeds 200 V
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

### 3. Applications

- Wave and pulse shapers for highly noisy environments

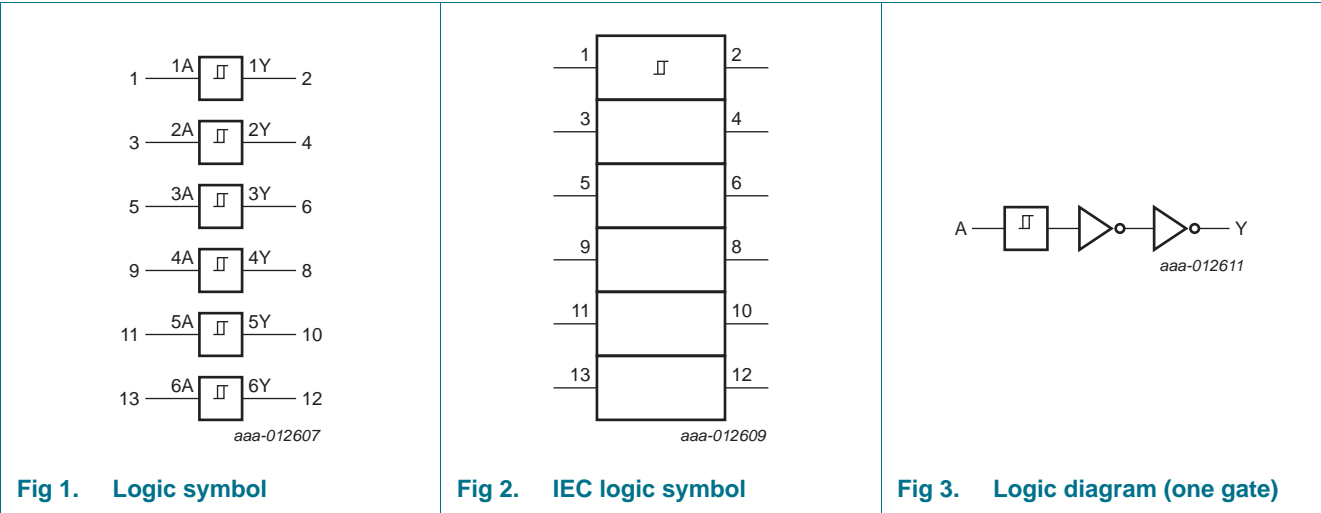
### 4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC7014N	$-40$ °C to $+125$ °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC7014D	$-40$ °C to $+125$ °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

