

74AHC3GU04

Inverter

Rev. 01 — 23 September 2004

Product data sheet

1. General description

The 74AHC3GU04 is a high-speed Si-gate CMOS device. This device provides the inverting single stage function.

2. Features

- Symmetrical output impedance
- High noise immunity
- ESD protection:
 - ◆ HBM EIA/JESD22-A114-B exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V
 - ◆ CDM EIA/JESD22-C101 exceeds 1000 V.
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- Output capability ± 8 mA drive
- Specified from -40 °C to $+85$ °C and from -40 °C to $+125$ °C.

3. Quick reference data

Table 1: Quick reference data

$GND = 0$ V; $T_{amb} = 25$ °C; $t_r = t_f \leq 3.0$ ns.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{PHL} , t_{PLH}	propagation delay nA to nY	$V_{CC} = 5$ V; $C_L = 15$ pF	-	2.5	5.5	ns
C_I	input capacitance		-	3.0	10	pF
C_{PD}	power dissipation capacitance		[1] - [2]	4	-	pF

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 = total load switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

[2] The condition is $V_i = GND$ to V_{CC} .

PHILIPS

4. Ordering information

Table 2: Ordering information

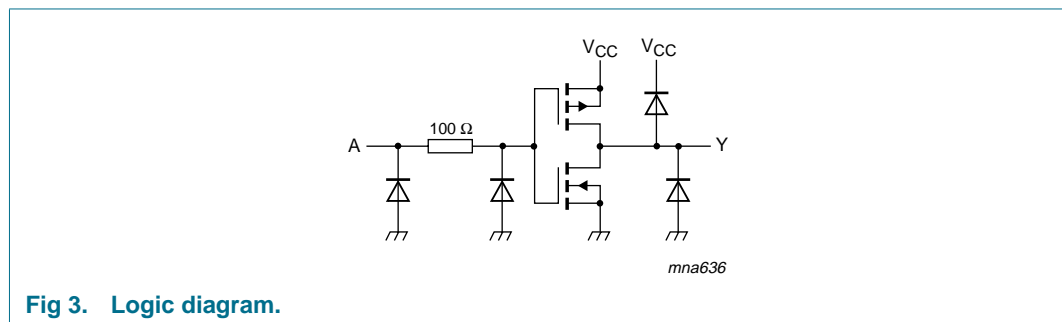
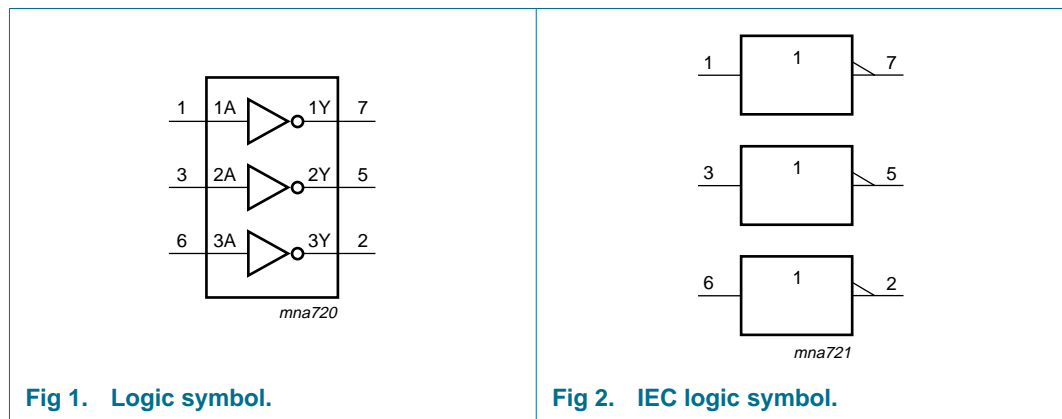
Type number	Package			
	Temperature range	Name	Description	Version
74AHC3GU04DP	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74AHC3GU04DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74AHC3GU04GM	-40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 0.95 × 1.95 × 0.5 mm	SOT833-1

