

# 74ALVC04

## Hex inverter

Rev. 5.1 — 14 July 2023

Product data sheet

## 1. General description

The 74ALVC04 is a hex inverter.

Schmitt-trigger action at all inputs makes the circuit tolerant for 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

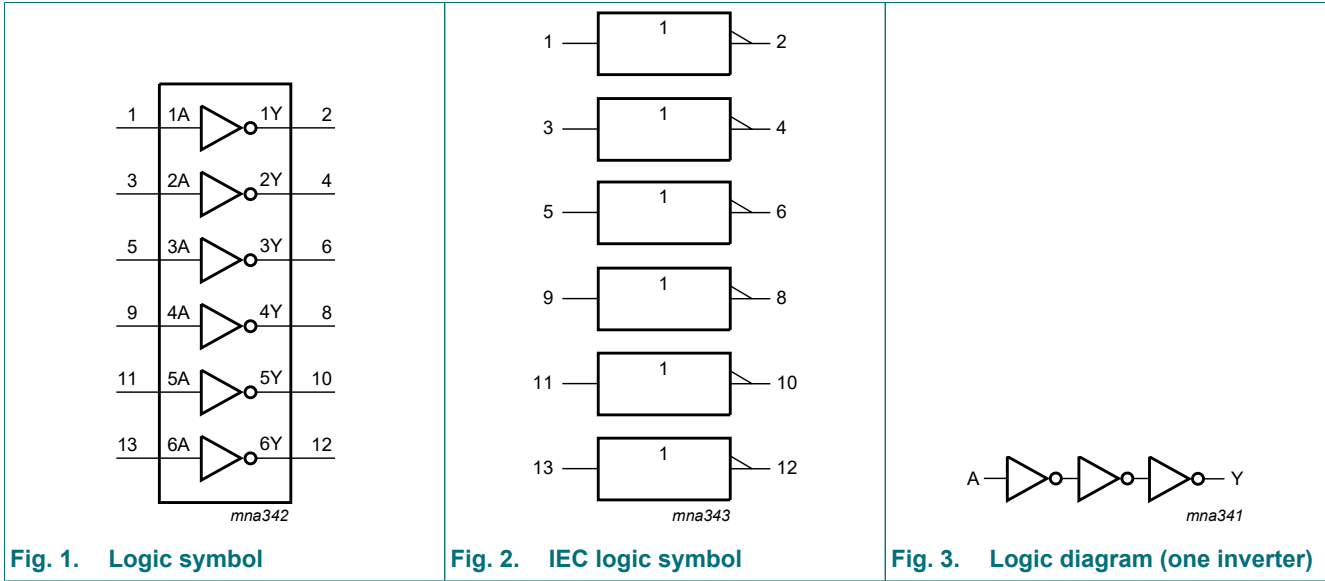
- Wide supply voltage range from 1.65 V to 3.6 V
- CMOS low power dissipation
- Overvoltage tolerant inputs to 3.6 V
- Direct interface with TTL levels
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD78 Class II.A
- Complies with JEDEC standards:
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

