

74AUP2GU04

Low-power dual unbuffered inverter

Rev. 7 — 9 August 2021

Product data sheet

1. General description

The 74AUP2GU04 is a dual unbuffered inverter. Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times. This device ensures very low static and dynamic power consumption across the entire V_{CC} range from 0.8 V to 3.6 V.

2. Features and benefits

- Wide supply voltage range from 0.8 V to 3.6 V
- CMOS low power dissipation
- High noise immunity
- Overvoltage tolerant inputs to 3.6 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Low static power consumption; $I_{CC} = 0.9 \mu\text{A}$ (maximum)
- Complies with JEDEC standards:
 - JESD8-12 (0.8 V to 1.3 V)
 - JESD8-11 (0.9 V to 1.65 V)
 - JESD8-7 (1.2 V to 1.95 V)
 - JESD8-5 (1.8 V to 2.7 V)
 - JESD8-B (2.7 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F Class 3A exceeds 5000 V
 - MM JESD22-A115-A exceeds 200 V
 - CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AUP2GU04GW	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74AUP2GU04GM	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
74AUP2GU04GN	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115
74AUP2GU04GS	-40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202

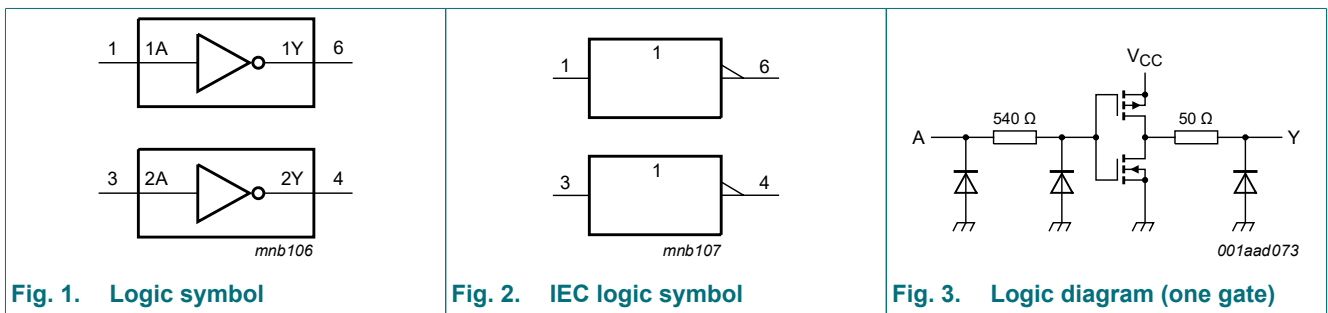
4. Marking

Table 2. Marking

Type number	Marking code[1]
74AUP2GU04GW	aD
74AUP2GU04GM	aD
74AUP2GU04GN	aD
74AUP2GU04GS	aD

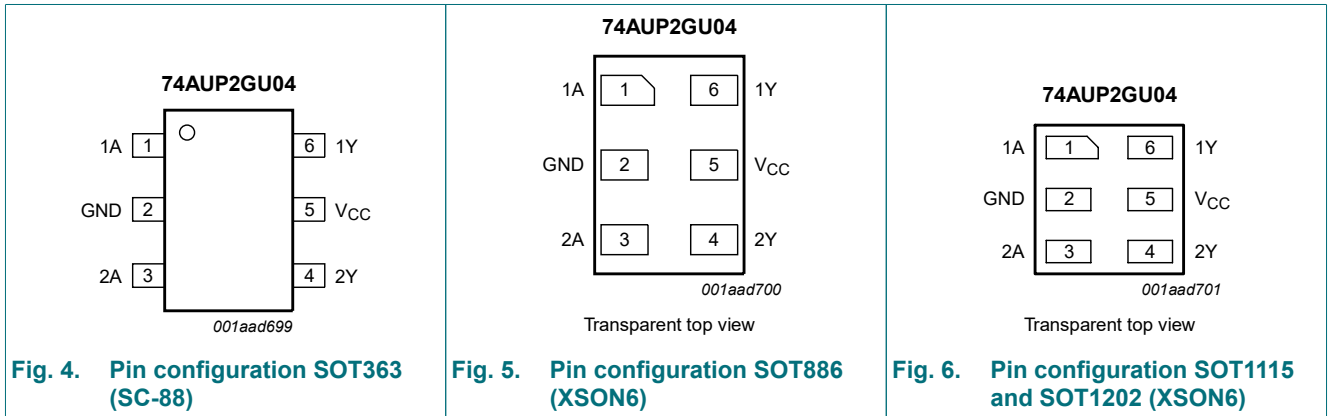
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

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

7. Functional description

Table 4. Function table

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

Input	Output
nA	nY
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	+4.6	V
I _{IK}	input clamping current	V _I < 0 V	-50	-	mA
V _I	input voltage	[1]	-0.5	+4.6	V
I _{OK}	output clamping current	V _O < 0 V	-50	-	mA
V _O	output voltage	[2]	-0.5	V _{CC} + 0.5	V
I _O	output current	V _O = 0 V to V _{CC}	-	±20	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C [3]	-	250	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 SOT363 (SC-88) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.
 For SOT886 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.
 For SOT1115 (XSON6) package: P_{tot} derates linearly with 3.2 mW/K above 71 °C.
 For SOT1202 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		0.8	3.6	V
V_I	input voltage		0	3.6	V
V_O	output voltage		0	V_{CC}	V
T_{amb}	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 0.8\text{ V to }3.6\text{ V}$	0	200	ns/V