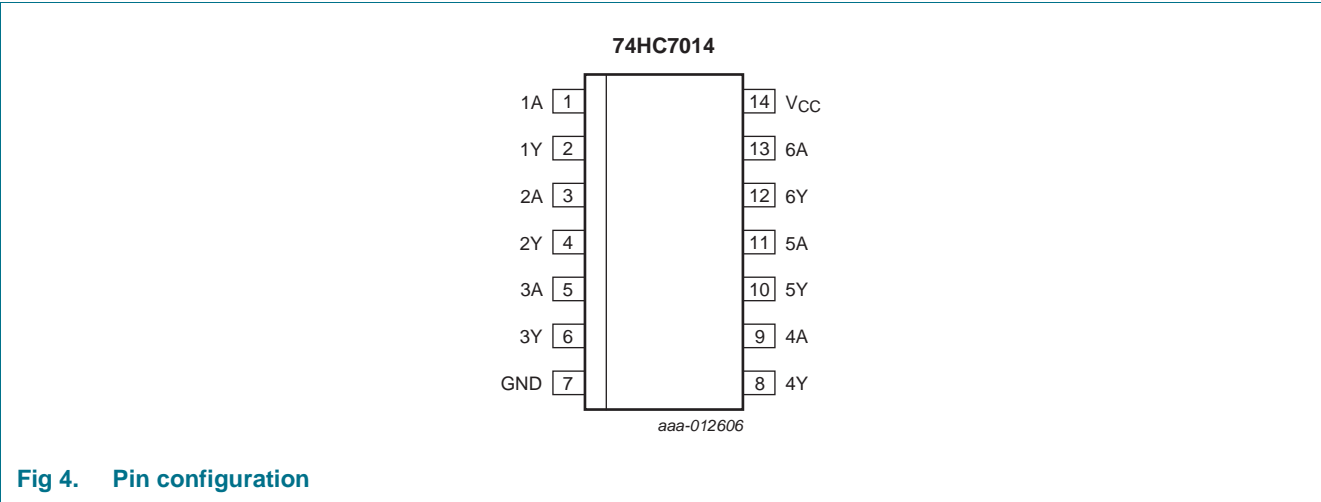


5. Functional diagram



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

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

## 7. Functional description

**Table 3. Functional table**<sup>[1]</sup>

Input	Output
nA	nY
L	L
H	H

[1] H = HIGH voltage level; L = LOW voltage level

## 8. 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
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup>	-	±20	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup>	-	±20	mA
$I_O$	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	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	DIP14 <sup>[2]</sup>	-	750	mW
		SO14 <sup>[2]</sup>	-	500	mW

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

[2] For DIP14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
For SO14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		2.0	5.0	6.0	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C

## 10. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = −40 °C to +85 °C		T <sub>amb</sub> = −40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
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; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = −4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I <sub>O</sub> = −5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	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; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 6.00 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	-	0.1	1.0	-	1.0	-	μA
		V <sub>CC</sub> = 3.00 V to 6.00 V; V <sub>I</sub> = 16 V or GND	-	-	0.5	5.0	-	5.0	-	μA
I <sub>CC</sub>	DC supply current	V <sub>CC</sub> = 3.00 V	-	0.7	1.4	-	1.8	-	2.1	mA
		V <sub>CC</sub> = 5.25 V	-	3.0	6.0	-	7.5	-	7.5	mA
		V <sub>CC</sub> = 6.00 V	-	3.7	7.4	-	10.0	-	13.0	mA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ; for test circuit, see [Figure 6](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = −40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
t <sub>PHL</sub>	HIGH to LOW propagation delay	nA to nY; see <a href="#">Figure 5</a>						
		V <sub>CC</sub> = 3.00 V	-	95	475		715	ns
		V <sub>CC</sub> = 4.75 V	-	38	115	-	175	ns
		V <sub>CC</sub> = 6.00 V	-	27	73	93	112	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	nA to nY; see <a href="#">Figure 5</a>						
		V <sub>CC</sub> = 3.00 V	-	47	175	220	260	ns
		V <sub>CC</sub> = 4.75 V	-	23	52	65	78	ns
		V <sub>CC</sub> = 6.00 V	-	18	46	58	70	ns
t <sub>t</sub>	transition time	see <a href="#">Figure 5</a> <a href="#">[1]</a>						
		V <sub>CC</sub> = 3.00 V	-	12	20	25	30	ns
		V <sub>CC</sub> = 4.75 V	-	7	15	19	22	ns
		V <sub>CC</sub> = 6.00 V	-	6	13	16	19	ns
C <sub>PD</sub>	power dissipation capacitance	per gate; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[2]</a>	-	9	-	-	-	pF

[1]  $t_t$  is the same as  $t_{\text{THL}}$  and  $t_{\text{TLH}}$ .

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

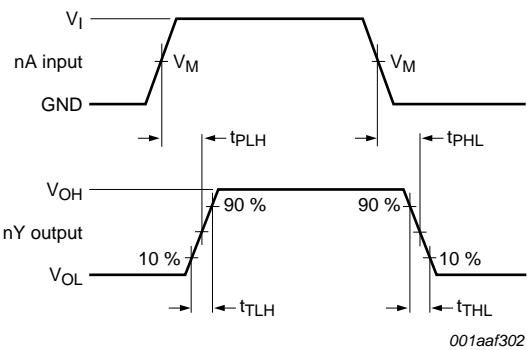
$C_L$  = output load capacitance in pF;

$V_{\text{CC}}$  = supply voltage in V;

$N$  = number of inputs switching;

