

74AHC04; 74AHCT04

hex inverter

Rev. 6 — 7 November 2011

Product data sheet

1. General description

The 74AHC04; 74AHCT04 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC04; 74AHCT04 provides six inverting buffers.

2. Features and benefits

- Balanced propagation delays
- Inputs accept voltages higher than V_{CC}
- Input levels:
 - ◆ For 74AHC04: CMOS level
 - ◆ For 74AHCT04: TTL level
- ESD protection:
 - ◆ HBM EIA/JESD22-A114F exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V
 - ◆ CDM EIA/JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC04				
74AHC04D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHC04PW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHC04BQ	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85\text{ mm}$	SOT762-1

Table 1. Ordering information ...continued

Type number	Package			
	Temperature range	Name	Description	Version
74AHCT04				
74AHCT04D	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHCT04PW	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHCT04BQ	–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

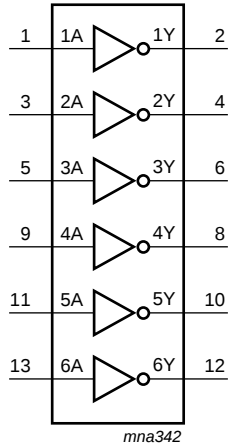


Fig 1. Logic symbol

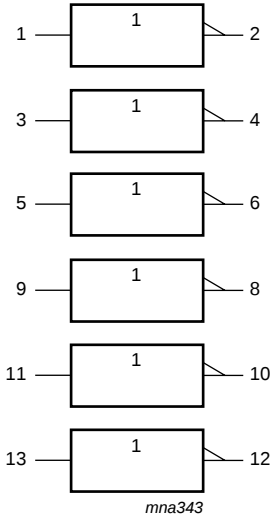


Fig 2. IEC logic symbol

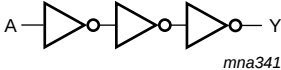
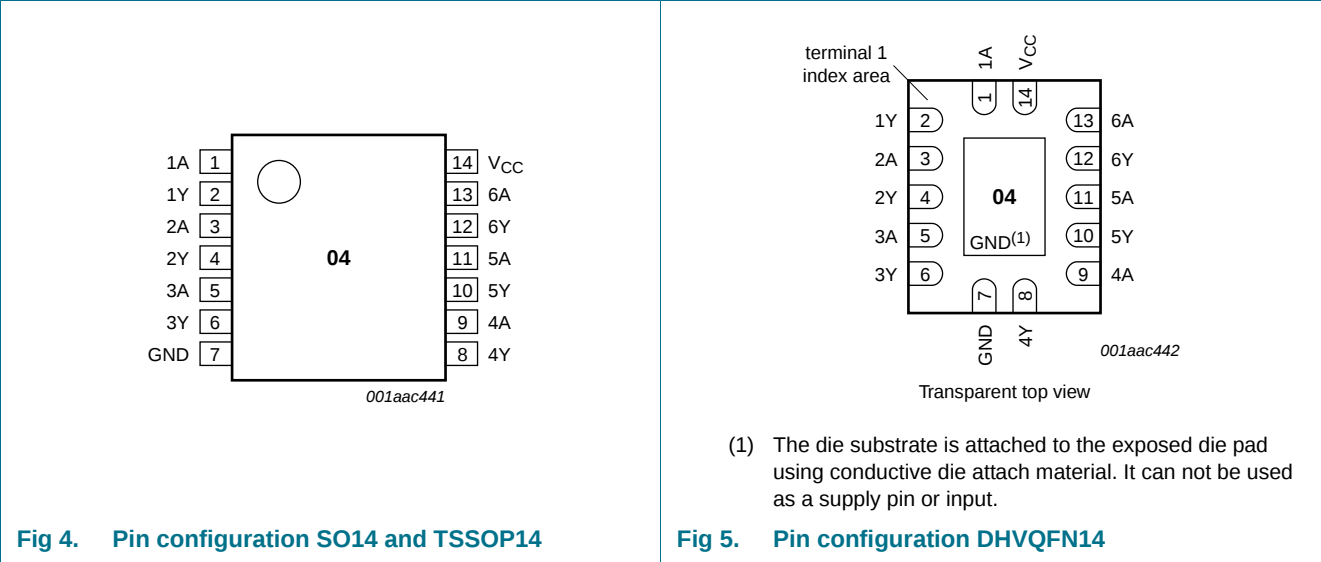


Fig 3. Logic diagram (one inverter)

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 table^[1]

Input nA	Output nY
L	H
H	L

[1] H = HIGH voltage level;
 L = LOW voltage level.

