

# 74LV05A

## Hex inverter with open-drain outputs

Rev. 1 — 19 December 2016

Product data sheet

### 1. General description

The 74LV05A is a hex inverter with open-drain outputs. 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 are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial power down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

### 2. Features and benefits

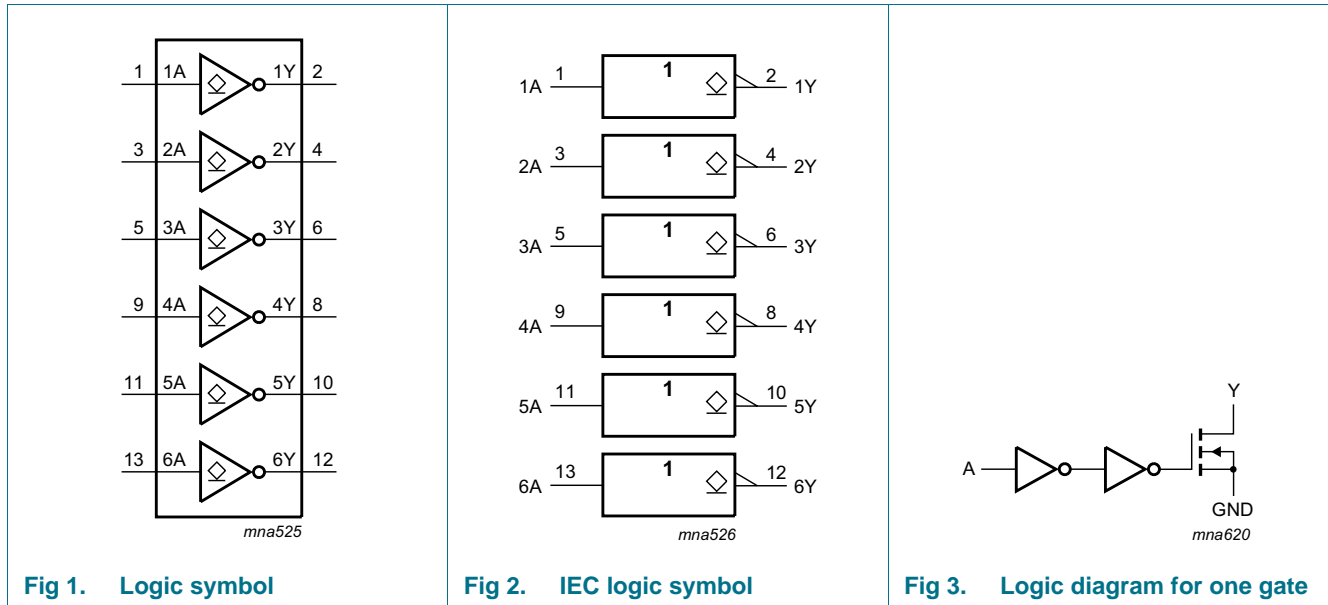
- Wide supply voltage range from 2.0 V to 5.5 V
- Typical  $V_{OL(p)} < 0.8$  V at  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Supports mixed-mode voltage operation on all ports
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
  - ◆ HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3 kV
  - ◆ MM JESD22-A115-A exceeds 150 V
  - ◆ CDM JESD22-C101E exceeds 2 kV
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

### 3. Ordering information

Table 1. Ordering information

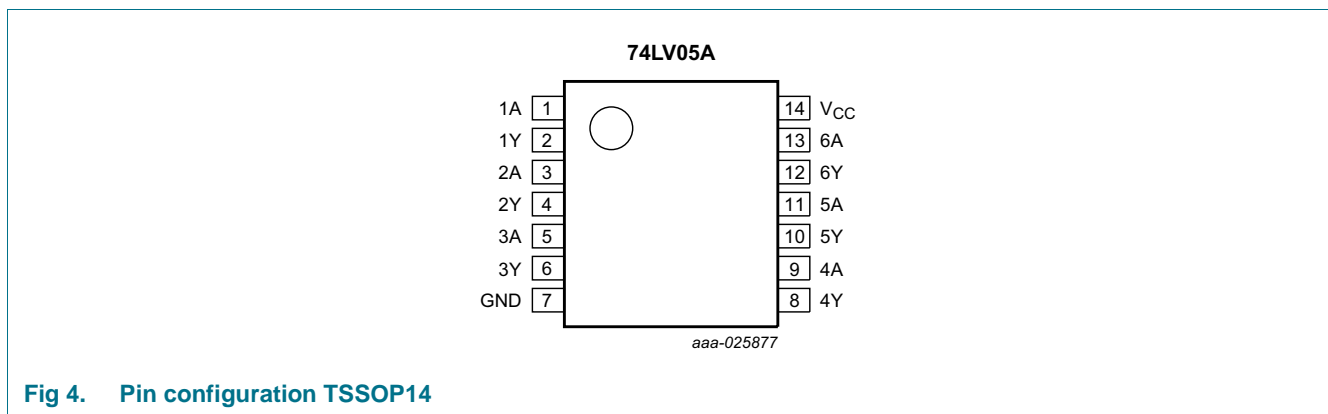
Type number	Package			Version
	Temperature range	Name	Description	
74LV05APW	$-40$ °C to $+125$ °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