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

12. Waveforms

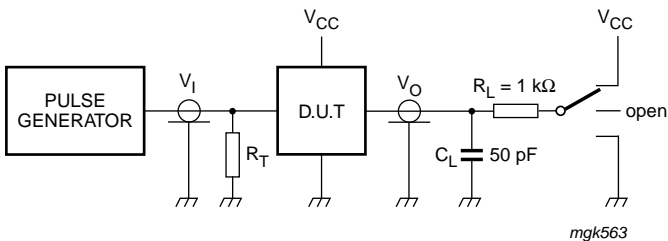


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 5. The input (nA) to output (nY) propagation delays and output transition times**

**Table 8. Measurement points**

Type	Input	Output
	$V_M$	$V_M$
74HC7014	$0.5V_{CC}$	$0.5V_{CC}$



Test data is given in [Table 9](#).  
Definitions test circuit:  
 $R_L$  = Load resistance.  
 $C_L$  = Load capacitance including jig and probe capacitance.  
 $R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

**Fig 6. Test circuit for measuring switching times**

**Table 9. Test data**

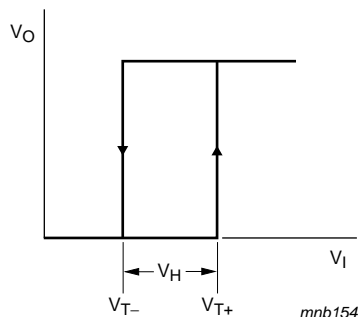
Type	Input		Test
	$V_I$	$t_r, t_f$	$t_{PHL}, t_{PLH}$
74HC7014	GND to $V_{CC}$	6 ns	open

## 13. Transfer characteristics

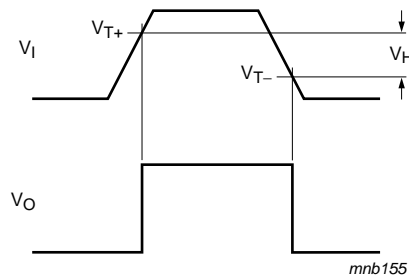
**Table 10. Transfer characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 7](#) and [Figure 8](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 3.00 V	-	1.86	1.95	-	1.95	-	1.95	V
		V <sub>CC</sub> = 4.75 V	-	2.94	3.08	-	3.08	-	3.08	V
		V <sub>CC</sub> = 5.00 V	-	3.10	3.25	-	3.25	-	3.25	V
		V <sub>CC</sub> = 5.25 V	-	3.25	3.41	-	3.41	-	3.41	V
		V <sub>CC</sub> = 6.00 V	-	3.72	3.90	-	3.90	-	3.90	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 3.00 V	1.65	1.74	-	1.65	-	1.65	-	V
		V <sub>CC</sub> = 4.75 V	2.62	2.76	-	2.62	-	2.62	-	V
		V <sub>CC</sub> = 5.00 V	2.75	2.90	-	2.75	-	2.75	-	V
		V <sub>CC</sub> = 5.25 V	2.89	3.05	-	2.89	-	2.89	-	V
		V <sub>CC</sub> = 6.00 V	3.30	3.48	-	3.30	-	3.30	-	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 3.00 V	50	120	-	50	-	50	-	V
		V <sub>CC</sub> = 4.75 V	100	180	-	100	-	100	-	V
		V <sub>CC</sub> = 5.00 V	120	200	-	120	-	120	-	V
		V <sub>CC</sub> = 5.25 V	130	210	-	130	-	130	-	V
		V <sub>CC</sub> = 6.00 V	160	240	-	160	-	160	-	V



**Fig 7. Transfer characteristic**



V<sub>T+</sub> and V<sub>T-</sub> limits at 70 % and 20 %.