5. Marking

Table 3: Marking

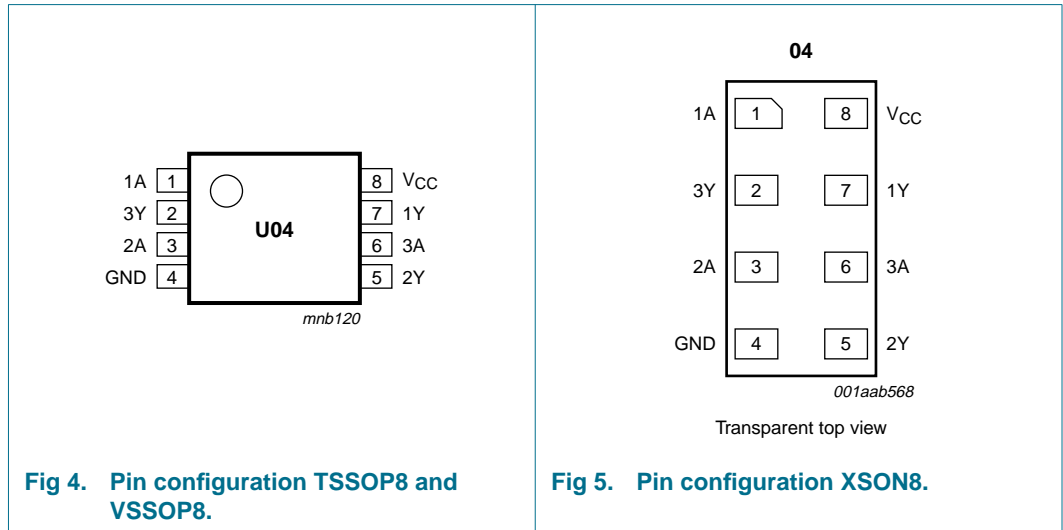
Type number	Marking code
74AHC3GU04DP	AU04
74AHC3GU04DC	AU4
74AHC3GU04GM	AU4

6. Functional diagram



7. Pinning information

7.1 Pinning



7.2 Pin description

Table 4: Pin description

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

8. Functional description

8.1 Function table

Table 5: Function table [1]

Input nA	Output nY
L	H
H	L

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

9. Limiting values

Table 6: 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	supply voltage		-0.5	+7.0	V
I_{IK}	input diode current	$V_I < -0.5$ V	-	-20	mA
I_{OK}	output diode current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	[1]	± 20	mA
I_O	output source or sink current	$V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V	-	± 25	mA
I_{CC}, I_{GND}	V_{CC} or GND current		-	± 75	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	power dissipation	$T_{amb} = -40$ °C to +125 °C	-	250	mW

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

10. Recommended operating conditions

Table 7: Recommended operating operations

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}	operating ambient temperature	see Section 11 and Section 12	-40	+25	+125	°C
t_r, t_f	input rise and fall times	$V_{CC} = 3.3$ V \pm 0.3 V	-	-	100	ns/V
		$V_{CC} = 5$ V \pm 0.5 V	-	-	20	ns/V

11. Static characteristics

Table 8: Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = 25\text{ °C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.7	-	-	V
		$V_{CC} = 3.0\text{ V}$	2.4	-	-	V
		$V_{CC} = 5.5\text{ V}$	4.4	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.3	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.6	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.1	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$V_{CC} = 2.0\text{ V}; I_O = -50\text{ }\mu\text{A}$	1.9	2.0	-	V
		$V_{CC} = 3.0\text{ V}; I_O = -50\text{ }\mu\text{A}$	2.9	3.0	-	V
		$V_{CC} = 4.5\text{ V}; I_O = -50\text{ }\mu\text{A}$	4.4	4.5	-	V
		$V_{CC} = 3.0\text{ V}; I_O = -4.0\text{ mA}$	2.58	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$V_{CC} = 2.0\text{ V}; I_O = 50\text{ }\mu\text{A}$	-	0	0.1	V
		$V_{CC} = 3.0\text{ V}; I_O = 50\text{ }\mu\text{A}$	-	0	0.1	V
		$V_{CC} = 4.5\text{ V}; I_O = 50\text{ }\mu\text{A}$	-	0	0.1	V
		$V_{CC} = 3.0\text{ V}; I_O = 4.0\text{ mA}$	-	-	0.36	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$	-	-	0.1	μA
		$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}; V_{CC} = 5.5\text{ V}$	-	-	1.0	μA
C_I	input capacitance		-	3.0	10	pF
$T_{amb} = -40\text{ °C to }85\text{ °C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.7	-	-	V
		$V_{CC} = 3.0\text{ V}$	2.4	-	-	V
		$V_{CC} = 5.5\text{ V}$	4.4	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.3	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.6	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.1	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	1.9	-	-	V
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 3.0\text{ V}$	2.9	-	-	V
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	4.4	-	-	V
		$I_O = -4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	2.48	-	-	V
	$I_O = -8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	3.8	-	-	V	