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		-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V	^[1] -20	-	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	^[1] -20	+20	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)	-25	+25	mA
I_{CC}	supply current		-	+75	mA
I_{GND}	ground current		-75	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C	^[2] -	500	mW

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

[2] For SO14 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.

For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.

For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

8. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
74AHC04						
V_{CC}	supply voltage		2.0	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0$ V to 3.6 V	-	-	100	ns/V
		$V_{CC} = 4.5$ V to 5.5 V	-	-	20	ns/V
74AHCT04						
V_{CC}	supply voltage		4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 4.5$ V to 5.5 V	-	-	20	ns/V

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; 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	
74AHC04										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V _{CC} = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V _{CC} = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V _{CC} = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V _{CC} = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = –50 µA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = –50 µA; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = –50 µA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = –4.0 mA; V _{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I _O = –8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.80	-	3.70	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 50 µA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	2.0	-	20	-	40	µA
C _I	input capacitance	V _I = V _{CC} or GND	-	3	10	-	10	-	10	pF
74AHCT04										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = –50 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = –8.0 mA	3.94	-	-	3.80	-	3.70	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 50 µA	-	0	0.1	-	0.1	-	0.1	V
		I _O = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	µA

Table 6. Static characteristics ...continued

At recommended operating conditions; 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	
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	2.0	-	20	-	40	μ A
ΔI_{CC}	additional supply current	per input pin; $V_I = V_{CC} - 2.1$ V; other pins at V_{CC} or GND; $I_O = 0$ A; $V_{CC} = 4.5$ V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C_I	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF

10. Dynamic characteristics

Table 7. Dynamic characteristicsVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
74AHC04										
t _{pd}	propagation delay	nA to nY; see Figure 6	[2]							
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	4.0	8.5	1.0	10.5	1.0	11.0	ns
		C _L = 50 pF	-	6.0	11.4	1.0	13	1.0	14.5	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.0	5.5	1.0	6.5	1.0	7.0	ns
		C _L = 50 pF	-	4.5	7.5	1.0	8.5	1.0	9.5	ns
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _I = GND to V _{CC}	[3]	-	13.5	-	-	-	-	pF

Table 7. Dynamic characteristics ...continued
Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
74AHCT04; V _{CC} = 4.5 V to 5.5 V										
t _{pd}	propagation delay	nA to nY; see Figure 6 ^[2]								
		C _L = 15 pF	-	3.0	6.7	1.0	7.5	1.0	8.5	ns
		C _L = 50 pF	-	4.5	7.7	1.0	8.5	1.0	10.0	ns
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _I = GND to V _{CC} ^[3]	-	13.9	-	-	-	-	-	pF

- [1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 V).
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] 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.

11. Waveforms

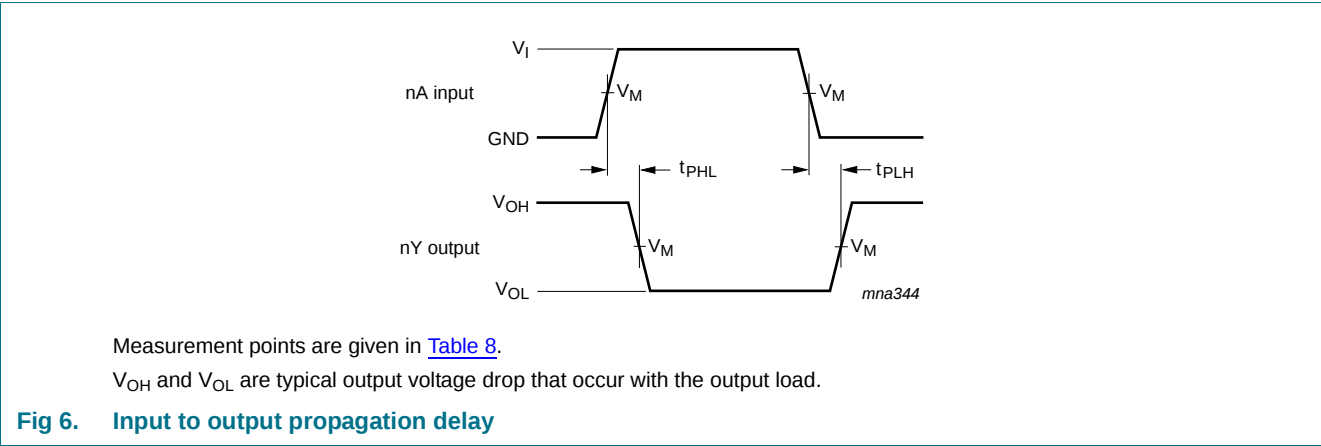


Table 8. Measurement points

Type	Input	Output
	V _M	V _M
74AHC04	0.5 × V _{CC}	0.5 × V _{CC}
74AHCT04	1.5 V	0.5 × V _{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.
 C_L = load capacitance including jig and probe capacitance.

