

74LV14

Hex inverting Schmitt trigger

Rev. 7 — 9 December 2015

Product data sheet

1. General description

The 74LV14 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC14 and 74HCT14.

The 74LV14 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 .

2. Features and benefits

- Wide operating voltage: 1.0 V to 5.5 V
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between $V_{CC} = 2.7$ V and $V_{CC} = 3.6$ V
- Typical output ground bounce < 0.8 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- Typical HIGH-level output voltage (V_{OH}) undershoot: > 2 V at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A 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
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LV14D	−40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LV14DB	−40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74LV14PW	−40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LV14BQ	−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

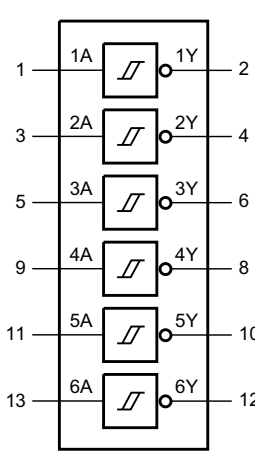


Fig 1. Logic symbol

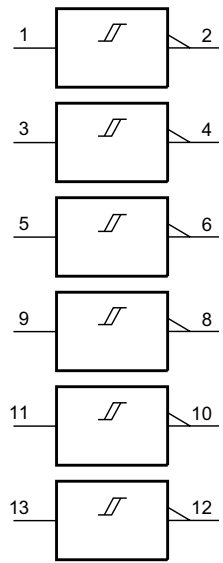


Fig 2. IEC logic symbol

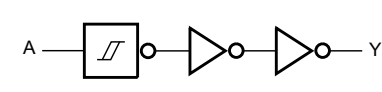
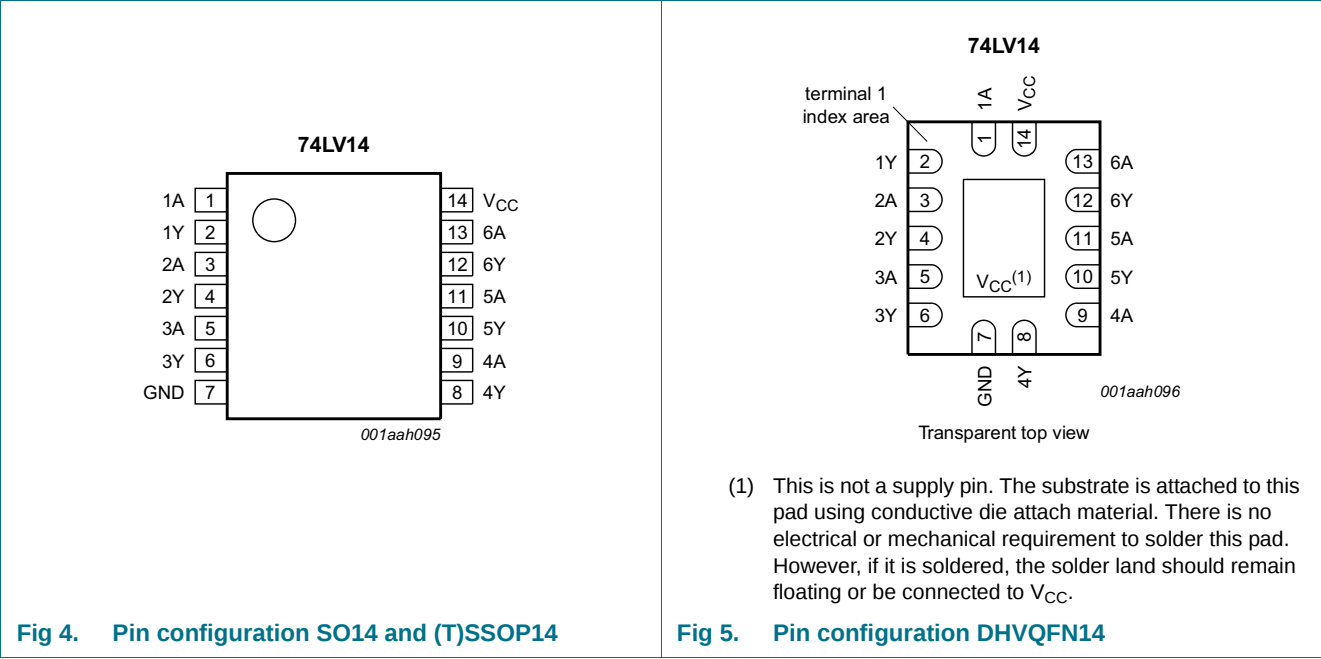


Fig 3. Logic diagram for one Schmitt trigger

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1A	1	data input
1Y	2	data output
2A	3	data input
2Y	4	data output
3A	5	data input
3Y	6	data output
GND	7	ground (0 V)
4Y	8	data output
4A	9	data input
5Y	10	data output
5A	11	data input
6Y	12	data output
6A	13	data input
V _{CC}	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_{CC}	supply voltage		-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1]	-	±20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1]	-	±50	mA
I_O	output current	$V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$	-	±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	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$			
		SO14 package [2]	-	500	mW
		(T)SSOP14 package [3]	-	500	mW
		DHVQFN14 package [4]	-	500	mW

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

[2] P_{tot} derates linearly with 8 mW/K above 70 °C.

