

# 74LVC14A

## Hex inverting Schmitt trigger with 5 V tolerant input

Rev. 7 — 24 July 2020

Product data sheet

### 1. General description

The 74LVC14A is a hex inverter with Schmitt-trigger inputs. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

### 2. Features and benefits

- 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 °C to +85 °C and from -40 °C to +125 °C

### 3. Applications

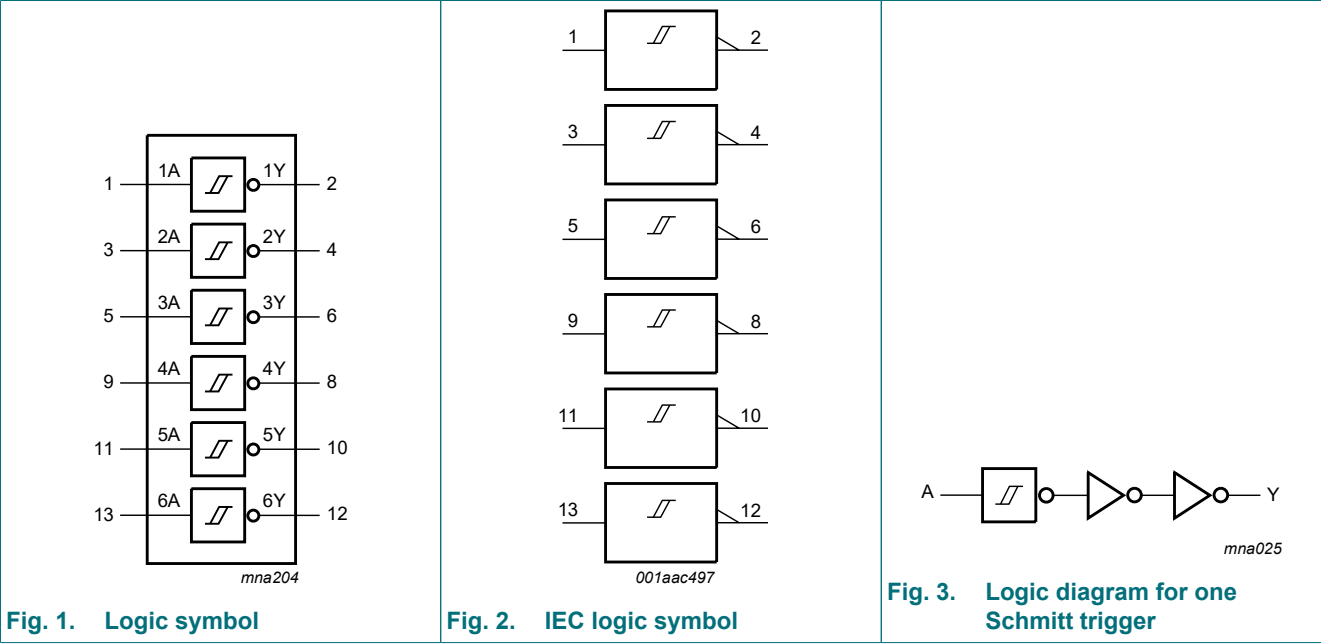
- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

