

# 74LV14A

## Hex inverting Schmitt trigger

Rev. 3 — 2 November 2016

Product data sheet

## 1. General description

The 74LV14A is a hex inverter with Schmitt-trigger inputs, capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

This device is fully specified for partial power down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

## 2. Features and benefits

- Wide supply voltage range from 2.0 V to 5.5 V
- Maximum  $t_{pd}$  of 10 ns at 5 V
- Typical  $V_{OL(p)} < 0.8$  V at  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Typical  $V_{OH(v)} > 2.3$  V at  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Supports mixed-mode voltage operation on all ports
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
  - ◆ HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3 kV
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 2 kV
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

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### 3. Ordering information

Table 1. Ordering information

Type number	Package	Name	Description	Version
74LV14APW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

### 4. Functional diagram

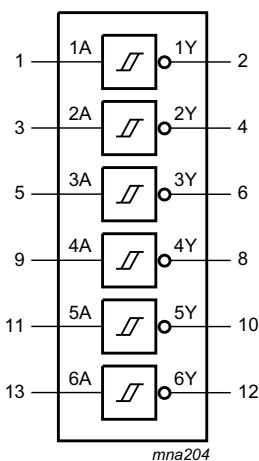


Fig 1. Logic symbol

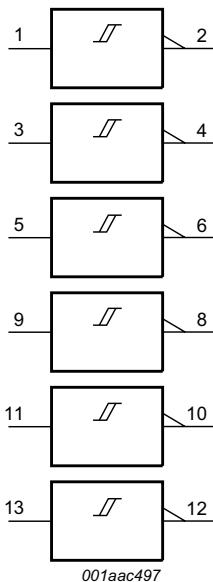


Fig 2. IEC logic symbol

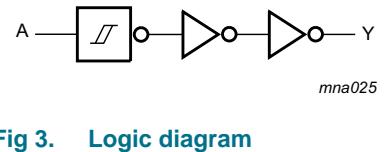


Fig 3. Logic diagram (one Schmitt-trigger)

### 5. Pinning information

#### 5.1 Pinning

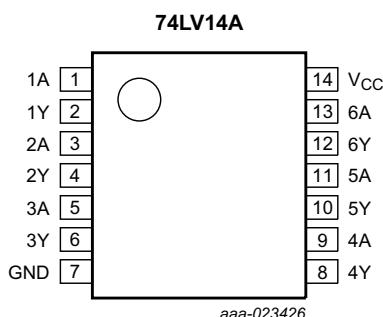


Fig 4. Pin configuration TSSOP14

## 5.2 Pin description

Table 2. Pin description

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

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Input	Output
nA	nY
L	H
H	L

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

## 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	+7.0	V
V <sub>I</sub>	input voltage		[1]	-0.5	+7.0
V <sub>O</sub>	output voltage	output HIGH or LOW state	[2][3]	-0.5	V <sub>CC</sub> + 0.5
		output power-down	[2]	-0.5	+7.0
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-20	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < 0 V	-50	-	mA
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±35	mA
I <sub>CC</sub>	supply current		-	70	mA
I <sub>GND</sub>	ground current		-70	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C	[4]	-	500 mW

[1] If the input current ratings are observed, the minimum input voltage ratings may be exceeded.

[2] If the output current ratings are observed, the output voltage ratings may be exceeded.

[3] This value is limited to 7 V maximum.

[4] For TSSOP14 packages: above 75 °C, the value of P<sub>tot</sub> derates linearly at 7 mW/K.

## 8. 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	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	output HIGH or LOW state	0	-	$V_{CC}$	V
		output power-down	0	-	5.5	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	-	50	ms/V
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	-	-	20	ms/V
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	-	1	ms/V