[3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

[4] P_{tot} derates linearly with 4.5 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	[1]	1.0	3.3	5.5	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C

[1] The static characteristics are guaranteed from $V_{CC} = 1.2\text{ V}$ to $V_{CC} = 5.5\text{ V}$, but LV devices are guaranteed to function down to $V_{CC} = 1.0\text{ V}$ (with input levels GND or V_{CC}).

10. Static characteristics

Table 6. Static characteristics

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	$T_{\text{amb}} = -40\text{ °C to }+85\text{ °C}$			$T_{\text{amb}} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ ^[1]	Max	Min	Max	
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}						
		$I_O = -100\text{ }\mu\text{A}; V_{\text{CC}} = 1.2\text{ V}$	-	1.2	-	-	-	V
		$I_O = -100\text{ }\mu\text{A}; V_{\text{CC}} = 2.0\text{ V}$	1.8	2.0	-	1.8	-	V
		$I_O = -100\text{ }\mu\text{A}; V_{\text{CC}} = 2.7\text{ V}$	2.5	2.7	-	2.5	-	V
		$I_O = -100\text{ }\mu\text{A}; V_{\text{CC}} = 3.0\text{ V}$	2.8	3.0	-	2.8	-	V
		$I_O = -100\text{ }\mu\text{A}; V_{\text{CC}} = 4.5\text{ V}$	4.3	4.5	-	4.3	-	V
		$I_O = -6\text{ mA}; V_{\text{CC}} = 3.0\text{ V}$	2.4	2.82	-	2.2	-	V
		$I_O = -12\text{ mA}; V_{\text{CC}} = 4.5\text{ V}$	3.6	4.2	-	3.5	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}						
		$I_O = 100\text{ }\mu\text{A}; V_{\text{CC}} = 1.2\text{ V}$	-	0	-	-	-	V
		$I_O = 100\text{ }\mu\text{A}; V_{\text{CC}} = 2.0\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 100\text{ }\mu\text{A}; V_{\text{CC}} = 2.7\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 100\text{ }\mu\text{A}; V_{\text{CC}} = 3.0\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 100\text{ }\mu\text{A}; V_{\text{CC}} = 4.5\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 6\text{ mA}; V_{\text{CC}} = 3.0\text{ V}$	-	0.25	0.40	-	0.50	V
		$I_O = 12\text{ mA}; V_{\text{CC}} = 4.5\text{ V}$	-	0.35	0.55	-	0.65	V
I_I	input leakage current	$V_I = V_{\text{CC}}$ or GND; $V_{\text{CC}} = 5.5\text{ V}$	-	-	1.0	-	1.0	μA
I_{CC}	supply current	$V_I = V_{\text{CC}}$ or GND; $I_O = 0\text{ A}$; $V_{\text{CC}} = 5.5\text{ V}$	-	-	20.0	-	40	μA
ΔI_{CC}	additional supply current	per input; $V_I = V_{\text{CC}} - 0.6\text{ V}$; $V_{\text{CC}} = 2.7\text{ V to }3.6\text{ V}$	-	-	500	-	850	μA
C_I	input capacitance		-	3.5	-	-	-	pF

[1] Typical values are measured at $T_{\text{amb}} = 25\text{ °C}$.

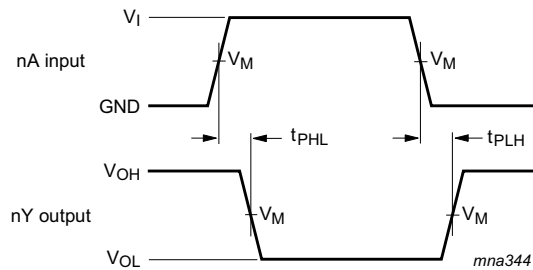
11. Dynamic characteristics

Table 7. Dynamic characteristics
GND = 0 V; For test circuit see Figure 7.