10. Static characteristics

Table 7. 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	$V_{CC} = 0.8\text{ V to }3.6\text{ V}$	$0.75 \times V_{CC}$	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 0.8\text{ V to }3.6\text{ V}$	-	-	$0.25 \times V_{CC}$	V
V_{OH}	HIGH-level output voltage	$V_I = \text{GND or } V_{CC}$				
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 0.8\text{ V to }3.6\text{ V}$	$V_{CC} - 0.1$	-	-	V
		$I_O = -1.1\text{ mA}; V_{CC} = 1.1\text{ V}$	$0.75 \times V_{CC}$	-	-	V
		$I_O = -1.7\text{ mA}; V_{CC} = 1.4\text{ V}$	1.11	-	-	V
		$I_O = -1.9\text{ mA}; V_{CC} = 1.65\text{ V}$	1.32	-	-	V
		$I_O = -2.3\text{ mA}; V_{CC} = 2.3\text{ V}$	2.05	-	-	V
		$I_O = -3.1\text{ mA}; V_{CC} = 2.3\text{ V}$	1.9	-	-	V
		$I_O = -2.7\text{ mA}; V_{CC} = 3.0\text{ V}$	2.72	-	-	V
V_{OL}	LOW-level output voltage	$V_I = \text{GND or } V_{CC}$				
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 0.8\text{ V to }3.6\text{ V}$	-	-	0.1	V
		$I_O = 1.1\text{ mA}; V_{CC} = 1.1\text{ V}$	-	-	$0.3 \times V_{CC}$	V
		$I_O = 1.7\text{ mA}; V_{CC} = 1.4\text{ V}$	-	-	0.31	V
		$I_O = 1.9\text{ mA}; V_{CC} = 1.65\text{ V}$	-	-	0.31	V
		$I_O = 2.3\text{ mA}; V_{CC} = 2.3\text{ V}$	-	-	0.31	V
		$I_O = 3.1\text{ mA}; V_{CC} = 2.3\text{ V}$	-	-	0.44	V
		$I_O = 2.7\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.31	V
	$I_O = 4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.44	V	
I_I	input leakage current	$V_I = \text{GND to } 3.6\text{ V}; V_{CC} = 0\text{ V to }3.6\text{ V}$	-	-	± 0.1	μA
I_{CC}	supply current	$V_I = \text{GND or } V_{CC}; I_O = 0\text{ A}; V_{CC} = 0.8\text{ V to }3.6\text{ V}$	-	-	0.5	μA
C_I	input capacitance	$V_{CC} = 0\text{ V to }3.6\text{ V}; V_I = \text{GND or } V_{CC}$	-	1.5	-	pF
C_O	output capacitance	$V_O = \text{GND}; V_{CC} = 0\text{ V}$	-	1.8	-	pF

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +85 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 0.8 V to 3.6 V	0.75 × V _{CC}	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 0.8 V to 3.6 V	-	-	0.25 × V _{CC}	V
V _{OH}	HIGH-level output voltage	V _I = GND or V _{CC}				
		I _O = -20 μA; V _{CC} = 0.8 V to 3.6 V	V _{CC} - 0.1	-	-	V
		I _O = -1.1 mA; V _{CC} = 1.1 V	0.7 × V _{CC}	-	-	V
		I _O = -1.7 mA; V _{CC} = 1.4 V	1.03	-	-	V
		I _O = -1.9 mA; V _{CC} = 1.65 V	1.30	-	-	V
		I _O = -2.3 mA; V _{CC} = 2.3 V	1.97	-	-	V
		I _O = -3.1 mA; V _{CC} = 2.3 V	1.85	-	-	V
		I _O = -2.7 mA; V _{CC} = 3.0 V	2.67	-	-	V
V _{OL}	LOW-level output voltage	V _I = GND or V _{CC}				
		I _O = 20 μA; V _{CC} = 0.8 V to 3.6 V	-	-	0.1	V
		I _O = 1.1 mA; V _{CC} = 1.1 V	-	-	0.3 × V _{CC}	V
		I _O = 1.7 mA; V _{CC} = 1.4 V	-	-	0.37	V
		I _O = 1.9 mA; V _{CC} = 1.65 V	-	-	0.35	V
		I _O = 2.3 mA; V _{CC} = 2.3 V	-	-	0.33	V
		I _O = 3.1 mA; V _{CC} = 2.3 V	-	-	0.45	V
		I _O = 2.7 mA; V _{CC} = 3.0 V	-	-	0.33	V
I _I	input leakage current	V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V	-	-	±0.5	μA
		V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 0.8 V to 3.6 V	-	-	0.9	μA
I _{CC}	supply current	V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 0.8 V to 3.6 V	-	-	0.9	μA
T_{amb} = -40 °C to +125 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 0.8 V to 3.6 V	0.75 × V _{CC}	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 0.8 V to 3.6 V	-	-	0.25 × V _{CC}	V
V _{OH}	HIGH-level output voltage	V _I = GND or V _{CC}				
		I _O = -20 μA; V _{CC} = 0.8 V to 3.6 V	V _{CC} - 0.11	-	-	V
		I _O = -1.1 mA; V _{CC} = 1.1 V	0.6 × V _{CC}	-	-	V
		I _O = -1.7 mA; V _{CC} = 1.4 V	0.93	-	-	V
		I _O = -1.9 mA; V _{CC} = 1.65 V	1.17	-	-	V
		I _O = -2.3 mA; V _{CC} = 2.3 V	1.77	-	-	V
		I _O = -3.1 mA; V _{CC} = 2.3 V	1.67	-	-	V
		I _O = -2.7 mA; V _{CC} = 3.0 V	2.40	-	-	V
I _I	input leakage current	V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V	-	-	±0.5	μA
		V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 0.8 V to 3.6 V	-	-	0.9	μA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{OL}	LOW-level output voltage	V _I = GND or V _{CC}				
		I _O = 20 μA; V _{CC} = 0.8 V to 3.6 V	-	-	0.11	V
		I _O = 1.1 mA; V _{CC} = 1.1 V	-	-	0.33 × V _{CC}	V
		I _O = 1.7 mA; V _{CC} = 1.4 V	-	-	0.41	V
		I _O = 1.9 mA; V _{CC} = 1.65 V	-	-	0.39	V
		I _O = 2.3 mA; V _{CC} = 2.3 V	-	-	0.36	V
		I _O = 3.1 mA; V _{CC} = 2.3 V	-	-	0.50	V
		I _O = 2.7 mA; V _{CC} = 3.0 V	-	-	0.36	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.50	V
I _I	input leakage current	V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V	-	-	±0.75	μA
I _{CC}	supply current	V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 0.8 V to 3.6 V	-	-	1.4	μA

