

# 74LVC06A

## Hex inverter with open-drain outputs

Rev. 6 — 10 November 2011

Product data sheet

### 1. General description

The 74LVC06A provides six inverting buffers. The outputs are open-drain and can be connected to other open-drain outputs to implement active-LOW wired-OR or active-HIGH wired-AND functions.

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 applications.

### 2. Features and benefits

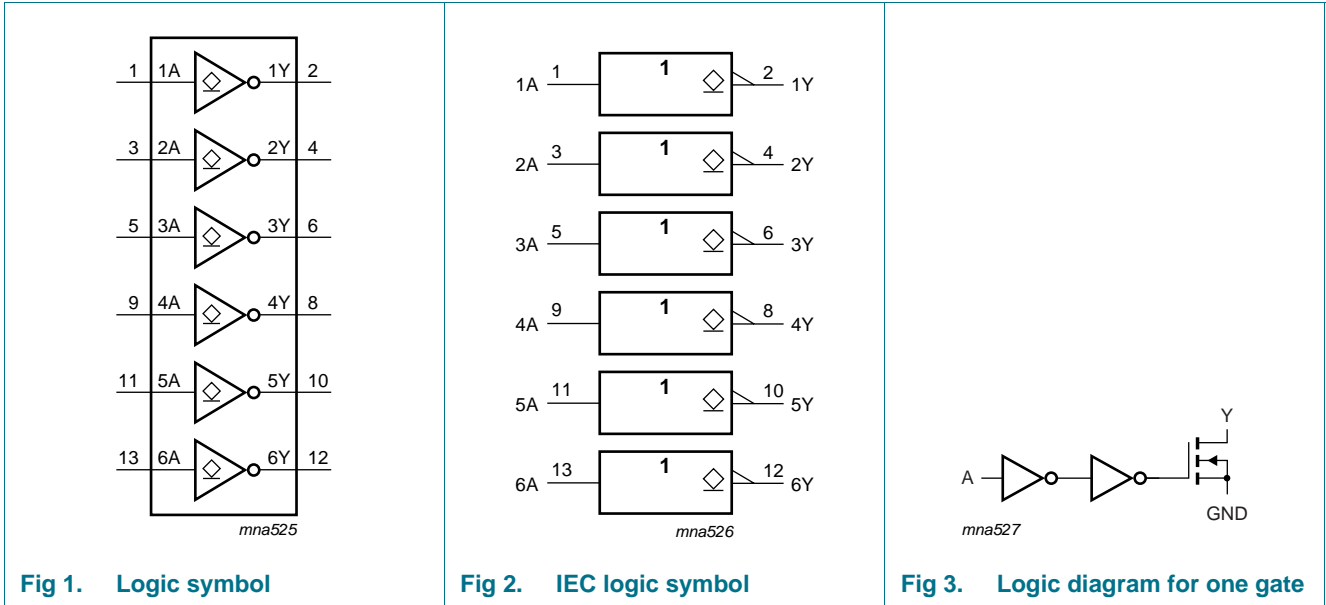
- 5 V tolerant inputs and outputs (open-drain) for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)
  - ◆ JESD8-C/JESD36 (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
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

