

# 74LVC14A

Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 5 — 23 December 2011

Product data sheet

## 1. General description

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

The inputs switch at different points for positive and negative-going signals. The difference between the positive voltage  $V_{T+}$  and the negative voltage  $V_{T-}$  is defined as the input hysteresis voltage  $V_H$ .

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 mixed 3.3 V and 5 V applications.

## 2. Features and benefits

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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
- Unlimited input rise and fall times
- Inputs accept voltages up to 5.5 V
- Complies with JEDEC standard JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 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



### 4. Ordering information

Table 1. 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

### 5. Functional diagram

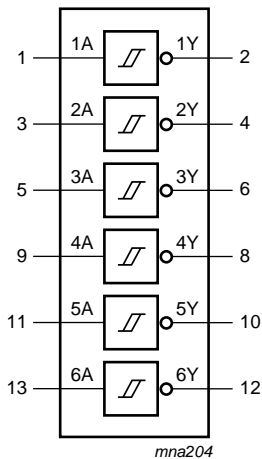


Fig 1. Logic symbol

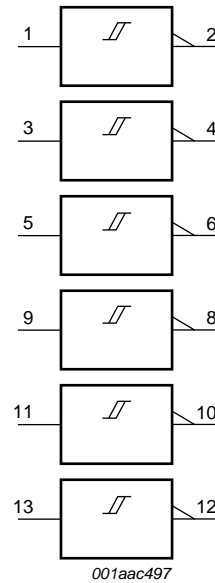


Fig 2. IEC logic symbol

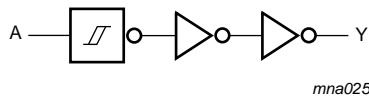
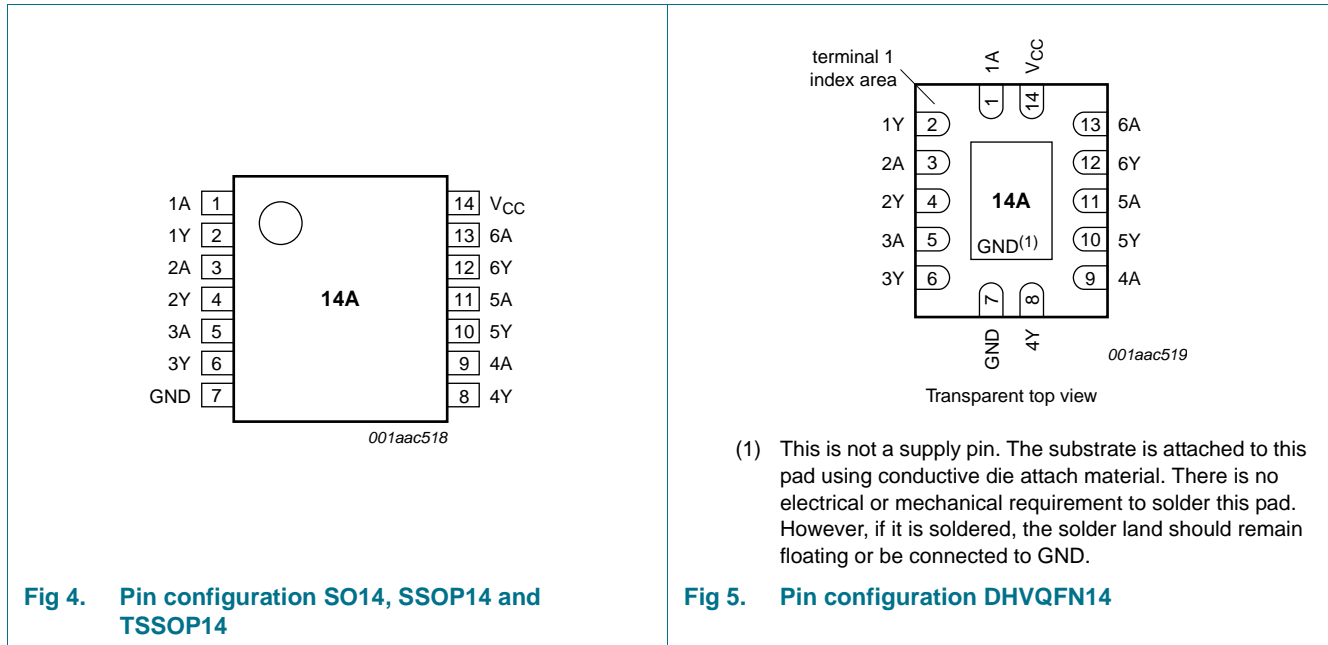