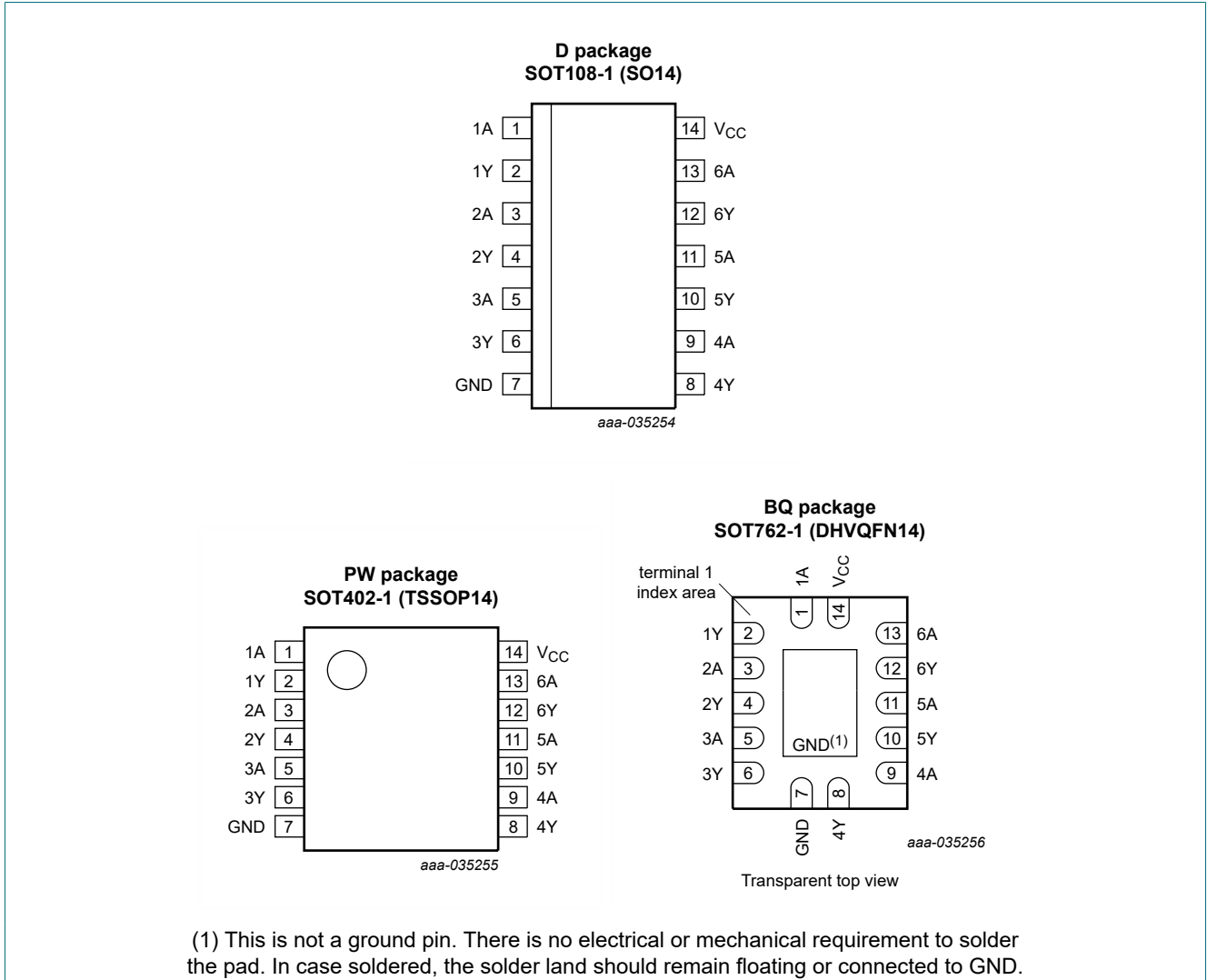
Type number	Package			Version
	Temperature range	Name	Description	
<a href="#">74ALVC04D</a>	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	<a href="#">SOT108-1</a>
<a href="#">74ALVC04PW</a>	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	<a href="#">SOT402-1</a>
<a href="#">74ALVC04BQ</a>	-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	<a href="#">SOT762-1</a>

### 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 table**

H = HIGH voltage level; L = LOW voltage level.

Input nA	Output nY
L	H
H	L

## 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	+4.6	V
$V_I$	input voltage		-0.5	+4.6	V
$V_O$	output voltage	none	-0.5	$V_{CC} + 0.5$	V
		power-down mode; $V_{CC} = 0$ V	-0.5	+4.6	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-	-50	mA
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	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	$T_{amb} = -40$ °C to +125 °C	-	500	mW

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

[2] For SOT108-1 (SO14) package:  $P_{tot}$  derates linearly with 10.1 mW/K above 100 °C.

For SOT402-1 (TSSOP14) package:  $P_{tot}$  derates linearly with 7.3 mW/K above 81 °C.

