

# 74LVC14A

Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 04 — 15 February 2005

Product data sheet

## 1. General description

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The 74LVC14A is a high-performance, low-power, low-voltage, Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device as a translator in a mixed 3.3 V and 5 V environment.

The 74LVC14A provides six inverting buffers with Schmitt-trigger action. It is capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

## 2. Features

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- Wide supply voltage range from 1.2 V to 3.6 V
- 5 V tolerant input for interfacing with 5 V logic
- CMOS low-power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- Unlimited input rise and fall times
- Complies with JEDEC standard:
  - ◆ JESD8-B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM EIA/JESD22-A114-B exceeds 2000 V
  - ◆ MM EIA/JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Applications

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- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

**PHILIPS**

## 4. Quick reference data

**Table 1: Quick reference data**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PHL}$ , $t_{PLH}$	propagation delay nA to nY	$V_{CC} = 3.3 \text{ V}$ ; $C_L = 50 \text{ pF}$	-	3.2	-	ns
$C_I$	input capacitance		-	4.0	-	pF
$C_{PD}$	power dissipation capacitance	$V_{CC} = 3.3 \text{ V}$	[1] [2]	10	-	pF

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

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

$N$  = number of inputs switching;

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

[2] The condition is  $V_I = \text{GND to } V_{CC}$ .

## 5. Ordering information

**Table 2: Ordering information**

Type number	Package			Version
	Temperature range	Name	Description	
74LVC14AD	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC14ADB	-40 °C to +125 °C	SSOP14	plastic thin shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74LVC14APW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC14ABQ	-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	SOT762-1