### 4. Ordering information

Table 1. Ordering information

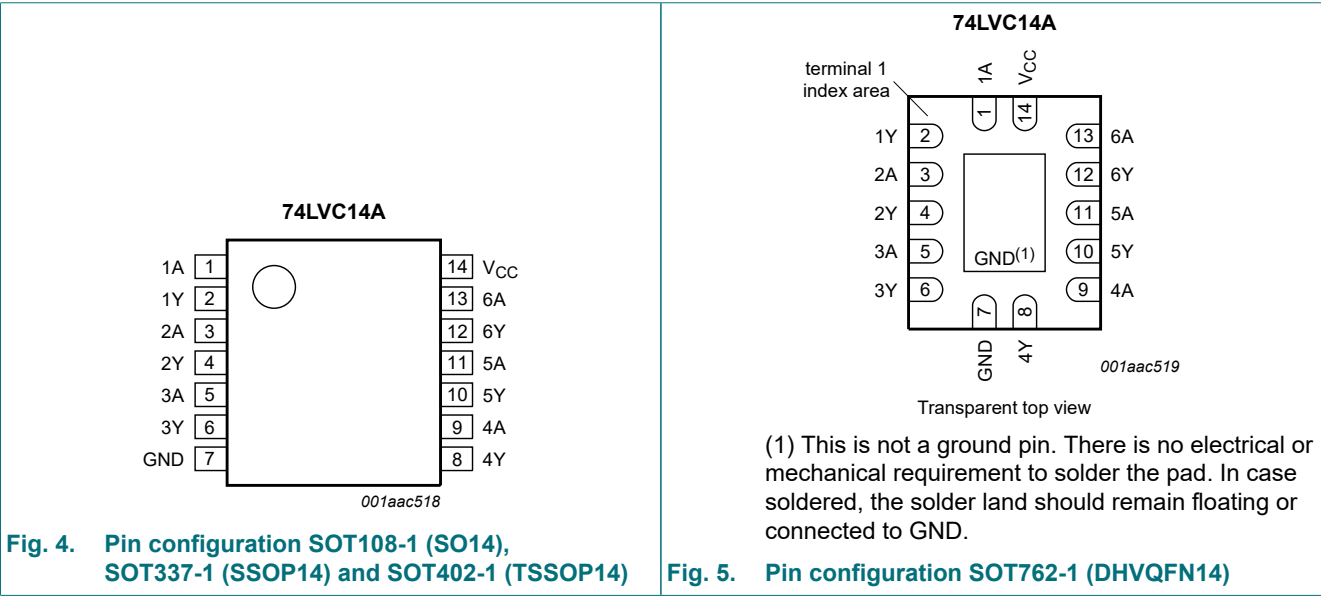
Type number	Package			
	Temperature range	Name	Description	Version
74LVC14AD	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC14ADB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74LVC14APW	-40 °C to +125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



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

H = HIGH voltage level; L = LOW voltage level

Input nA	Output nY
L	H
H	L

## 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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V
V <sub>I</sub>	input voltage	[1]	-0.5	+6.5	V
V <sub>O</sub>	output voltage	[2]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or 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>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	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 [3]	-	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] For SOT108-1 (SO14) package: P<sub>tot</sub> derates linearly with 10.1 mW/K above 100 °C.

For SOT337-1 (SSOP14) package: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °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.

## 9. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	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 [1]	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
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	2.0	-	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 Fig. 7.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
$t_{pd}$	propagation delay	nA to nY; see Fig. 6 [2]						
		$V_{CC} = 1.2 \text{ V}$	-	16	-	-	-	ns
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	1.0	6.1	12.7	1.0	14.7	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.5	3.5	7.8	1.5	10.0	ns
		$V_{CC} = 2.7 \text{ V}$	1.5	3.6	7.5	1.5	9.5	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	1.0	3.2	6.4	1.0	8.0	ns
$t_{sk(o)}$	output skew time	$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ [3]	-	-	1.0	-	1.5	ns
$C_{PD}$	power dissipation capacitance	per buffer; $V_I = \text{GND to } V_{CC}$ [4]						
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	-	9.0	-	-	-	pF
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	12.5	-	-	-	pF
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	-	15.6	-	-	-	pF

[1] Typical values are measured at  $T_{amb} = 25 \text{ °C}$  and  $V_{CC} = 1.2 \text{ V}$ ,  $1.8 \text{ V}$ ,  $2.5 \text{ V}$ ,  $2.7 \text{ V}$ , and  $3.3 \text{ V}$  respectively.

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

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

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

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

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

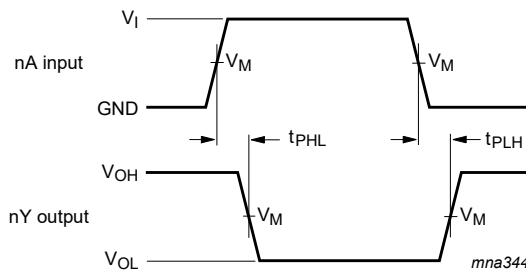
$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