Fig 7. Load circuitry for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74AHC04	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74AHCT04	3.0 V	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Package outline

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

SOT108-1

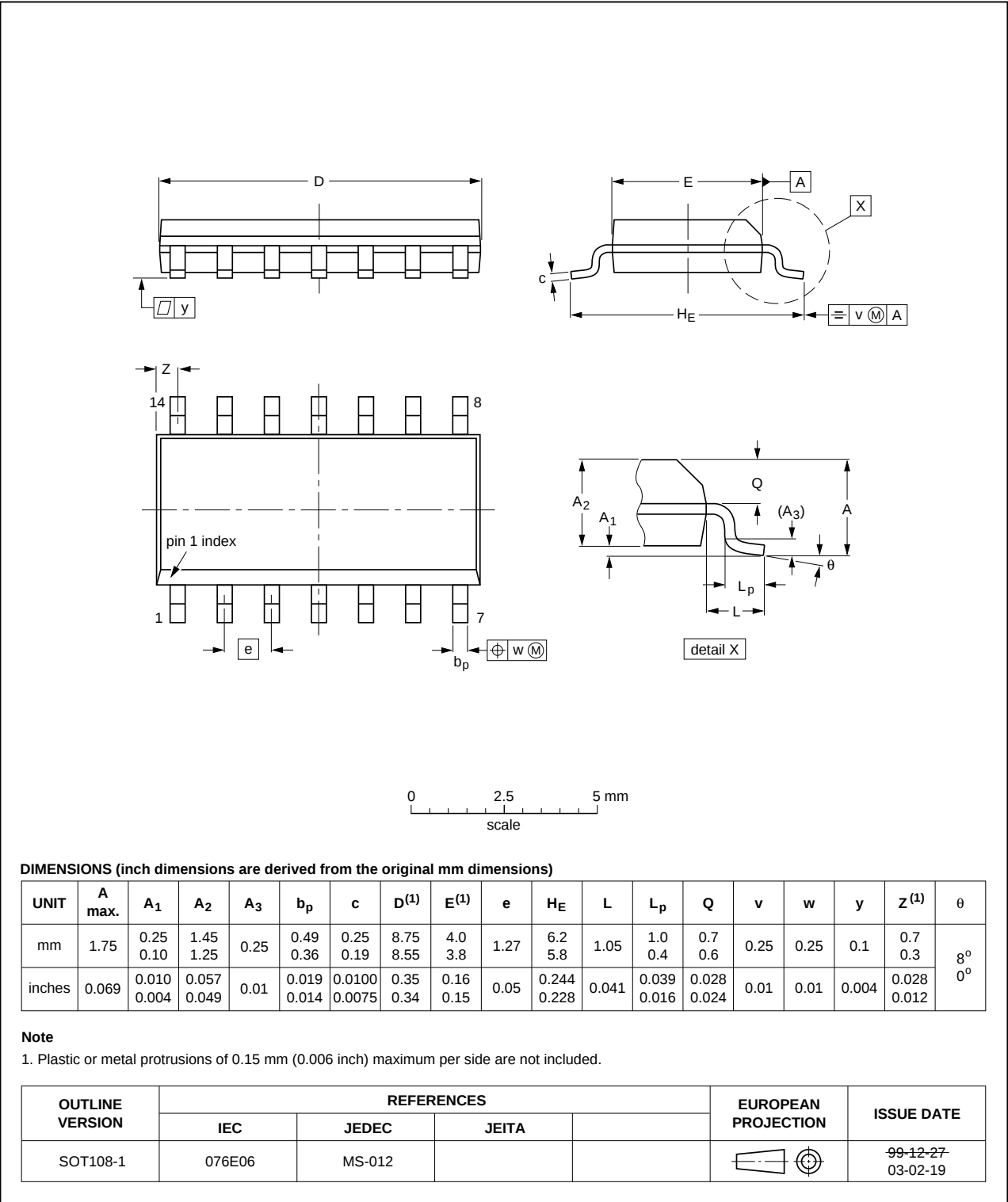


Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1

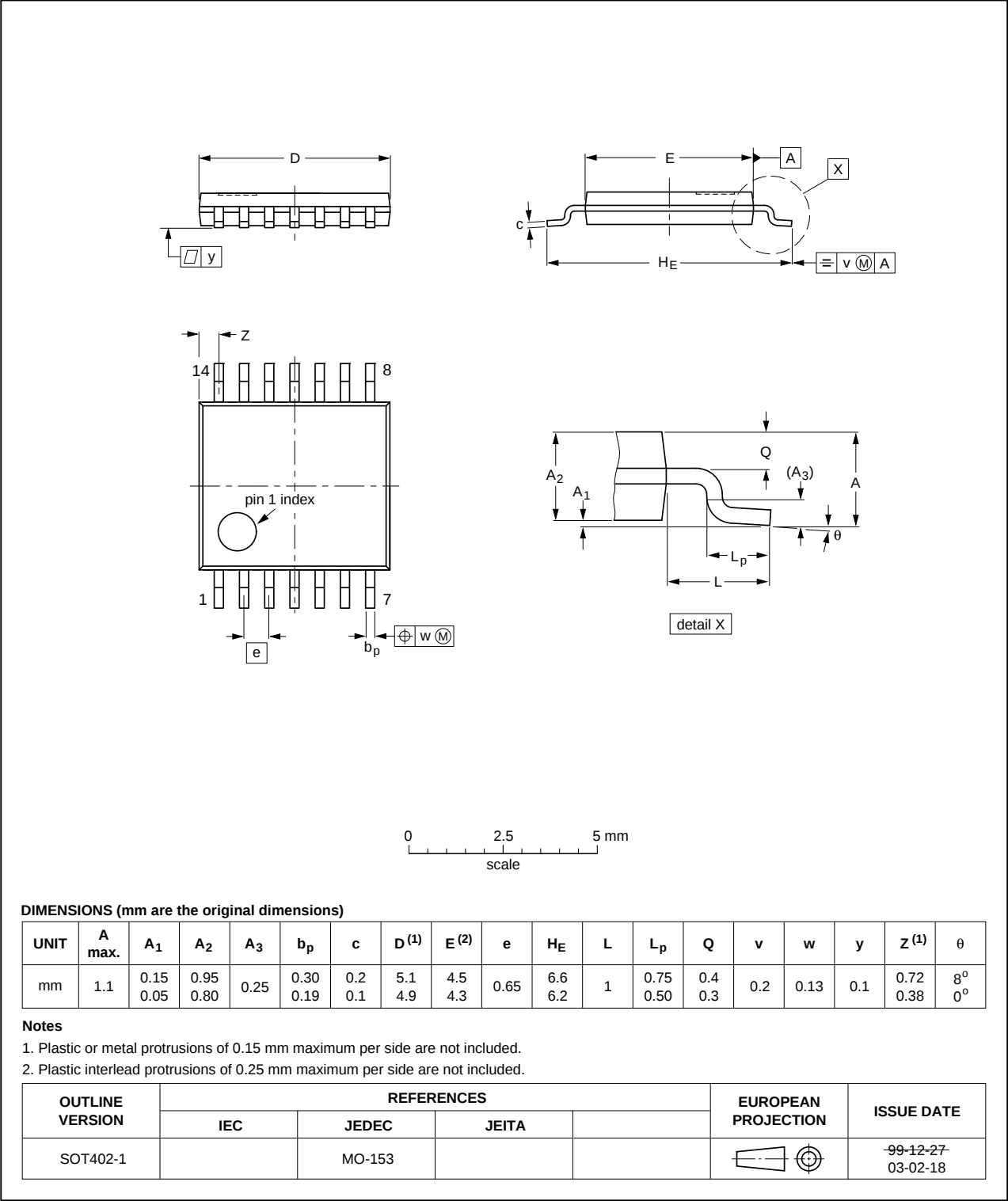


Fig 9. Package outline SOT402-1 (TSSOP14)