### 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
$V_{CC}$	supply voltage		-0.5	+7.0	V
$V_I$	input voltage	[1]	-0.5	+7.0	V
$V_O$	output voltage	output HIGH or LOW state [2][3]	-0.5	$V_{CC} + 0.5$	V
		output power-down [2]	-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-20	-	mA
$I_{OK}$	output clamping current	$V_O < 0$ V	-50	-	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 35$	mA
$I_{CC}$	supply current		-	70	mA
$I_{GND}$	ground current		-70	-	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] This value is limited to 7 V maximum.

[4] For TSSOP14 packages: above 75 °C the value of  $P_{tot}$  derates linearly at 7 mW/K.

## 8. 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		2.0	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	output LOW state, power-down or 3-state mode	0	-	5.5	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3$ V to 2.7 V	-	-	200	ns/V
		$V_{CC} = 3.0$ V to 3.6 V	-	-	100	ns/V
		$V_{CC} = 4.5$ V to 5.5 V	-	-	20	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2 V	1.5	-	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7V <sub>CC</sub>	-	-	0.7V <sub>CC</sub>	-	0.7V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.7V <sub>CC</sub>	-	-	0.7V <sub>CC</sub>	-	0.7V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.7V <sub>CC</sub>	-	-	0.7V <sub>CC</sub>	-	0.7V <sub>CC</sub>	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2 V	-	-	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.3V <sub>CC</sub>	-	0.3V <sub>CC</sub>	-	0.3V <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>								
		V <sub>CC</sub> = 2.0 V to 5.5 V; I <sub>O</sub> = 50 μA	-	-	0.1	-	0.1	-	0.1	V
		V <sub>CC</sub> = 2.3 V; I <sub>O</sub> = 2 mA	-	-	0.4	-	0.4	-	0.4	V
		V <sub>CC</sub> = 3.0 V; I <sub>O</sub> = 6 mA	-	-	0.44	-	0.44	-	0.44	V
		V <sub>CC</sub> = 4.5 V; I <sub>O</sub> = 12 mA	-	-	0.55	-	0.55	-	0.55	V
I <sub>OZ</sub>	OFF-state output current	V <sub>CC</sub> = 5.5 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = GND to 5.5 V	-	-	±0.25	-	±2.5	-	±2.5	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = GND to 5.5 V; V <sub>CC</sub> = 0 V	-	-	0.5	-	5	-	5	μA
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	±0.1	-	±1	-	±1	μA
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	-	-	2	-	20	-	20	μA

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**  
*GND = 0 V. For test circuit see Figure 6.*

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max	
t <sub>PZL</sub>	OFF-state to LOW propagation delay	nA to nY; see Figure 5								
		V <sub>CC</sub> = 2.3 V to 2.7 V								
		C <sub>L</sub> = 15 pF	-	5.5	12.2	1	15	1	16.5	ns
		C <sub>L</sub> = 50 pF	-	7.8	16.6	1	19.5	1	21	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V								
		C <sub>L</sub> = 15 pF	-	4.2	7.1	1	8.5	1	9.5	ns
		C <sub>L</sub> = 50 pF	-	6.2	10.6	1	12	1	13	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V								
		C <sub>L</sub> = 15 pF	-	3.3	5.5	1	6.5	1	7.5	ns
C <sub>L</sub> = 50 pF	-	5.0	7.5	1	8.5	1	9.5	ns		
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	nA to nY; see Figure 5								
		V <sub>CC</sub> = 2.3 V to 2.7 V								
		C <sub>L</sub> = 15 pF	-	5.1	10.4	1	13	1	13.5	ns
		C <sub>L</sub> = 50 pF	-	9.7	15.2	1	18	1	18.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V								
		C <sub>L</sub> = 15 pF	-	4.0	7.1	1	8.5	1	9	ns
		C <sub>L</sub> = 50 pF	-	7.4	10.6	1	12	1	12.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V								
		C <sub>L</sub> = 15 pF	-	3.1	5.5	1	6.5	1	7	ns
C <sub>L</sub> = 50 pF	-	5.3	7.5	1	8.5	1	9	ns		
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	2	6	-	6	-	6	pF
C <sub>O</sub>	output capacitance	V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	4.5	-	-	-	-	-	pF
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> ; [2] C <sub>L</sub> = 50 pF; f = 10 MHz								
		V <sub>CC</sub> = 3.3 V	-	2.2	-	-	-	-	-	pF
		V <sub>CC</sub> = 5.0 V	-	2.7	-	-	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