Symbol	Parameter	Conditions	T _{amb} = −40 °C to +85 °C			T _{amb} = −40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
t _{pd}	propagation delay	nA to nY; see Figure 6 ^[2]						
		V _{CC} = 1.2 V	-	80	-	-	-	ns
		V _{CC} = 2.0 V	-	27	37	-	48	ns
		V _{CC} = 2.7 V	-	20	28	-	35	ns
		V _{CC} = 3.0 V to 3.6 V; C _L = 15 pF ^[3]	-	13	-	-	-	ns
		V _{CC} = 3.0 V to 3.6 V ^[3]	-	15	22	-	28	ns
		V _{CC} = 4.5 V to 5.5 V	-	-	18	-	23	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} ^[4]	-	15	-	-	-	pF

- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V).
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
P_D = C_{PD} × V_{CC}² × f_i × N + Σ(C_L × V_{CC}² × 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 V
N = number of inputs switching
Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

12. Waveforms

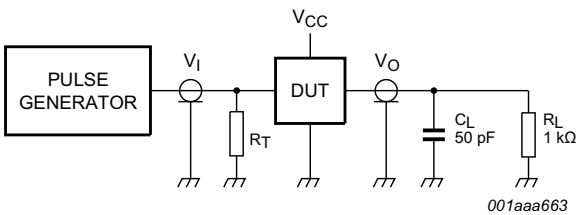


Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 6. The input (nA) to output (nY) propagation delays

Table 8. Measurement points

Supply voltage	Input	Output
V _{CC}	V _M	V _M
< 2.7 V	0.5V _{CC}	0.5V _{CC}
2.7 V to 3.6 V	1.5 V	1.5 V
≥ 4.5 V	0.5V _{CC}	0.5V _{CC}



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

Fig 7. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input	
V _{CC}	V _I	t _r , t _f
< 2.7 V	V _{CC}	≤ 2.5 ns
2.7 V to 3.6 V	2.7 V	≤ 2.5 ns
≥ 4.5 V	V _{CC}	≤ 2.5 ns

13. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 8](#) and [Figure 9](#).

Symbol	Parameter	Conditions	T _{amb} = −40 °C to +85 °C			T _{amb} = −40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
V _{T+}	positive-going threshold voltage	V _{CC} = 1.2 V	-	0.70	-	-	-	V
		V _{CC} = 2.0 V	0.8	1.10	1.4	0.8	1.4	V
		V _{CC} = 2.7 V	1.0	1.45	2.0	1.0	2.0	V
		V _{CC} = 3.0 V	1.2	1.60	2.2	1.2	2.2	V
		V _{CC} = 3.6 V	1.5	1.95	2.4	1.5	2.4	V
		V _{CC} = 4.5 V	1.7	2.50	3.15	1.7	3.15	V
		V _{CC} = 5.5 V	2.1	3.00	3.85	2.1	3.85	V

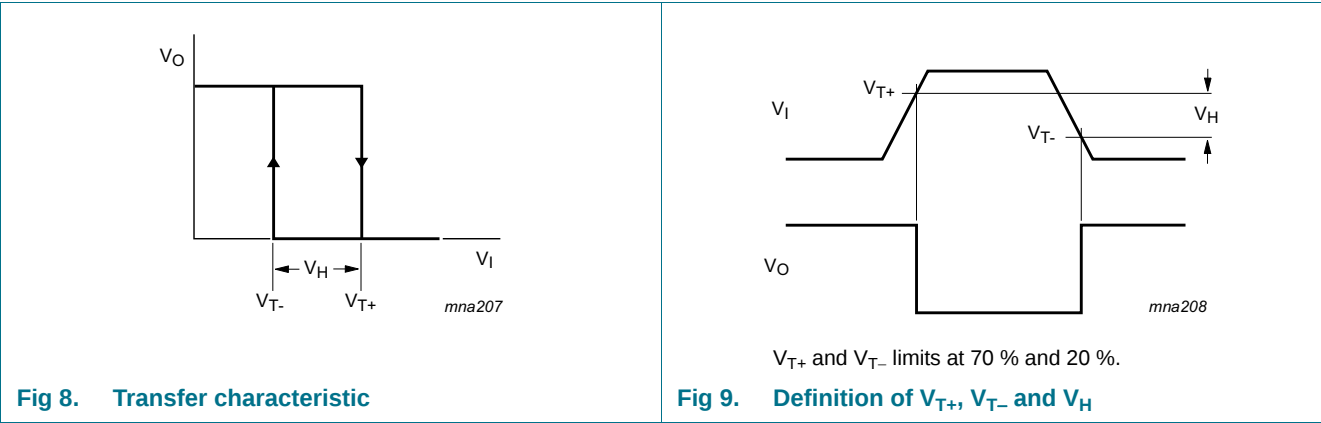
Table 10. Transfer characteristics ...continued