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 8.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
C_L = 5 pF										
t _{pd}	propagation delay	nA to nY; see Fig. 7 [2]								
		V _{CC} = 0.8 V	-	6.2	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	0.9	2.3	4.4	0.9	4.8	0.9	5.3	ns
		V _{CC} = 1.4 V to 1.6 V	0.7	1.7	3.1	0.6	3.4	0.6	3.8	ns
		V _{CC} = 1.65 V to 1.95 V	0.5	1.4	2.6	0.5	2.9	0.5	3.2	ns
		V _{CC} = 2.3 V to 2.7 V	0.4	1.1	2.0	0.4	2.3	0.4	2.6	ns
		V _{CC} = 3.0 V to 3.6 V	0.3	1.0	1.8	0.3	2.1	0.3	2.4	ns
C_L = 10 pF										
t _{pd}	propagation delay	nA to nY; see Fig. 7 [2]								
		V _{CC} = 0.8 V	-	9.6	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	1.2	3.1	6.1	1.2	6.8	1.2	7.5	ns
		V _{CC} = 1.4 V to 1.6 V	1.0	2.3	4.0	0.9	4.6	0.9	5.1	ns
		V _{CC} = 1.65 V to 1.95 V	0.8	1.9	3.3	0.7	3.8	0.7	4.2	ns
		V _{CC} = 2.3 V to 2.7 V	0.6	1.5	2.7	0.6	3.1	0.6	3.5	ns
		V _{CC} = 3.0 V to 3.6 V	0.5	1.3	2.4	0.5	2.7	0.5	3.0	ns
C_L = 15 pF										
t _{pd}	propagation delay	nA to nY; see Fig. 7 [2]								
		V _{CC} = 0.8 V	-	13.0	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	1.6	3.8	7.9	1.4	8.8	1.4	9.7	ns
		V _{CC} = 1.4 V to 1.6 V	1.3	2.8	4.9	1.1	5.7	1.1	6.3	ns
		V _{CC} = 1.65 V to 1.95 V	1.0	2.3	4.0	0.9	4.7	0.9	5.2	ns
		V _{CC} = 2.3 V to 2.7 V	0.8	1.9	3.2	0.8	3.7	0.8	4.1	ns
		V _{CC} = 3.0 V to 3.6 V	0.7	1.6	2.9	0.7	3.3	0.7	3.7	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
C_L = 30 pF										
t _{pd}	propagation delay	nA to nY; see Fig. 7 [2]								
		V _{CC} = 0.8 V	-	23.2	-	-	-	-	-	ns
		V _{CC} = 1.1 V to 1.3 V	2.4	6.0	13.1	2.2	14.8	2.2	16.3	ns
		V _{CC} = 1.4 V to 1.6 V	2.0	4.2	7.6	1.8	9.0	1.8	9.9	ns
		V _{CC} = 1.65 V to 1.95 V	1.7	3.6	6.1	1.5	7.2	1.5	8.0	ns
		V _{CC} = 2.3 V to 2.7 V	1.4	2.9	4.8	1.3	5.7	1.3	6.3	ns
		V _{CC} = 3.0 V to 3.6 V	1.2	2.5	4.3	1.1	5.1	1.1	5.7	ns
C_L = 5 pF, 10 pF, 15 pF and 30 pF										
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _I = GND to V _{CC} [3] [4]								
		V _{CC} = 0.8 V	-	1.1	-	-	-	-	-	pF
		V _{CC} = 1.1 V to 1.3 V	-	1.1	-	-	-	-	-	pF
		V _{CC} = 1.4 V to 1.6 V	-	1.3	-	-	-	-	-	pF
		V _{CC} = 1.65 V to 1.95 V	-	1.5	-	-	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	3.0	-	-	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	4.5	-	-	-	-	pF	

- [1] All typical values are measured at nominal V_{CC}.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] All specified values are the average typical values over all stated loads.
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz;
 f_o = output frequency in MHz;
 C_L = 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.