$N$  = number of inputs switching

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

### 11.1. Waveforms and test circuit

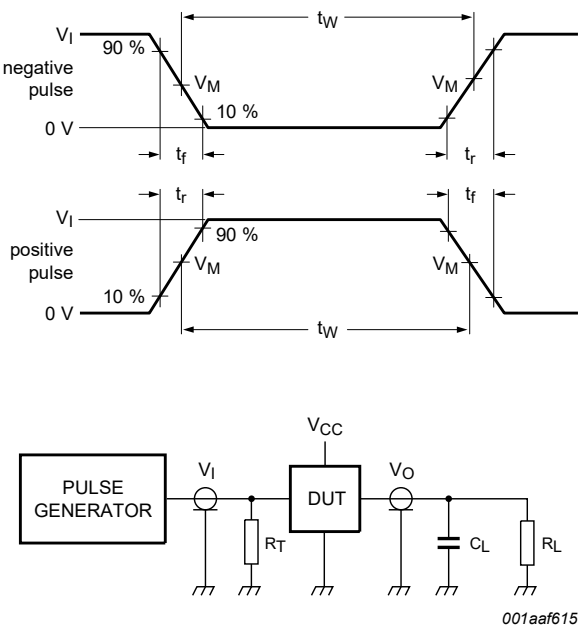


$V_M = 1.5 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$

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

$V_{OL}$  and  $V_{OH}$  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. Test circuit 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	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	1 k $\Omega$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	1 k $\Omega$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	500 $\Omega$
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$
3.0 V to 3.6 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$

12. Transfer characteristics

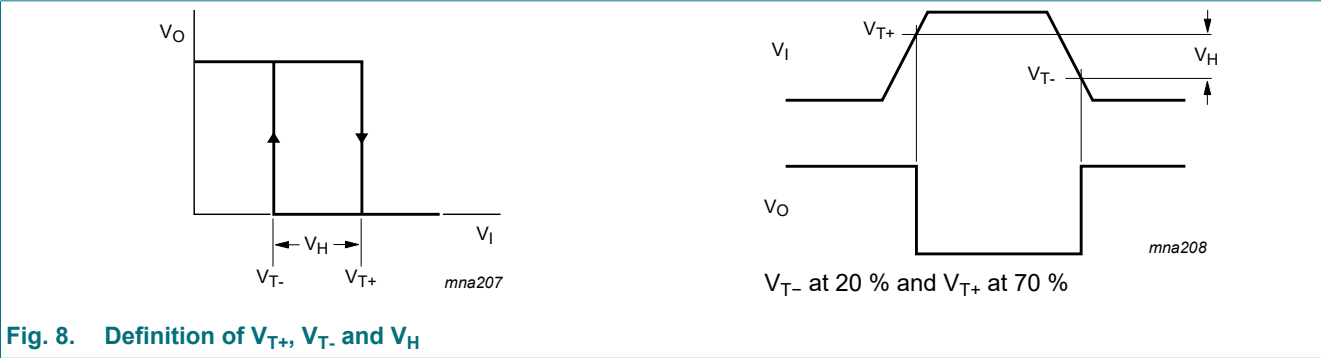
Table 9. Transfer characteristics

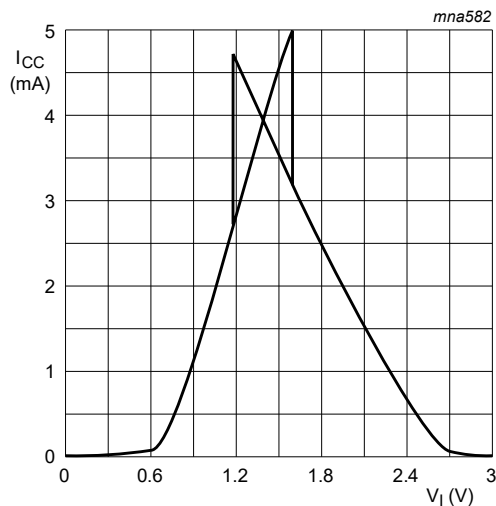
Voltages are referenced to GND (ground = 0 V); see Fig. 8.

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 [1]	0.3	1.2	0.3	1.2	V

[1] Typical transfer characteristic is displayed in Fig. 9.