6. Functional diagram

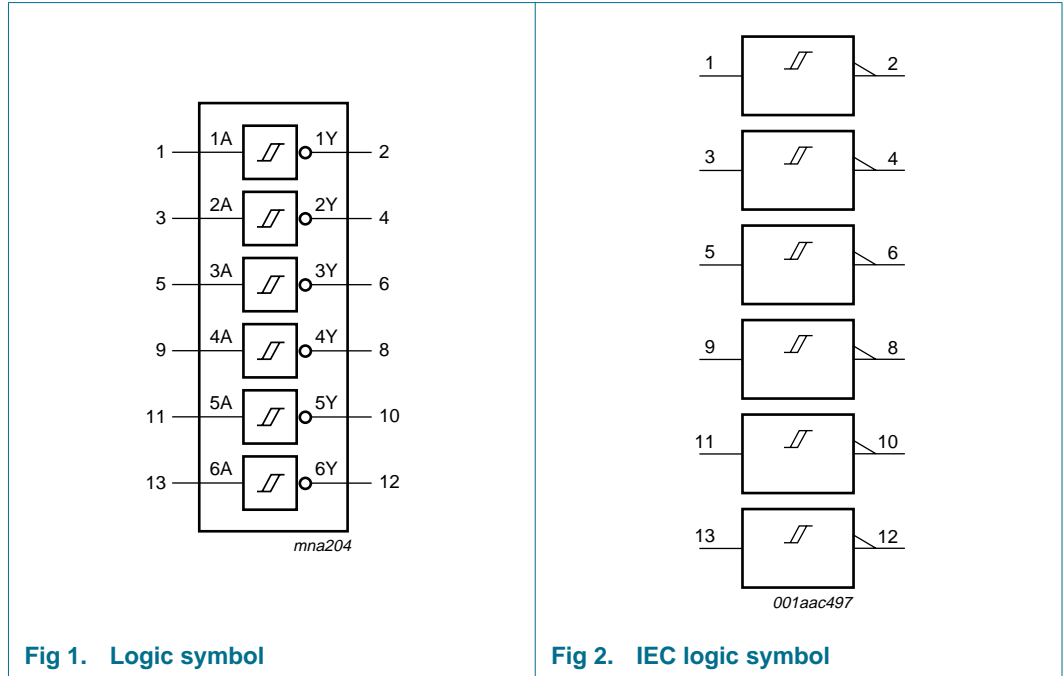


Fig 1. Logic symbol

Fig 2. IEC logic symbol

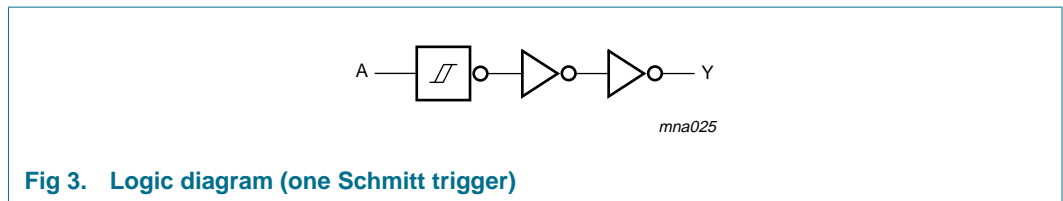
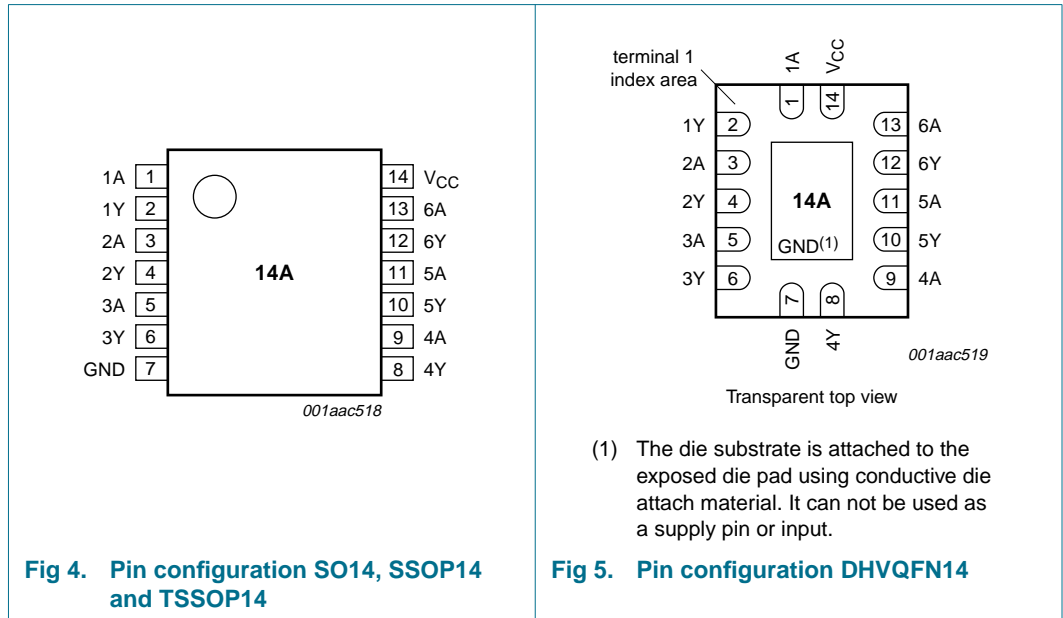


Fig 3. Logic diagram (one Schmitt trigger)

## 7. Pinning information

### 7.1 Pinning



### 7.2 Pin description

Table 3: Pin description

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

## 8. Functional description

### 8.1 Function table

Table 4: Function table <sup>[1]</sup>

Input nA	Output nY
L	H
H	L

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

## 9. Limiting values

Table 5: 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	+6.5	V
$V_I$	input voltage		<sup>[1]</sup> -0.5	+6.5	V
$V_O$	output voltage		<sup>[1]</sup> -0.5	$V_{CC} + 0.5$	V
$I_{IK}$	input diode current	$V_I < 0$ V	-	-50	mA
$I_{OK}$	output diode current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$I_O$	output source or sink current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{CC}, I_{GND}$	$V_{CC}$ or GND current		-	$\pm 100$	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	<sup>[3]</sup> -	500	mW

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

[2] When  $V_{CC} = 0$  V (Power-down mode), the output voltage can be 3.6 V in normal operation.

[3] For SO14 packages:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

For (T)SSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 10. Recommended operating conditions

**Table 6: Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	for maximum speed performance	2.7	-	3.6	V
		for low-voltage applications	1.2	-	3.6	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C

## 11. Static characteristics

**Table 7: Static characteristics**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math> [1]</b>						
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -100\text{ }\mu\text{A}$ ; $V_{CC} = 2.7\text{ V to }3.6\text{ V}$	$V_{CC} - 0.2$	-	-	V
		$I_O = -8\text{ mA}$ ; $V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$V_{CC} - 0.5$	-	-	V
		$I_O = -12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	$V_{CC} - 0.5$	-	-	V
		$I_O = -18\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	$V_{CC} - 0.6$	-	-	V
$V_{OL}$	LOW-level voltage output	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 100\text{ }\mu\text{A}$ ; $V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	0.2	V
		$I_O = 8\text{ mA}$ ; $V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.6	V
		$I_O = 12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	-	-	0.4	V
		$I_O = 24\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	-	-	0.55	V
$I_{LI}$	input leakage current	$V_{CC} = 3.6\text{ V}$ ; $V_I = 5.5\text{ V or GND}$	-	$\pm 0.1$	$\pm 5$	$\mu\text{A}$
$I_{CC}$	quiescent supply current	$V_{CC} = 3.6\text{ V}$ ; $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$	-	0.1	10	$\mu\text{A}$
$\Delta I_{CC}$	additional quiescent supply current per input pin	$V_{CC} = 2.7\text{ V to }3.6\text{ V}$ ; $V_I = V_{CC} - 0.6\text{ V}$ ; $I_O = 0\text{ A}$	-	5	500	$\mu\text{A}$
$C_I$	input capacitance		-	4.0	-	pF
<b><math>T_{amb} = -40\text{ °C to }+125\text{ °C}</math></b>						
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -100\text{ }\mu\text{A}$ ; $V_{CC} = 2.7\text{ V to }3.6\text{ V}$	$V_{CC} - 0.3$	-	-	V
		$I_O = -8\text{ mA}$ ; $V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$V_{CC} - 0.65$	-	-	V
		$I_O = -12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	$V_{CC} - 0.65$	-	-	V
		$I_O = -18\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	$V_{CC} - 0.75$	-	-	V
		$I_O = -24\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	$V_{CC} - 1$	-	-	V