11.1. Waveforms and test circuit

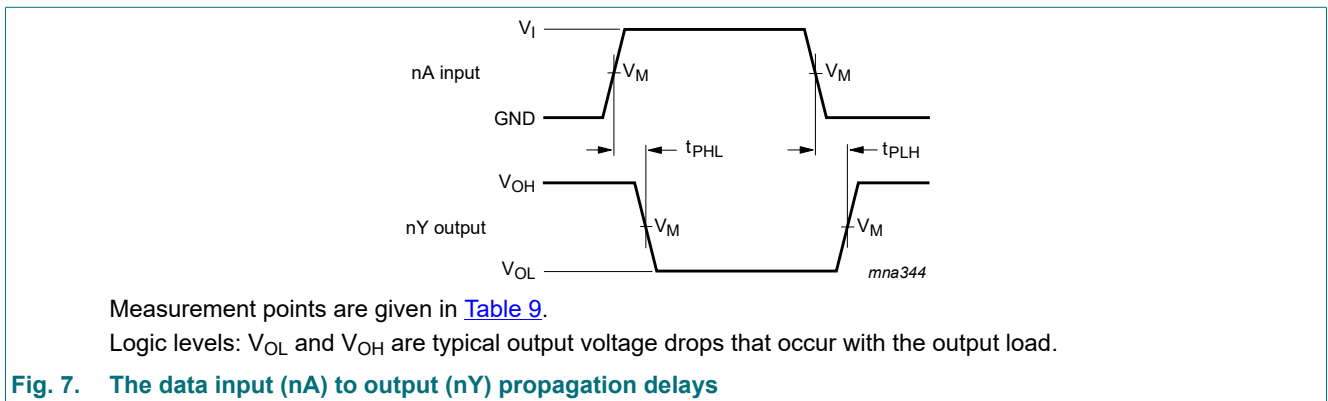
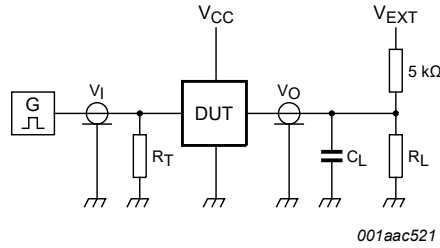


Table 9. Measurement points

Supply voltage	Input			Output
V _{CC}	V _M	V _I	t _r = t _f	V _M
0.8 V to 3.6 V	0.5 × V _{CC}	V _{CC}	≤ 3.0 ns	0.5 × V _{CC}



Test data is given in [Table 10](#).

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 the output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig. 8. Test circuit for measuring switching times

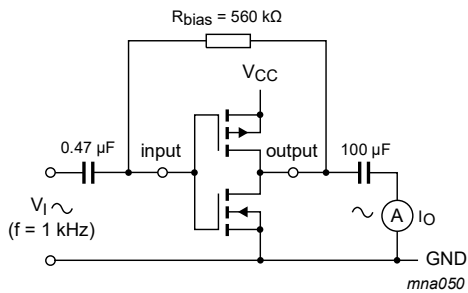
Table 10. Test data

Supply voltage	Load		V_{EXT}		
V_{CC}	C_L	R_L [1]	t_{PLH} , t_{PHL}	t_{PZH} , t_{PHZ}	t_{PZL} , t_{PLZ}
0.8 V to 3.6 V	5 pF, 10 pF, 15 pF and 30 pF	5 kΩ or 1 MΩ	open	GND	$2 \times V_{CC}$

[1] For measuring enable and disable times $R_L = 5 \text{ k}\Omega$.

For measuring propagation delays, set-up and hold times and pulse width $R_L = 1 \text{ M}\Omega$.

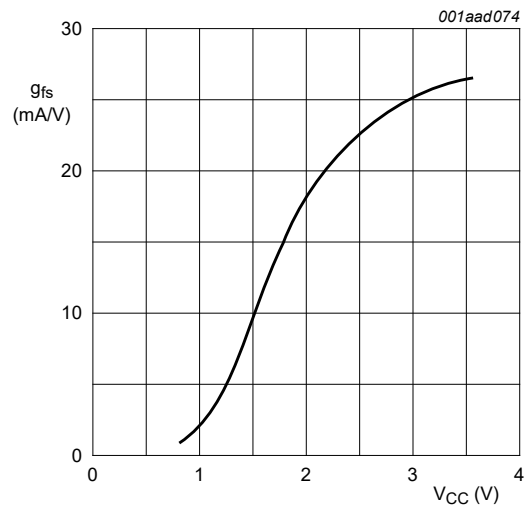
12. Additional characteristics



$$g_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

V_O is constant.

Fig. 9. Test set-up for measuring forward transconductance



$T_{amb} = 25 \text{ }^\circ\text{C}$.