Table 8: Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = 50 μA; V _{CC} = 2.0 V	-	-	0.1	V
		I _O = 50 μA; V _{CC} = 3.0 V	-	-	0.1	V
		I _O = 50 μA; V _{CC} = 4.5 V	-	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.44	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.44	V
I _{LI}	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	1.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	10	μA
C _I	input capacitance		-	-	10	pF
T_{amb} = -40 °C to +125 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.7	-	-	V
		V _{CC} = 3.0 V	2.4	-	-	V
		V _{CC} = 5.5 V	4.4	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.3	V
		V _{CC} = 3.0 V	-	-	0.6	V
		V _{CC} = 5.5 V	-	-	1.1	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	-	-	V
		I _O = -50 μA; V _{CC} = 3.0 V	2.9	-	-	V
		I _O = -50 μA; V _{CC} = 4.5 V	4.4	-	-	V
		I _O = -4.0 mA; V _{CC} = 3.0 V	2.40	-	-	V
		I _O = -8.0 mA; V _{CC} = 4.5 V	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	-	-	0.1	V
		I _O = 50 μA; V _{CC} = 3.0 V	-	-	0.1	V
		I _O = 50 μA; V _{CC} = 4.5 V	-	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.55	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.55	V
I _{LI}	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	2.0	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	40	μA
C _I	input capacitance		-	-	10	pF

12. Dynamic characteristics

Table 9: Dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); $t_r = t_f \leq 3.0$ ns. See [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = 25$ °C						
t_{PHL} , t_{PLH}	propagation delay nA to nY	see Figure 6				
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	[1] -	3.0	7.1	ns
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	[1] -	4.3	10.6	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	[2] -	2.5	5.5	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	[2] -	3.5	7.0	ns
C_{PD}	power dissipation capacitance		[3][4] -	4	-	pF
$T_{amb} = -40$ °C to 85 °C						
t_{PHL} , t_{PLH}	propagation delay nA to nY	see Figure 6				
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	1.0	-	8.5	ns
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	1.0	-	12.0	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	1.0	-	6.0	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	1.0	-	8.0	ns
$T_{amb} = -40$ °C to 125 °C						
t_{PHL} , t_{PLH}	propagation delay nA to nY	see Figure 6				
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	1.0	-	10.0	ns
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	1.0	-	13.5	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	1.0	-	7.0	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	1.0	-	9.0	ns

[1] Typical values are measured at $V_{CC} = 3.3$ V.

[2] Typical values are measured at $V_{CC} = 5.0$ V.

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

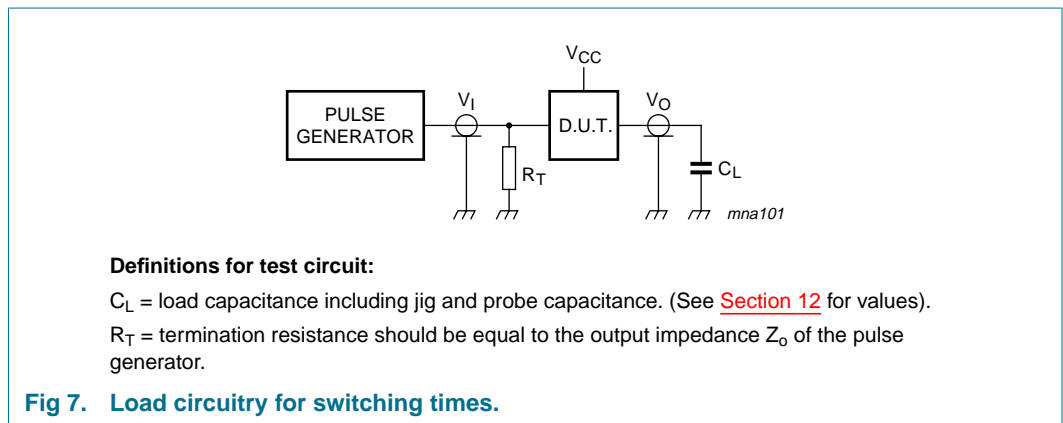
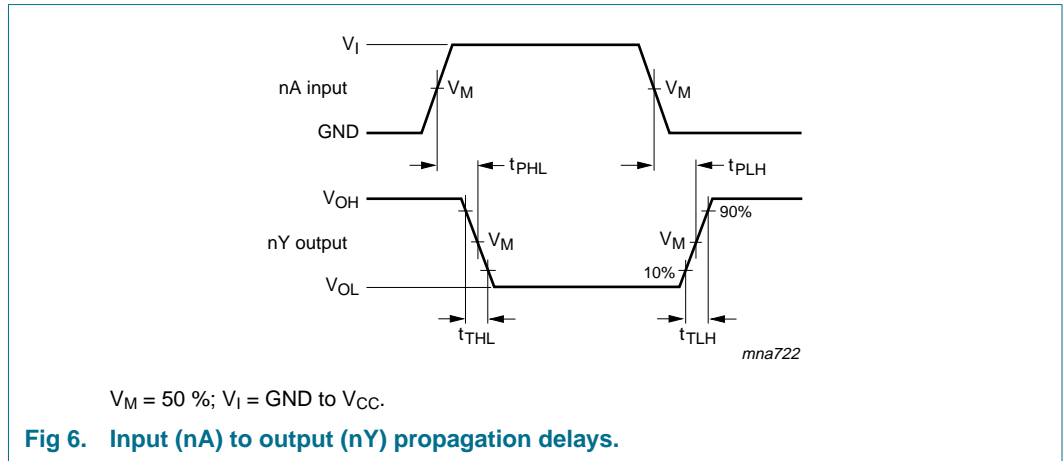
V_{CC} = supply voltage in Volts;

N = total load switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

[4] The condition is $V_I = GND$ to V_{CC} .