### 3. Ordering information

Table 1. Ordering information

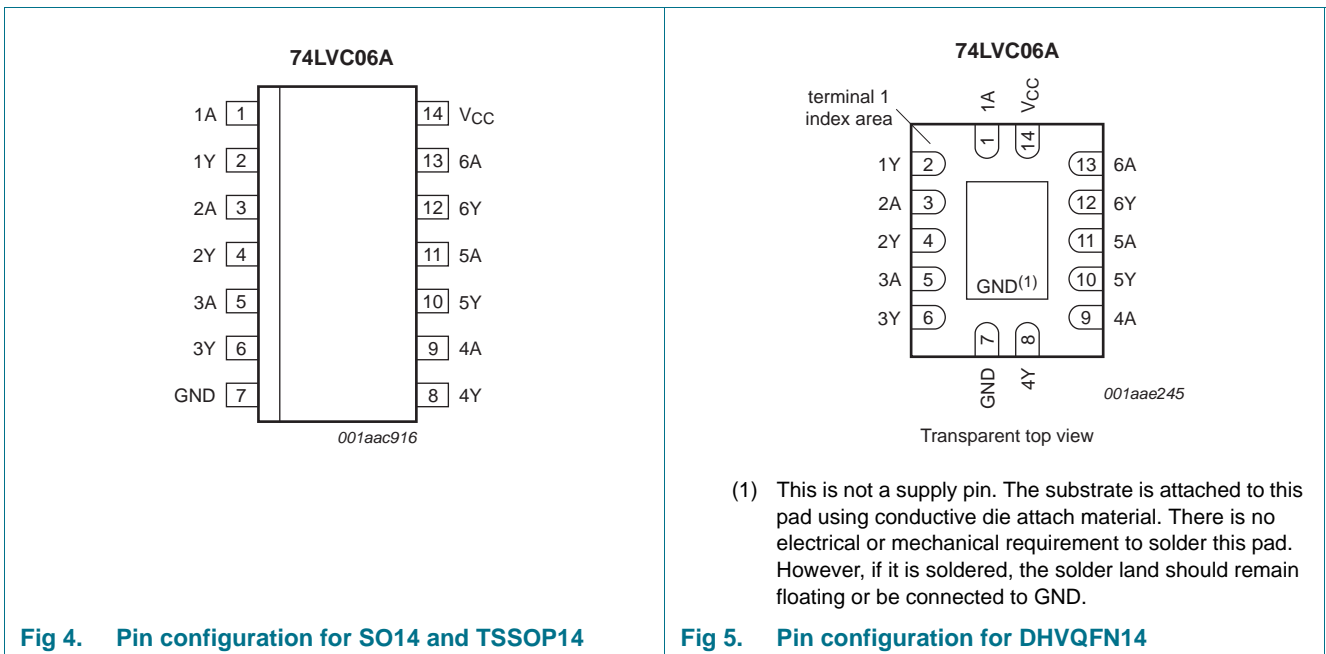
Type number	Package			
	Temperature range	Name	Description	Version
74LVC06AD	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC06APW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP14	plastic thin shrink outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC06ABQ	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85$ mm	SOT762-1

### 4. Functional diagram



### 5. Pinning information

#### 5.1 Pinning



## 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 selection [1]

Input	Output
nA	nY
L	Z
H	L

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state

## 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	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0	-50	-	mA
V <sub>I</sub>	input voltage		[1] -0.5	+6.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < 0	-50	-	mA
V <sub>O</sub>	output voltage	active mode	[2] -0.5	+6.5	V
		high-impedance mode	[2] -0.5	+6.5	V
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 SO14 packages: above 70 °C derate linearly with 8 mW/K.  
 For TSSOP14 packages: above 60 °C derate linearly with 5.5 mW/K.  
 For DHVQFN14 packages: above 60 °C derate linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	5.5	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	active mode	0	-	5.5	V
		high-impedance mode	0	-	5.5	V
T <sub>amb</sub>	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 5.5 V	0	-	10	ns/V

## 9. 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>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7 × V <sub>CC</sub>	-	-	0.7 × V <sub>CC</sub>	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.30 × V <sub>CC</sub>	-	0.30 × V <sub>CC</sub>	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.20	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.6	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.3	-	0.75	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	I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	-	0.8	V
		V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V	-	±0.1	±5	-	±20	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> ; V <sub>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 1.65 V to 5.5 V	-	±0.1	±10	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V	-	±0.1	±10	-	±20	μA

**Table 6. Static characteristics ...continued**

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	
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 5.5 V	-	5	500	-	5000	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 5.5 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	5.0	-	-	-	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.

## 10. 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>PZL</sub>	OFF-state to LOW propagation delay	nA to nY; see <a href="#">Figure 6</a> V <sub>CC</sub> = 1.2 V	-	9	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.5	2.8	5.7	0.5	6.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	1.9	3.1	0.5	4.0	ns
		V <sub>CC</sub> = 2.7 V	0.5	1.8	3.9	0.5	5.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	1.8	3.7	0.5	5.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7	1.5	2.5	0.7	3.5	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	nA to nY; see <a href="#">Figure 6</a> V <sub>CC</sub> = 1.2 V	-	10	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.5	2.6	5.7	0.5	6.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	1.4	3.1	0.5	4.0	ns
		V <sub>CC</sub> = 2.7 V	0.5	2.6	3.9	0.5	5.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	2.2	3.7	0.5	5.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.6	1.5	2.6	0.6	3.5	ns
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[2]</a>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	6.5	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	6.9	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	7.2	-	-	-	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, 3.3 V and 5.0 V respectively.[2] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