**Table 7: Static characteristics ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>OL</sub>	LOW-level voltage output	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.3	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.75	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.8	V
I <sub>LI</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND	-	-	±20	μA
I <sub>CC</sub>	quiescent supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	-	40	μA
ΔI <sub>CC</sub>	additional quiescent supply current per input pin	V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	-	5	mA

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

## 12. Dynamic characteristics

**Table 8: Dynamic characteristics**Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay nA to nY	see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 1.2 V	-	16	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.0	7.8	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.6	7.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.2	6.4	ns
t <sub>sk(0)</sub>	skew		[2]	-	1.0	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>CC</sub> = 3.3 V	[3] [4]	10	-	pF
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay nA to nY	see <a href="#">Figure 6</a>				
		V <sub>CC</sub> = 1.2 V	-	-	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	-	10.0	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	-	8.0	ns
t <sub>sk(0)</sub>	skew		[2]	-	1.5	ns

[1] All typical values are measured at nominal V<sub>CC</sub> and T<sub>amb</sub> = 25 °C.

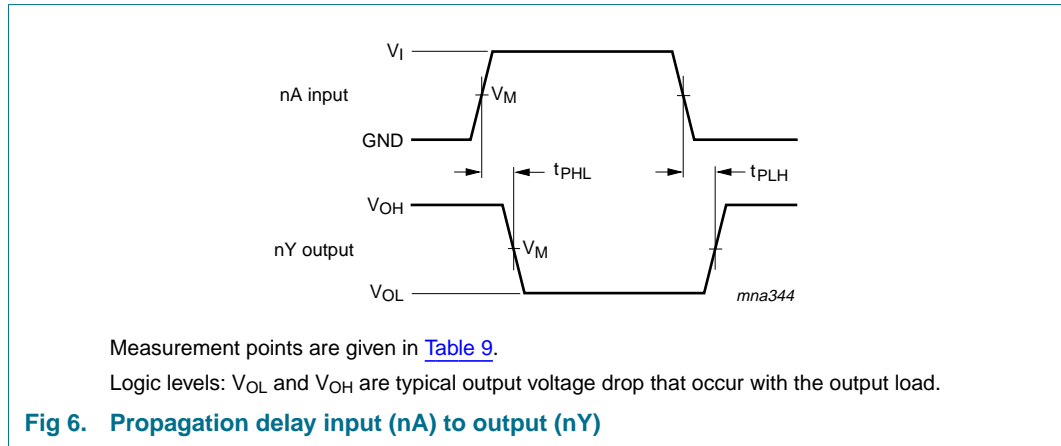
[2] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) 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;

Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.[4] The condition is V<sub>I</sub> = GND to V<sub>CC</sub>.

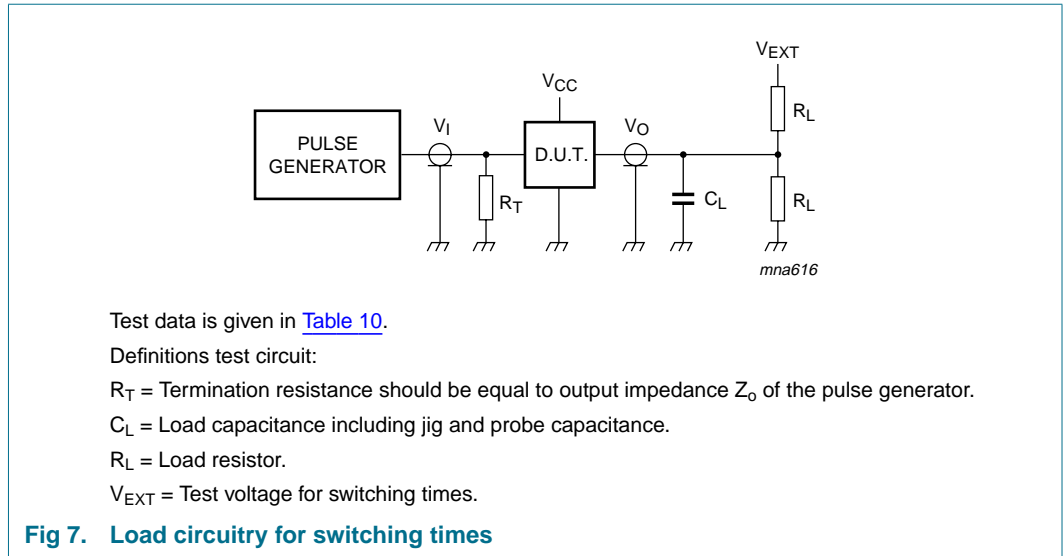
### 13. Waveforms



**Table 9: Measurement points**

Supply	Input	Output
$V_{CC}$	$V_M$	$V_M$
1.2 V	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
2.3 V to 2.7 V	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V





**Table 10: Test data**

Supply	Input		Load		$V_{EXT}$
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$
1.2 V	$V_{CC}$	$\leq 2.5$ ns	30 pF	500 $\Omega$	open
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.5$ ns	30 pF	500 $\Omega$	open
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open