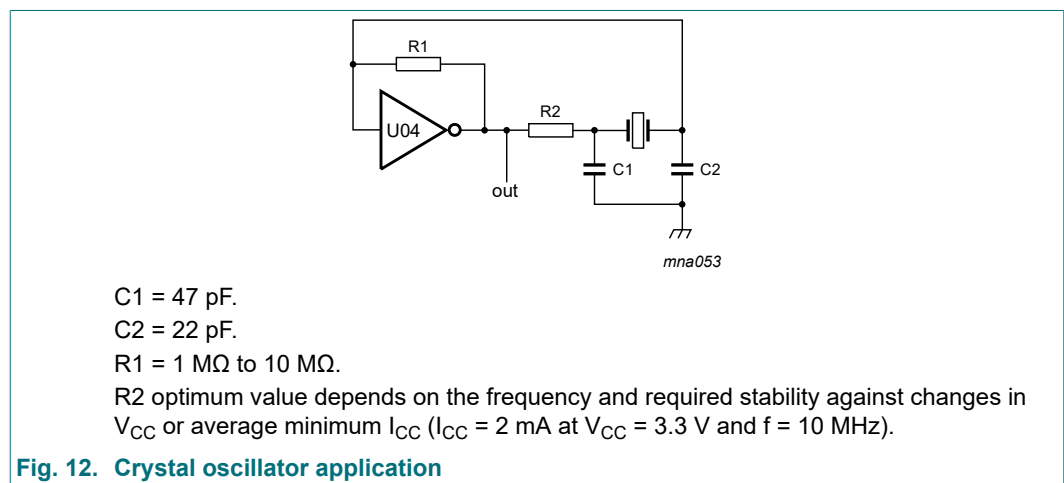
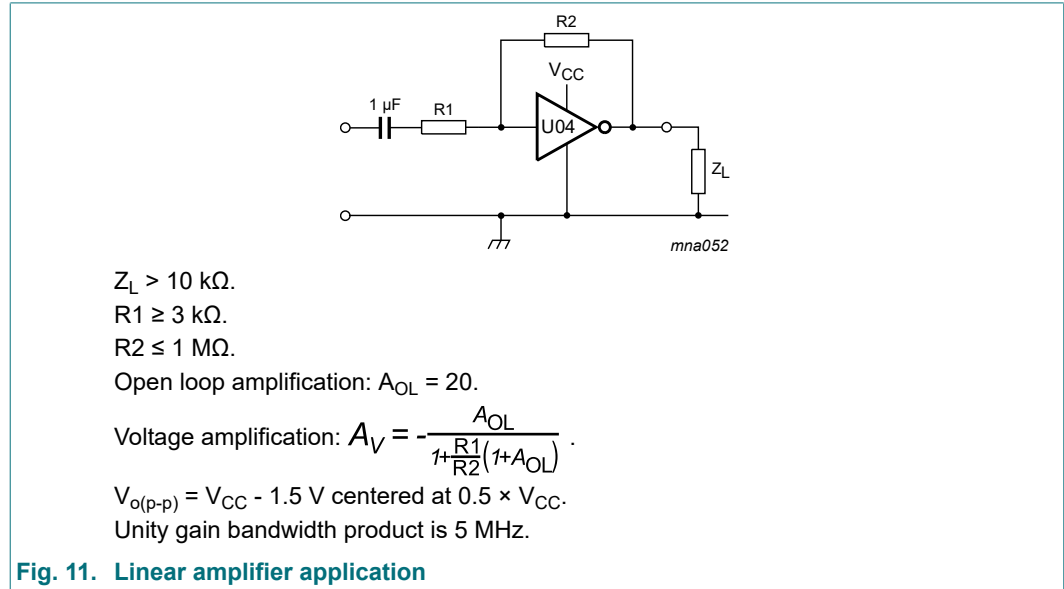
Fig. 10. Typical forward transconductance as a function of supply voltage

13. Application information

Some applications for the 74AUP2GU04 are:

- Linear amplifier (see [Fig. 11](#))
- Crystal oscillator (see [Fig. 12](#))

Remark: All values given are typical values unless otherwise specified.



