

# 74LVC2GU04

Dual unbuffered inverter

Rev. 13 — 20 January 2022

Product data sheet

## 1. General description

The 74LVC2GU04 is a dual unbuffered inverter. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

## 2. Features and benefits

- Wide supply voltage range from 1.65 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- $\pm 24$  mA output drive ( $V_{CC} = 3.0$  V)
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard no. 8-1A
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 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			Version
	Temperature range	Name	Description	
74LVC2GU04GW	$-40$ °C to $+125$ °C	TSSOP6	plastic thin shrink small outline package; 6 leads; body width 1.25 mm	SOT363-2
74LVC2GU04GV	$-40$ °C to $+125$ °C	SC-74; TSOP6	plastic surface-mounted package; 6 leads	SOT457
74LVC2GU04GM	$-40$ °C to $+125$ °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body $1 \times 1.45 \times 0.5$ mm	SOT886
74LVC2GU04GN	$-40$ °C to $+125$ °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body $0.9 \times 1.0 \times 0.35$ mm	SOT1115
74LVC2GU04GS	$-40$ °C to $+125$ °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body $1.0 \times 1.0 \times 0.35$ mm	SOT1202

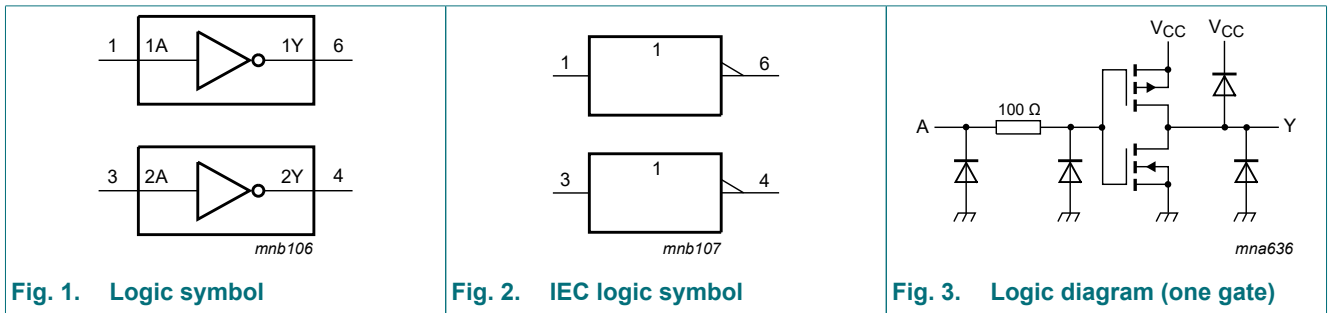
## 4. Marking

Table 2. Marking codes

Type number	Marking [1]
74LVC2GU04GW	YD
74LVC2GU04GV	VU4
74LVC2GU04GM	YD
74LVC2GU04GN	YD
74LVC2GU04GS	YD

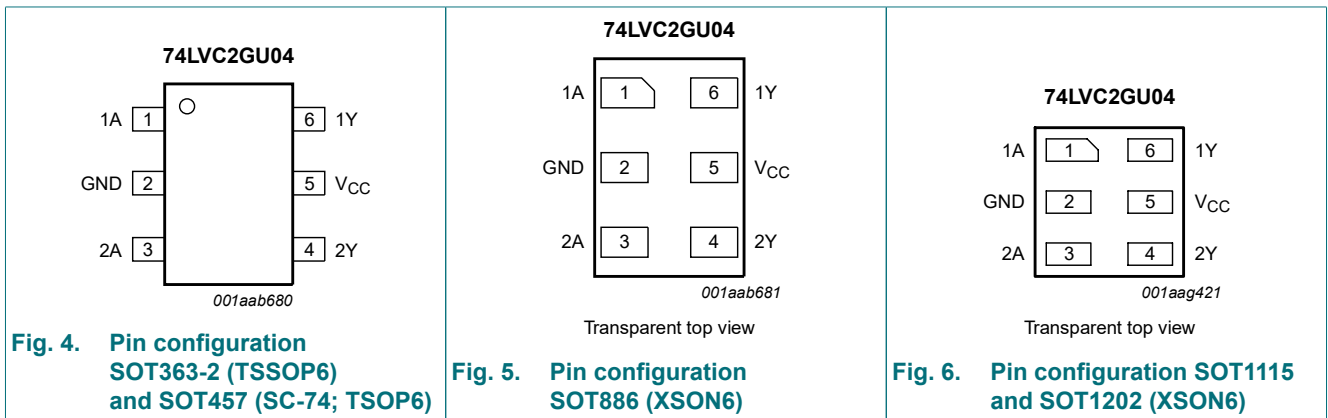
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 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 <sub>CC</sub>	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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
V <sub>I</sub>	input voltage	[1]	-0.5	+6.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < 0 V	-50	-	mA
V <sub>O</sub>	output voltage	Active mode [1]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C [2]	-	250	mW

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

[2] For SOT363-2 (TSSOP6) package: P<sub>tot</sub> derates linearly with 3.7 mW/K above 83 °C.