## 9. Static characteristics

**Table 6. Static characteristics**

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	
$V_{T+}$	positive-going threshold voltage	$V_{CC} = 2.5 \text{ V}$	-	-	1.75	-	1.75	-	1.75	V
		$V_{CC} = 3.3 \text{ V}$	-	-	2.31	-	2.31	-	2.31	V
		$V_{CC} = 5.0 \text{ V}$	-	-	3.5	-	3.5	-	3.5	V
$V_{T-}$	negative-going threshold voltage	$V_{CC} = 2.5 \text{ V}$	0.75	-	-	0.75	-	0.75	-	V
		$V_{CC} = 3.3 \text{ V}$	0.99	-	-	0.99	-	0.99	-	V
		$V_{CC} = 5.0 \text{ V}$	1.5	-	-	1.5	-	1.5	-	V
$V_H$	hysteresis voltage	$V_{CC} = 2.5 \text{ V}$	0.25	-	-	0.25	-	0.25	-	V
		$V_{CC} = 3.3 \text{ V}$	0.33	-	-	0.33	-	0.33	-	V
		$V_{CC} = 5.0 \text{ V}$	0.5	-	-	0.5	-	0.5	-	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$V_{CC} = 2.0 \text{ V to } 5.5 \text{ V}; I_O = -50 \mu\text{A}$	$V_{CC} - 0.1$	-	-	$V_{CC} - 0.1$	-	$V_{CC} - 0.1$	-	V
		$V_{CC} = 2.3 \text{ V}; I_O = -2 \text{ mA}$	2	-	-	2	-	2	-	V
		$V_{CC} = 3.0 \text{ V}; I_O = -6 \text{ mA}$	2.48	-	-	2.48	-	2.48	-	V
		$V_{CC} = 4.5 \text{ V}; I_O = -12 \text{ mA}$	3.8	-	-	3.8	-	3.8	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$V_{CC} = 2.0 \text{ V to } 5.5 \text{ V}; I_O = 50 \mu\text{A}$	-	-	0.1	-	0.1	-	0.1	V
		$V_{CC} = 2.3 \text{ V}; I_O = 2 \text{ mA}$	-	-	0.4	-	0.4	-	0.4	V
		$V_{CC} = 3.0 \text{ V}; I_O = 6 \text{ mA}$	-	-	0.44	-	0.44	-	0.44	V
		$V_{CC} = 4.5 \text{ V}; I_O = 12 \text{ mA}$	-	-	0.55	-	0.55	-	0.55	V

**Table 6. Static characteristics ...continued**  
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	
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O$ = GND to 5.5 V; $V_{CC} = 0$ V	-	-	0.5	-	5	-	5	$\mu A$
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 0$ V to 5.5 V	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	2	-	20	-	20	$\mu A$

## 9.1 Transfer characteristics waveforms

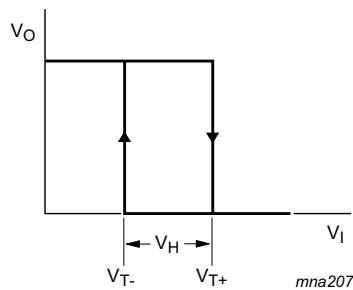


Fig 5. Transfer characteristics

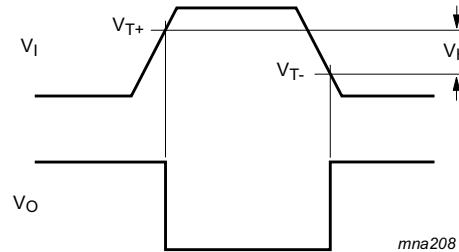


Fig 6. Transfer characteristics definitions

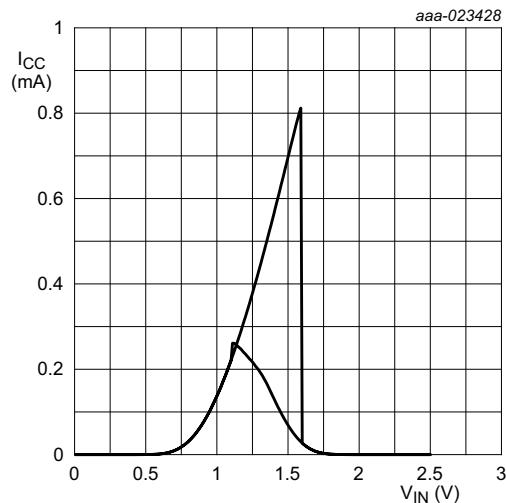
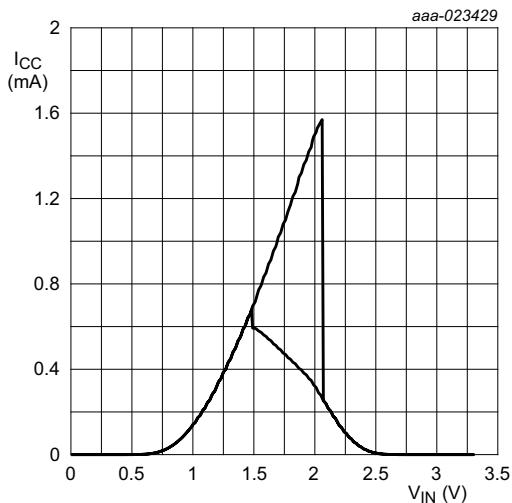
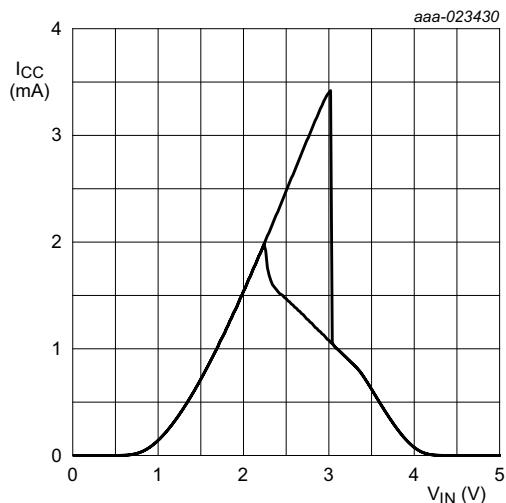
a.  $V_{CC} = 2.5$  Vb.  $V_{CC} = 3.3$  Vc.  $V_{CC} = 5.0$  V