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

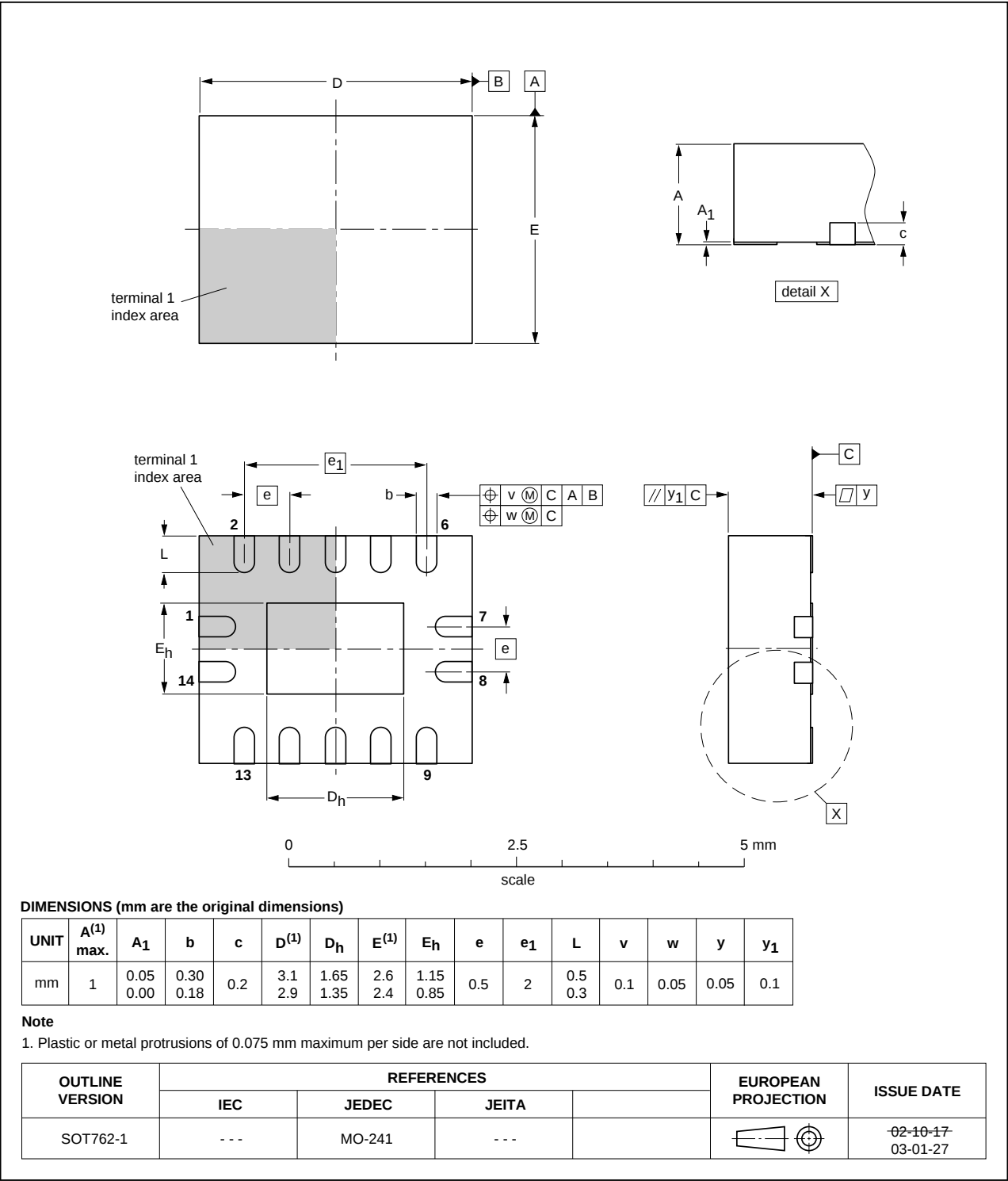


Fig 10. Package outline SOT762-1 (DHVQFN14)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT04 v.6	20111107	Product data sheet	-	74AHC_AHCT04 v.5
Modifications:	• Legal pages updated.			
74AHC_AHCT04 v.5	20110411	Product data sheet	-	74AHC_AHCT04 v.4
74AHC_AHCT04 v.4	20080514	Product data sheet	-	74AHC_AHCT04 v.3
74AHC_AHCT04 v.3	20050207	Product data sheet	-	74AHC_AHCT04 v.2
74AHC_AHCT04 v.2	19990927	Product specification	-	74AHC_AHCT04 v.1
74AHC_AHCT04 v.1	19990225	Product specification	-	-

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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