Fig 3. Logic diagram for one Schmitt trigger

## 6. Pinning information

### 6.1 Pinning



### 6.2 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

## 7. Functional description

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

Input nA	Output nY
L	H
H	L

[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	+6.5	V
$V_I$	input voltage		[1] -0.5	+6.5	V
$V_O$	output voltage		[2][3] -0.5	$V_{CC} + 0.5$	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[4] -	500	mW

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

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

[4] 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.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
$V_I$	input voltage		0	-	5.5	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	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>						
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V
V <sub>OL</sub>	LOW-level voltage output	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>						
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND	-	±0.1	±5	-	±20	μA
I <sub>CC</sub>	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	-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional 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	500	-	5000	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	4.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nY; see <a href="#">Figure 6</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	16	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	6.1	12.7	1.0	14.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	3.5	7.8	1.5	10.0	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.6	7.5	1.5	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.2	6.4	1.0	8.0	ns
t <sub>sk(o)</sub>	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>	-	-	1.0	-	1.5	ns

**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	9.0	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	12.5	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	15.6	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

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

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

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

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

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

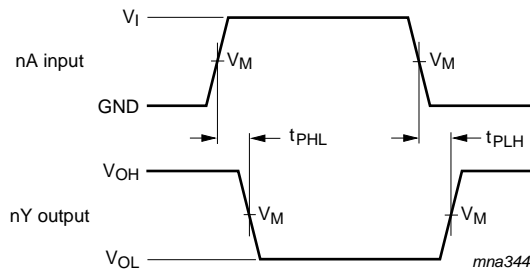
C<sub>L</sub> = output load capacitance in pF

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

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.

## 12. Waveforms

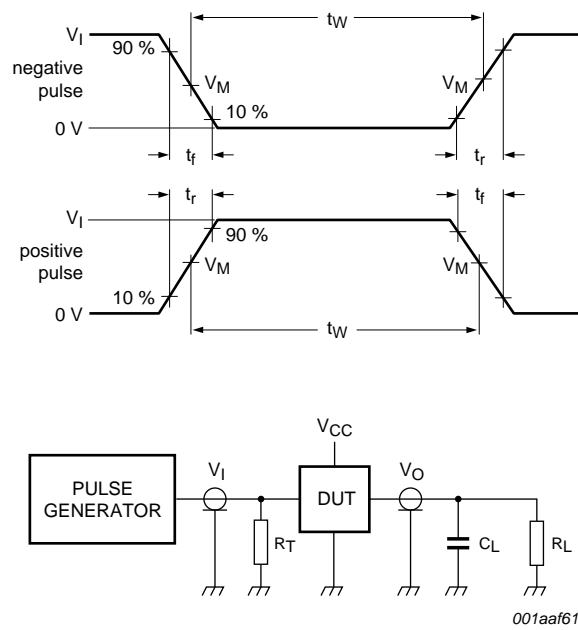


$$V_M = 1.5 \text{ V at } V_{CC} \geq 2.7 \text{ V}$$

$$V_M = 0.5 \times V_{CC} \text{ at } V_{CC} < 2.7 \text{ V.}$$

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

**Fig 6. Propagation delay input (nA) to output (nY)**



Test data is given in [Table 8](#). Definitions for 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 7. Load circuitry for measuring switching times**

**Table 8. Test data**

Supply voltage	Input		Load	
	$V_I$	$t_r, t_f$	$C_L$	$R_L$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$

