



**THE DATASHEET OF
74LVC2GU04GM,115**



74LVC2GU04

Dual unbuffered inverter

Rev. 11 — 9 October 2018

Product data sheet

1. General description

The 74LVC2GU04 provides two unbuffered inverters. Each inverter is a single stage with unbuffered output.

The inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device in a mixed 3.3 V and 5 V environment.

2. Features and benefits

- Wide supply voltage range from 1.65 V to 5.5 V
- 5 V tolerant input/output for interfacing with 5 V logic
- High noise immunity
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- ± 24 mA output drive ($V_{CC} = 3.0$ V)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Input accepts voltages up to 5 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 | SC-88 | plastic surface-mounted package; 6 leads | SOT363 |
| 74LVC2GU04GV | -40 °C to $+125$ °C | TSOP6 | plastic surface-mounted package (TSOP6); 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 |
| 74LVC2GU04GF | -40 °C to $+125$ °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body $1 \times 1 \times 0.5$ mm | SOT891 |
| 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 |

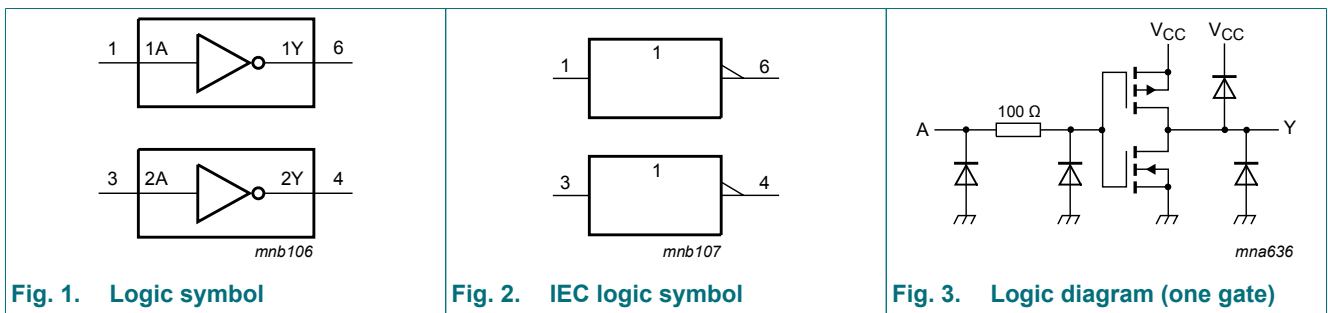
4. Marking

Table 2. Marking codes

| Type number | Marking [1] |
|--------------|-------------|
| 74LVC2GU04GW | YD |
| 74LVC2GU04GV | VU4 |
| 74LVC2GU04GM | YD |
| 74LVC2GU04GF | YD |
| 74LVC2GU04GN | YD |
| 74LVC2GU04GS | YD |

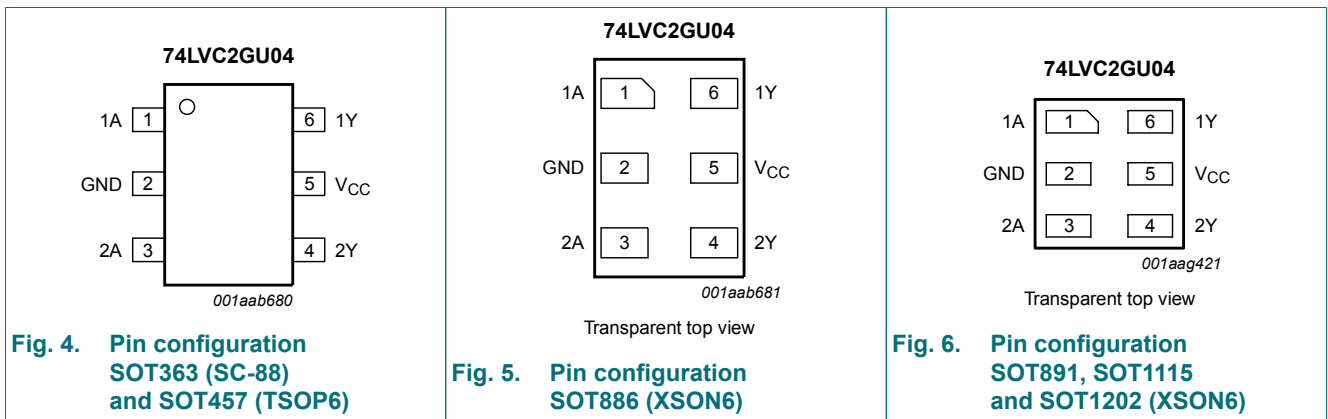
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