14. Package outline

Plastic surface-mounted package; 6 leads

SOT363

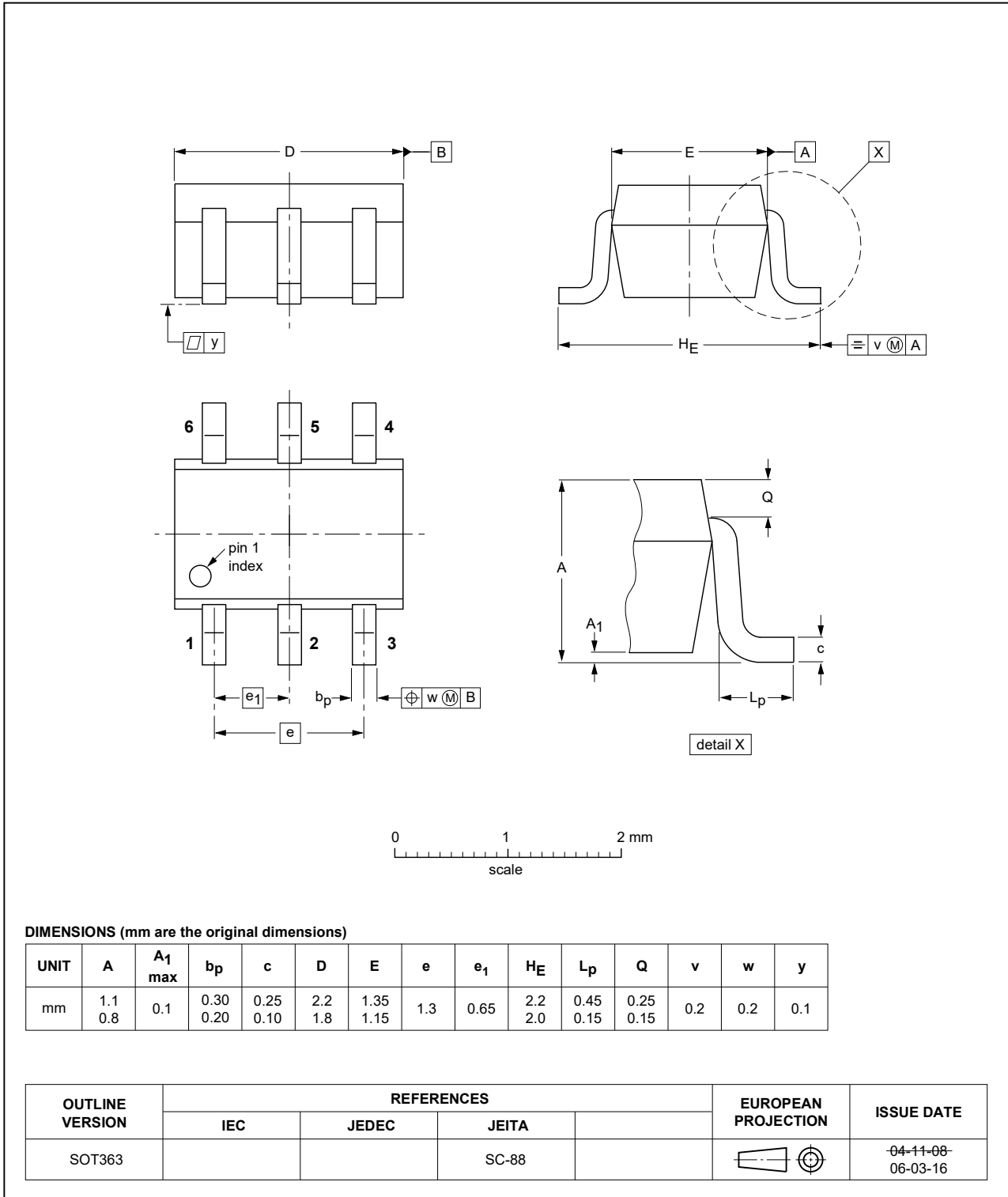


Fig. 13. Package outline SOT363 (SC-88)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886