### 13. Transfer characteristics

**Table 9. Transfer characteristics**

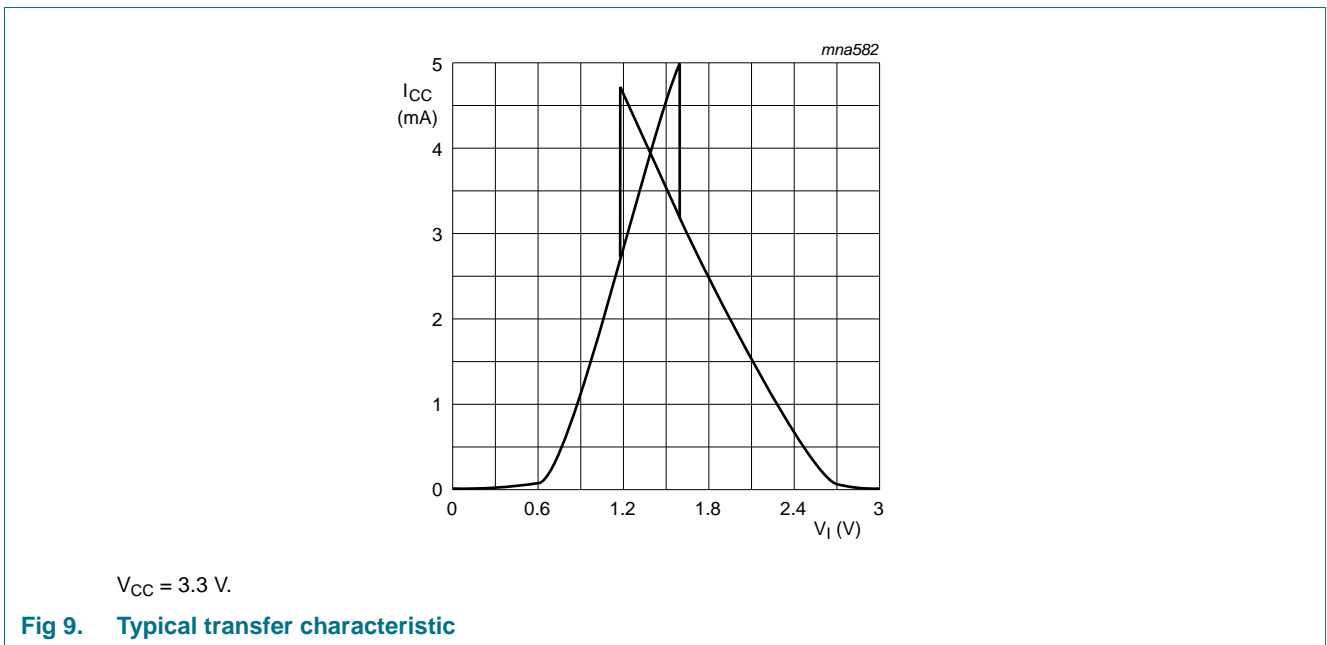
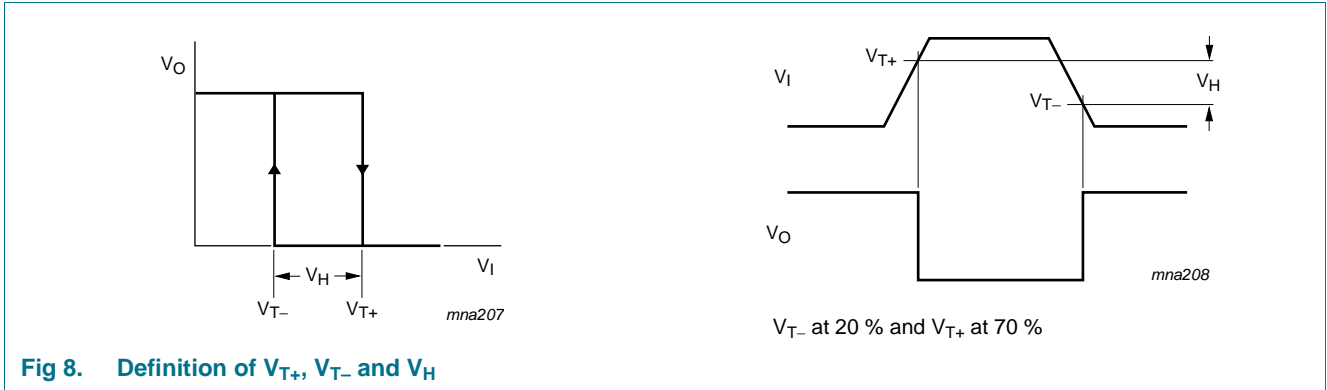
Voltages are referenced to GND (ground = 0 V); see [Figure 8](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Max	Min	Max	
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 1.2 V	0.2	1.0	0.2	1.0	V
		V <sub>CC</sub> = 1.65 V	0.4	1.3	0.4	1.3	V
		V <sub>CC</sub> = 1.95 V	0.6	1.5	0.6	1.5	V
		V <sub>CC</sub> = 2.3 V	0.8	1.7	0.8	1.7	V
		V <sub>CC</sub> = 2.5 V	0.9	1.7	0.9	1.7	V
		V <sub>CC</sub> = 2.7 V	1.1	2	1.1	2	V
		V <sub>CC</sub> = 3 V	1.2	2	1.2	2	V
		V <sub>CC</sub> = 3.6 V	1.2	2	1.2	2	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 1.2 V	0.12	0.75	0.12	0.75	V
		V <sub>CC</sub> = 1.65 V	0.15	0.85	0.15	0.85	V
		V <sub>CC</sub> = 1.95 V	0.25	0.95	0.25	0.95	V
		V <sub>CC</sub> = 2.3 V	0.4	1.1	0.4	1.1	V
		V <sub>CC</sub> = 2.5 V	0.4	1.2	0.4	1.2	V
		V <sub>CC</sub> = 2.7 V	0.8	1.4	0.8	1.4	V
		V <sub>CC</sub> = 3 V	0.8	1.5	0.8	1.5	V
		V <sub>CC</sub> = 3.6 V	0.8	1.5	0.8	1.5	V
V <sub>H</sub>	hysteresis voltage (V <sub>T+</sub> - V <sub>T-</sub> )	V <sub>CC</sub> = 1.2 V	0.1	1.0	0.1	1.0	V
		V <sub>CC</sub> = 1.65 V	0.2	1.15	0.2	1.15	V
		V <sub>CC</sub> = 1.95 V	0.2	1.25	0.2	1.25	V
		V <sub>CC</sub> = 2.3 V	0.3	1.3	0.3	1.3	V
		V <sub>CC</sub> = 2.5 V	0.3	1.3	0.3	1.3	V
		V <sub>CC</sub> = 2.7 V	0.3	1.1	0.3	1.1	V
		V <sub>CC</sub> = 3 V	0.3	1.2	0.3	1.2	V
		V <sub>CC</sub> = 3.6 V <sup>[1]</sup>	0.3	1.2	0.3	1.2	V