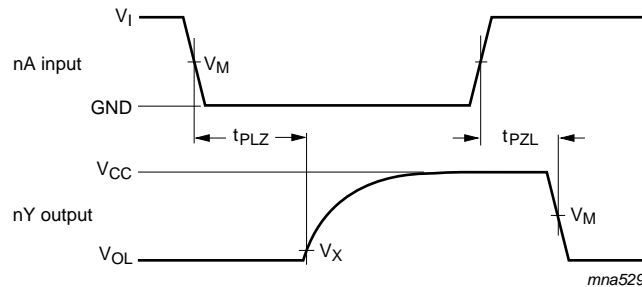
$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHzC<sub>L</sub> = output load capacitance in pFV<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

## 11. Waveforms



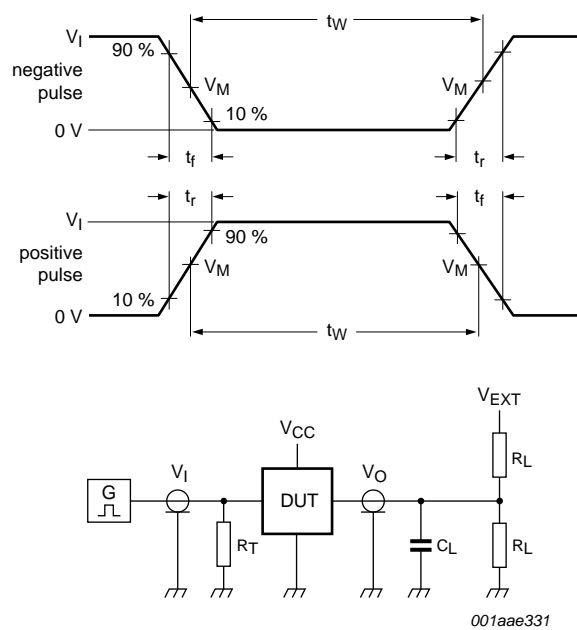
Measurement points are given in [Table 8](#)

Logic level:  $V_{OL}$  is a typical output voltage level that occurs with the output load.

**Fig 6. The input nA to output nY propagation delays**

**Table 8. Measurement points**

Supply voltage	Input	Output
$V_{CC}$	$V_M$	$V_X$
$< 2.7\text{ V}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15\text{ V}$
$\geq 2.7\text{ V to } 3.6\text{ V}$	$1.5\text{ V}$	$V_{OL} + 0.3\text{ V}$
$\geq 4.5\text{ V to } 5.5\text{ V}$	$0.5 \times V_{CC}$	$V_{OL} + 0.3\text{ V}$



Test data is given in [Table 9](#).

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.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 7. Load circuitry for switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
4.5 V to 5.5 V	$V_{CC}$	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