For SOT762-1 (DHVQFN14) package:  $P_{tot}$  derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		1.65	3.6	V
$V_I$	input voltage		0	3.6	V
$V_O$	output voltage	$V_{CC} = 1.65$ to 3.6 V	0	$V_{CC}$	V
		power-down mode; $V_{CC} = 0$ V	0	3.6	V
$T_{amb}$	ambient temperature	in free air	-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65$ V to 2.7 V	0	20	ns/V
		$V_{CC} = 2.7$ V to 3.6 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 <sub>IH</sub>	HIGH-level input voltage	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>IL</sub>	LOW-level input voltage	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>OH</sub>	HIGH-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 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	V
		I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 1.65 V	1.25	1.51	-	1.25	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.3 V	1.8	2.10	-	1.8	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 2.3 V	1.7	2.01	-	1.7	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	2.53	-	2.2	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	2.76	-	2.4	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	2.68	-	2.2	-	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 3.6 V	-	-	0.2	-	0.2	V
		I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 1.65 V	-	0.11	0.3	-	0.3	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.3 V	-	0.17	0.4	-	0.4	V
		I <sub>O</sub> = 18 mA; V <sub>CC</sub> = 2.3 V	-	0.25	0.6	-	0.6	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	0.16	0.4	-	0.4	V
		I <sub>O</sub> = 18 mA; V <sub>CC</sub> = 3.0 V	-	0.23	0.4	-	0.45	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	0.30	0.55	-	0.55	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 3.6 V or GND	-	±0.1	±5	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 3.6 V	-	±0.1	±10	-	±80	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	-	0.2	20	-	160	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	5	750	-	750	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	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 Fig. 5.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nY; see Fig. 4 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	2.4	4.4	1.0	5.1	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	1.8	3.0	1.0	3.5	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.3	3.3	1.0	3.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.0	2.8	1.0	3.2	ns
C <sub>PD</sub>	power dissipation capacitance	per inverter; V <sub>I</sub> = GND to V <sub>CC</sub> ; [3] V <sub>CC</sub> = 3.3 V	-	26	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.

[3] 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 MHz;

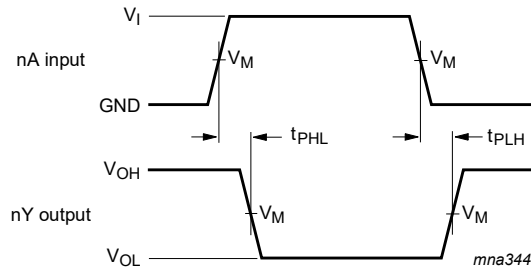
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

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.

## 10.1. Waveforms and test circuit



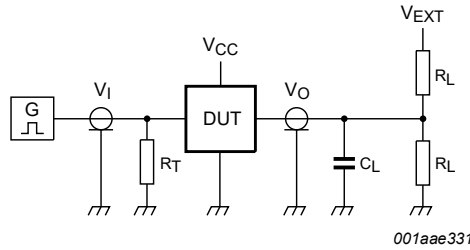
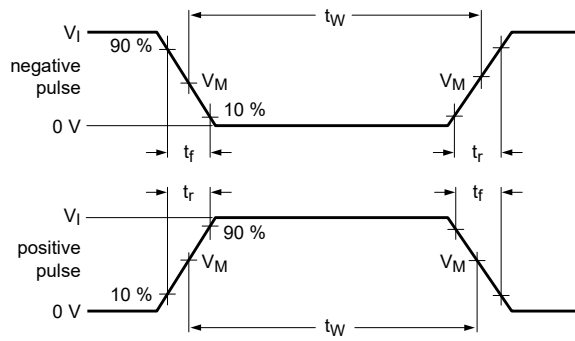
Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig. 4. Input (nA) to output (nY) propagation delays**

**Table 8. Measurement points**

Supply voltage $V_{CC}$	Input $V_I$	$V_M$
1.65 V to 1.95 V	$V_{CC}$	$0.5 \times V_{CC}$
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$
2.7 V	2.7 V	1.5 V
3.0 V to 3.6 V	2.7 V	1.5 V



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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;

$C_L$  = Load capacitance including jig and probe capacitance;

$R_L$  = Load resistance;

$V_{EXT}$  = Test voltage for switching times.