Fig 7. Typical transfer characteristics

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

GND = 0 V. For test circuit, see [Figure 9](#).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nY; see <a href="#">Figure 8</a> <sup>[2]</sup>								
		V <sub>CC</sub> = 2.3 V to 2.7 V								
		C <sub>L</sub> = 15 pF	-	5.6	19.7	1	22	1	23	ns
		C <sub>L</sub> = 50 pF	-	8.7	24	1	27	1	28	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V								
		C <sub>L</sub> = 15 pF	-	4.4	12.8	1	15	1	16	ns
		C <sub>L</sub> = 50 pF	-	6.7	16.3	1	18.5	1	19.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V								
		C <sub>L</sub> = 15 pF	-	3.4	8.6	1	10	1	11	ns
		C <sub>L</sub> = 50 pF	-	5.2	10.6	1	12	1	13	ns
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	2	6	-	6	-	6	pF
C <sub>O</sub>	output capacitance	V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	5	-	-	-	-	-	pF
C <sub>PD</sub>	power dissipation capacitance	per buffer; <sup>[3]</sup> C <sub>L</sub> = 50 pF; f = 10 MHz; V <sub>I</sub> = GND to V <sub>CC</sub>								
		V <sub>CC</sub> = 3.3 V	-	8	-	-	-	-	-	pF
		V <sub>CC</sub> = 5.0 V	-	9	-	-	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation P<sub>D</sub> (μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

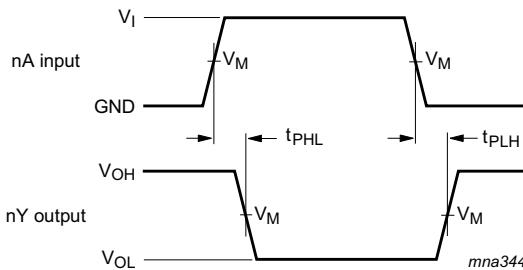
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in Volts.

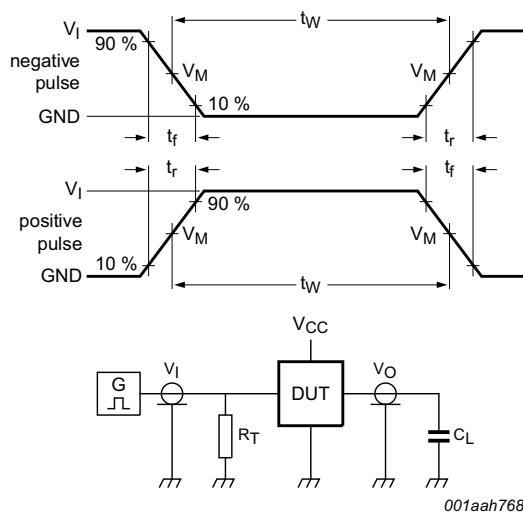
**Table 8. Noise characteristics**GND = 0 V. For test circuit, see [Figure 9](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Typ	Max	
<b>V<sub>CC</sub> = 3.3 V; C<sub>L</sub> = 50 pF</b>						
V <sub>OL(p)</sub>	LOW-level output voltage (peak)		-	0.2	0.8	V
V <sub>OL(v)</sub>	LOW-level output voltage (valley)		-0.8	-0.1	-	V
V <sub>OH(v)</sub>	HIGH-level output voltage (valley)		-	3.1	-	V
V <sub>IH(AC)</sub>	AC HIGH-level input voltage		2.31	-	-	V
V <sub>IL(AC)</sub>	AC LOW-level input voltage		-	-	0.99	V

## 11. Waveforms

Measurement points are given in [Table 6](#).V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.**Fig 8. Propagation delay input (nA) to output (nY)****Table 9. Measurement points**

Input	Output
V <sub>M</sub>	V <sub>M</sub>
0.5V <sub>CC</sub>	0.5V <sub>CC</sub>



Test data is given in [Table 10](#).