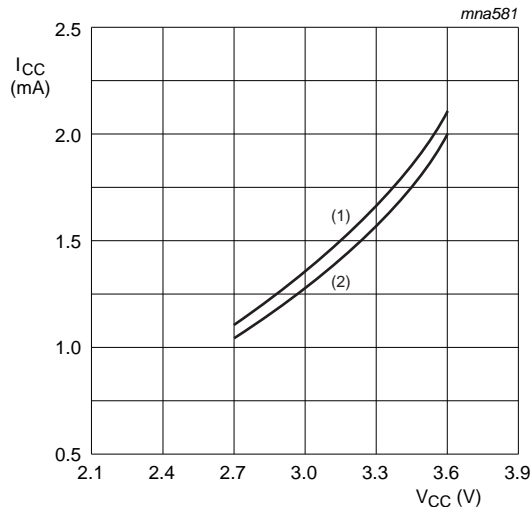
[1] Typical transfer characteristic is displayed in [Figure 9](#).



14. Waveforms transfer characteristics



15. Application information



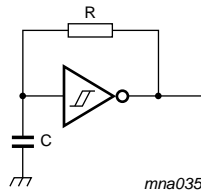
(1) Positive-going edge.

(2) Negative going-edge.

Linear change of V<sub>I</sub> between 0.8 V to 2.0 V.

All values given are typical unless otherwise specified.