**Fig 8. Definition of V<sub>T+</sub>, V<sub>T-</sub> and V<sub>H</sub>**

14. Package outline

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

SOT27-1

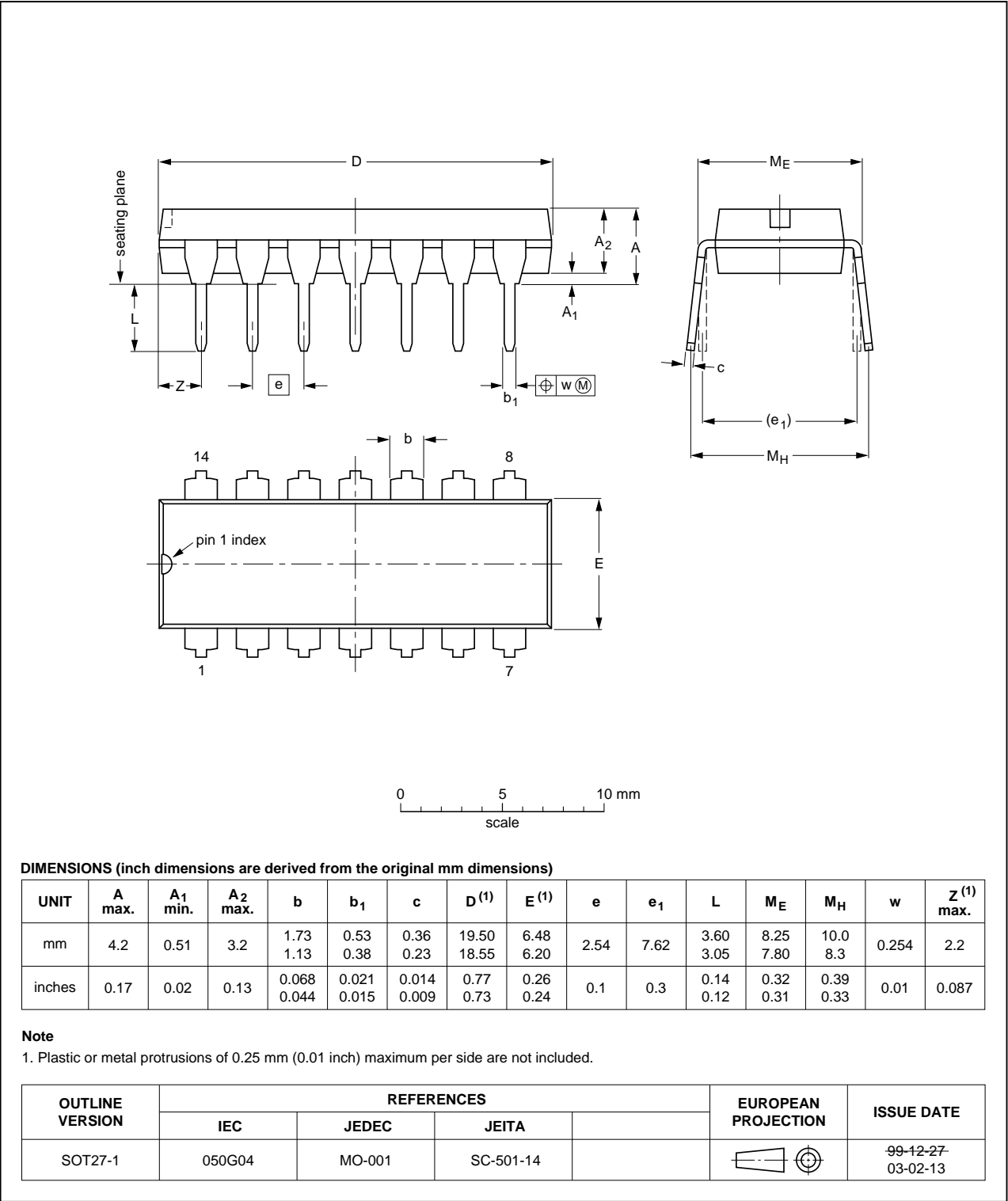


Fig 9. Package outline SOT27-1 (DIP14)