12.1. Waveforms transfer characteristics

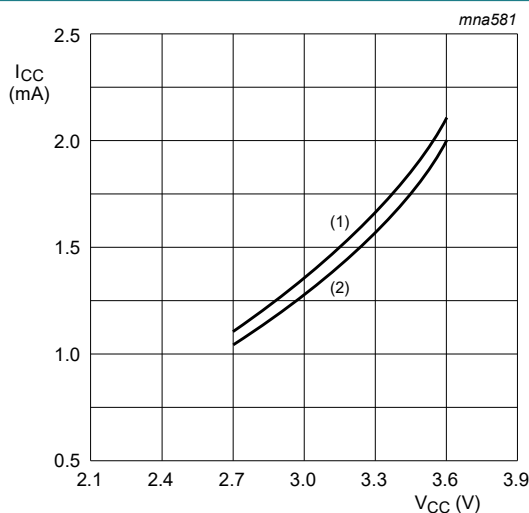




$V_{CC} = 3.3 \text{ V}$ .

**Fig. 9. Typical transfer characteristic**

### 13. Application information

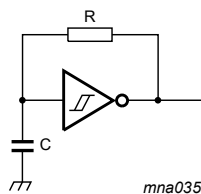


- (1) Positive-going edge.
- (2) Negative going-edge.

Linear change of  $V_I$  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**



14. Package outline

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

SOT108-1

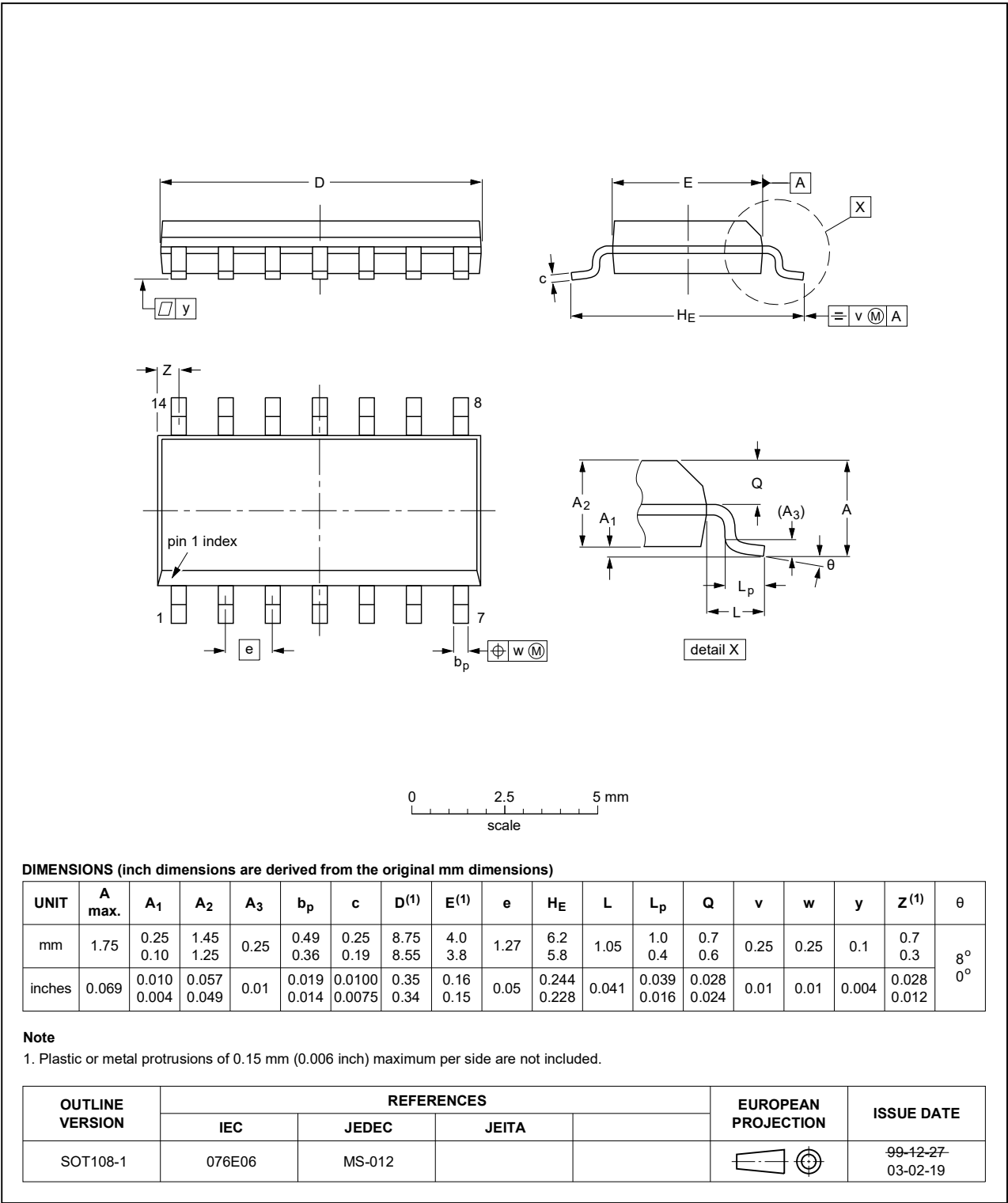


Fig. 12. Package outline SOT108-1 (SO14)