Fig 10. Average supply current as a function of supply voltage



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC} \text{ at } V_{CC} = 3.0 \text{ V}$$

Fig 11. Relaxation oscillator

16. Package outline

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

SOT108-1

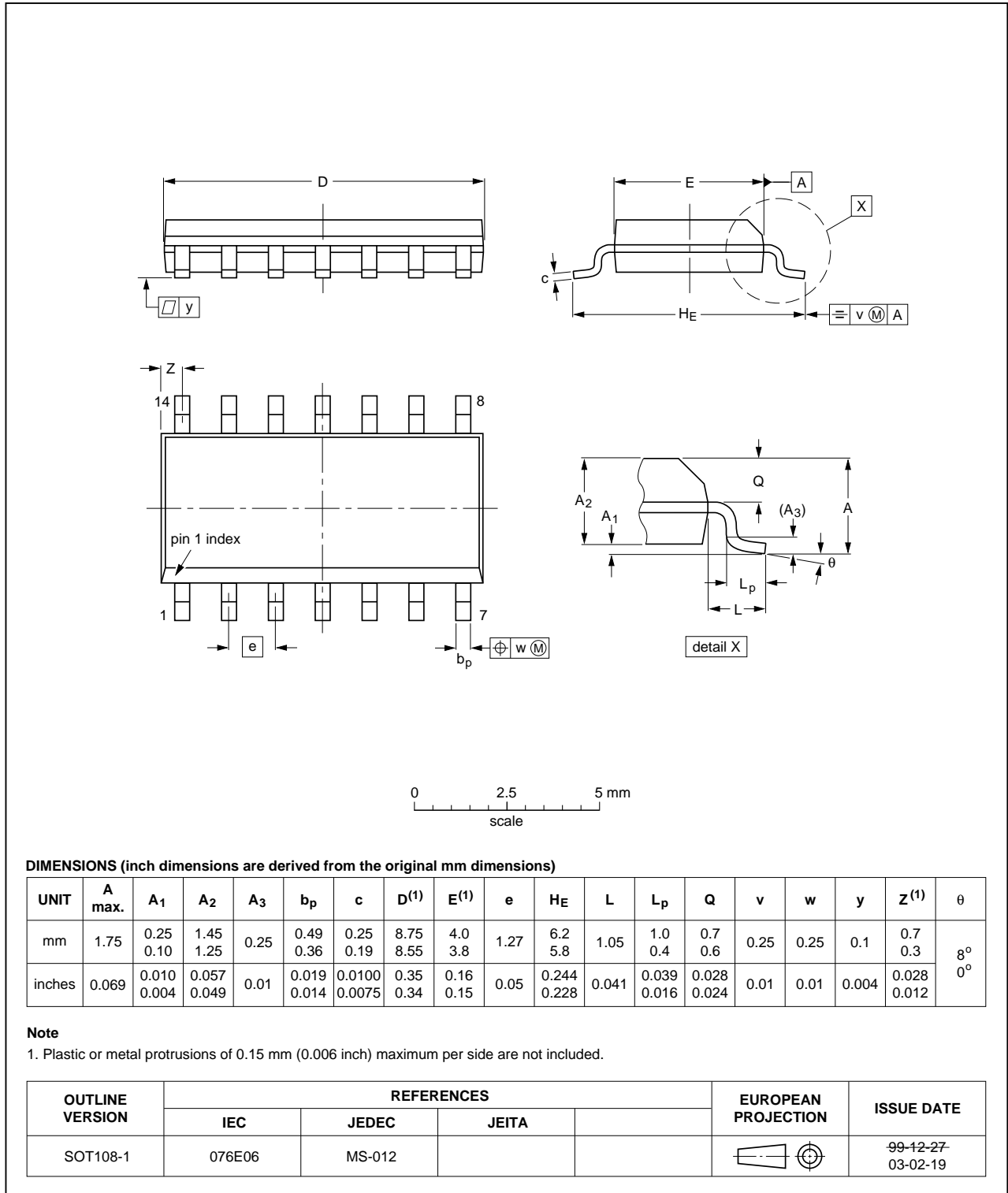


Fig 12. Package outline SOT108-1 (SO14)