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

$S1$  = Test selection switch

**Fig 9. Test circuit for measuring switching times**

**Table 10. Test data**

Input		Load	Test
$V_I$	$t_r, t_f$	$C_L$	
GND to $V_{CC}$	3.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$

## 12. Package outline

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

SOT402-1

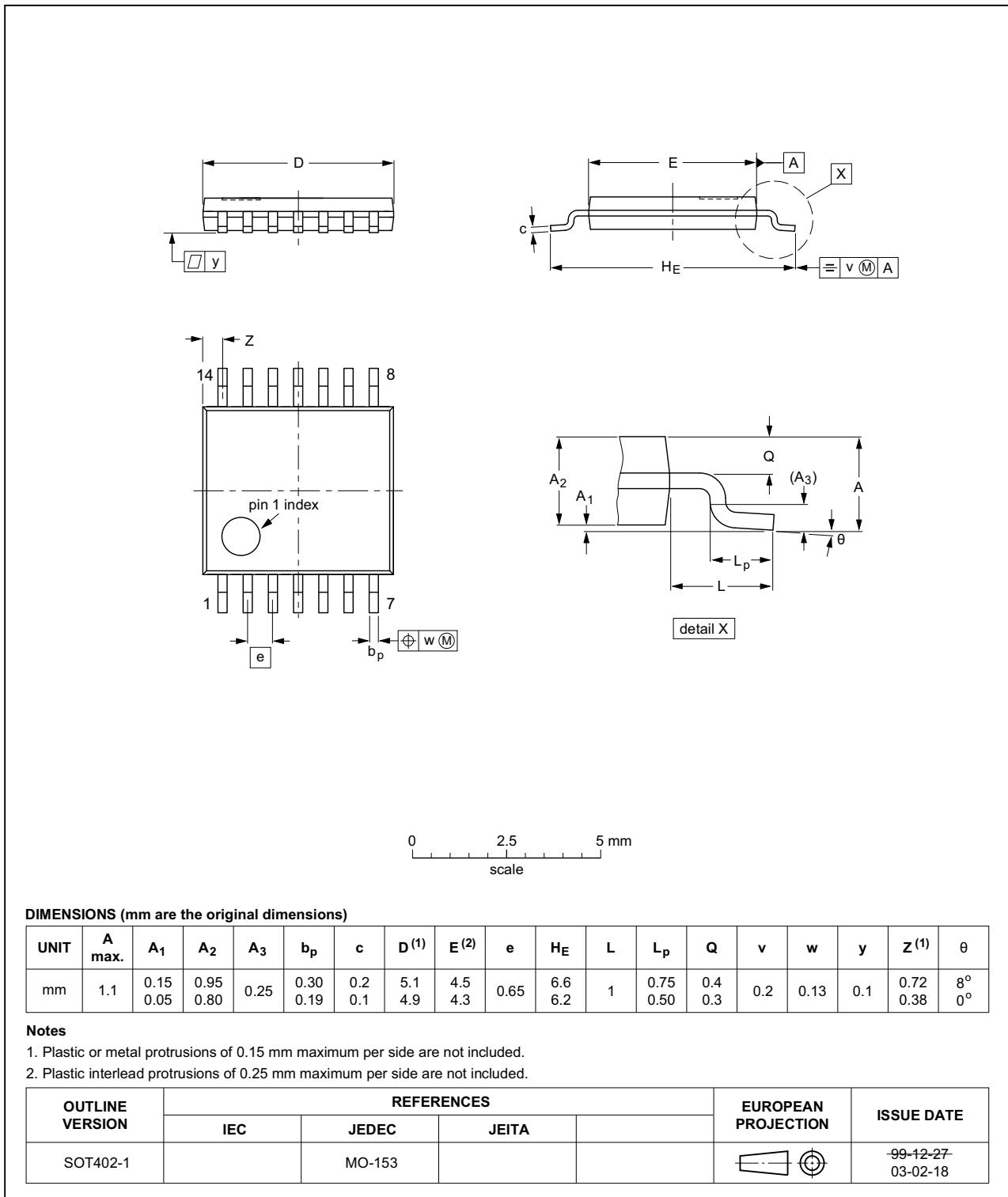


Fig 10. Package outline SOT402-1 (TSSOP14)

## 13. Abbreviations

**Table 11. Abbreviations**

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

## 14. Revision history

**Table 12. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV14A v.3	20161102	Product data sheet	-	74LV14A v.2
Modifications:	<ul style="list-style-type: none"><li>Type numbers 74LV14AD and 74LV14ABQ removed.</li></ul>			
74LV14A v.2	20160809	Product data sheet	-	74LV14A v.1
Modifications:	<ul style="list-style-type: none"><li><u>Section 1 "General description"</u>: Typo corrected.</li></ul>			
74LV14A v.1	20160613	Product data sheet	-	-

## 15. Legal information

### 15.1 Data sheet status

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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