

74AHC3GU04-Q100

Triple unbuffered inverter

Rev. 1 — 18 November 2013

Product data sheet

1. General description

The 74AHC3GU04-Q100 is a high-speed Si-gate CMOS device. This device provides three inverter gates with unbuffered outputs.

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 $+125\text{ }^{\circ}\text{C}$
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pf}$, $R = 0\text{ }\Omega$)

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC3GU04DP-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74AHC3GU04DC-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1



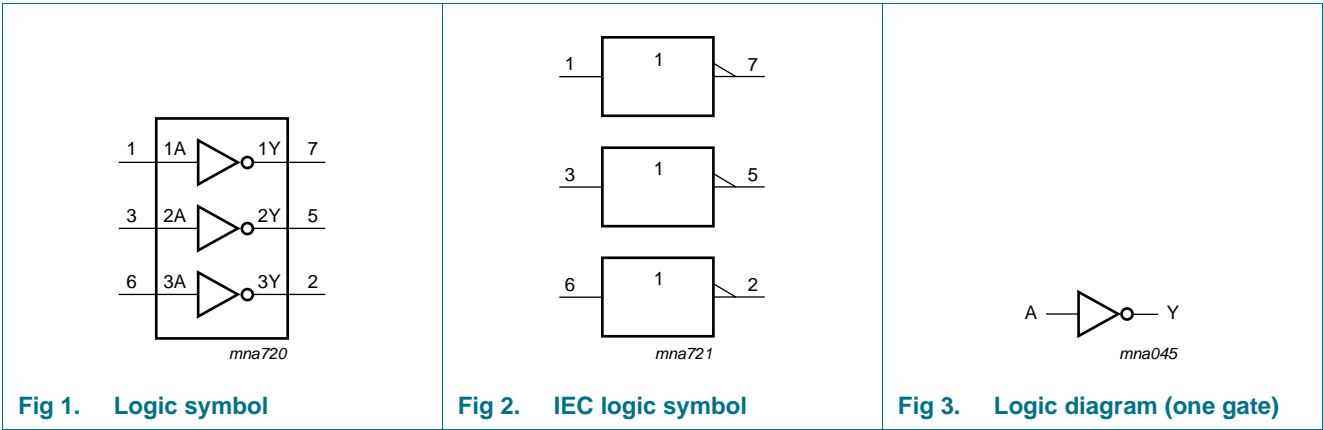
4. Marking

Table 2. Marking codes

Type number	Marking code ^[1]
74AHC3GU04DP-Q100	AU4
74AHC3GU04DC-Q100	AU4

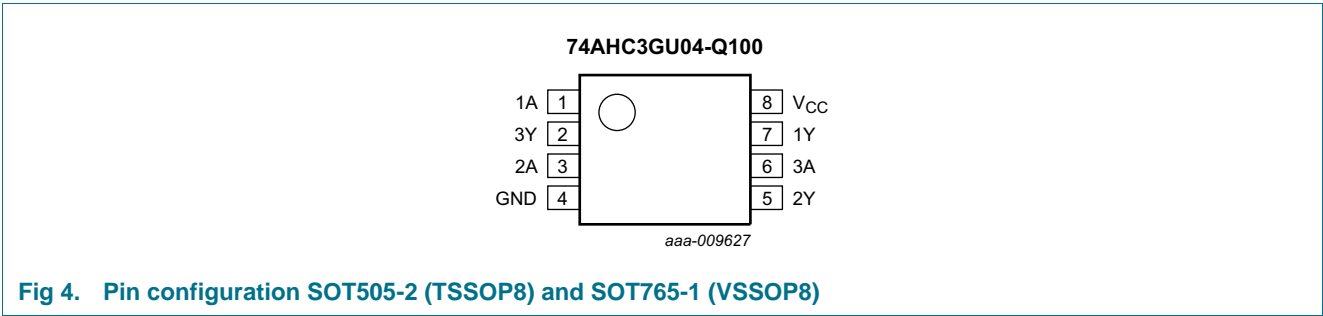
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
1A, 2A, 3A	1, 3, 6	data input
GND	4	ground (0 V)
1Y, 2Y, 3Y	7, 5, 2	data output
V _{CC}	8	supply voltage

7. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level

Input	Output
A	Y
L	H
H	L

8. Limiting values

Table 5. 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	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 V	-	±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] -	250	mW

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

[2] For TSSOP8 package: above 55 °C the value of P_{tot} derates linearly with 2.5 mW/K.
For VSSOP8 package: above 110 °C the value of P_{tot} derates linearly with 8 mW/K.