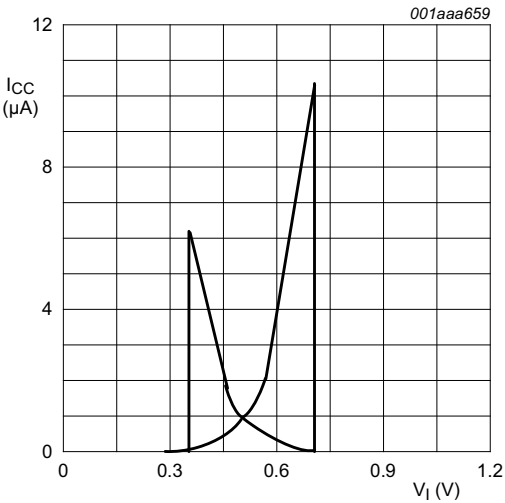
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 8](#) and [Figure 9](#).

Symbol	Parameter	Conditions	T _{amb} = –40 °C to +85 °C			T _{amb} = –40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
V _{T–}	negative-going threshold voltage	V _{CC} = 1.2 V	-	0.34	-	-	-	V
		V _{CC} = 2.0 V	0.3	0.65	0.9	0.3	0.9	V
		V _{CC} = 2.7 V	0.4	0.90	1.4	0.4	1.4	V
		V _{CC} = 3.0 V	0.6	1.05	1.5	0.6	1.5	V
		V _{CC} = 3.6 V	0.8	1.30	1.8	0.8	1.8	V
		V _{CC} = 4.5 V	0.9	1.60	2.0	0.9	2.0	V
		V _{CC} = 5.5 V	1.1	2.00	2.6	1.1	2.6	V
V _H	hysteresis voltage	V _{CC} = 1.2 V	-	0.3	-	-	-	V
		V _{CC} = 2.0 V	0.2	0.55	0.8	0.2	0.8	V
		V _{CC} = 2.7 V	0.3	0.60	1.1	0.3	1.1	V
		V _{CC} = 3.0 V	0.4	0.65	1.2	0.4	1.2	V
		V _{CC} = 3.6 V	0.4	0.70	1.2	0.4	1.2	V
		V _{CC} = 4.5 V	0.4	0.80	1.4	0.4	1.4	V
		V _{CC} = 5.5 V	0.6	1.00	1.5	0.6	1.5	V

[1] All typical values are measured at T_{amb} = 25 °C.

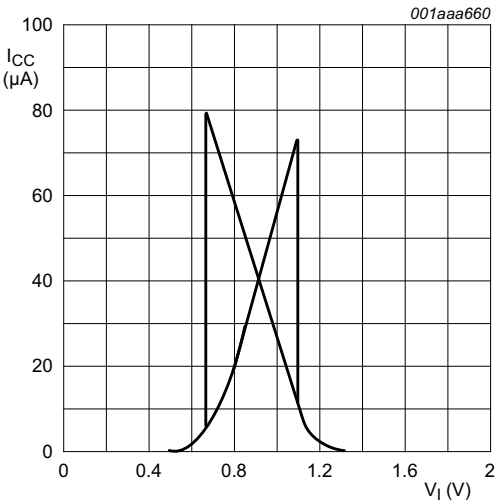
14. Waveforms transfer characteristics





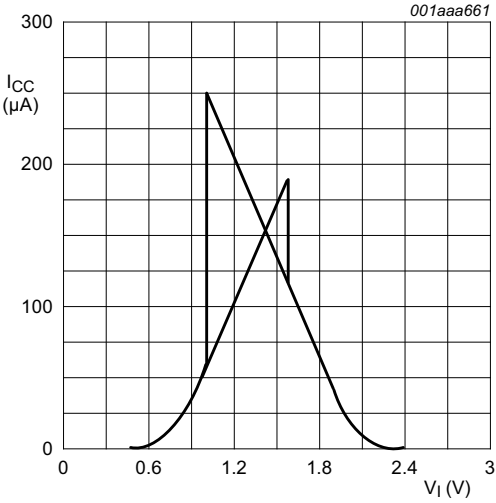
$V_{CC} = 1.2\text{ V}$.

Fig 10. Typical 74LV14 transfer characteristics



$V_{CC} = 2.0\text{ V}$.

Fig 11. Typical 74LV14 transfer characteristics



$V_{CC} = 3.0\text{ V}$.