For SOT457 (SC-74; TSOP6) package: P<sub>tot</sub> derates linearly with 4.1 mW/K above 89 °C.

For SOT886 (XSON6) package: P<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C.

For SOT1115 (XSON6) package: P<sub>tot</sub> derates linearly with 3.2 mW/K above 71 °C.

For SOT1202 (XSON6) package: P<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C.

## 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		1.65	-	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	Active mode	0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65\text{ V to }2.7\text{ V}$	-	-	20	ns/V
		$V_{CC} = 2.7\text{ V to }5.5\text{ V}$	-	-	10	ns/V

## 10. Static characteristics

**Table 7. 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	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.65\text{ V to }5.5\text{ V}$	$0.75V_{CC}$	-	-	$0.8V_{CC}$	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.65\text{ V to }5.5\text{ V}$	-	-	$0.25V_{CC}$	-	$0.2V_{CC}$	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = -100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$	$V_{CC} - 0.1$	-	-	$V_{CC} - 0.1$	-	V
		$I_O = -4\text{ mA}; V_{CC} = 1.65\text{ V}$	1.2	-	-	0.95	-	V
		$I_O = -8\text{ mA}; V_{CC} = 2.3\text{ V}$	1.9	-	-	1.7	-	V
		$I_O = -12\text{ mA}; V_{CC} = 2.7\text{ V}$	2.2	-	-	1.9	-	V
		$I_O = -24\text{ mA}; V_{CC} = 3.0\text{ V}$	2.3	-	-	2.0	-	V
		$I_O = -32\text{ mA}; V_{CC} = 4.5\text{ V}$	3.8	-	-	3.4	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = 100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$	-	-	0.1	-	0.1	V
		$I_O = 4\text{ mA}; V_{CC} = 1.65\text{ V}$	-	-	0.45	-	0.7	V
		$I_O = 8\text{ mA}; V_{CC} = 2.3\text{ V}$	-	-	0.3	-	0.45	V
		$I_O = 12\text{ mA}; V_{CC} = 2.7\text{ V}$	-	-	0.4	-	0.6	V
		$I_O = 24\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.55	-	0.8	V
		$I_O = 32\text{ mA}; V_{CC} = 4.5\text{ V}$	-	-	0.55	-	0.8	V
$I_I$	input leakage current	$V_I = 5.5\text{ V or GND}; V_{CC} = 0\text{ V to }5.5\text{ V}$	-	$\pm 0.1$	$\pm 1$	-	$\pm 1$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = 5.5\text{ V or GND}; I_O = 0\text{ A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$	-	0.1	4	-	4	$\mu\text{A}$
$C_I$	input capacitance	$V_{CC} = 3.3\text{ V}; V_I = \text{GND to }V_{CC}$	-	5	-	-	-	pF

[1] All typical values are measured at  $V_{CC} = 3.3\text{ V}$  and at  $T_{amb} = 25\text{ °C}$ .

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

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

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. 7 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.5	2.3	5.0	0.5	6.3	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.3	1.8	4.0	0.3	5.0	ns
		V <sub>CC</sub> = 2.7 V	0.3	2.6	4.5	0.3	5.6	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.3	2.3	3.7	0.3	4.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.3	1.7	3.0	0.3	3.8	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 3.3 V [3]	-	7.8	-			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, 3.3 V and 5.0 V respectively.