## 14. Transfer characteristics

**Table 11: Transfer characteristics**

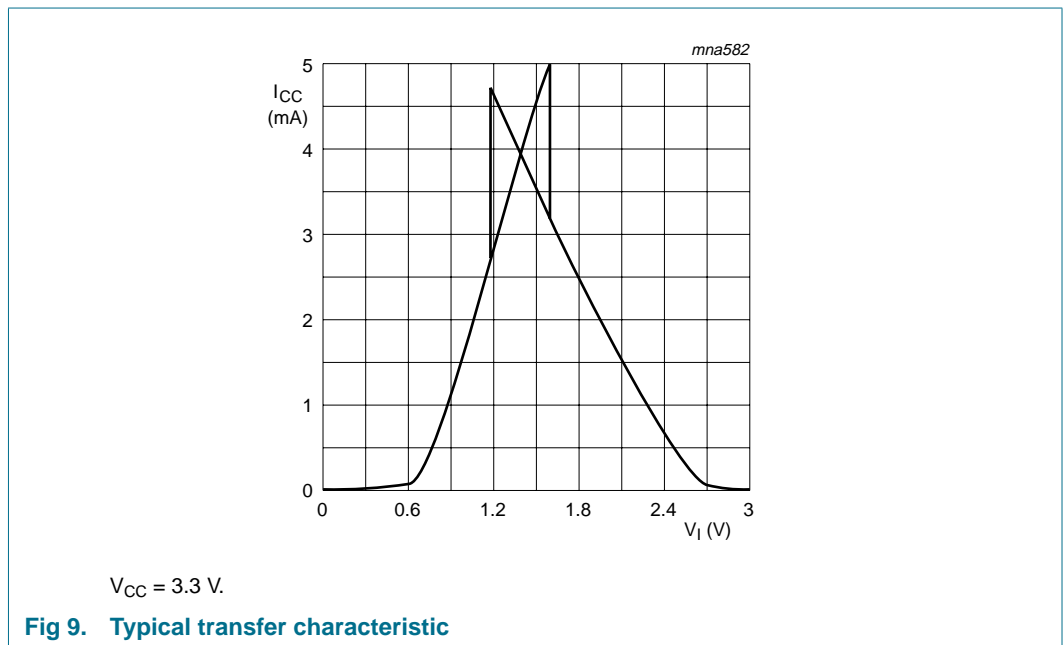
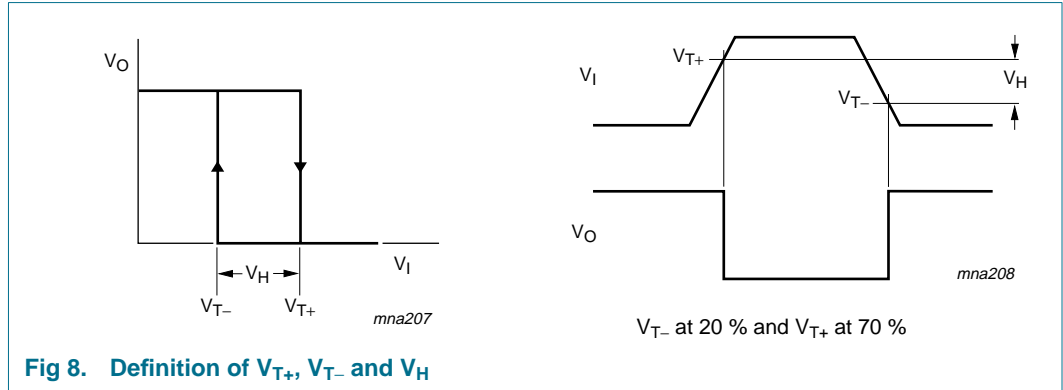
The  $V_{IH}$  and  $V_{IL}$  from the family static characteristics are superseded by the  $V_{T+}$  and  $V_{T-}$ . Voltages are referenced to GND (ground = 0 V); see [Figure 8](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math> [1]</b>						
$V_{T+}$	positive-going threshold	$V_{CC} = 1.2\text{ V}$	-	-	1.2	V
		$V_{CC} = 2.5\text{ V}$	0.9	-	1.7	V
		$V_{CC} = 2.7\text{ V}$	1.1	-	2.0	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	1.1	-	2.0	V
$V_{T-}$	negative-going threshold	$V_{CC} = 1.2\text{ V}$	0	-	-	V
		$V_{CC} = 2.5\text{ V}$	0.4	-	1.2	V
		$V_{CC} = 2.7\text{ V}$	0.8	-	1.5	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0.8	-	1.5	V
$V_H$	hysteresis ( $V_{T+} - V_{T-}$ )	$V_{CC} = 1.2\text{ V}$	-	-	-	V
		$V_{CC} = 2.5\text{ V}$	0.3	-	-	V
		$V_{CC} = 2.7\text{ V}$	0.3	0.4	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$ [2]	0.3	0.45	-	V
<b><math>T_{amb} = -40\text{ °C to }+125\text{ °C}</math></b>						
$V_{T+}$	positive-going threshold	$V_{CC} = 1.2\text{ V}$	-	-	1.2	V
		$V_{CC} = 2.5\text{ V}$	0.9	-	1.7	V
		$V_{CC} = 2.7\text{ V}$	1.1	-	2.0	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	1.1	-	2.0	V
$V_{T-}$	negative-going threshold	$V_{CC} = 1.2\text{ V}$	0	-	-	V
		$V_{CC} = 2.5\text{ V}$	0.4	-	1.2	V
		$V_{CC} = 2.7\text{ V}$	0.8	-	1.5	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0.8	-	1.5	V
$V_H$	hysteresis ( $V_{T+} - V_{T-}$ )	$V_{CC} = 1.2\text{ V}$	-	-	-	V
		$V_{CC} = 2.5\text{ V}$	0.2	-	-	V
		$V_{CC} = 2.7\text{ V}$	0.3	-	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0.3	-	-	V