12. Package outline

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

SOT108-1

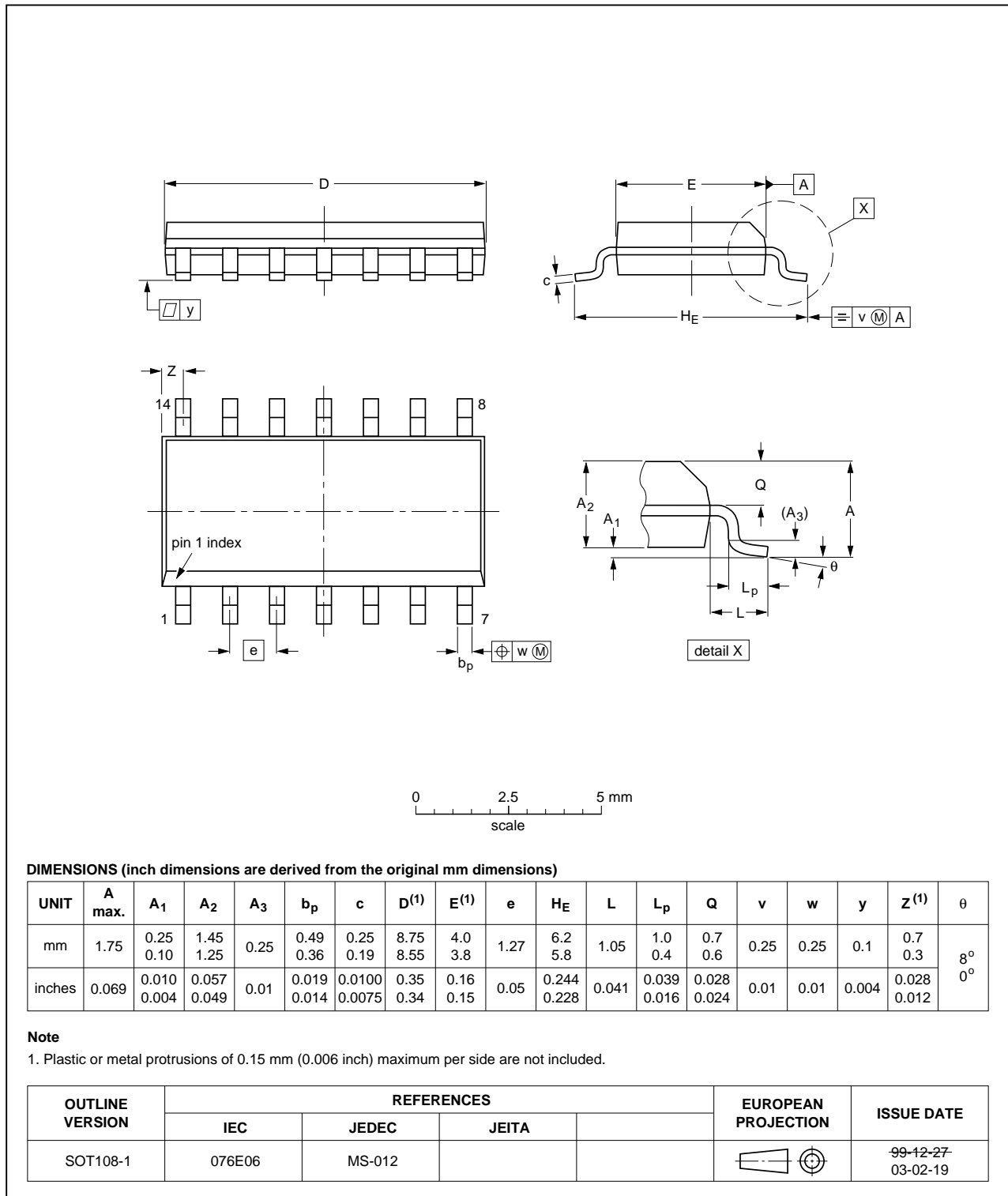


Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1

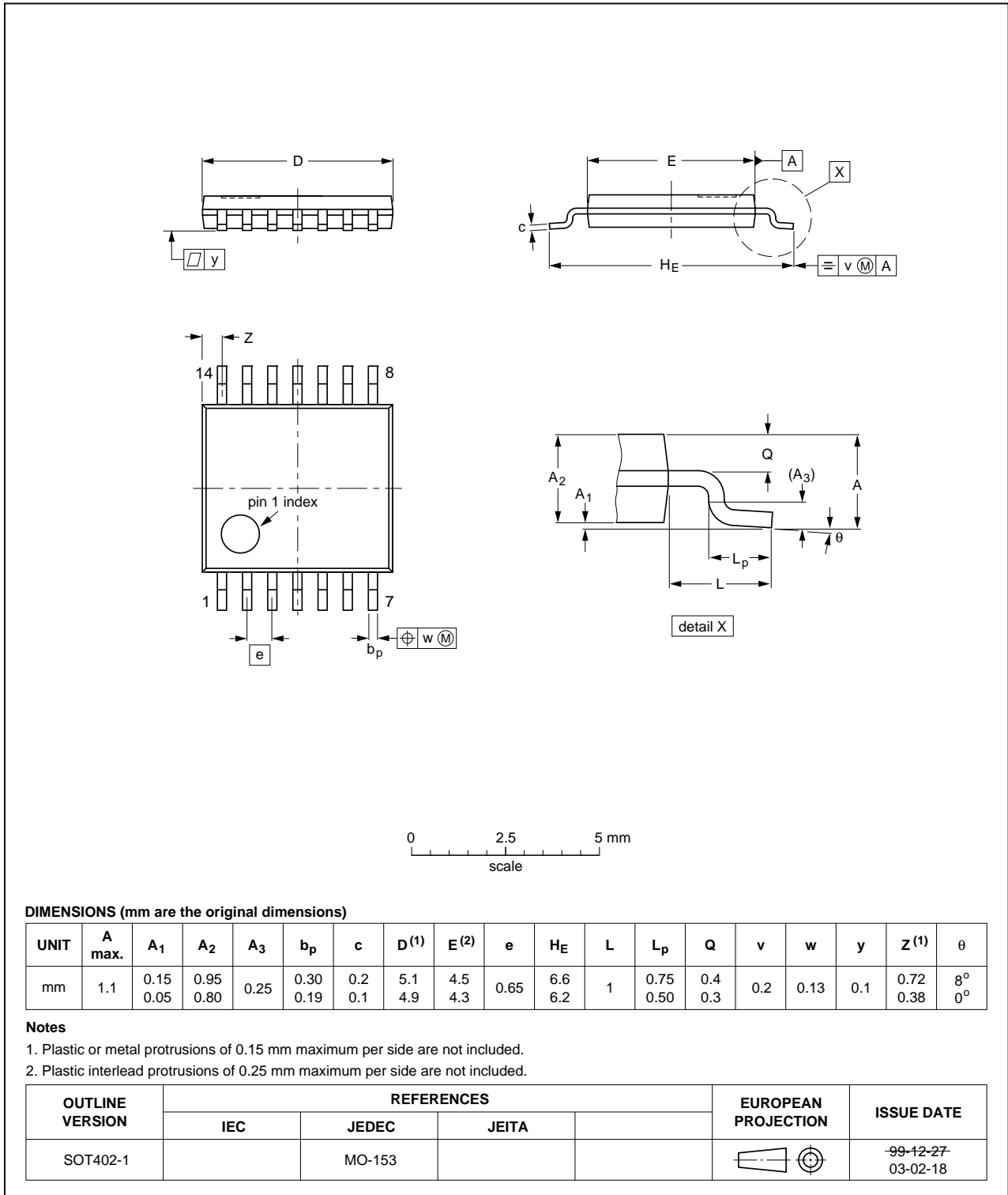


Fig 9. Package outline SOT402-1 (TSSOP14)