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

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

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

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

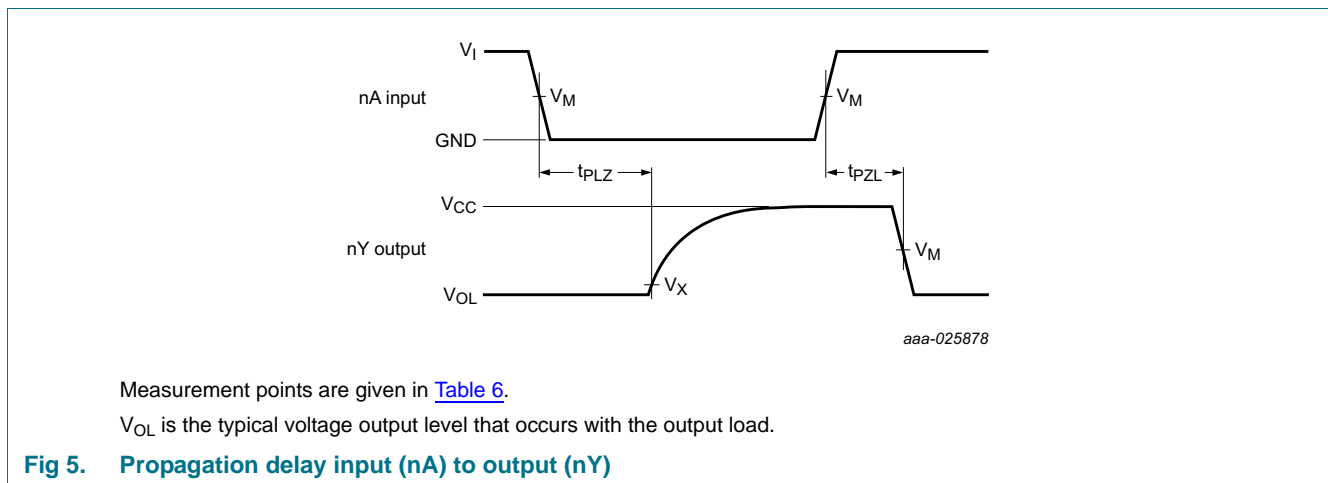
C<sub>L</sub> = output load capacitance in pF;

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

**Table 8. Noise characteristics**  
*GND = 0 V. For test circuit see Figure 6.*

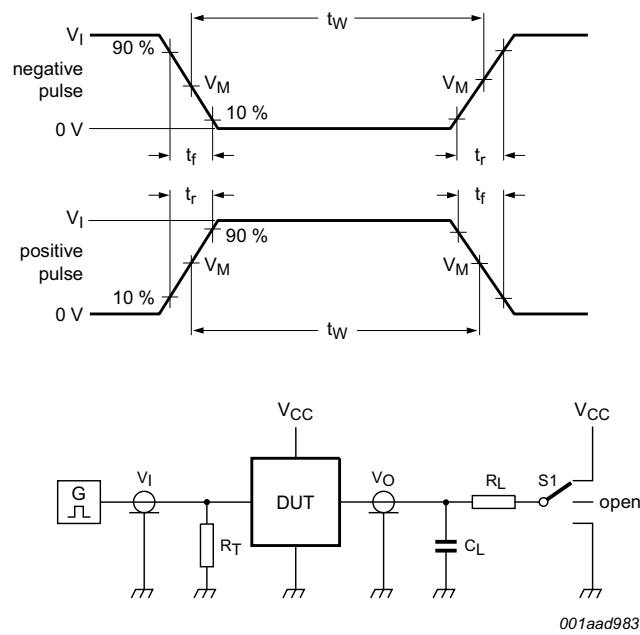
Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Typ	Max	
<b>V<sub>CC</sub> = 3.3 V; C<sub>L</sub> = 50 pF</b>						
V <sub>OL(p)</sub>	LOW-level output voltage (peak)		-	0.2	0.8	V
V <sub>OL(v)</sub>	LOW-level output voltage (valley)		-0.8	-0.1	-	V
V <sub>IH(AC)</sub>	AC HIGH-level input voltage (dynamic)		2.31	-	-	V
V <sub>IL(AC)</sub>	AC LOW-level input voltage (dynamic)		-	-	0.99	V

## 11. Waveforms



**Table 9. Measurement points**

Input	Output	
V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>
0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>	V <sub>OL</sub> + 0.3 V



Test data is given in [Table 10](#).