9. Recommended operating conditions

Table 6. 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		0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V _{CC} = 3.3 V \pm 0.3 V	-	-	100	ns/V
		V _{CC} = 5.0 V \pm 0.5 V	-	-	20	ns/V

10. Static characteristics

Table 7. 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 _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.7	-	-	1.7	-	1.7	-	V
		V _{CC} = 3.0 V	2.4	-	-	2.4	-	2.4	-	V
		V _{CC} = 5.5 V	4.4	-	-	4.4	-	4.4	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.3	-	0.3	-	0.3	V
		V _{CC} = 3.0 V	-	-	0.6	-	0.6	-	0.6	V
		V _{CC} = 5.5 V	-	-	1.1	-	1.1	-	1.1	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -50 μ A; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -50 μ A; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = -50 μ A; 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
V _{OL}	LOW-level output voltage	I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
		V _I = V _{IH} or V _{IL}								
		I _O = 50 μ A; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μ A; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μ A; 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 _I	input leakage current	I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
		V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μ A
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	1.0	-	10	-	40	μ A
C _I	input capacitance		-	3.0	10	-	10	-	10	pF

11. Dynamic characteristics

Table 8. 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	Max	Min	Max	Min	Max	
t _{pd}	propagation delay	nA to nY; see Figure 5 [1]								
		V _{CC} = 3.0 V to 3.6 V [2]								
		C _L = 15 pF	-	3.0	7.1	1.0	8.5	1.0	10.0	ns
		C _L = 50 pF	-	4.3	10.6	1.0	12.0	1.0	13.5	ns
		V _{CC} = 4.5 V to 5.5 V [3]								
		C _L = 15 pF	-	2.5	5.5	1.0	6.0	1.0	7.0	ns
		C _L = 50 pF	-	3.5	7.0	1.0	8.0	1.0	9.0	ns
C _{PD}	power dissipation capacitance	per buffer; [4] V _I = GND to V _{CC}	-	4	-	-	-	-	-	pF

- [1] t_{pd} is the same as t_{PLH} and t_{PHL} .
- [2] Typical values are measured at $V_{CC} = 3.3 \text{ V}$.
- [3] Typical values are measured at $V_{CC} = 5.0 \text{ V}$.
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$
 - 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;
 - $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

12. Waveforms

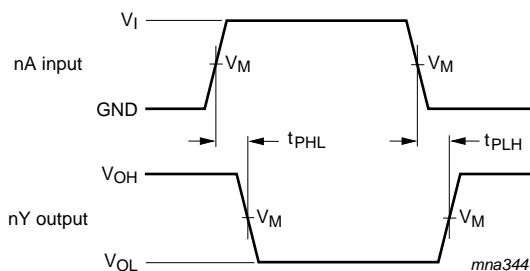
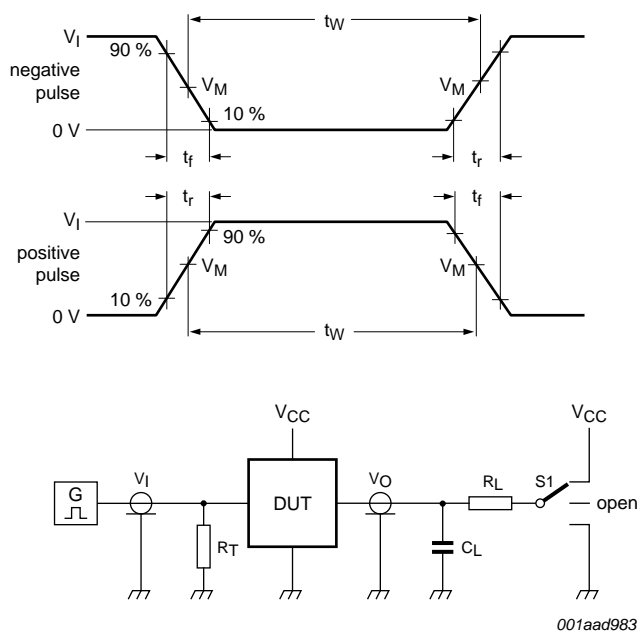


Fig 5. The input (nA) to output (nY) propagation delays.