Fig 12. Typical 74LV14 transfer characteristics

15. Application information

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$$P_{\text{add}} = f_i \times (t_r \times \Delta I_{\text{CC(AV)}} + t_f \times \Delta I_{\text{CC(AV)}}) \times V_{\text{CC}} \text{ where:}$$

P_{add} = additional power dissipation (μW);

f_i = input frequency (MHz);

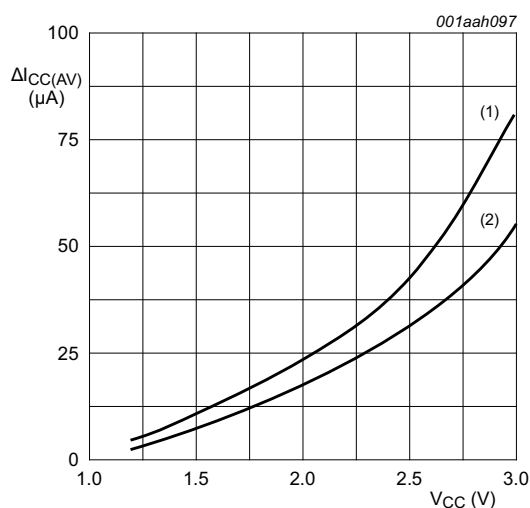
t_r = rise time (ns); 10 % to 90 %;

t_f = fall time (ns); 90 % to 10 %;

$\Delta I_{\text{CC(AV)}}$ = average additional supply current (μA).

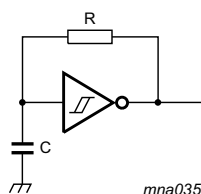
Average $\Delta I_{\text{CC(AV)}}$ differs with positive or negative input transitions, as shown in [Figure 13](#).

An example of a relaxation circuit using the 74LV14 is shown in [Figure 14](#).