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

SOT108-1

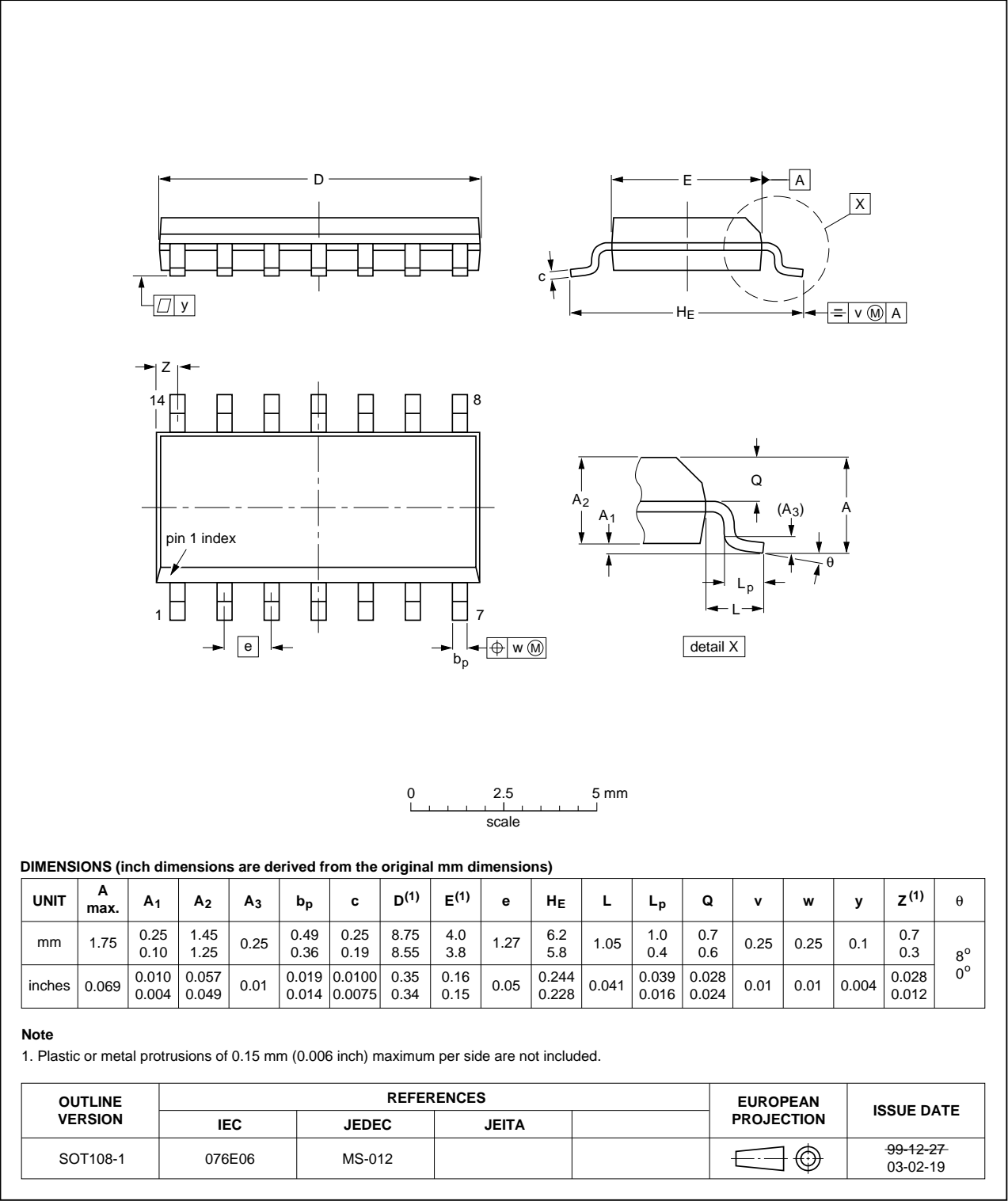


Fig 10. Package outline SOT108-1 (SO14)

## 15. Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC7014 v.3	20140430	Product data sheet	-	74HC7014_CVN 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></ul>			
74HC7014_CVN v.2	19980708	Product specification	-	74HC7014 v.1
74HC7014 v.1	19930901	Product specification	-	-

## 17. Legal information

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Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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Date of release: 30 April 2014

Document identifier: 74HC7014