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

SOT337-1

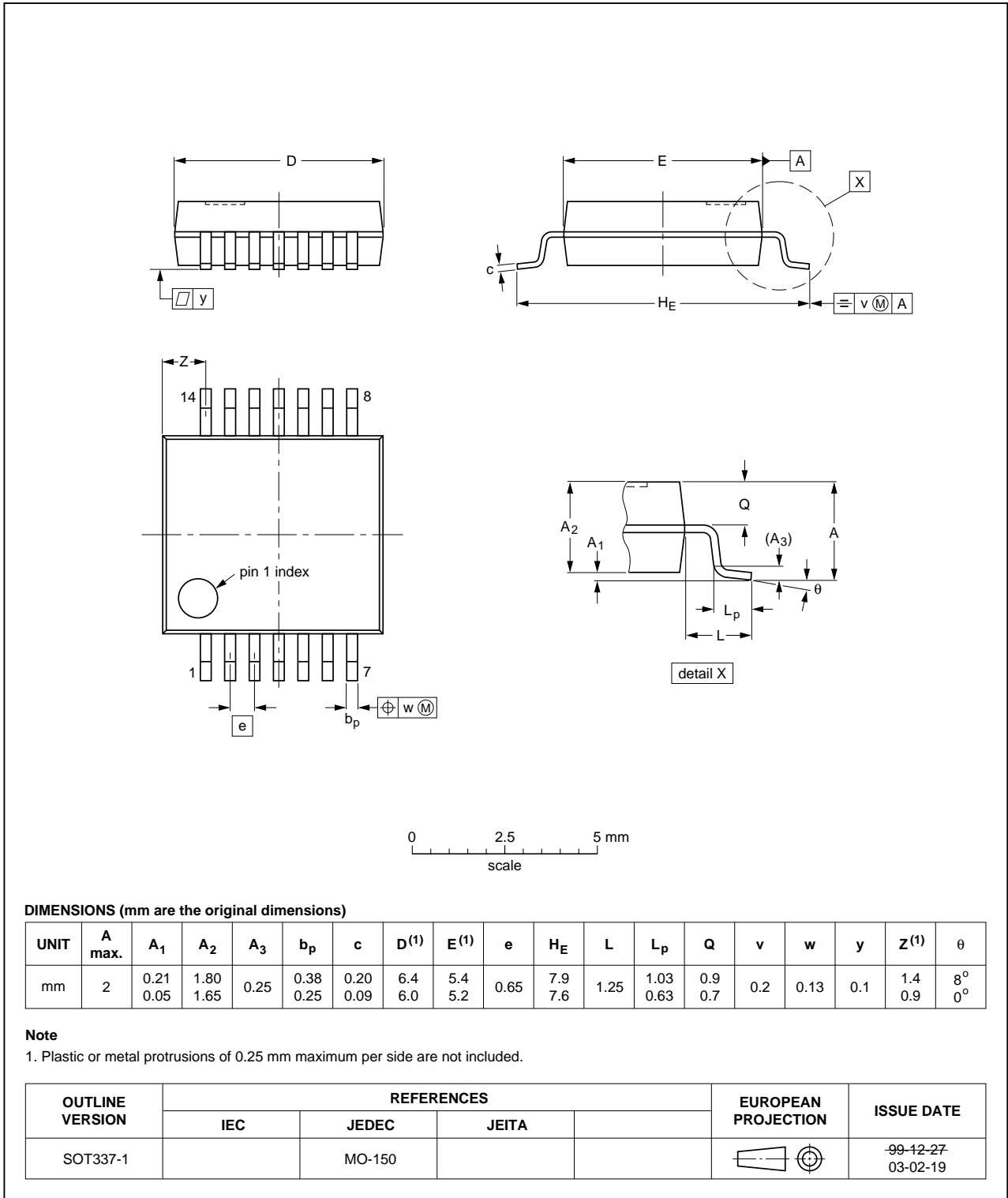