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

SOT337-1

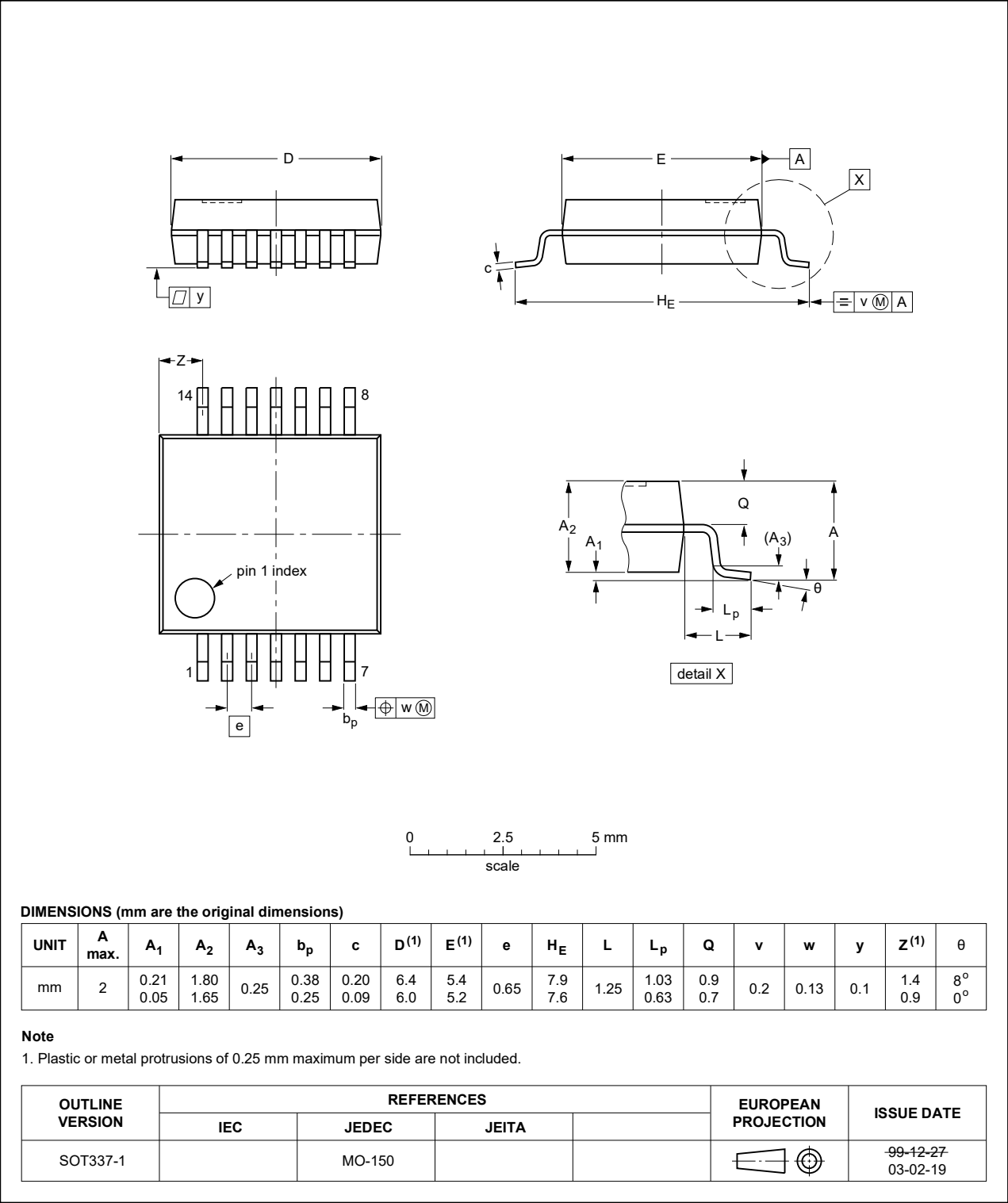


Fig. 