

74LVC06A-Q100

Hex inverter with open-drain outputs

Rev. 1 — 14 May 2013

Product data sheet

1. General description

The 74LVC06A-Q100 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - ◆ Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- 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:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVC06AD-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC06APW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC06ABQ-Q100	-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

4. Functional diagram

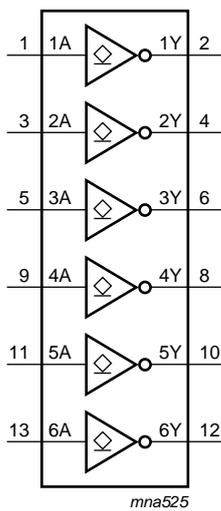


Fig 1. Logic symbol

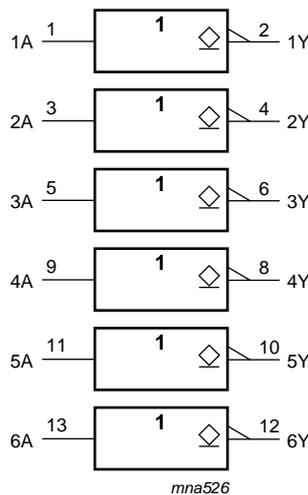


Fig 2. IEC logic symbol

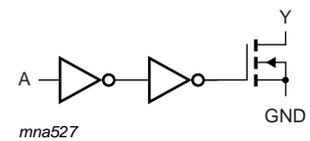
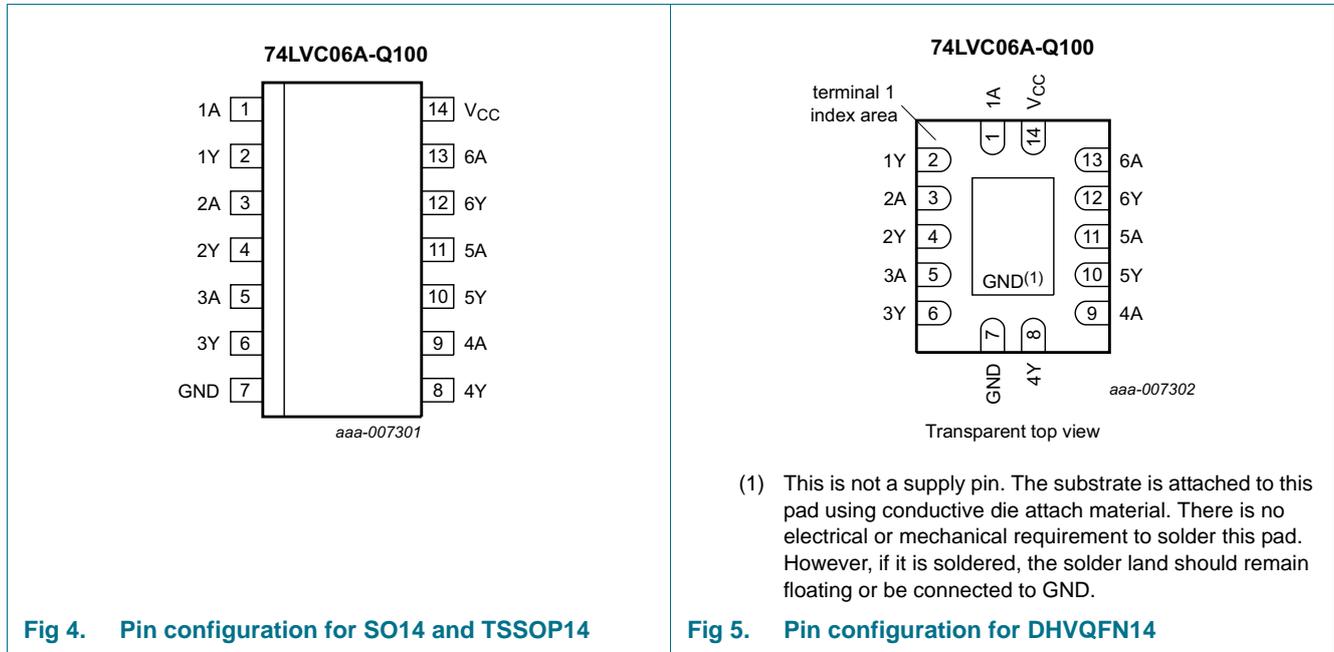