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

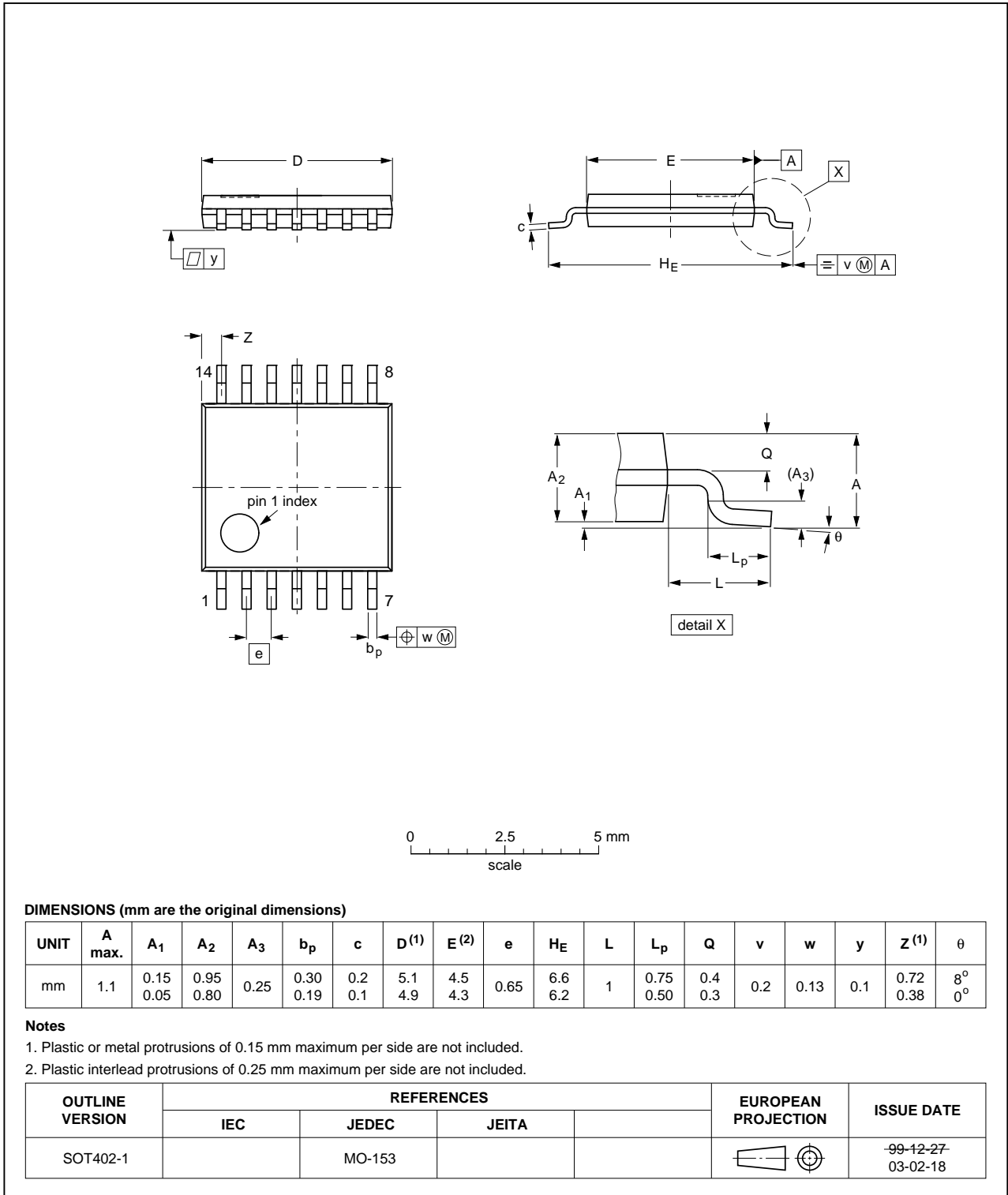


Fig 14. Package outline SOT402-1 (TSSOP14)