**Fig. 5. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ 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	6 V	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	6 V	GND



### 11. Package outline

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

SOT108-1

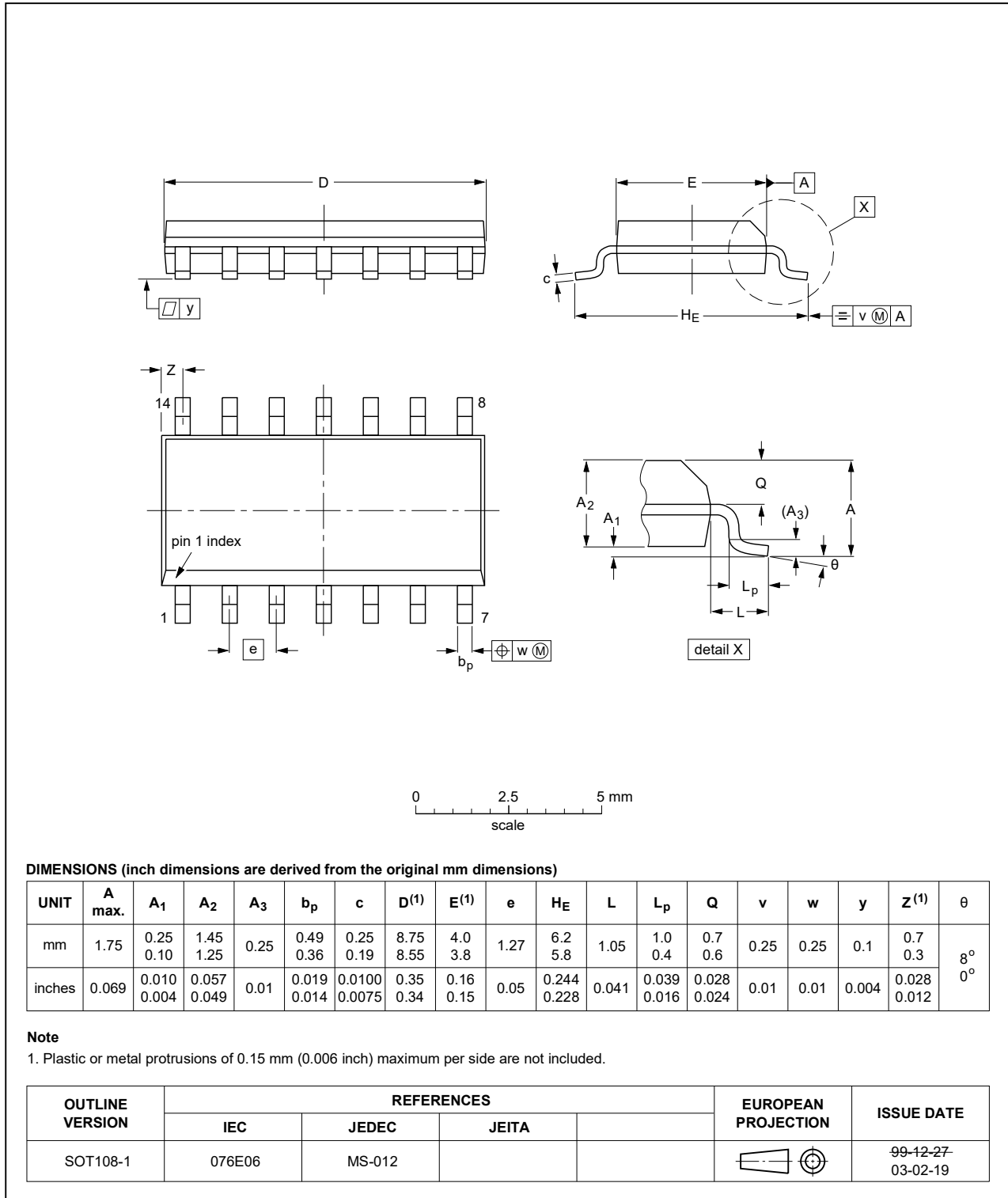


Fig. 6. Package outline SOT108-1 (SO14)