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

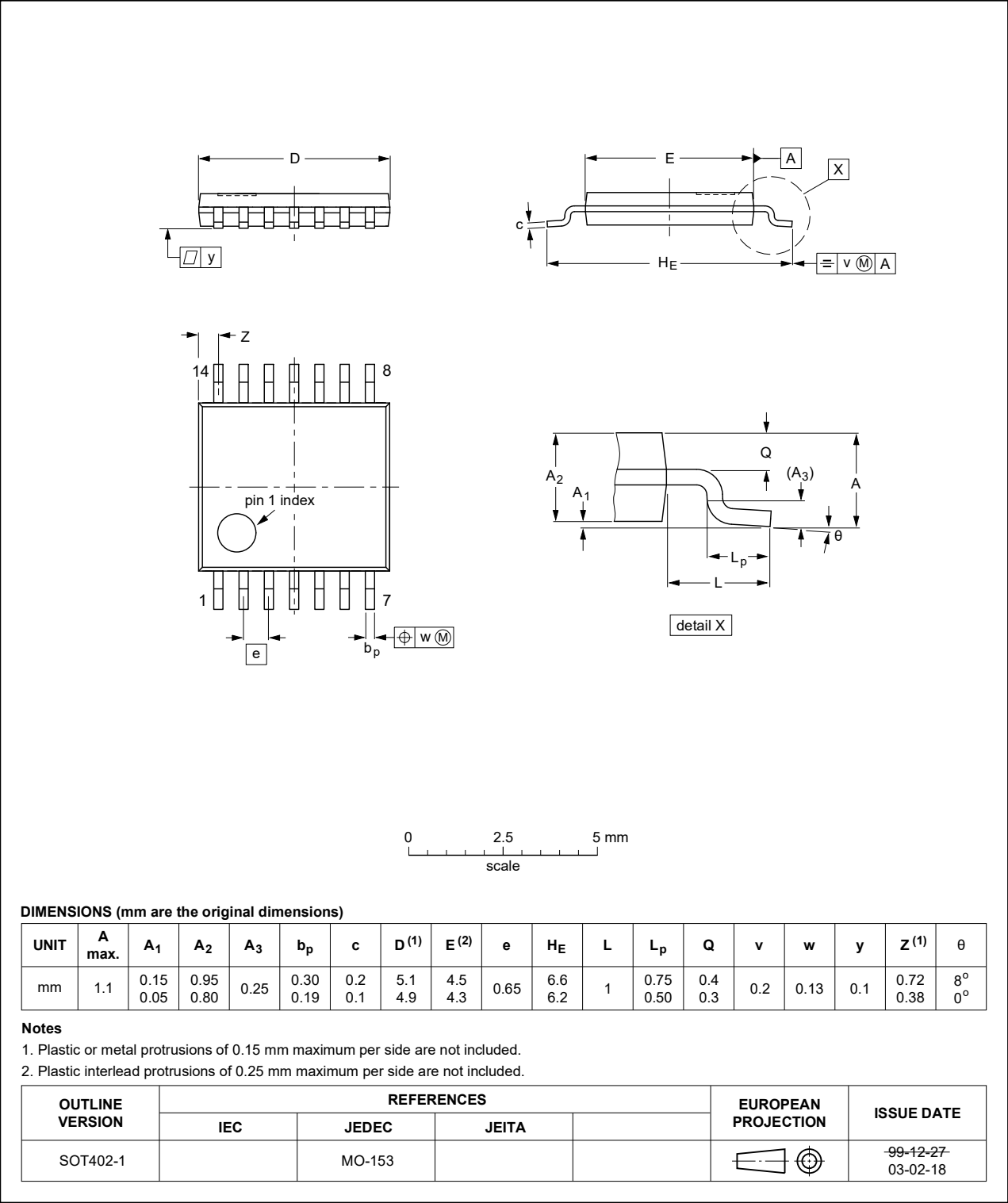


Fig. 14. Package outline SOT402-1 (TSSOP14)