Type	Input	Output
	V_M	V_M
74AHC3GU04-Q100	$0.5V_{CC}$	$0.5V_{CC}$



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 resistance.

S1 = Test selection switch.

Fig 6. Test circuit for measuring switching times

Table 10. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74AHC3GU04-Q100	V_{CC}	≤ 3 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

13. Typical transfer characteristics

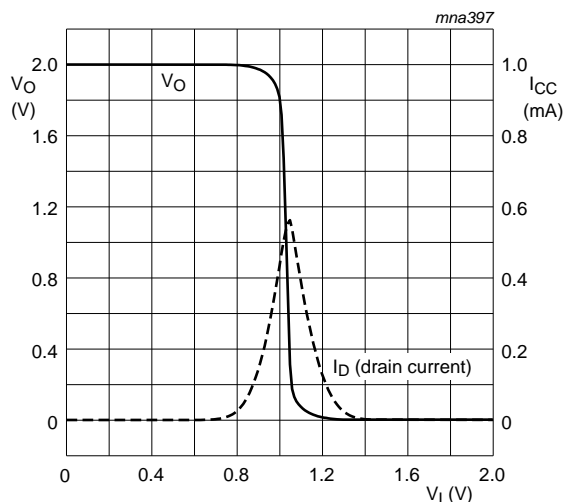


Fig 7. $V_{CC} = 2.0 \text{ V}$; $I_O = 0 \text{ A}$

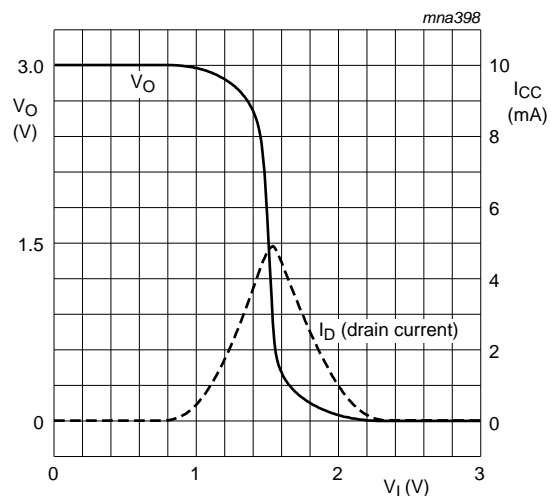


Fig 8. $V_{CC} = 3.0 \text{ V}$; $I_O = 0 \text{ A}$

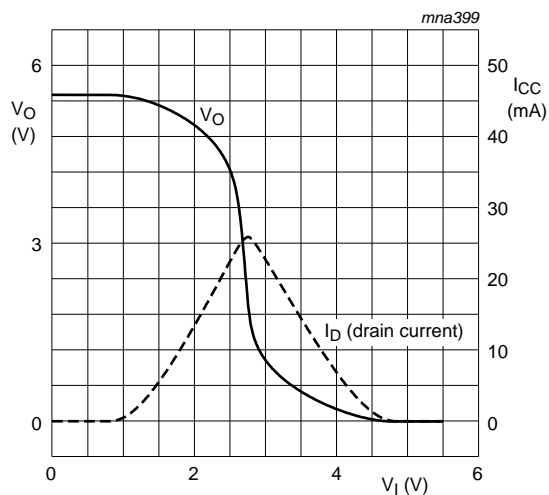


Fig 9. $V_{CC} = 5.5 \text{ V}$; $I_O = 0 \text{ A}$

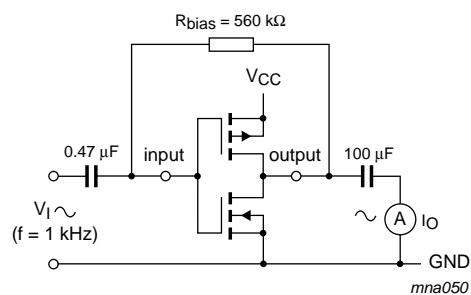


Fig 10. Test set-up for measuring forward transconductance $g_{fs} = \Delta I_O / \Delta V_I$ at V_O is constant