Definitions test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator

$C_L$  = Load capacitance including jig and probe capacitance

$R_L$  = Load resistor

S1 = Test selection switch

**Fig 6. Test circuit for measuring switching times**

**Table 10. Test data**

Input		Load		S1 position
$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLZ}, t_{PZL}$
GND to $V_{CC}$	3.0 ns	15 pF, 50 pF	1 k $\Omega$	$V_{CC}$

## 12. Package outline

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

SOT402-1

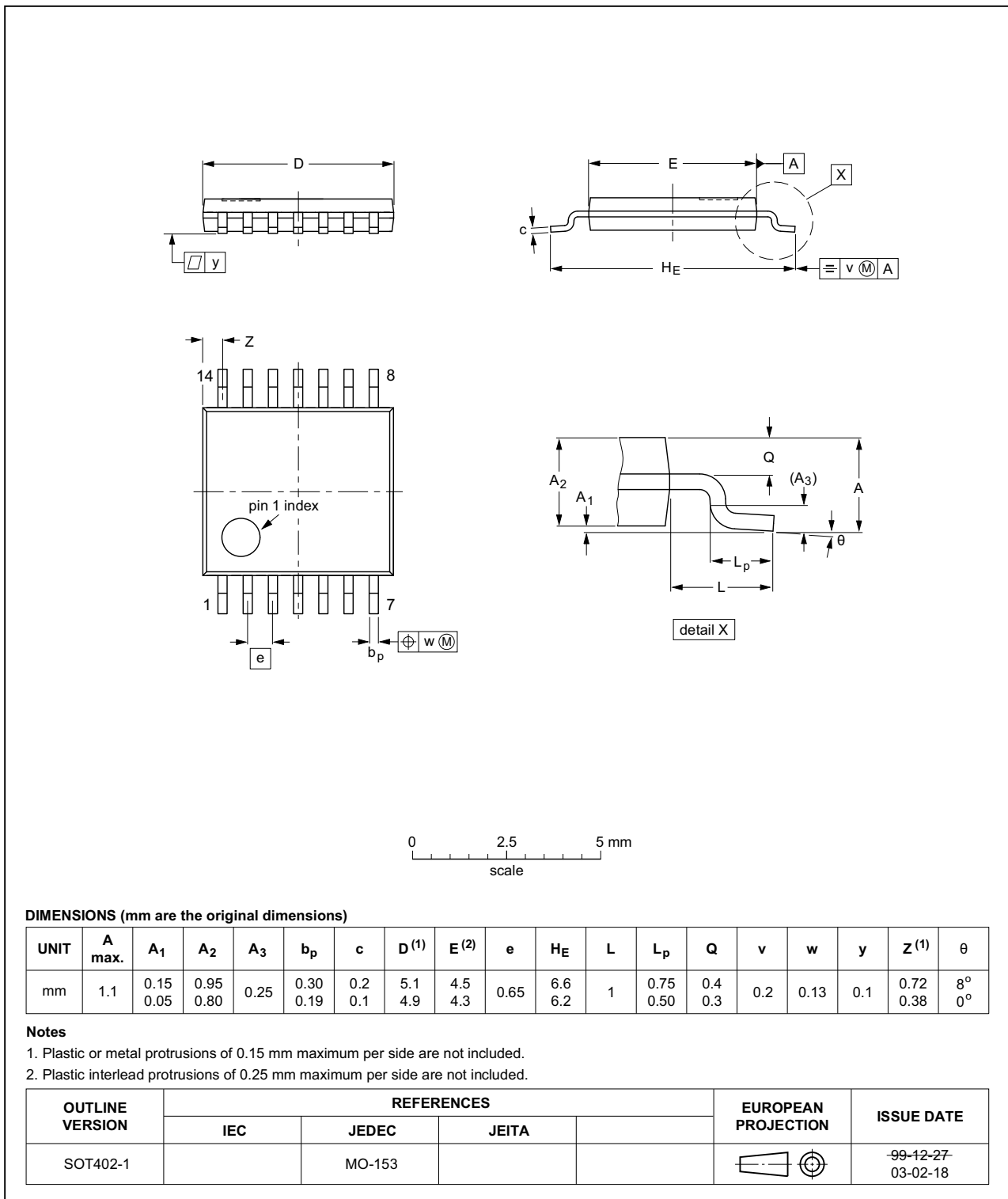


Fig 7. Package outline SOT402-1 (TSSOP14)



## 13. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charge Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV05A v.1	20161219	Product data sheet	-	-

## 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.

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