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

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

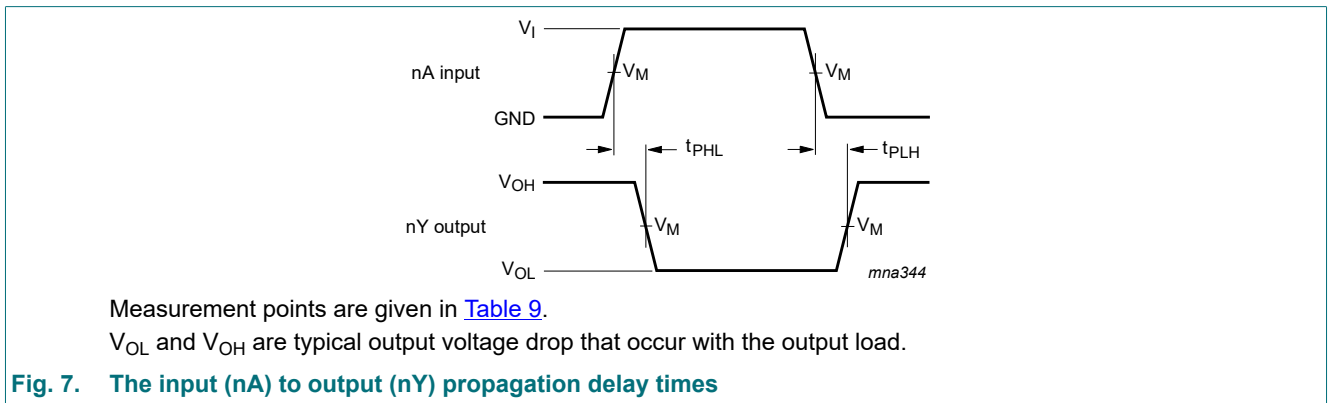
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

∑(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

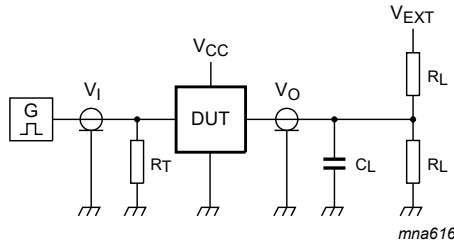
### 11.1. Waveforms and test circuit



**Fig. 7. The input (nA) to output (nY) propagation delay times**

**Table 9. Measurement points**

Supply voltage	Input	Output
V <sub>CC</sub>	V <sub>M</sub>	V <sub>M</sub>
1.65 V to 1.95 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>
2.3 V to 2.7 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V
4.5 V to 5.5 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>



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

Definitions for test circuit:

$R_L$  = Load resistance;

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

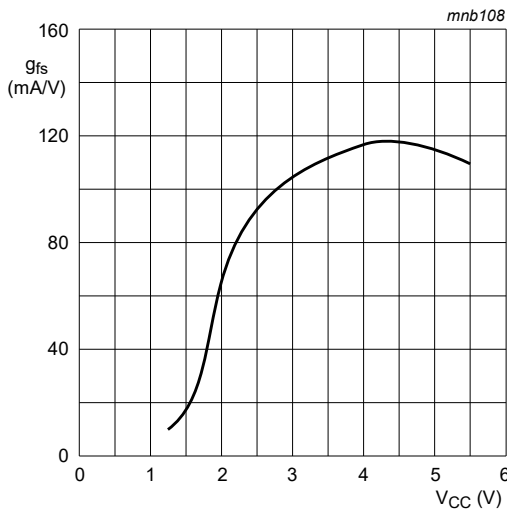
$R_T$  = Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator;

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

**Fig. 8. Test circuit for measuring switching times**

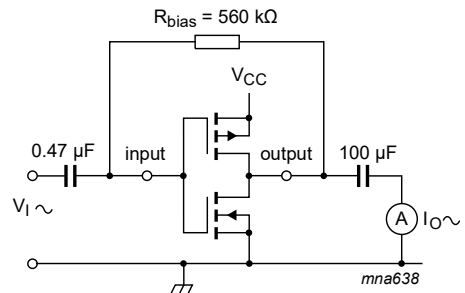
**Table 10. Test data**

Supply voltage	Input		Load		$V_{EXT}$
$V_{CC}$	$V_I$	$t_r = t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1 k $\Omega$	open
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open
4.5 V to 5.5 V	$V_{CC}$	$\leq 2.5$ ns	50 pF	500 $\Omega$	open



$T_{amb} = 25$  °C.

**Fig. 9. Typical forward transconductance as a function of supply voltage**



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

$f_i = 1$  kHz.

$V_O$  is constant.

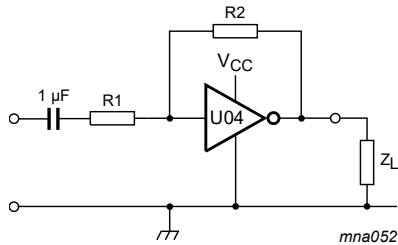
**Fig. 10. Test set-up for measuring forward transconductance**

## 12. Application information

Some applications are:

- Linear amplifier (see [Fig. 11](#))
- In crystal oscillator design (see [Fig. 12](#))

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



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

$$A_u = - \frac{G_{OL}}{1 + \frac{R_1}{R_2} (1 + G_{OL})}$$

$G_{OL}$  = open loop gain.