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 _{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 | +6.5 | V |
| I _{IK} | input clamping current | V _I < 0 V | -50 | - | mA |
| V _I | input voltage | [1] | -0.5 | +6.5 | V |
| I _{OK} | output clamping current | V _O < 0 V | -50 | - | mA |
| V _O | output voltage | Active mode [1][2] | -0.5 | V _{CC} + 0.5 | V |
| I _O | output current | V _O = 0 V to V _{CC} | - | ±50 | mA |
| I _{CC} | supply current | | - | 100 | mA |
| I _{GND} | ground current | | -100 | - | 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 and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] When V_{CC} = 0 V (Power-down mode), the output voltage can be 5.5 V in normal operation.

[3] For SC-88 and TSOP6 packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
For XSON6 packages: above 118 °C the value of P_{tot} derates linearly with 7.8 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 | | 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 | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | | $T_{amb} = -40\text{ °C to }+125\text{ °C}$ | | 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 | $V_I = V_{IH}$ or V_{IL} | | | | | | |
| | | $I_O = -100\text{ }\mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$ | $V_{CC} - 0.1$ | - | - | $V_{CC} - 0.1$ | - | 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 | $V_I = V_{IH}$ or V_{IL} | | | | | | |
| | | $I_O = 100\text{ }\mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$ | - | - | 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 | $V_I = 5.5\text{ V or GND}; V_{CC} = 0\text{ V to }5.5\text{ V}$ | - | ± 0.1 | ± 1 | - | ± 1 | μA |
| 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 | μA |
| 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 | T _{amb} = -40 °C to +85 °C | | | T _{amb} = -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|---|-------------------------------------|---------|-----|--------------------------------------|-----|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| t _{pd} | propagation delay | nA to nY; see Fig. 7 [2] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | 0.5 | 2.3 | 5.0 | 0.5 | 6.3 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 0.3 | 1.8 | 4.0 | 0.3 | 5.0 | ns |
| | | V _{CC} = 2.7 V | 0.3 | 2.6 | 4.5 | 0.3 | 5.6 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 0.3 | 2.3 | 3.7 | 0.3 | 4.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | 0.3 | 1.7 | 3.0 | 0.3 | 3.8 | ns |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} ; V _{CC} = 3.3 V [3] | - | 7.8 | - | | | pF |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

[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).

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

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;

∑(C_L × V_{CC}² × f_o) = sum of outputs.

11.1. Waveforms and test circuit

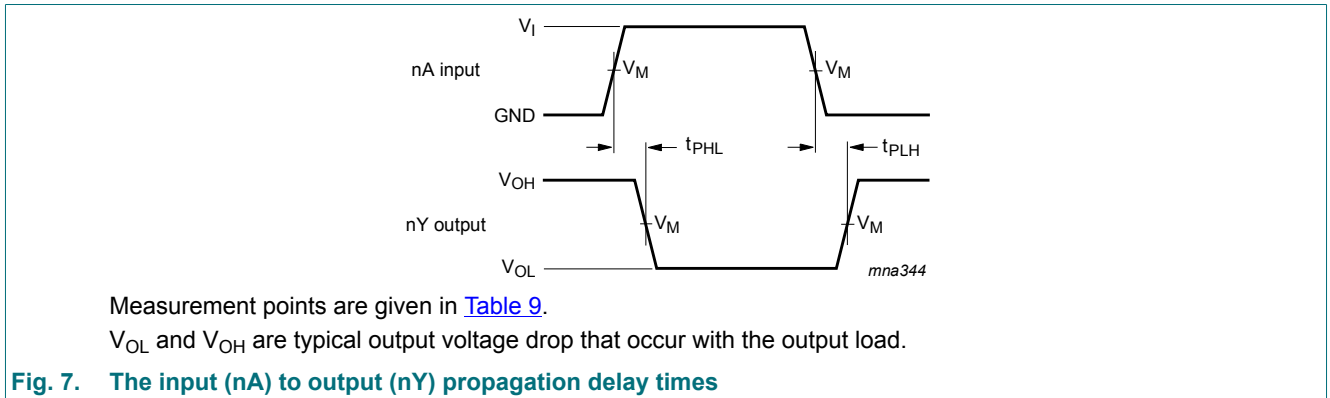
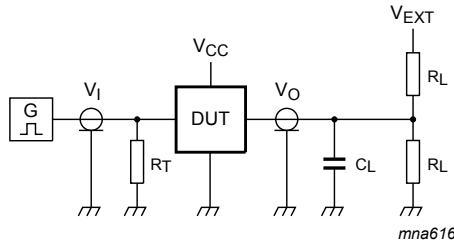