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

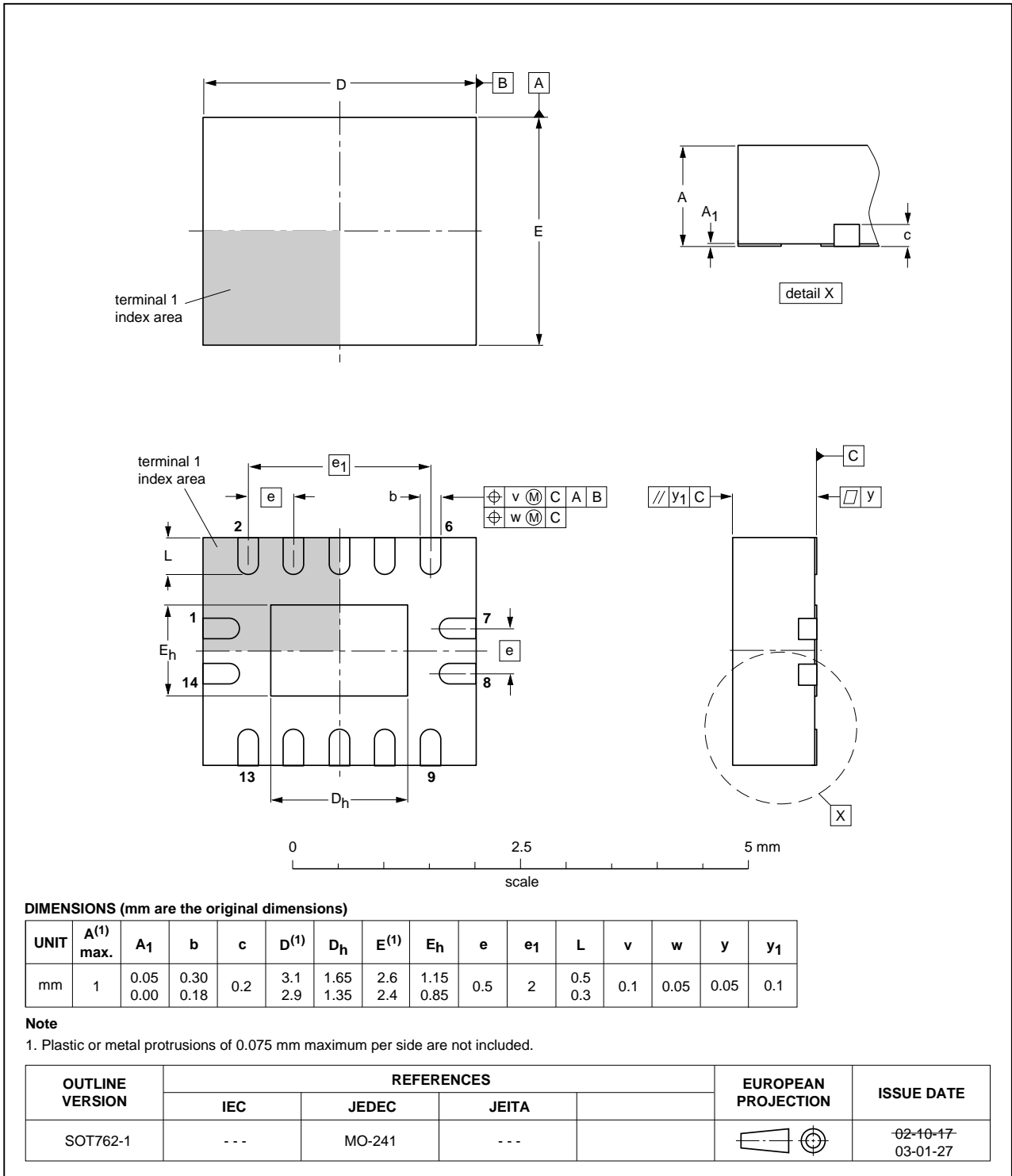


Fig 10. Package outline SOT762-1 (DHVQFN14)

## 13. 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

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC06A v.6	20111110	Product data sheet	-	74LVC06A v.5
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Table 6</a>: Conditions column, additional supply current <math>V_{CC}</math> range updated</li> </ul>			
74LVC06A v.5	20111024	Product data sheet	-	74LVC06A v.4
Modifications:	<ul style="list-style-type: none"> <li>• Table 7: values added for lower voltage ranges</li> </ul>			
74LVC06A v.4	20110810	Product data sheet	-	74LVC06A v.3
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>• Table 4, Table 5, Table 6, Table 7, and Table 9: values added for lower voltage ranges.</li> </ul>			
74LVC06A v.3	20031127	Product specification	-	74LVC06A v.2
74LVC06A v.2	20030828	Product specification	-	74LVC06A v.1
74LVC06A v.1	20000307	Product specification	-	-

## 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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## 17. Contents

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<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>1</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>2</b>
5.1	Pinning .....	2
5.2	Pin description .....	3
<b>6</b>	<b>Functional description</b> .....	<b>3</b>
<b>7</b>	<b>Limiting values</b> .....	<b>3</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>4</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>4</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>5</b>
<b>11</b>	<b>Waveforms</b> .....	<b>6</b>
<b>12</b>	<b>Package outline</b> .....	<b>8</b>
<b>13</b>	<b>Abbreviations</b> .....	<b>11</b>
<b>14</b>	<b>Revision history</b> .....	<b>11</b>
<b>15</b>	<b>Legal information</b> .....	<b>12</b>
15.1	Data sheet status .....	12
15.2	Definitions .....	12
15.3	Disclaimers .....	12
15.4	Trademarks .....	13
<b>16</b>	<b>Contact information</b> .....	<b>13</b>
<b>17</b>	<b>Contents</b> .....	<b>14</b>