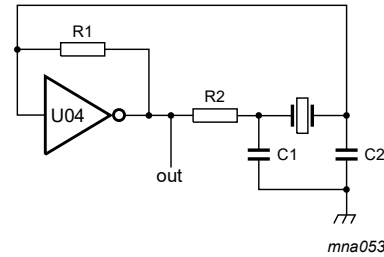
$A_u$  = voltage amplification.

$R_1 \geq 3 \text{ k}\Omega$ ,  $R_2 \leq 1 \text{ M}\Omega$ .

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

Typical unity gain bandwidth product is 5 MHz.

**Fig. 11. Linear amplifier configuration**



$C_1 = 47 \text{ pF}$  (typical).

$C_2 = 22 \text{ pF}$  (typical).

$R_1 = 1 \text{ M}\Omega$  to  $10 \text{ M}\Omega$  (typical).

$R_2$  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 when  $V_{CC} = 3.3 \text{ V}$  and  $f = 10 \text{ MHz}$ ).

**Fig. 12. Crystal oscillator configuration**

### 13. Package outline

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm

SOT363-2

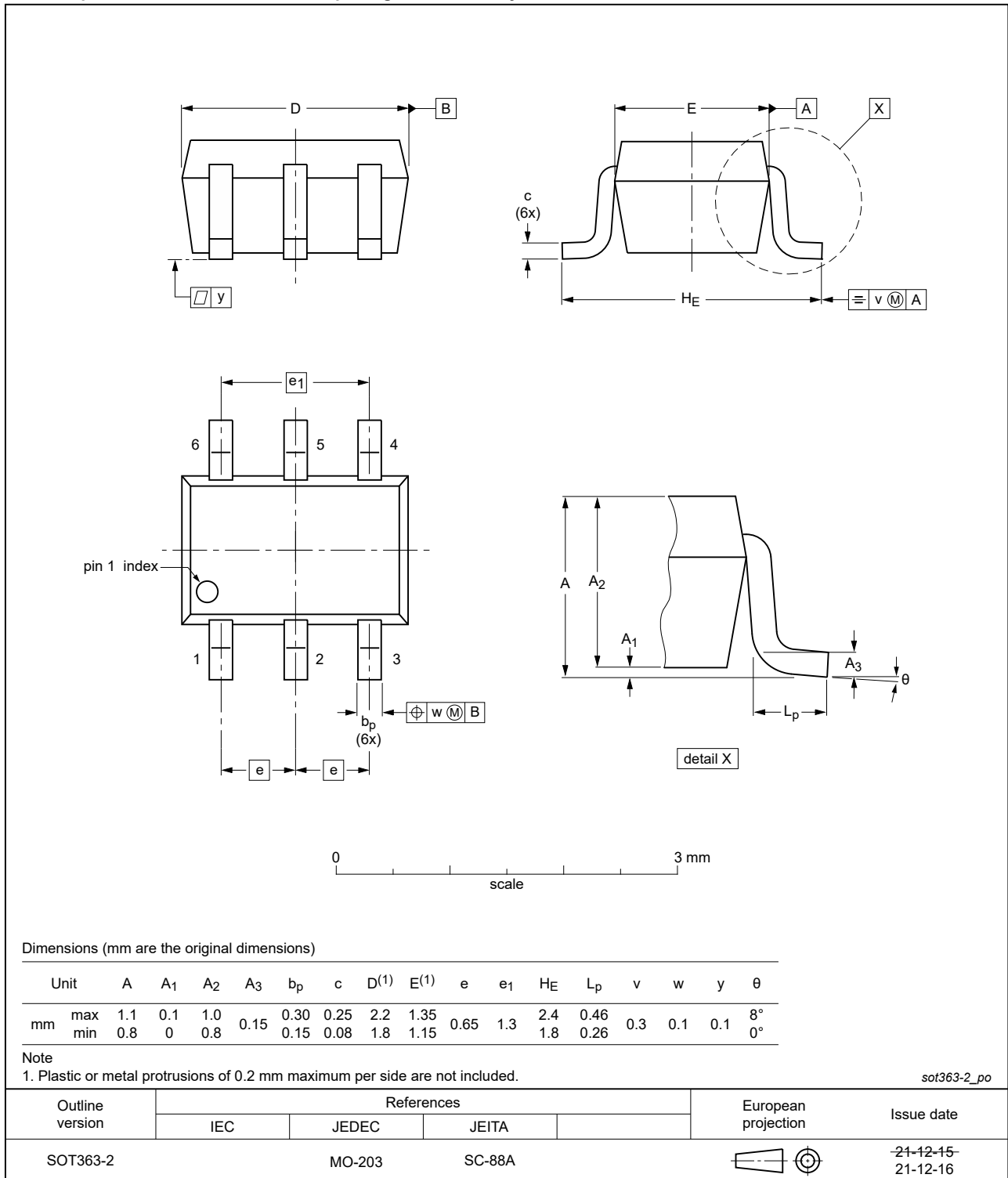


Fig. 13. Package outline SOT363-2 (TSSOP6)