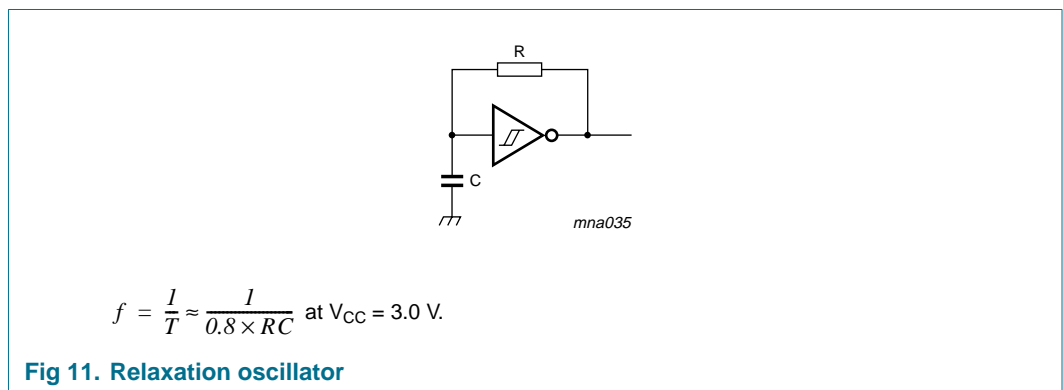
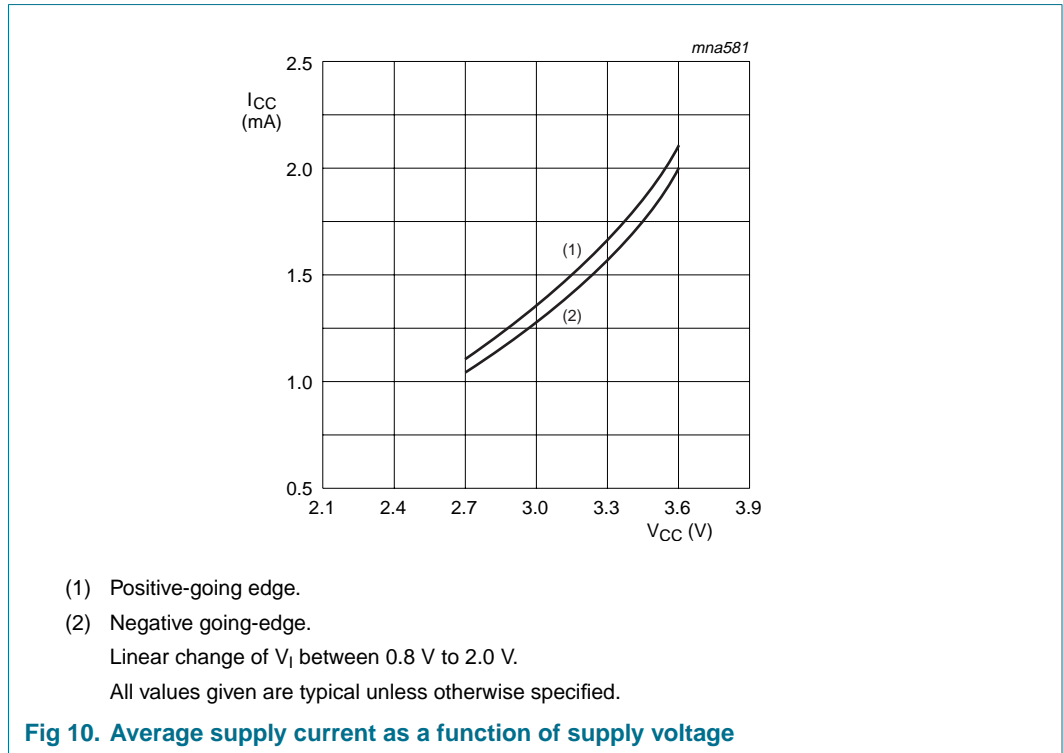
[1] All typical values are measured at nominal  $V_{CC}$  and  $T_{amb} = 25\text{ °C}$ .

[2] Typical transfer characteristic is displayed in [Figure 9](#).