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

SOT402-1

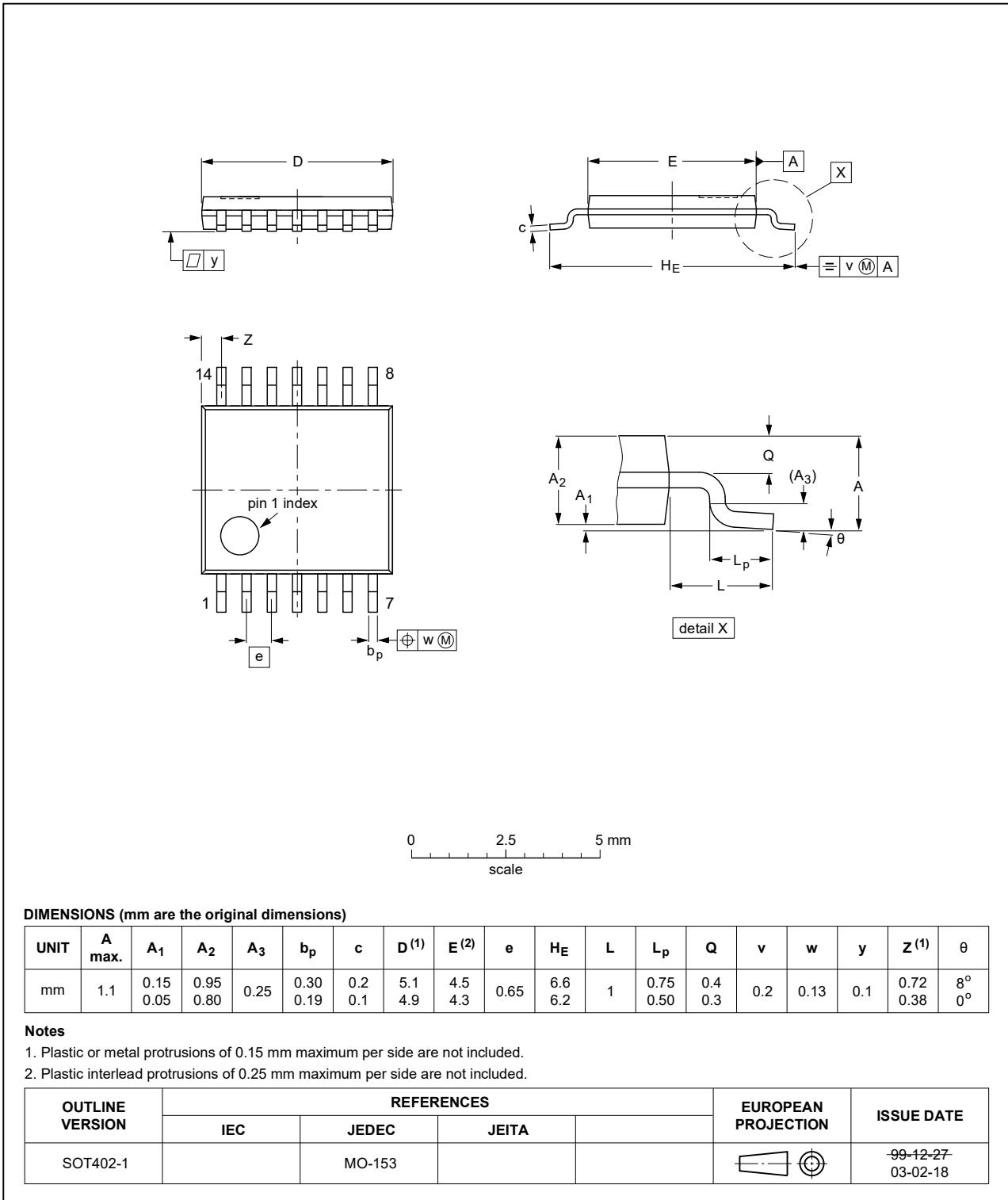


Fig. 7. Package outline SOT402-1 (TSSOP14)