Plastic, surface-mounted package (SC-74; TSOP6); 6 leads

SOT457

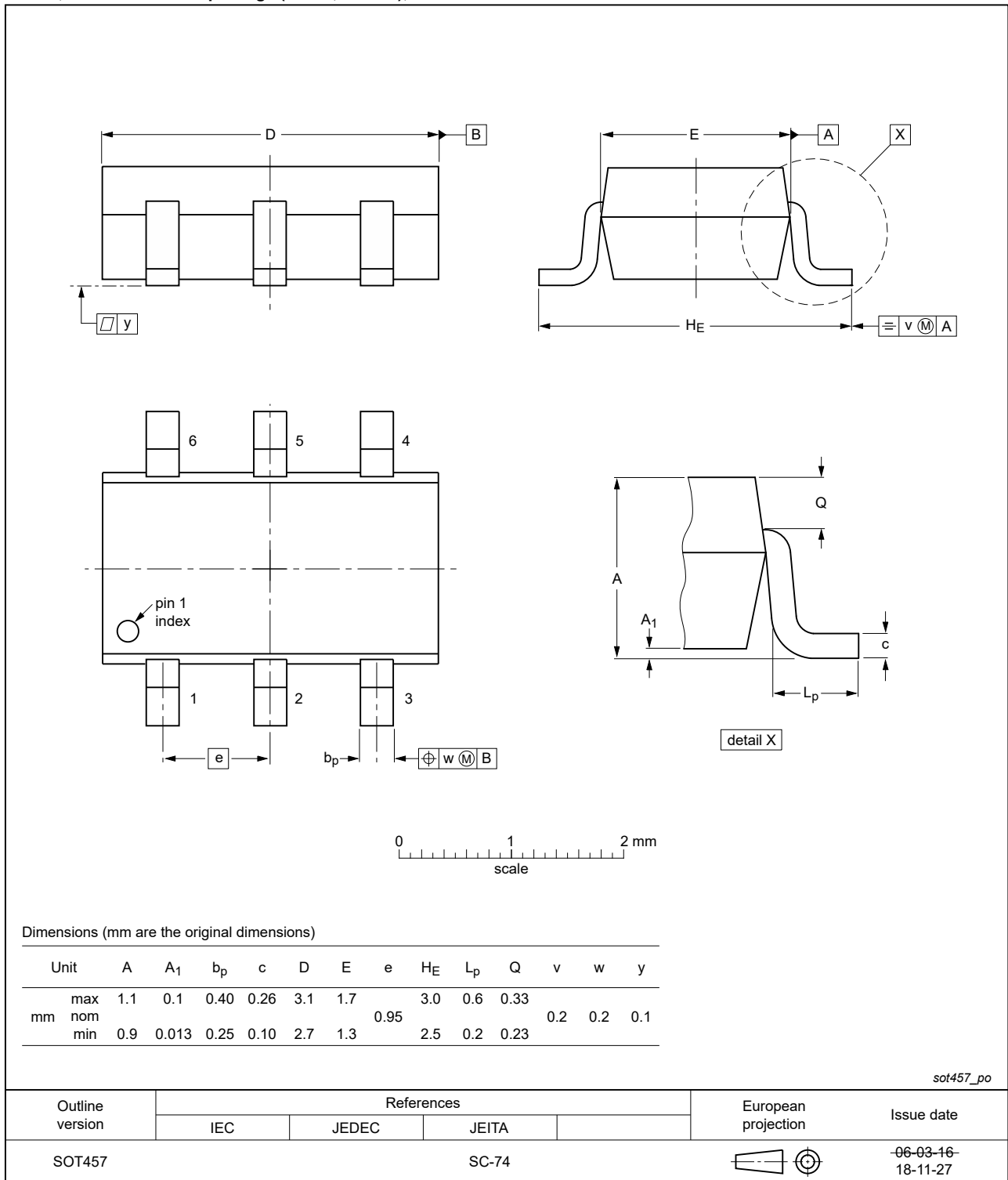


Fig. 14. Package outline SOT457 (SC-74; TSOP6)