15. Waveforms transfer characteristics



16. Application information



17. Package outline

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

SOT108-1

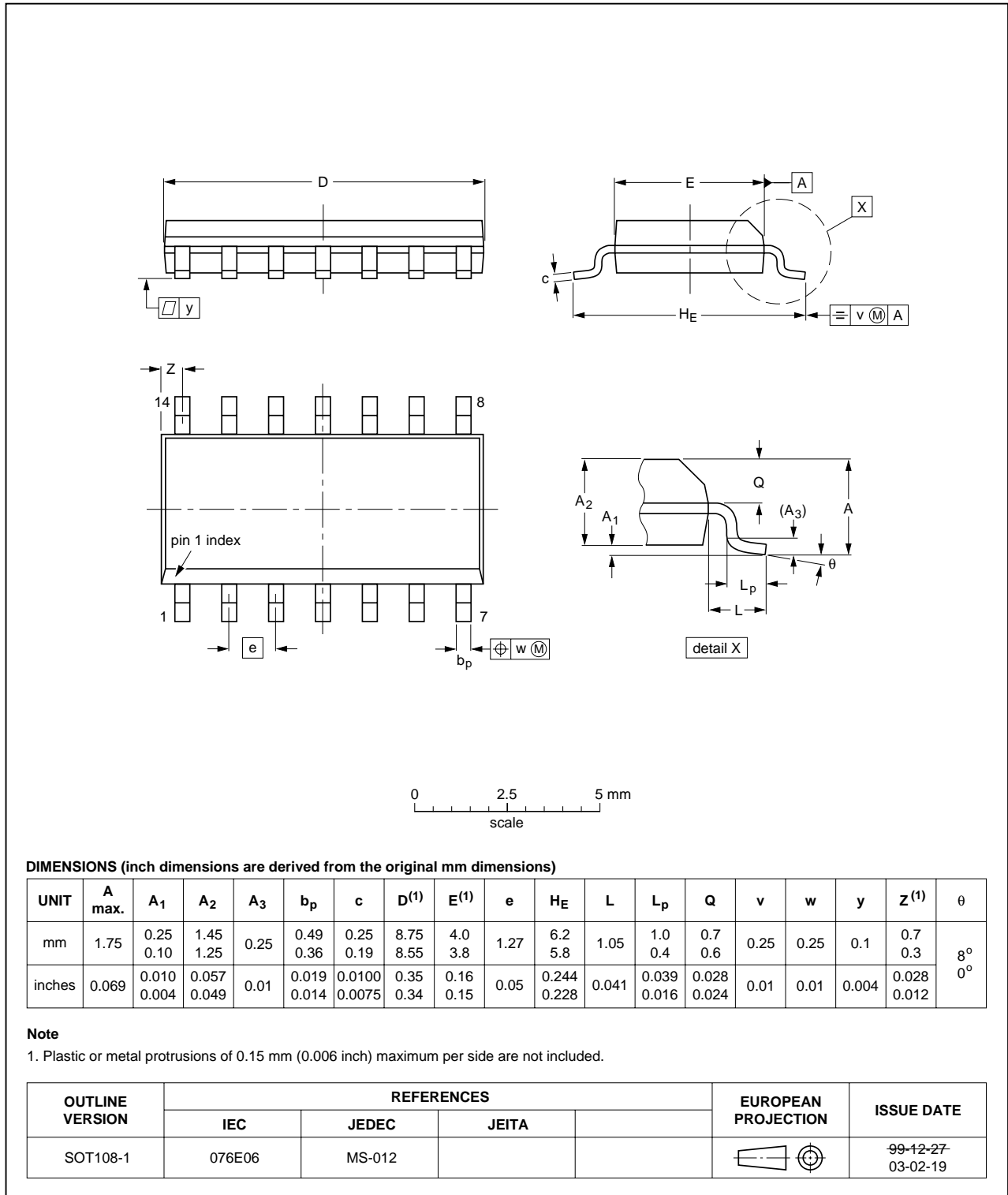


Fig 12. Package outline SOT108-1 (SO14)