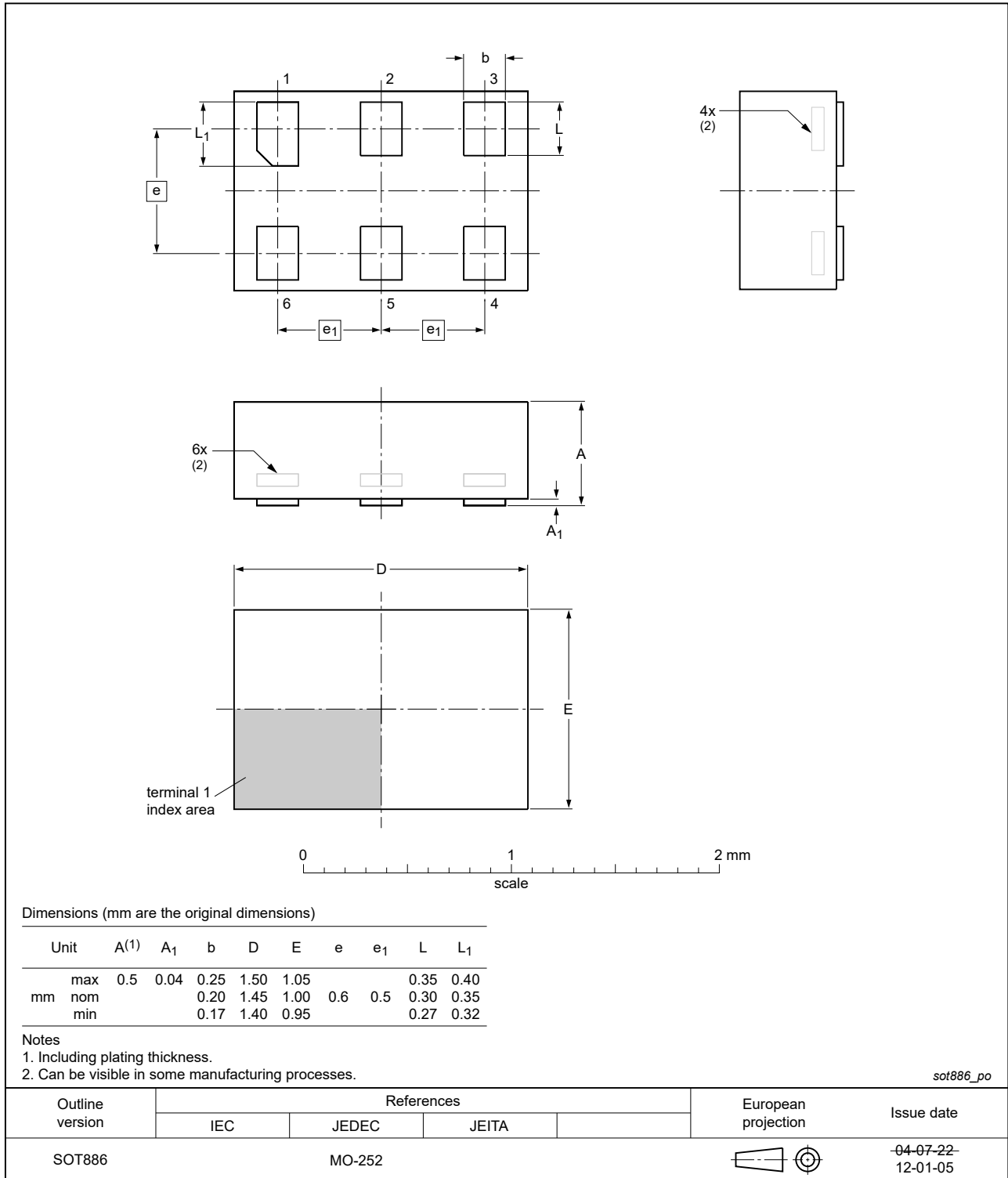


Fig. 14. Package outline SOT886 (XSON6)

XSON6: extremely thin small outline package; no leads;
6 terminals; body 0.9 x 1.0 x 0.35 mm

SOT1115

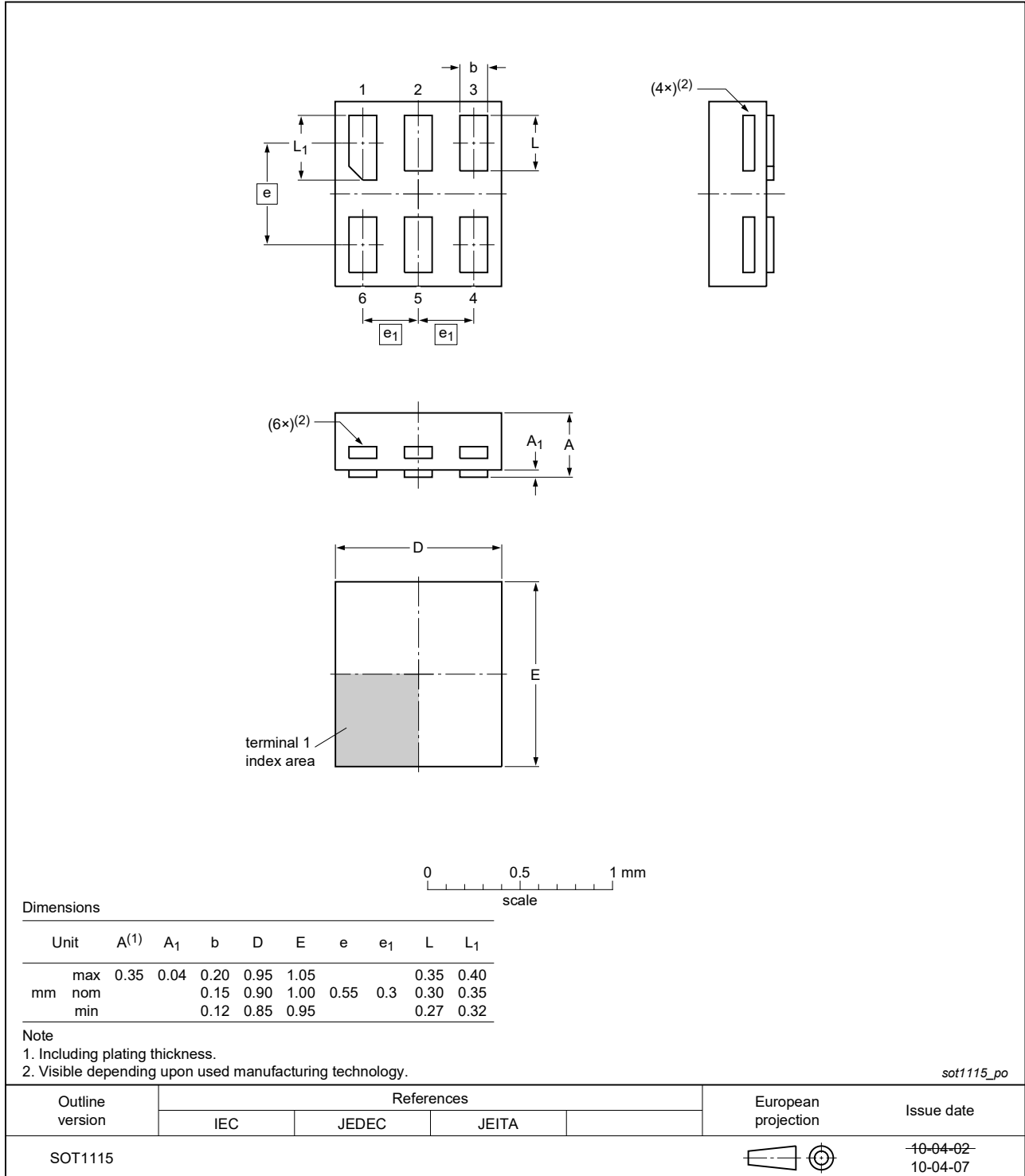


Fig. 15. Package outline SOT1115 (XSON6)