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

SOT886

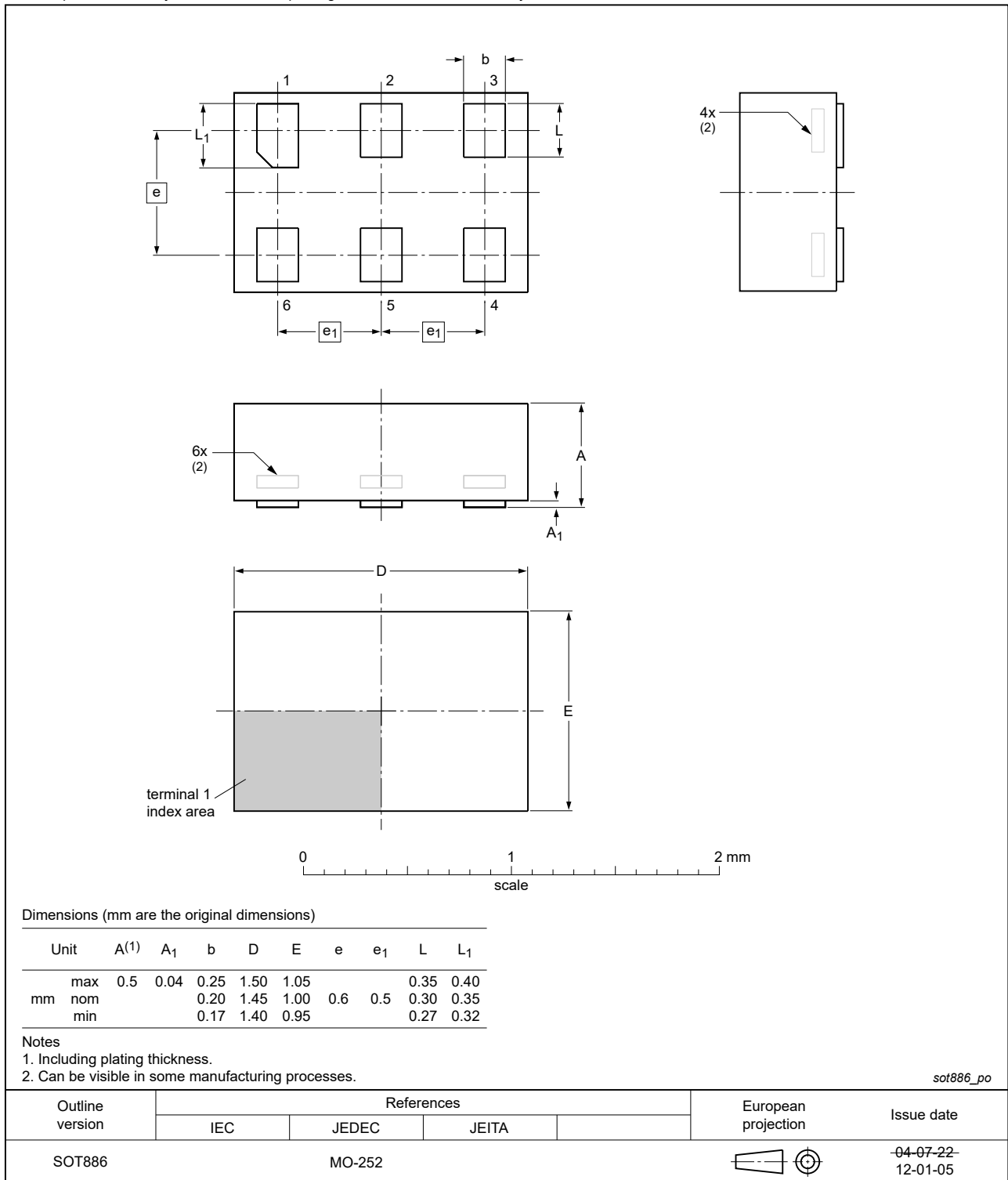


Fig. 15. Package outline SOT886 (XSON6)