13. AC waveforms



13.1 Typical transfer characteristics

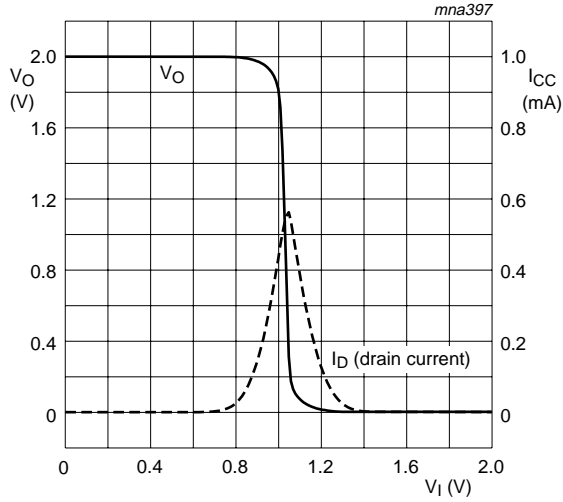


Fig 8. $V_{CC} = 2.0\text{ V}$; $I_O = 0\text{ A}$.

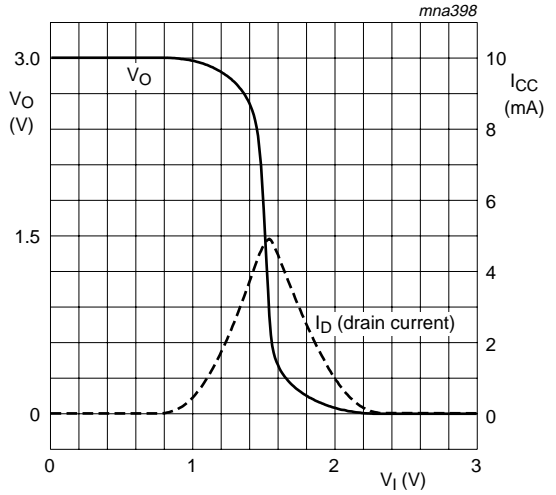


Fig 9. $V_{CC} = 3.0\text{ V}$; $I_O = 0\text{ A}$.