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

SOT337-1

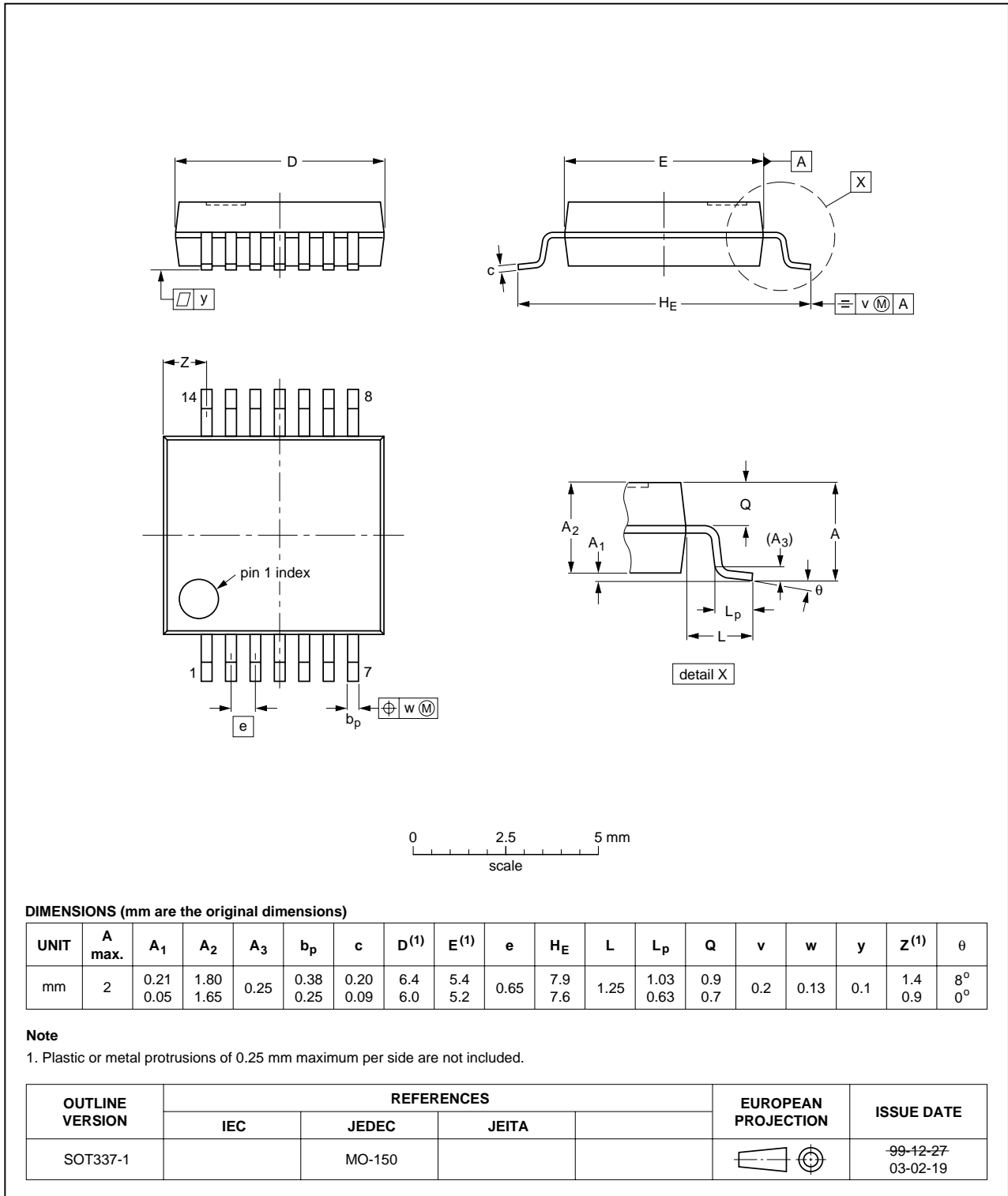


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

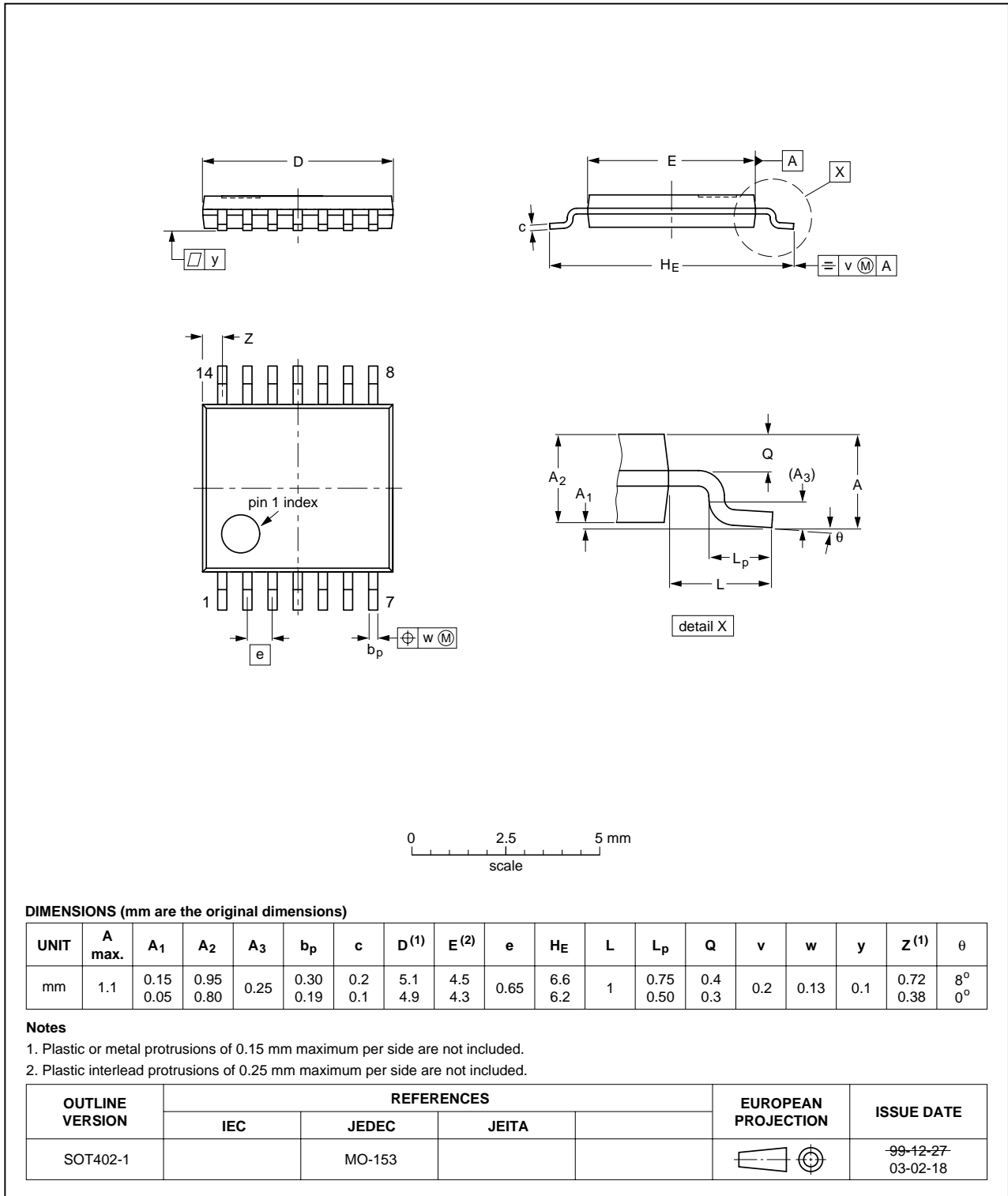


Fig 14. Package outline SOT402-1 (TSSOP14)