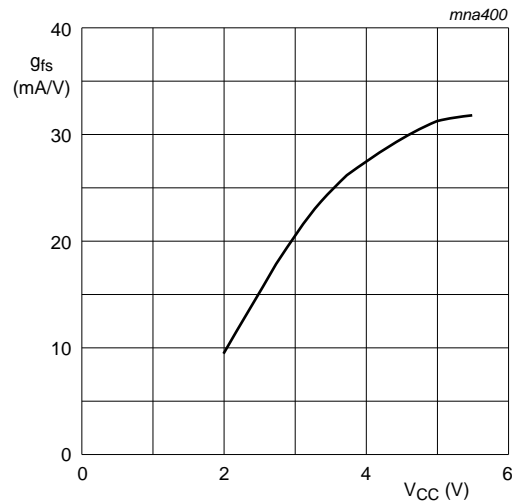


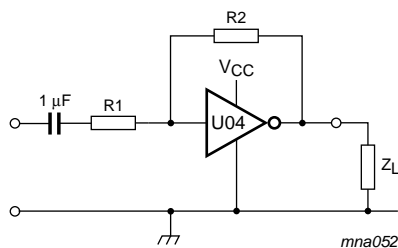
Fig 11. Typical forward transconductance g_{fs} as a function of the supply voltage at $T_{amb} = 25^\circ\text{C}$

14. Application information

Some applications are:

- Linear amplifier (see [Figure 12](#))
- Crystal oscillator design (see [Figure 13](#))

Remark: All values given are typical unless otherwise specified.



Maximum $V_{O(p-p)} = V_{CC} - 1.5\text{ V}$ centered at $0.5 \times V_{CC}$.

$$G_v = -\frac{G_{ol}}{1 + \frac{R1}{R2}(1 + G_{ol})}$$

G_{ol} = open loop gain

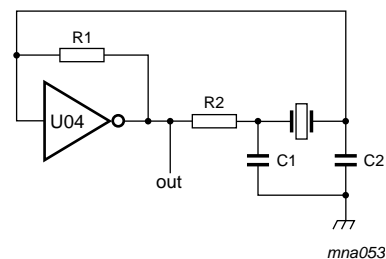
G_v = voltage gain

$R1 \geq 3\text{ k}\Omega$, $R2 \leq 1\text{ M}\Omega$

$Z_L > 10\text{ k}\Omega$; $G_{ol} = 20$ (typ.)

Typical unity gain bandwidth product is 5 MHz.

Fig 12. Used as a linear amplifier



$C1 = 47\text{ pF}$ (typ.)

$C2 = 22\text{ pF}$ (typ.)

$R1 = 1\text{ M}\Omega$ to $10\text{ M}\Omega$ (typ.)

$R2$ optimum value depends on the frequency and required stability against changes in V_{CC} or average minimum I_{CC} (I_{CC} is typically 2 mA at $V_{CC} = 3\text{ V}$ and $f = 1\text{ MHz}$).

Fig 13. Crystal oscillator configuration

Table 11. External components for resonator ($f < 1$ MHz)*All values given are typical and must be used as an initial set-up.*

Frequency	R1	R2	C1	C2
10 kHz to 15.9 kHz	22 M Ω	220 k Ω	56 pF	20 pF
16 kHz to 24.9 kHz	22 M Ω	220 k Ω	56 pF	10 pF
25 kHz to 54.9 kHz	22 M Ω	100 k Ω	56 pF	10 pF
55 kHz to 129.9 kHz	22 M Ω	100 k Ω	47 pF	5 pF
130 kHz to 199.9 kHz	22 M Ω	47 k Ω	47 pF	5 pF
200 kHz to 349.9 kHz	22 M Ω	47 k Ω	47 pF	5 pF
350 kHz to 600 kHz	22 M Ω	47 k Ω	47 pF	5 pF