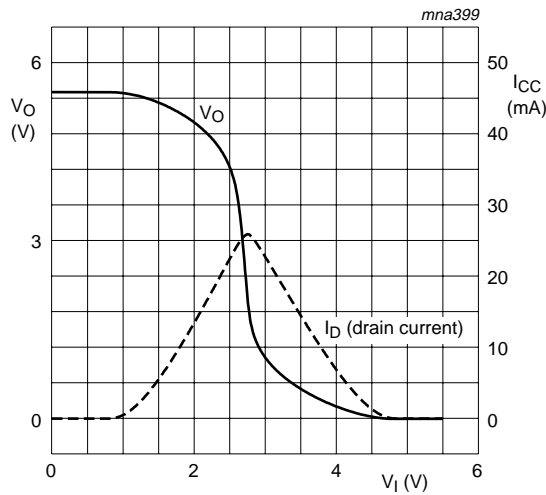
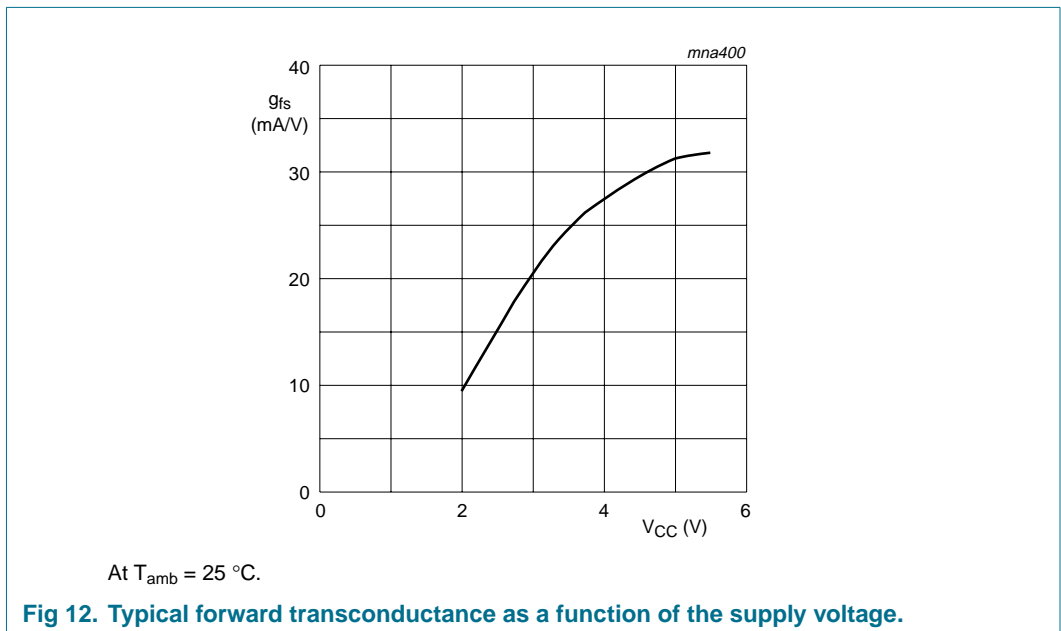
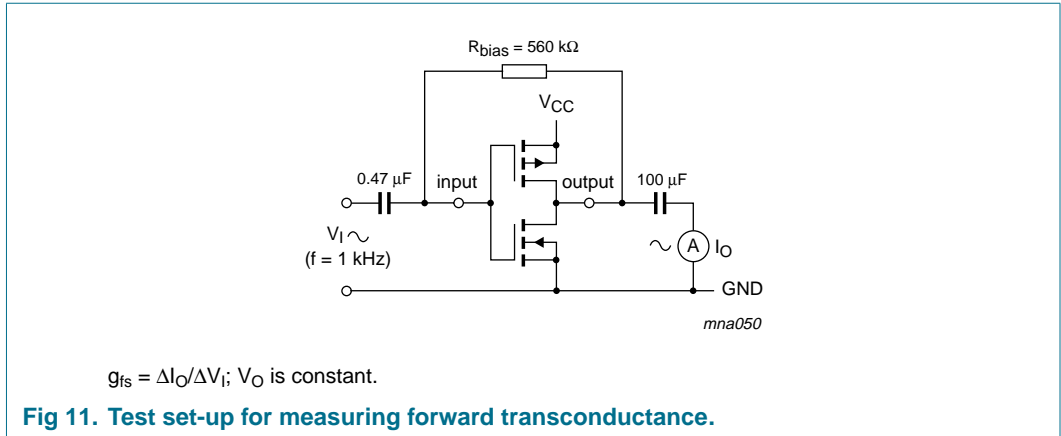


Fig 10. $V_{CC} = 5.5\text{ V}$; $I_O = 0\text{ A}$.

13.2 Forward transconductance



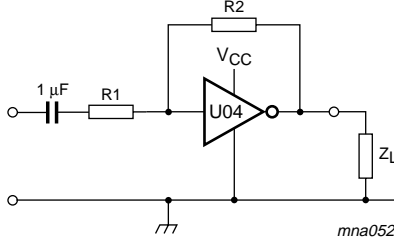
14. Application information

Some applications are:

- Linear amplifier see [Figure 13](#)
- In crystal oscillator design see [Figure 14](#).

Remark: All values given are typical unless otherwise specified.

14.1 Linear amplifier



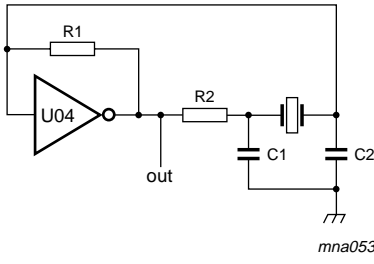
$V_{O(max)(p-p)} = V_{CC} - 1.5 \text{ V centered at } 0.5 \times V_{CC}.$

$$A_u = \frac{A_{OL}}{1 + \frac{R1}{R2}(1 + A_{OL})}$$

A_{OL} = open loop amplification.
 A_u = voltage amplification.
 $R1 \geq 3 \text{ k}\Omega$; $R2 \leq 1 \text{ M}\Omega$.
 $Z_L > 10 \text{ k}\Omega$; $A_{OL} = 20$ (typical).
 Typical unity gain bandwidth product is 5 MHz.

Fig 13. Used as a linear amplifier.

14.2 Crystal oscillator



$C1 = 47 \text{ pF}$ (typical).
 $C2 = 22 \text{ pF}$ (typical).
 $R1 = 1 \text{ M}\Omega$ to $10 \text{ M}\Omega$ (typical).
 $R2$ 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 14. Crystal oscillator configuration.