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

SOT1115

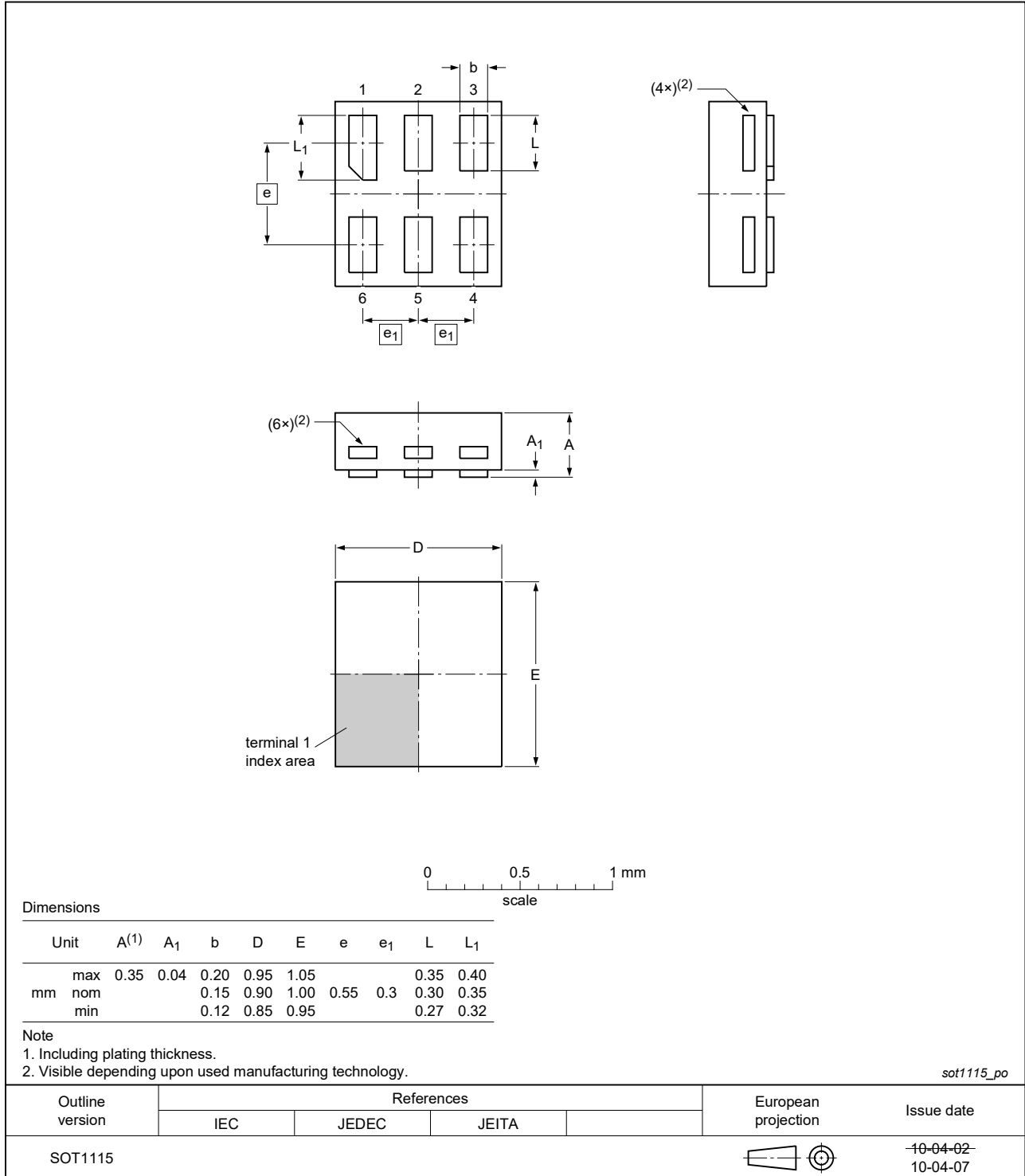


Fig. 16. Package outline SOT1115 (XSON6)