Table 12. Optimum value for R2

Frequency	R2	Optimum for
3 kHz	2.0 k Ω	minimum required I _{CC}
	8.0 k Ω	minimum influence due to change in V _{CC}
6 kHz	1.0 k Ω	minimum required I _{CC}
	4.7 k Ω	minimum influence by V _{CC}
10 kHz	0.5 k Ω	minimum required I _{CC}
	2.0 k Ω	minimum influence by V _{CC}
14 kHz	0.5 k Ω	minimum required I _{CC}
	1.0 k Ω	minimum influence by V _{CC}
>14 kHz	-	replace R2 by C3 with a typical value of 35 pF

15. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

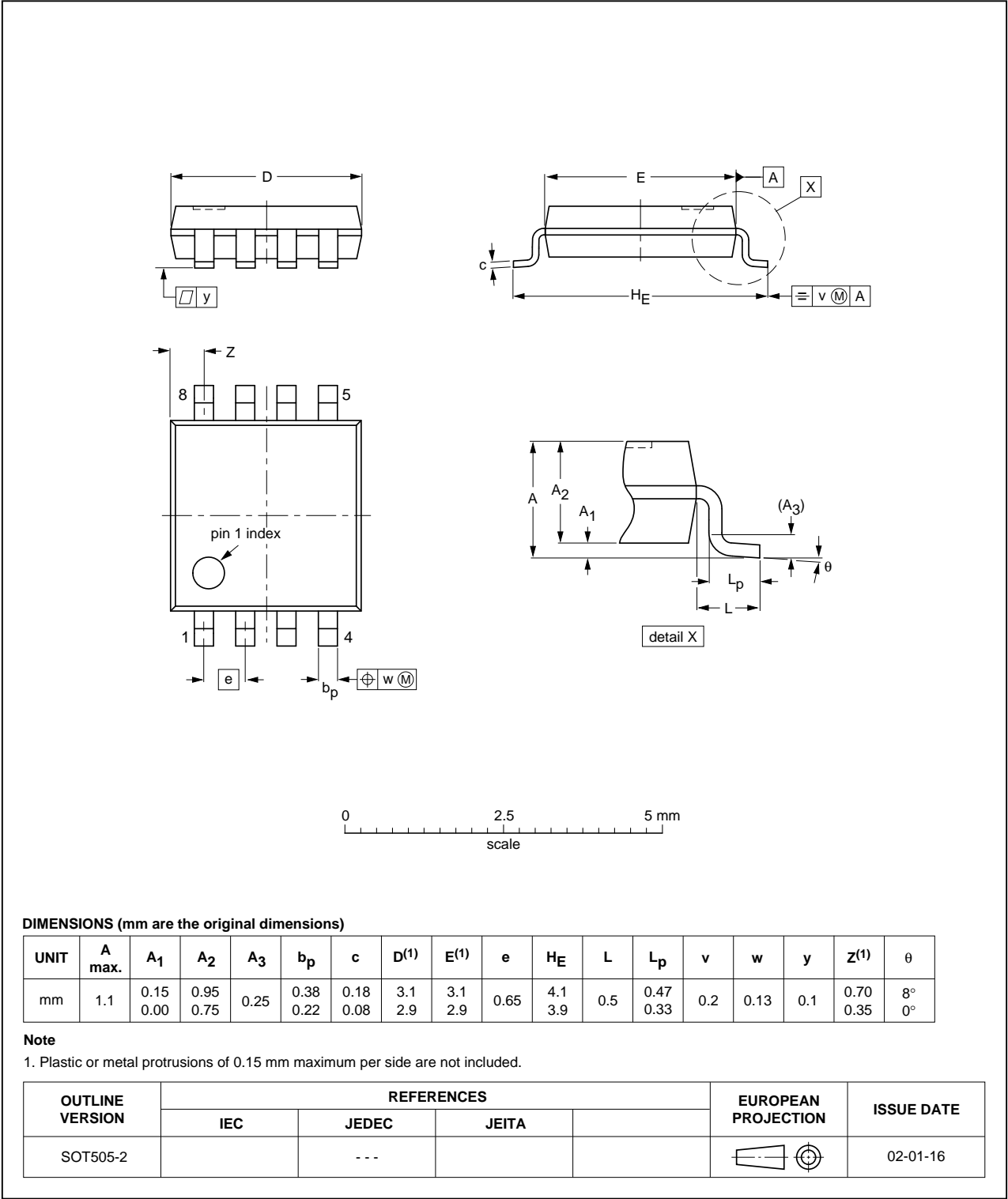