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

Fig 13. Average additional supply current as a function of V_{CC}



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$$

Fig 14. Relaxation oscillator

16. Package outline

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

SOT108-1

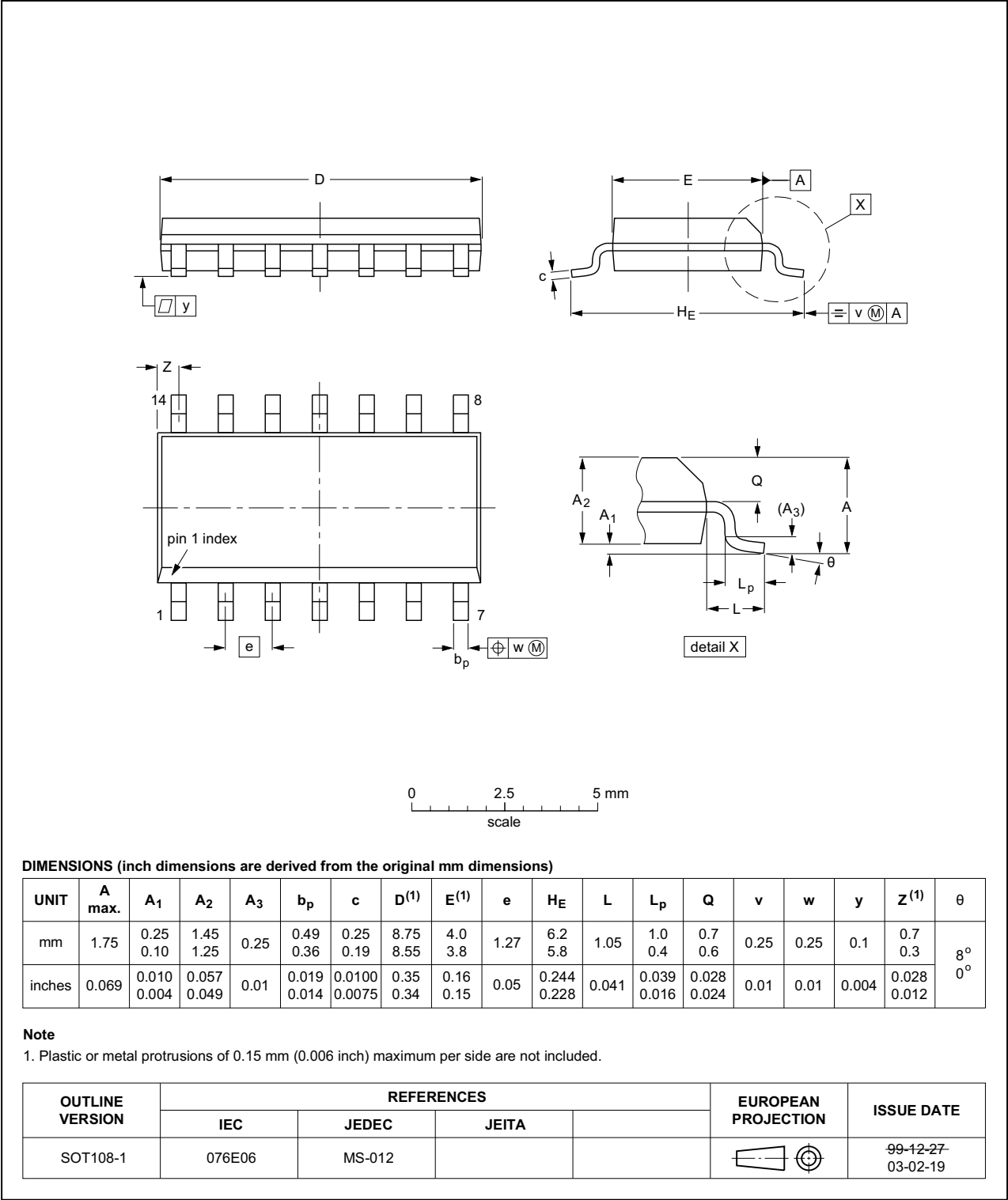


Fig 15. Package outline SOT108-1 (SO14)

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

SOT337-1

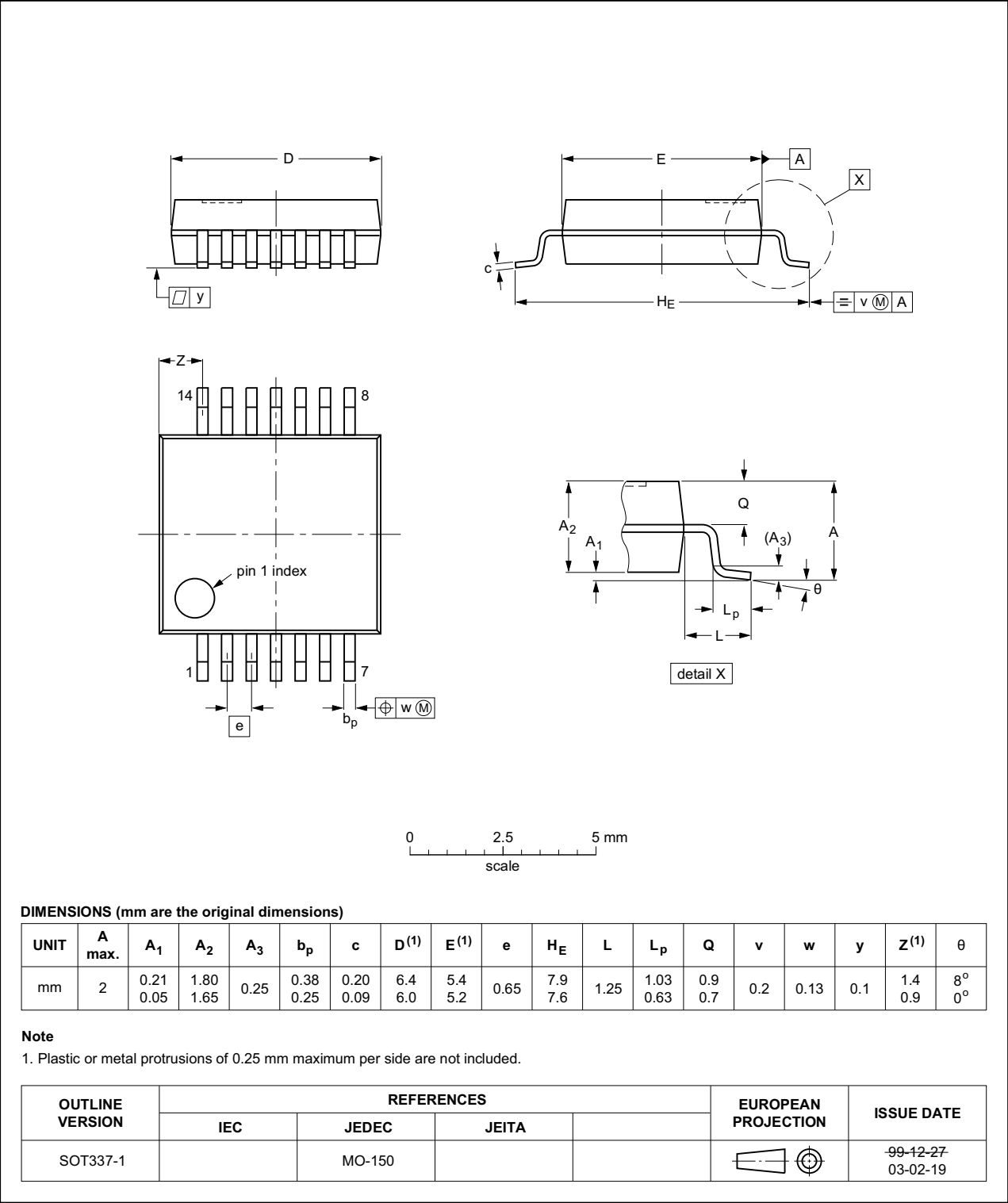


Fig 16. Package outline SOT337-1 (SSOP14)