XSON6: extremely thin small outline package; no leads;
6 terminals; body 1.0 x 1.0 x 0.35 mm

SOT1202

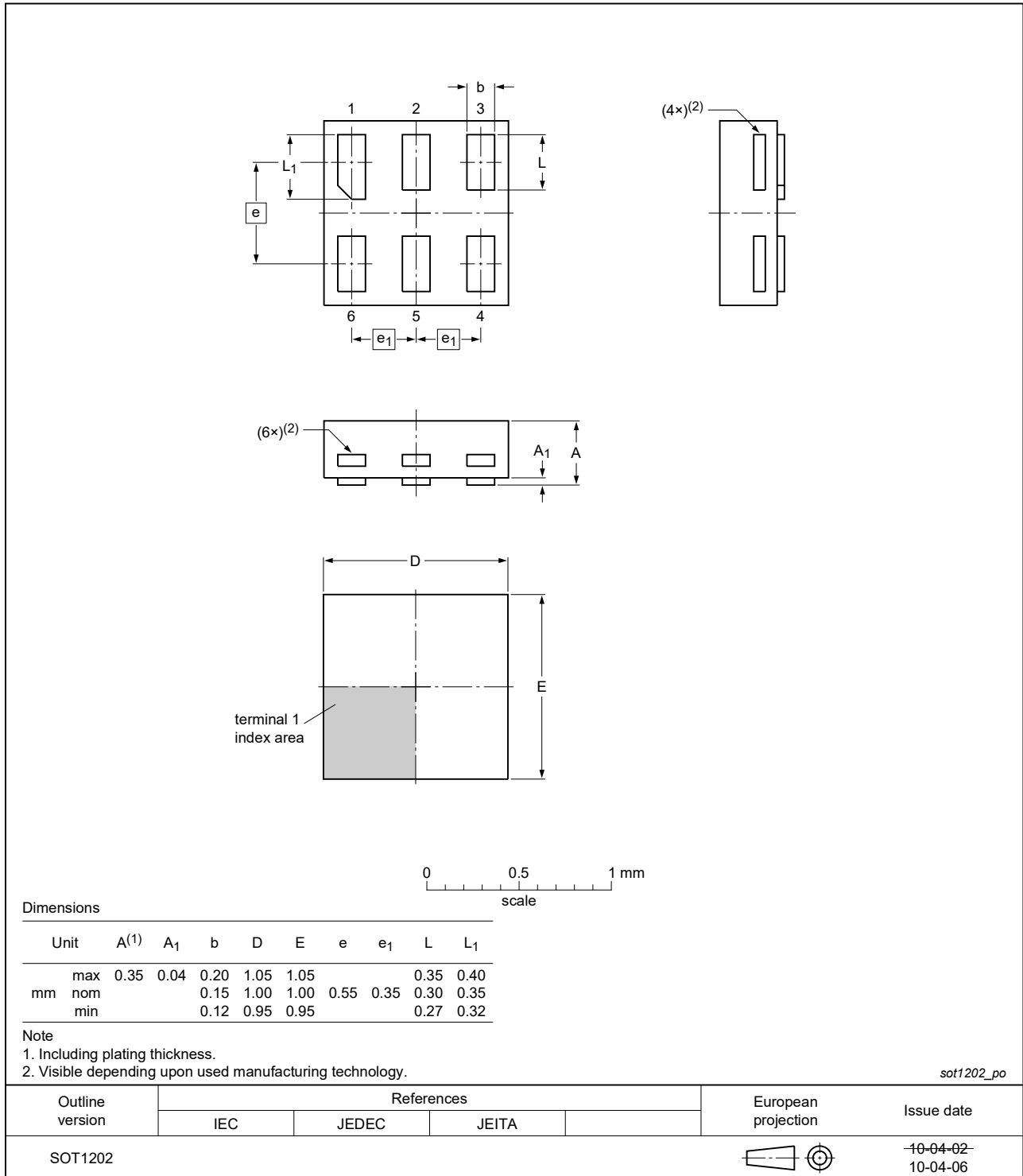


Fig. 16. Package outline SOT1202 (XSON6)

15. Abbreviations

Table 11. Abbreviations

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

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AUP2GU04 v.7	20210809	Product data sheet	-	74AUP2GU04 v.6
Modifications:	<ul style="list-style-type: none"> Type number 74AUP2GU04GF (SOT891/XSON6) removed. Section 1 and Section 2 updated. Table 5: Derating values for P_{tot} total power dissipation updated. 			
74AUP2GU04 v.6	20190128	Product data sheet	-	74AUP2GU04 v.5
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. 			
74AUP2GU04 v.5	20131011	Product data sheet	-	74AUP2GU04 v.4
Modifications:	<ul style="list-style-type: none"> Package outline drawing of SOT886 (Fig. 14) modified. 			
74AUP2GU04 v.4	20111207	Product data sheet	-	74AUP2GU04 v.3
Modifications:	<ul style="list-style-type: none"> Legal pages updated. 			
74AUP2GU04 v.3	20101110	Product data sheet	-	74AUP2GU04 v.2
74AUP2GU04 v.2	20090703	Product data sheet	-	74AUP2GU04 v.1
74AUP2GU04 v.1	20061215	Product data sheet	-	-

17. Legal information

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.
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