Table 10: External components for resonator (f < 1 MHz)

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

Remark: All values given are typical and must be used as initial set-up.

Table 11: Optimum value for R2

Frequency (kHz)	R2 (k Ω)	Optimum for
3	2.0	minimum required I _{CC}
	8.0	minimum influence due to change in V _{CC}
6	1.0	minimum required I _{CC}
	4.7	minimum influence due to change in V _{CC}
10	0.5	minimum required I _{CC}
	2.0	minimum influence due to change in V _{CC}
14	0.5	minimum required I _{CC}
	1.0	minimum influence due to change in V _{CC}
>14	-	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

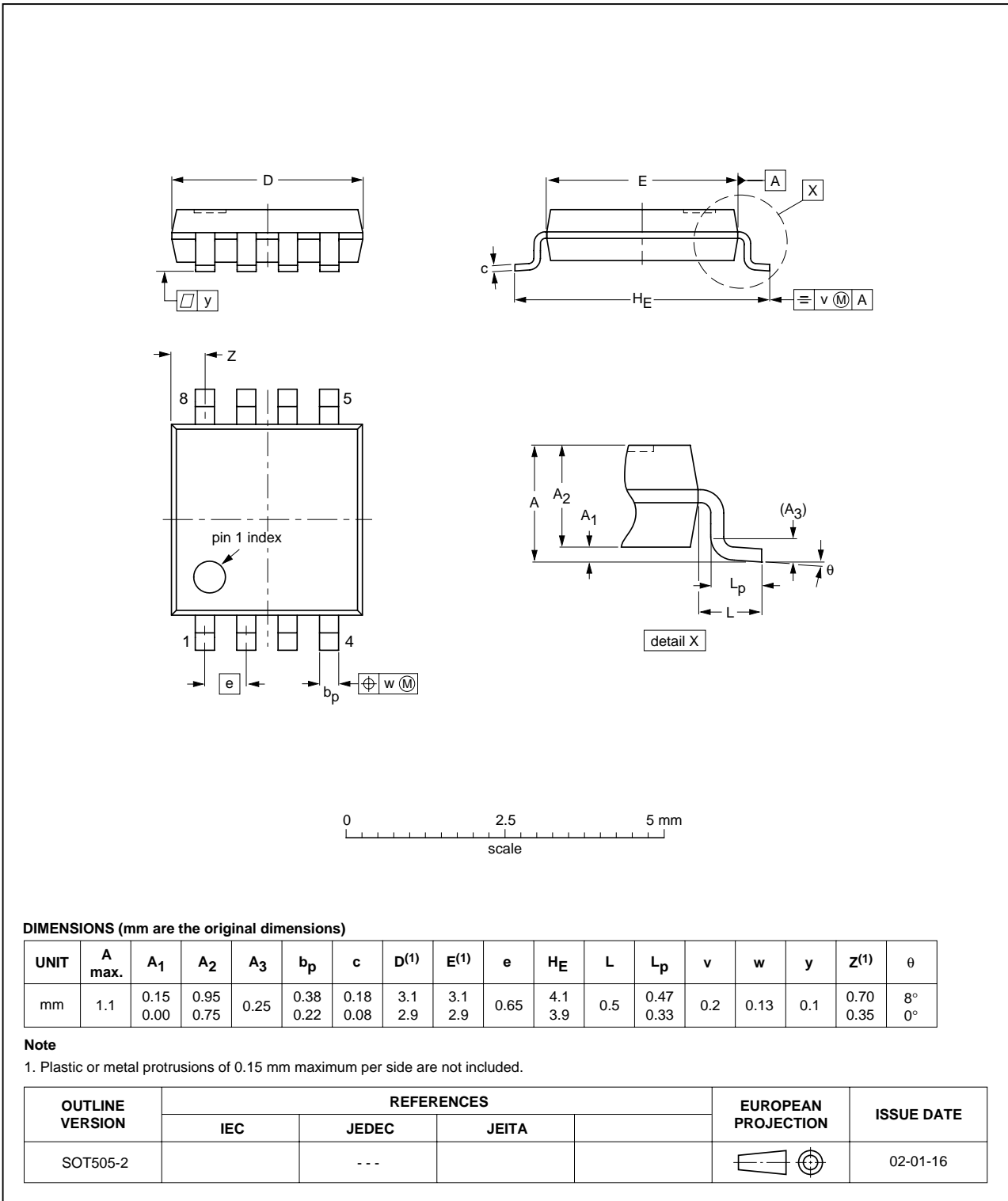


Fig 15. Package outline SOT505-2 (TSSOP8).