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

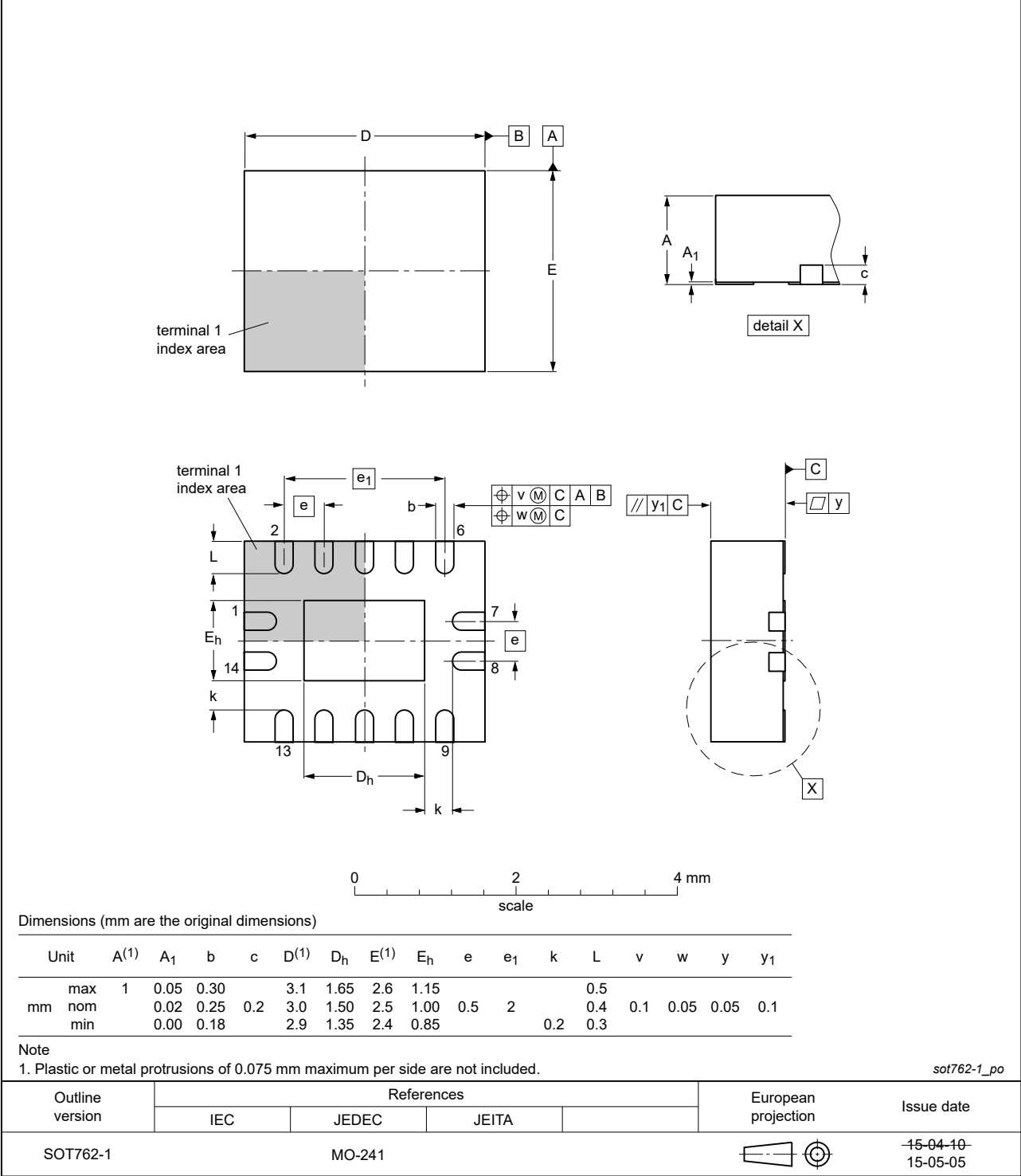


Fig. 15. Package outline SOT762-1 (DHVQFN14)

## 15. Abbreviations

Table 10. Abbreviations

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

## 16. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC14A v.7	20200724	Product data sheet	-	74LVC14A v.6
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="#">Section 1</a> updated.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74LVC14A v.6	20160610	Product data sheet	-	74LVC14A v.5
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 4</a>: table note removed (errata).</li> </ul>			
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	-	-

## Hex inverting Schmitt trigger with 5 V tolerant input

## 17. 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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