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

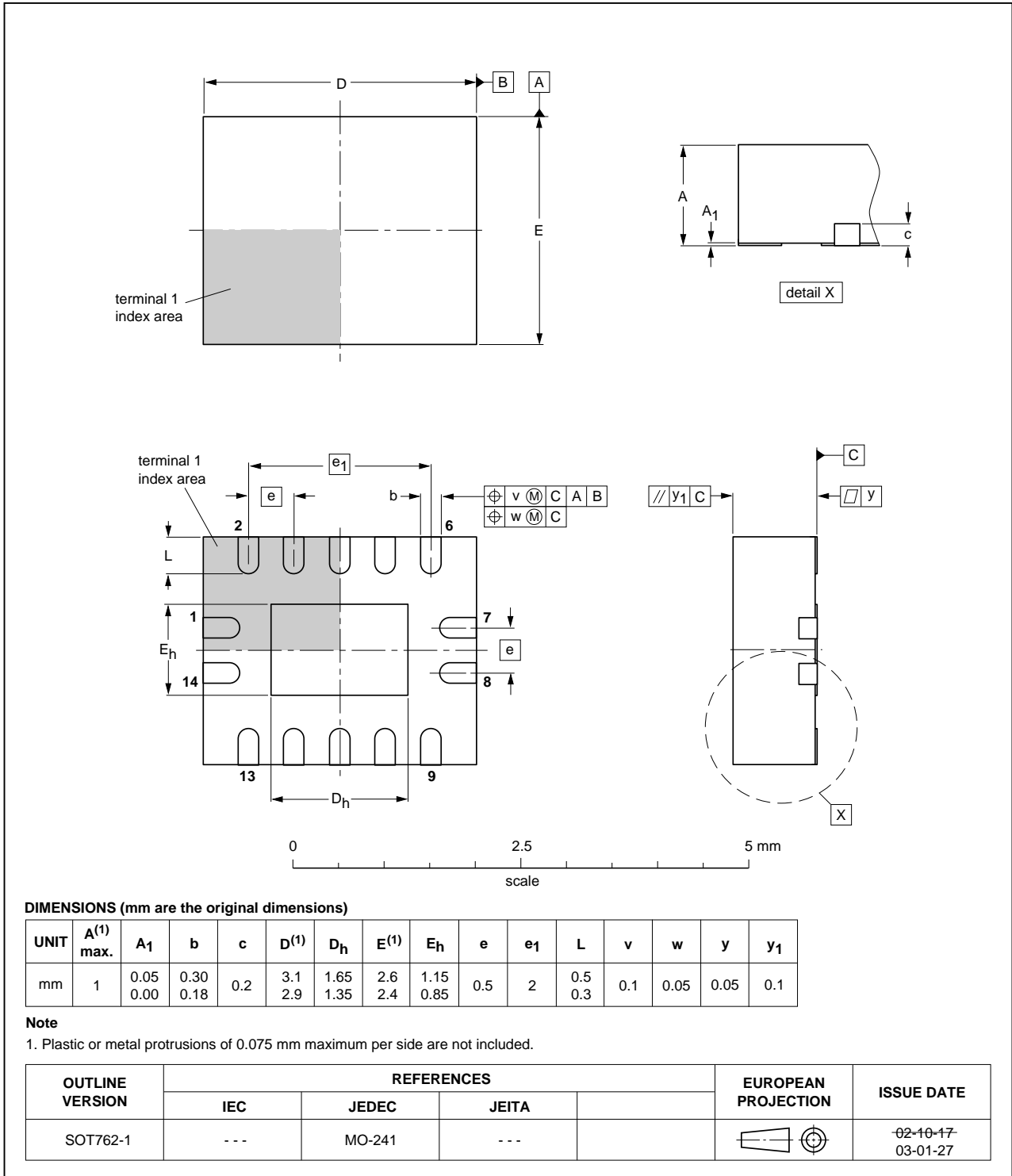


Fig 15. Package outline SOT762-1 (DHVQFN14)

## 17. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 18. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC14A v.5	20111223	Product data sheet	-	74LVC14A v.4
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><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a> and <a href="#">Table 8</a>: values added for lower voltage ranges.</li> </ul>			
74LVC14A v.4	20050215	Product data sheet	-	74LVC14A v.3
74LVC14A v.3	20030228	Product specification	-	74LVC14A v.2
74LVC14A v.2	20020315	Product specification	-	74LVC14A v.1
74LVC14A v.1	19980428	Product specification	-	-

## 19. Legal information

### 19.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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