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

SOT402-1

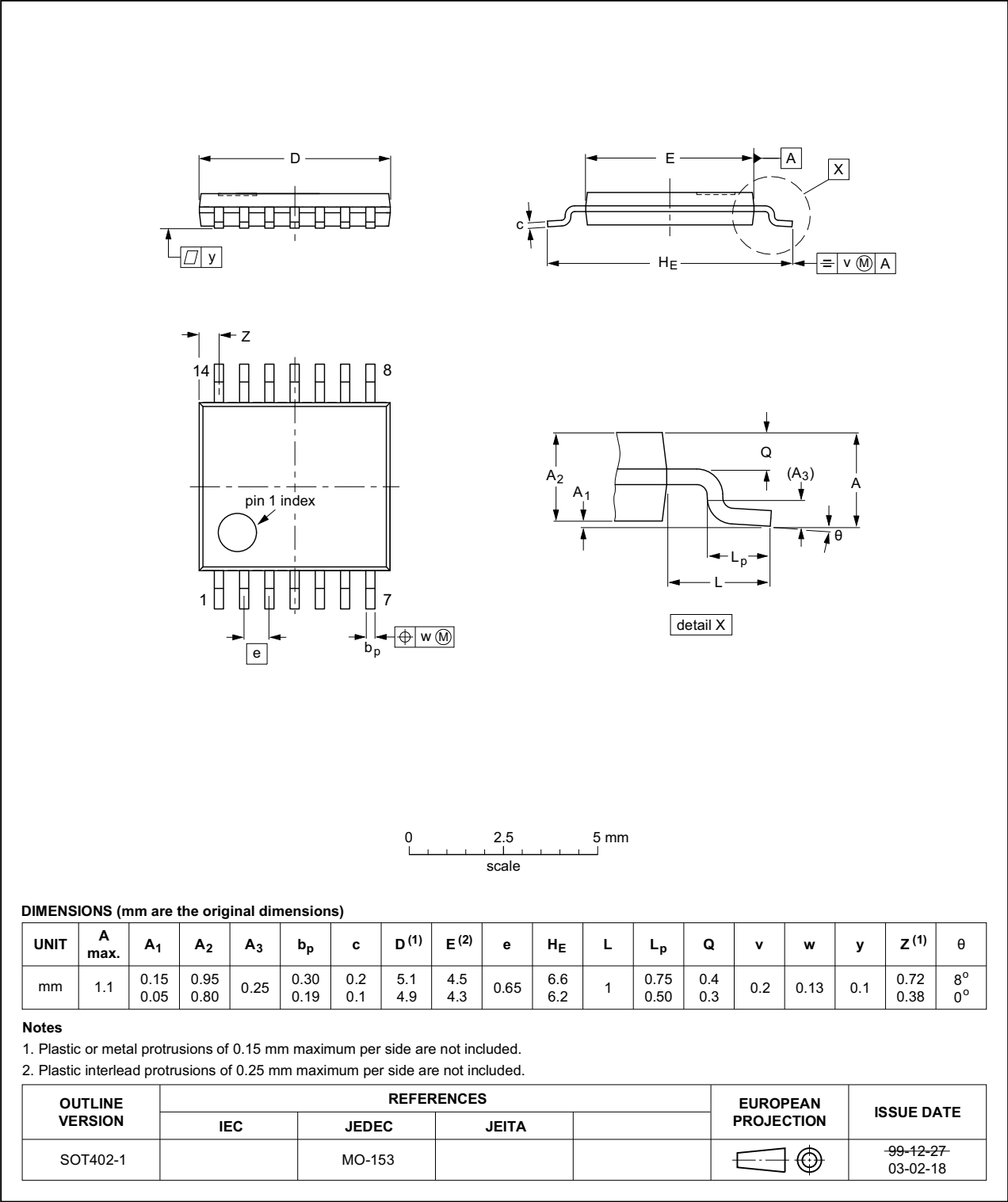


Fig 17. Package outline SOT402-1 (TSSOP14)