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

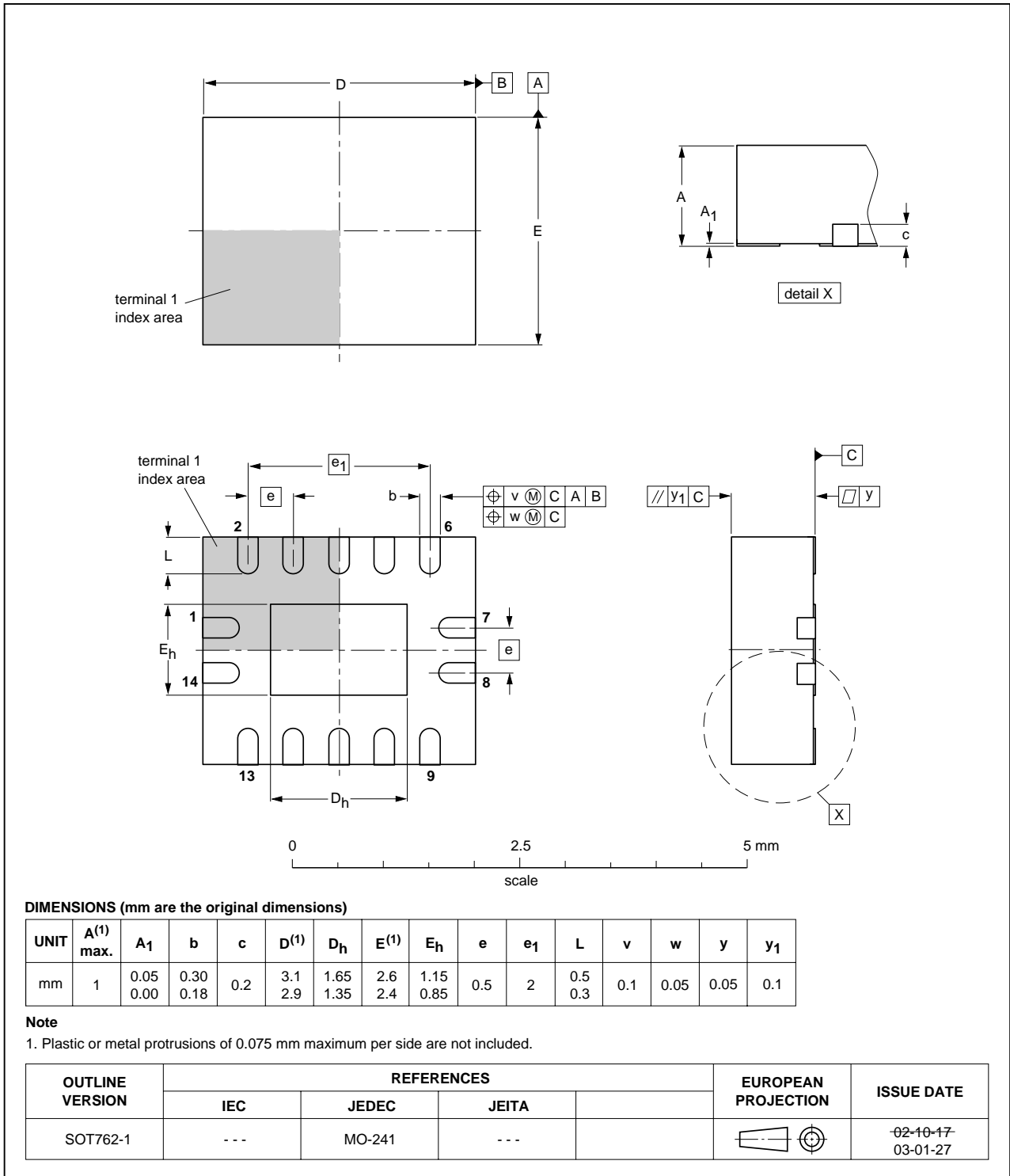


Fig 15. Package outline SOT762-1 (DHVQFN14)



## 18. Revision history

Table 12: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
74LVC14A_4	20050215	Product data sheet	-	9397 750 14591	74LVC14A_3
Modifications:					
			<ul style="list-style-type: none"><li>• The format of this data sheet is redesigned to comply with the current presentation and information standard of Philips Semiconductors.</li><li>• General text updates.</li></ul>		
74LVC14A_3	20030228	Product specification	-	9397 750 10536	74LVC14A_2
74LVC14A_2	20020315	Product specification	-	9397 750 09449	74LVC14A_1
74LVC14A_1	19980428	Product specification	-	9397 750 04484	-

## 19. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[3]</sup>	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).

[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.

## 20. 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.

**Application information** — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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