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

SOT1202

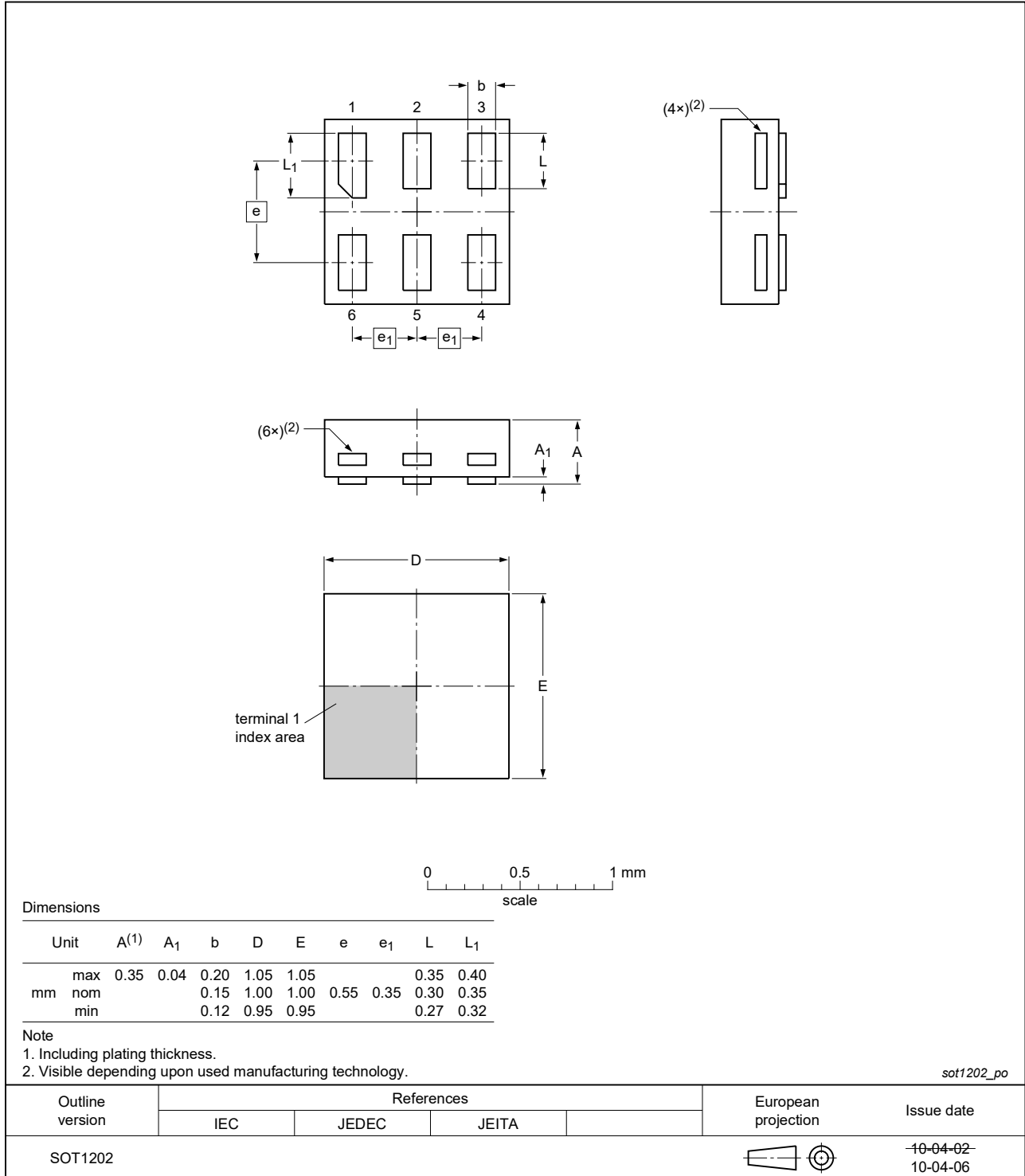


Fig. 17. Package outline SOT1202 (XSON6)

## 14. Abbreviations

Table 11. Abbreviations

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

## 15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2GU04 v.13	20220120	Product data sheet	-	74LVC2GU04 v.12
Modifications:	<ul style="list-style-type: none"> <li>Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6).</li> </ul>			
74LVC2GU04 v.12	20210419	Product data sheet	-	74LVC2GU04 v.11
Modifications:	<ul style="list-style-type: none"> <li>Type number 74LVC2GU04GF (SOT891 / XSON6) removed.</li> <li><a href="#">Section 1</a> updated.</li> <li><a href="#">Section 8</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li><a href="#">Fig. 14</a>: Package outline drawing SOT457 (SC-74; TSOP6) modified.</li> </ul>			
74LVC2GU04 v.11	20181009	Product data sheet	-	74LVC2GU04 v.10
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>			
74LVC2GU04 v.10	20170210	Product data sheet	-	74LVC2GU04 v.9
Modifications:	<ul style="list-style-type: none"> <li>Watermarks removed.</li> </ul>			
74LVC2GU04 v.9	20161215	Product data sheet	-	74LVC2GU04 v.8
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 7</a>: The maximum limits for leakage current and supply current have changed.</li> </ul>			
74LVC2GU04 v.8	20120703	Product data sheet	-	74LVC2GU04 v.7
Modifications:	<ul style="list-style-type: none"> <li>Package outline drawing of SOT886 (<a href="#">Fig. 15</a>) modified.</li> </ul>			
74LVC2GU04 v.7	20111128	Product data sheet	-	74LVC2GU04 v.6
Modifications:	<ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>			
74LVC2GU04 v.6	20101027	Product data sheet	-	74LVC2GU04 v.5
74LVC2GU04 v.5	20091027	Product data sheet	-	74LVC2GU04 v.4
74LVC2GU04 v.4	20070521	Product data sheet	-	74LVC2GU04 v.3
74LVC2GU04 v.3	20040921	Product specification	-	74LVC2GU04 v.2
74LVC2GU04 v.2	20040524	Product specification	-	74LVC2GU04 v.1
74LVC2GU04 v.1	20030829	Product specification	-	-

## 16. 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.
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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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Date of release: 20 January 2022

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