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

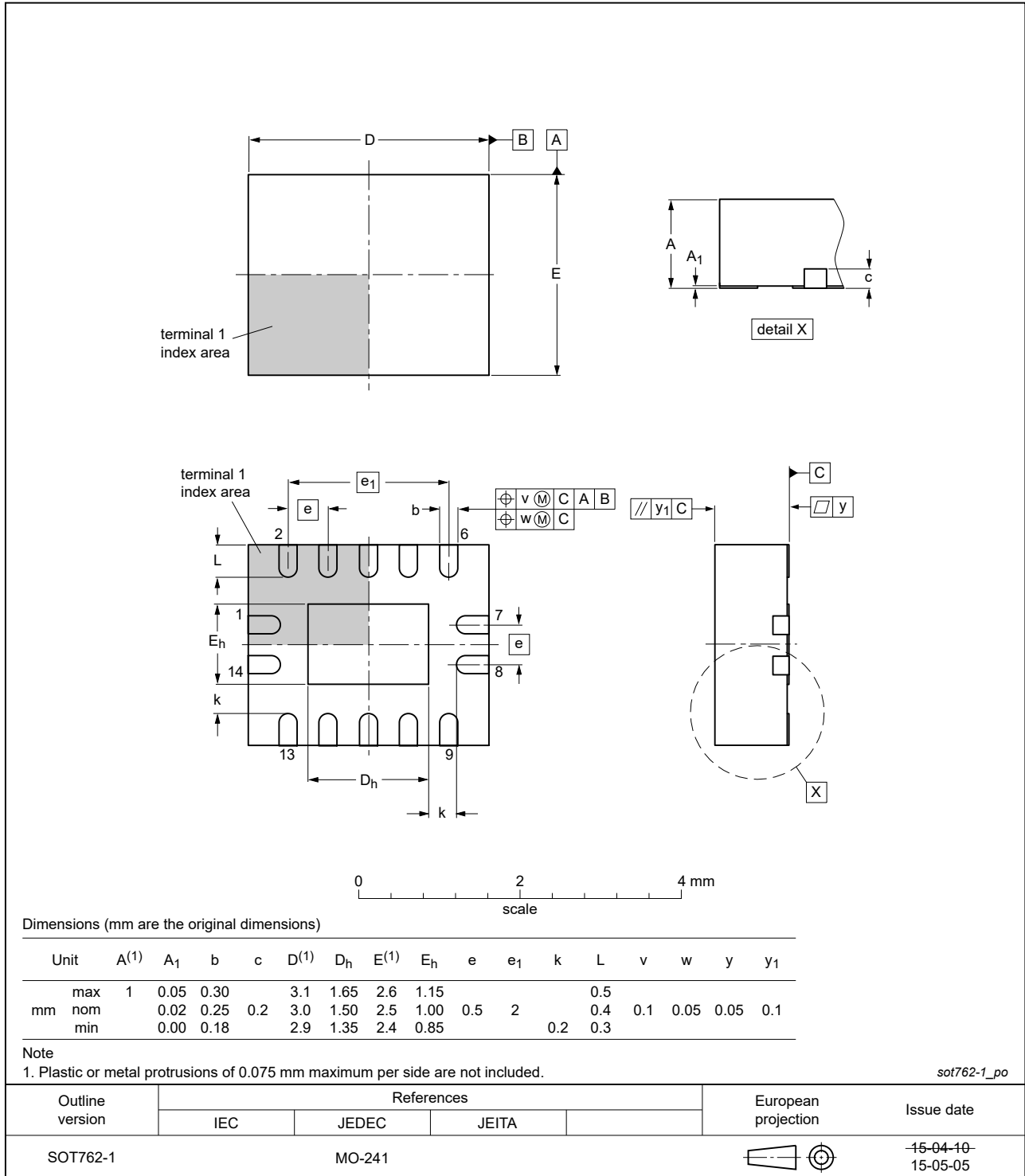


Fig. 8. Package outline SOT762-1 (DHVQFN14)

## 12. 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
TTL	Transistor-Transistor Logic

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ALVC04 v.5.1	20230714	Product data sheet	-	74ALVC04 v.4
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 2</a>: ESD specification updated according to the latest JEDEC standard.</li> <li>Specifications for -40 °C to +125 °C added.</li> </ul>			
74ALVC04 v.4	20210430	Product data sheet	-	74ALVC04 v.3
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 1</a> updated.</li> <li><a href="#">Section 2</a>: Reference to JESD36 removed.</li> <li><a href="#">Section 7</a>: Derating values for <math>P_{tot}</math> total power dissipation have been updated.</li> </ul>			
74ALVC04 v.3	20171005	Product data sheet	-	74ALVC04 v.2
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> </ul>			
74ALVC04 v.2	20030514	Product specification	-	74ALVC04 v.1
74ALVC04 v.1	20030204	Product specification	-	-

## 14. Legal information

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Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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