Fig 3. Logic diagram for one gate

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 _{CC}	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	+6.5	V
I_{IK}	input clamping current	$V_I < 0$	-50	-	mA
V_I	input voltage		[1] -0.5	+6.5	V
I_{OK}	output clamping current	$V_O < 0$	-50	-	mA
V_O	output voltage	active mode	[2] -0.5	+6.5	V
		high-impedance mode	[2] -0.5	+6.5	V
I_O	output current	$V_O = 0\text{ V to }V_{CC}$	-	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	$T_{amb} = -40\text{ °C to }+125\text{ °C}$	[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_{CC}	supply voltage		1.65	-	5.5	V
		functional	1.2	-	-	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage	active mode	0	-	5.5	V
		high-impedance mode	0	-	5.5	V
T_{amb}	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65\text{ V to }2.7\text{ V}$	0	-	20	ns/V
		$V_{CC} = 2.7\text{ V to }5.5\text{ V}$	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 ^[1]	Max	Min	Max									
V _{IH}	HIGH-level input voltage	V _{CC} = 1.2 V	1.08	-	-	1.08	-	V								
		V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}	-	-	0.65 × V _{CC}	-	V								
		V _{CC} = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V								
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V								
		V _{CC} = 4.5 V to 5.5 V	0.7 × V _{CC}	-	-	0.7 × V _{CC}	-	V								
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	0.12	-	0.12	V								
		V _{CC} = 1.65 V to 1.95 V	-	-	0.35 × V _{CC}	-	0.35 × V _{CC}	V								
		V _{CC} = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V								
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V								
		V _{CC} = 4.5 V to 5.5 V	-	-	0.30 × V _{CC}	-	0.30 × V _{CC}	V								
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}	-	-	-	-	-	-								
		I _O = 100 μA; V _{CC} = 1.65 V to 5.5 V	-	-	0.20	-	0.3	V								
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.45	-	0.6	V								
		I _O = 8 mA; V _{CC} = 2.3 V	-	-	0.3	-	0.75	V								
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.4	-	0.6	V								
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.55	-	0.8	V								
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 1.65 V to 5.5 V	-	±0.1	±5	-	±20	μA								
		I _{OZ}	OFF-state output current	V _I = V _{IH} ; V _O = 5.5 V or GND; V _{CC} = 1.65 V to 5.5 V	-	±0.1	±10	-	±20	μA						
				I _{OFF}	power-off leakage current	V _I or V _O = 5.5 V; V _{CC} = 0 V	-	±0.1	±10	-	±20	μA				
						I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	0.1	10	-	40	μA		
								ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 5.5 V	-	5	500	-	5000	μA
										C _I	input capacitance	V _{CC} = 0 V to 5.5 V; V _I = GND to V _{CC}	-	5.0	-	-

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 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 ^[1]	Max	Min	Max	
t _{PZL}	OFF-state to LOW propagation delay	nA to nY; see Figure 6						
		V _{CC} = 1.2 V	-	9	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	0.5	2.8	5.7	0.5	6.7	ns
		V _{CC} = 2.3 V to 2.7 V	0.5	1.9	3.1	0.5	4.0	ns
		V _{CC} = 2.7 V	0.5	1.8	3.9	0.5	5.0	ns
		V _{CC} = 3.0 V to 3.6 V	0.5	1.8	3.7	0.5	5.0	ns
t _{PLZ}	LOW to OFF-state propagation delay	nA to nY; see Figure 6						
		V _{CC} = 1.2 V	-	10	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	0.5	2.6	5.7	0.5	6.7	ns
		V _{CC} = 2.3 V to 2.7 V	0.5	1.4	3.1	0.5	4.0	ns
		V _{CC} = 2.7 V	0.5	2.6	3.9	0.5	5.0	ns
		V _{CC} = 3.0 V to 3.6 V	0.5	2.2	3.7	0.5	5.0	ns
C _{PD}	power dissipation capacitance	per buffer; V _I = GND to V _{CC} [2]						
		V _{CC} = 1.65 V to 1.95 V	-	6.5	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	6.9	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	7.2	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