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

SOT765-1

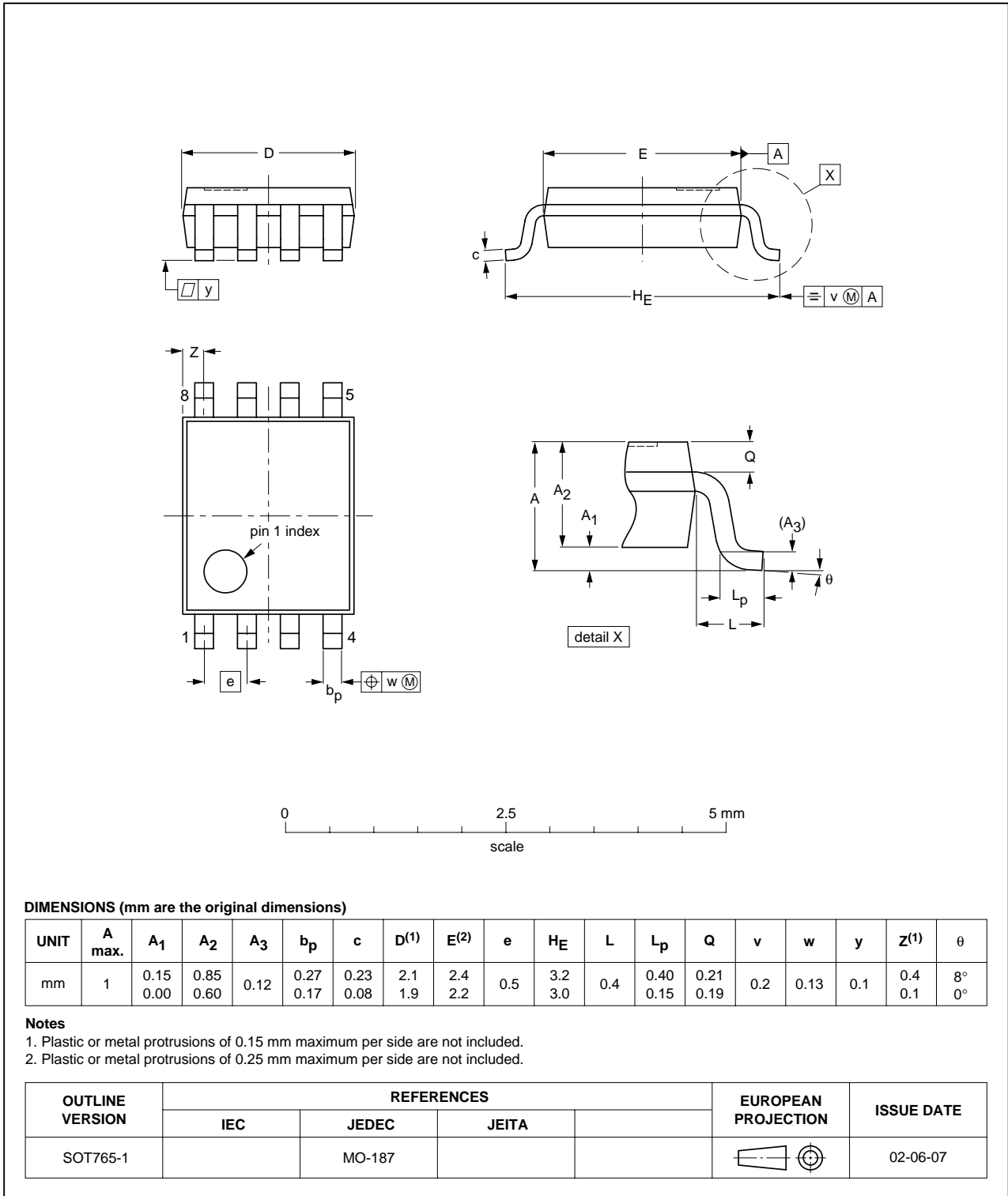


Fig 16. Package outline SOT765-1 (VSSOP8).