Fig 14. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm

SOT765-1

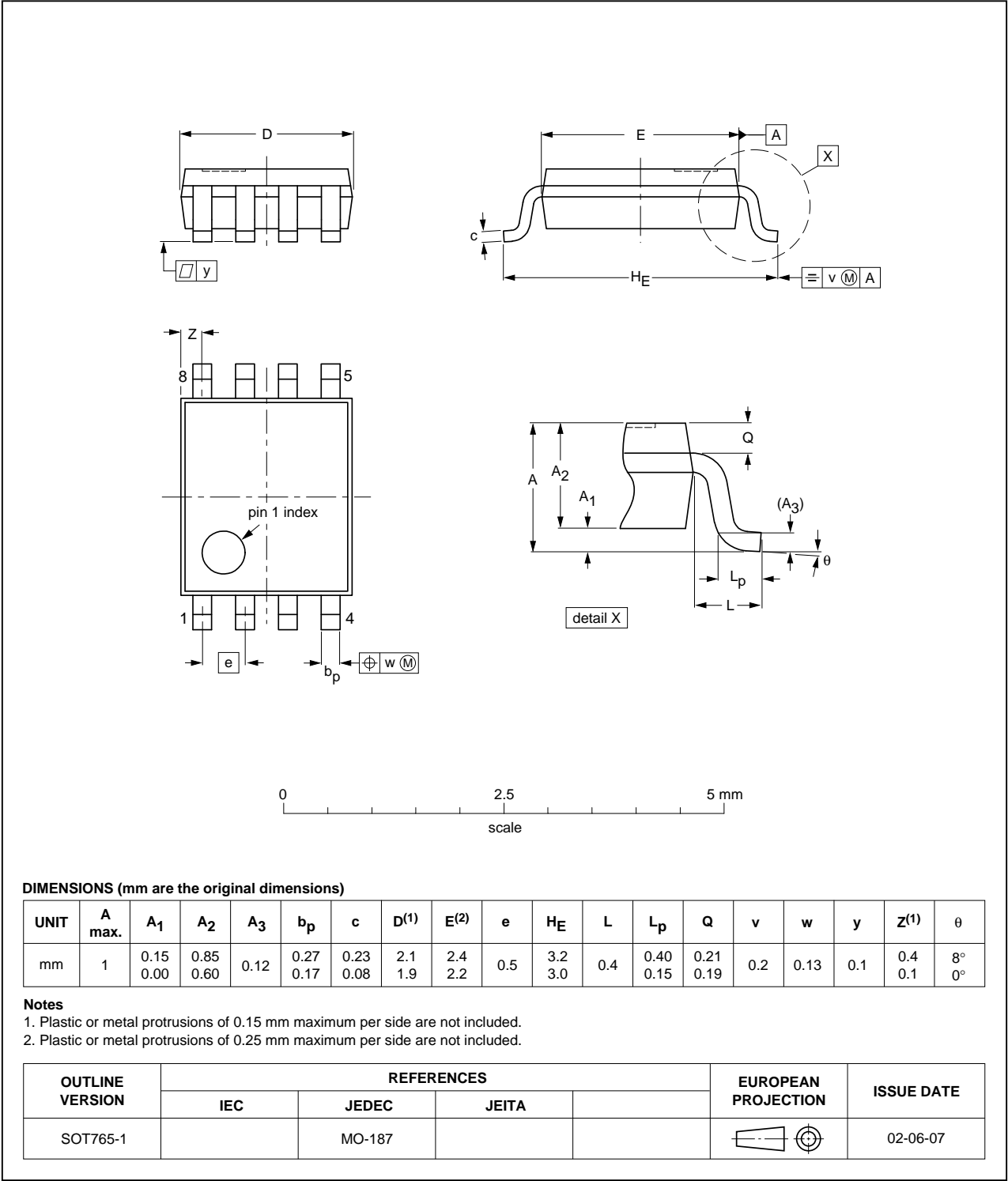


Fig 15. Package outline SOT765-1 (VSSOP8)

16. Abbreviations

Table 13. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

17. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC3GU04_Q100 v.1	20131118	Product data sheet	-	-

18. Legal information

18.1 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.
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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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