[2] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

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

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

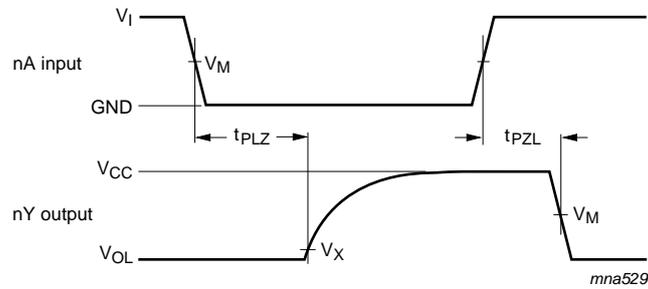
C_L = output load capacitance in pF

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. Waveforms



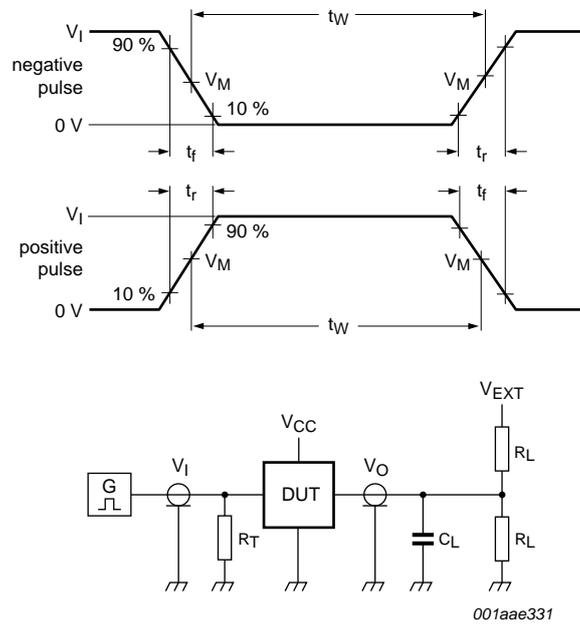
Measurement points are given in [Table 8](#)

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 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}	≤ 2 ns	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
4.5 V to 5.5 V	V_{CC}	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND

12. Package outline

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

SOT108-1

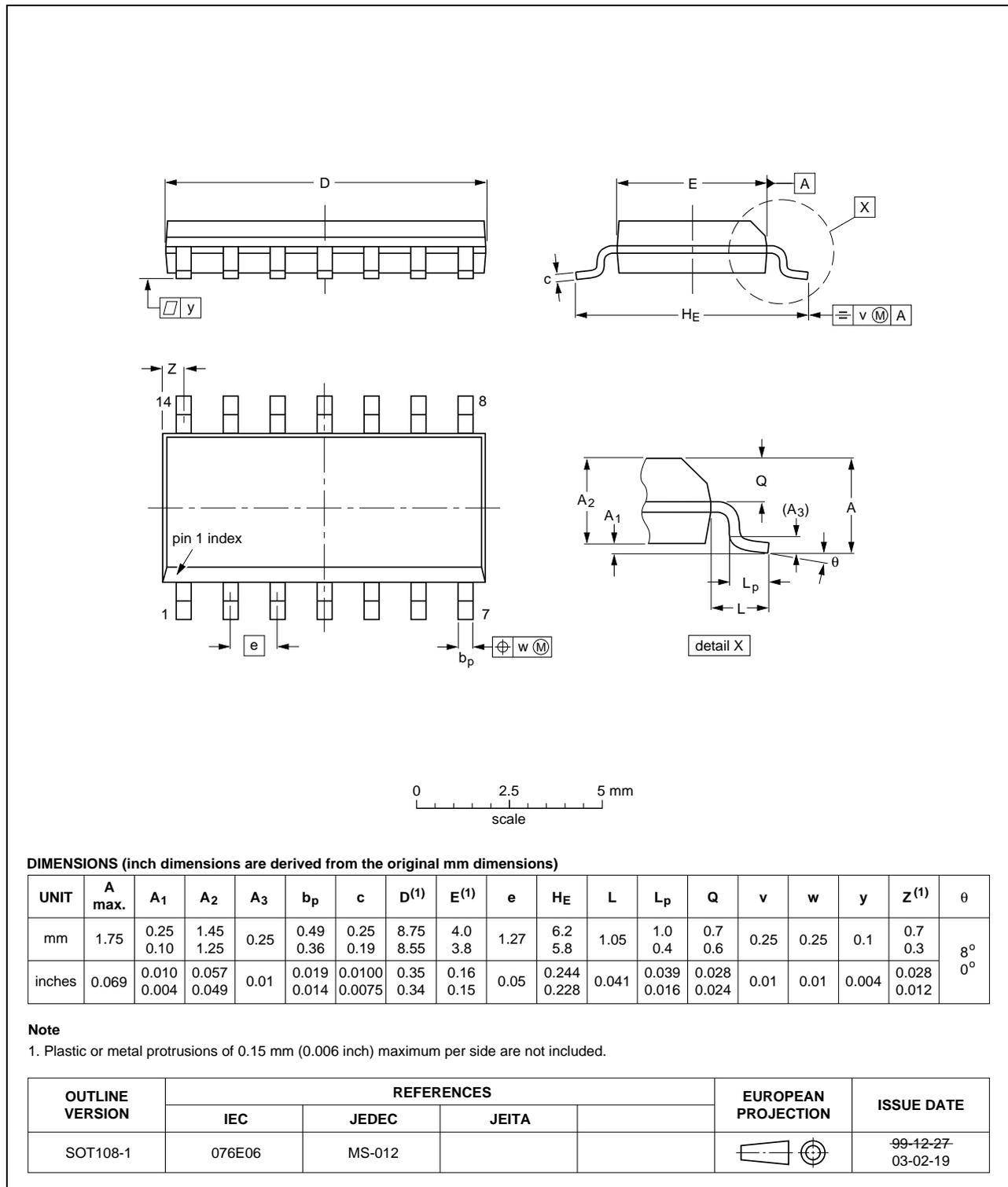


Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1

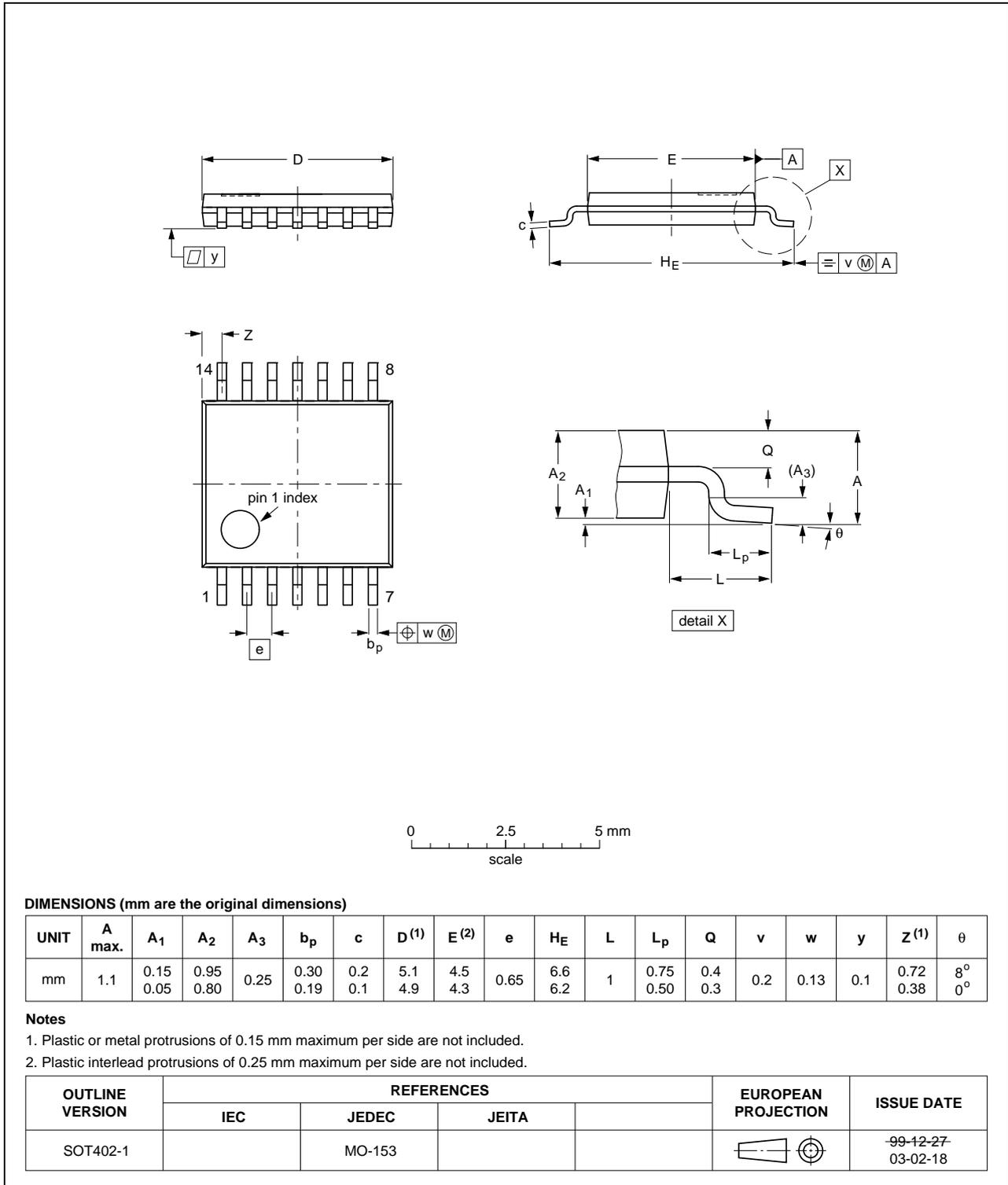


Fig 9. Package outline SOT402-1 (TSSOP14)