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

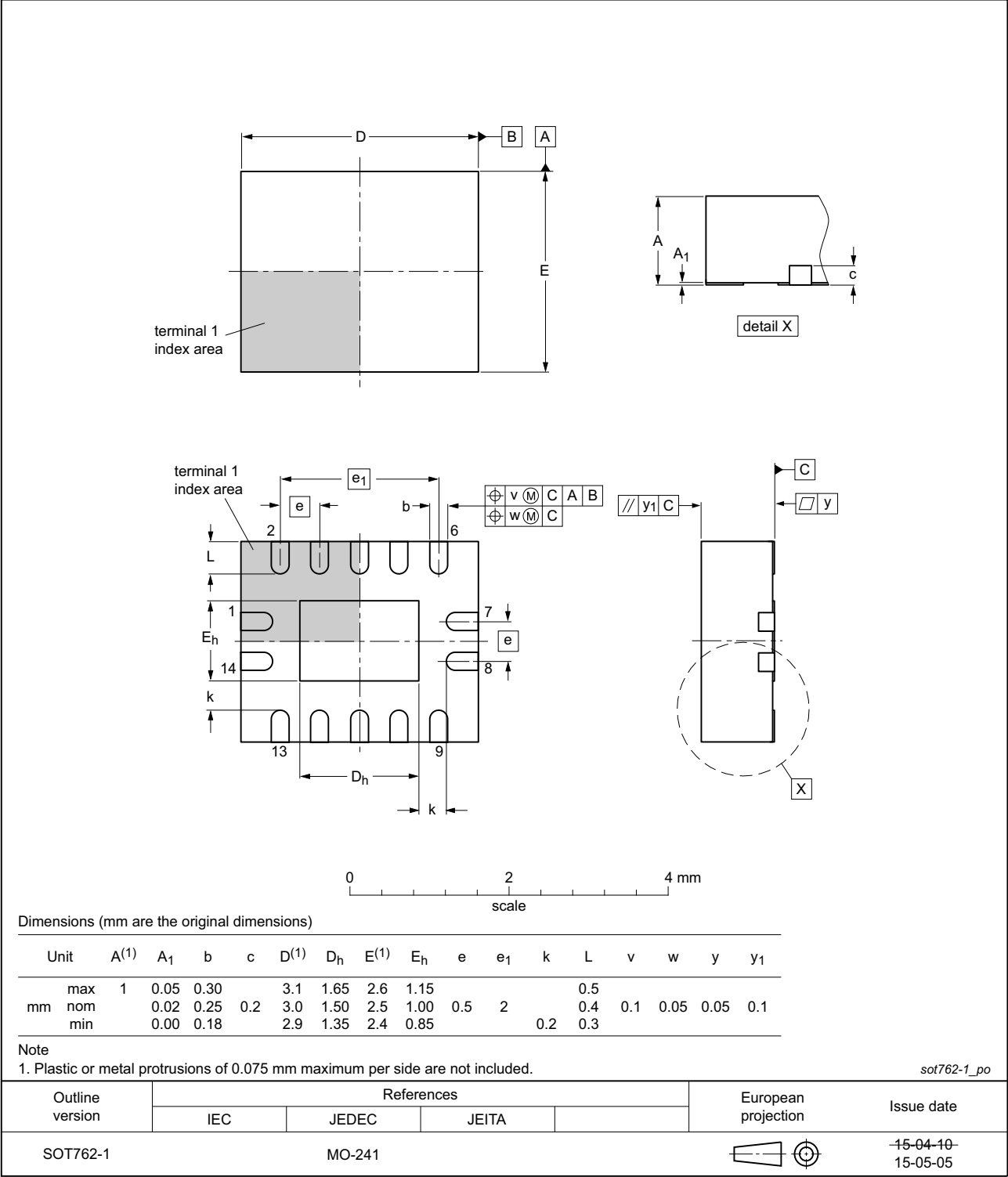


Fig 18. Package outline SOT762-1 (DHVQFN14)

17. Abbreviations

Table 11. Abbreviations

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

18. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV14 v.7	20151209	Product data sheet	-	74LV14 v.6
Modifications:	• Type number 74LV14N (SOT27-1) removed.			
74LV14 v.6	20111212	Product data sheet	-	74LV14 v.5
Modifications:	• Legal pages updated.			
74LV14 v.5	20110105	Product data sheet	-	74LV14 v.4
74LV14 v.4	20090702	Product data sheet	-	74LV14 v.3
74LV14 v.3	20071220	Product data sheet	-	74LV14 v.2
74LV14 v.2	19980420	Product specification	-	74LV14 v.1
74LV14 v.1	19970203	Product specification	-	-

19. Legal information

19.1 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".

[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.nexperia.com>.

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