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 0.95 x 1.95 x 0.5 mm

SOT833-1

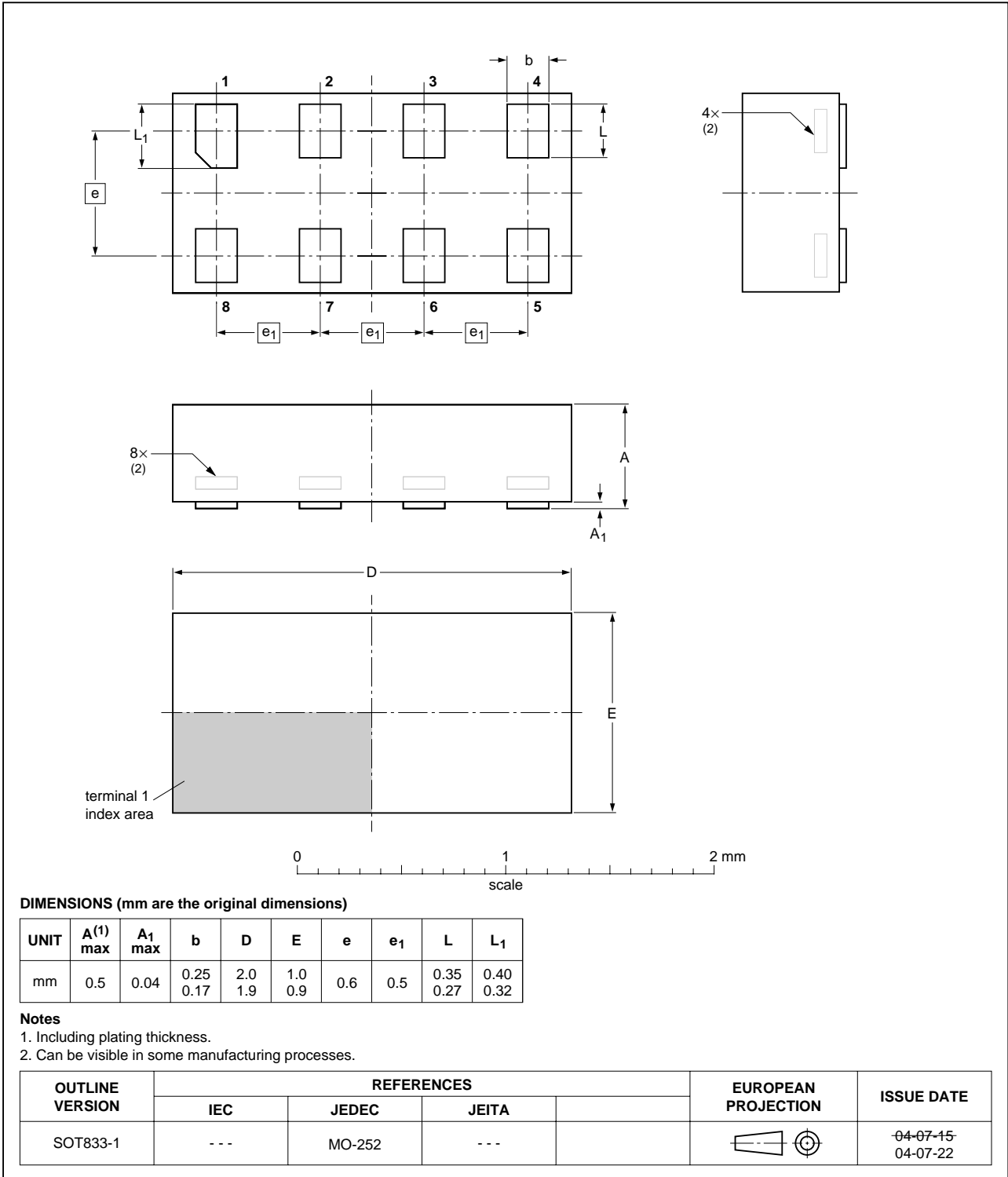


Fig 17. Package outline SOT833-1 (XSON8).

16. Revision history

Table 12: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74AHC3GU04_2	20040923	product data sheet	-	9397 750 13742	74AHC3GU04_1
Modifications:	Addition of SOT833 and changes in Ordering information and ESD protection.				
74AHC3GU04_1	20040305	product data sheet	-	9397 750 12754	-

17. Data sheet status

Level	Data sheet status ^[1]	Product status ^[2] ^[3]	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

18. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

19. Disclaimers

Life support — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status 'Production'), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

20. Contact information

For additional information, please visit: <http://www.semiconductors.philips.com>

For sales office addresses, send an email to: sales.addresses@www.semiconductors.philips.com

21. Contents

1	General description	1
2	Features	1
3	Quick reference data	1
4	Ordering information	2
5	Marking	2
6	Functional diagram	2
7	Pinning information	3
7.1	Pinning	3
7.2	Pin description	3
8	Functional description	3
8.1	Function table	3
9	Limiting values	4
10	Recommended operating conditions	4
11	Static characteristics	5
12	Dynamic characteristics	7
13	AC waveforms	8
13.1	Typical transfer characteristics	9
13.2	Forward transconductance	10
14	Application information	10
14.1	Linear amplifier	11
14.2	Crystal oscillator	11
15	Package outline	13
16	Revision history	16
17	Data sheet status	17
18	Definitions	17
19	Disclaimers	17
20	Contact information	17



© Koninklijke Philips Electronics N.V. 2004

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Date of release: 23 September 2004
Document number: 9397 750 13742

Published in The Netherlands