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

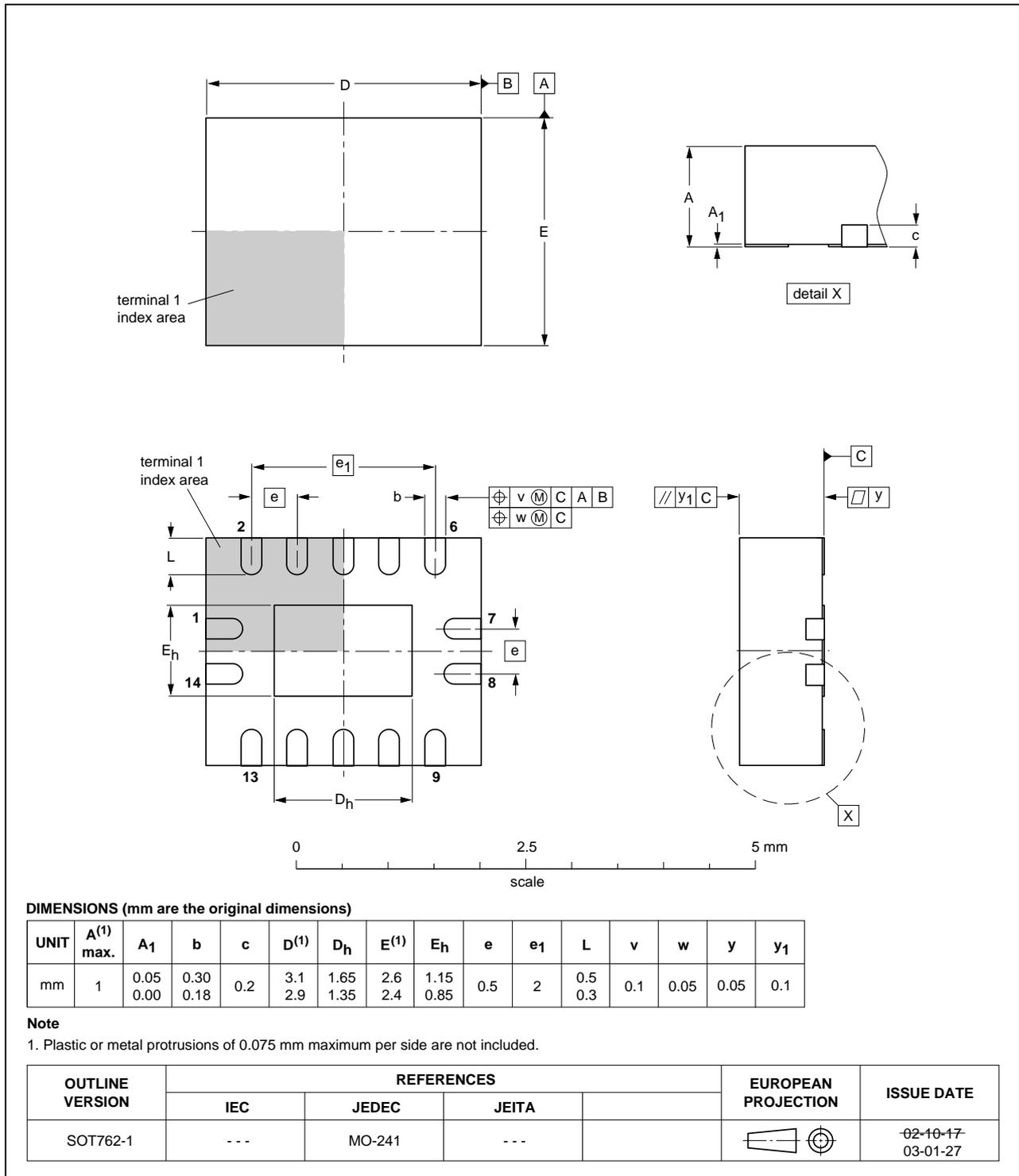


Fig 10. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
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_Q100 v.1	20130514	Product data sheet	-	-

15. Legal information

15.1 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.

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[2] The term 'short data sheet' is explained in section "Definitions".

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