Fig. 7. The input (nA) to output (nY) propagation delay times

Table 9. Measurement points

| Supply voltage | Input | Output |
|------------------|-----------------------|-----------------------|
| V _{CC} | V _M | V _M |
| 1.65 V to 1.95 V | 0.5 × V _{CC} | 0.5 × V _{CC} |
| 2.3 V to 2.7 V | 0.5 × V _{CC} | 0.5 × V _{CC} |
| 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 _{CC} | 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.

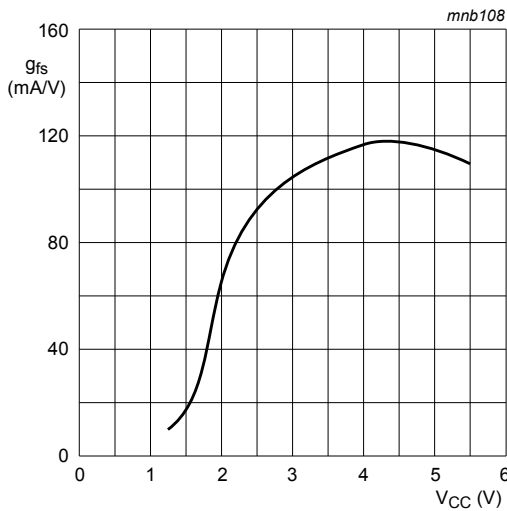
R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

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

Fig. 8. Test circuit for measuring switching times

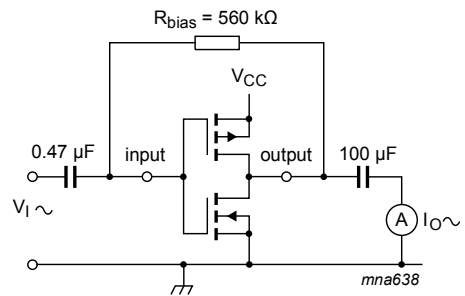
Table 10. Test data

| Supply voltage | 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} | ≤ 2.0 ns | 30 pF | 1 k Ω | open |
| 2.3 V to 2.7 V | V_{CC} | ≤ 2.0 ns | 30 pF | 500 Ω | open |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open |
| 4.5 V to 5.5 V | V_{CC} | ≤ 2.5 ns | 50 pF | 500 Ω | 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.

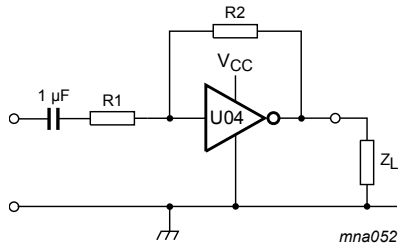
Fig. 10. Test set-up for measuring forward transconductance

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.



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

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

G_{OL} = open loop gain.

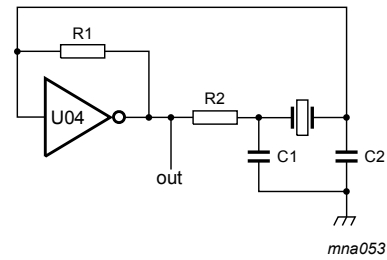
A_u = voltage amplification.

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

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

Typical unity gain bandwidth product is 5 MHz.

Fig. 11. Linear amplifier configuration



$C1 = 47 \text{ pF}$ (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 $V_{CC} = 3.3 \text{ V}$ and $f = 10 \text{ MHz}$).

Fig. 12. Crystal oscillator configuration

13. Package outline

Plastic surface-mounted package; 6 leads

SOT363

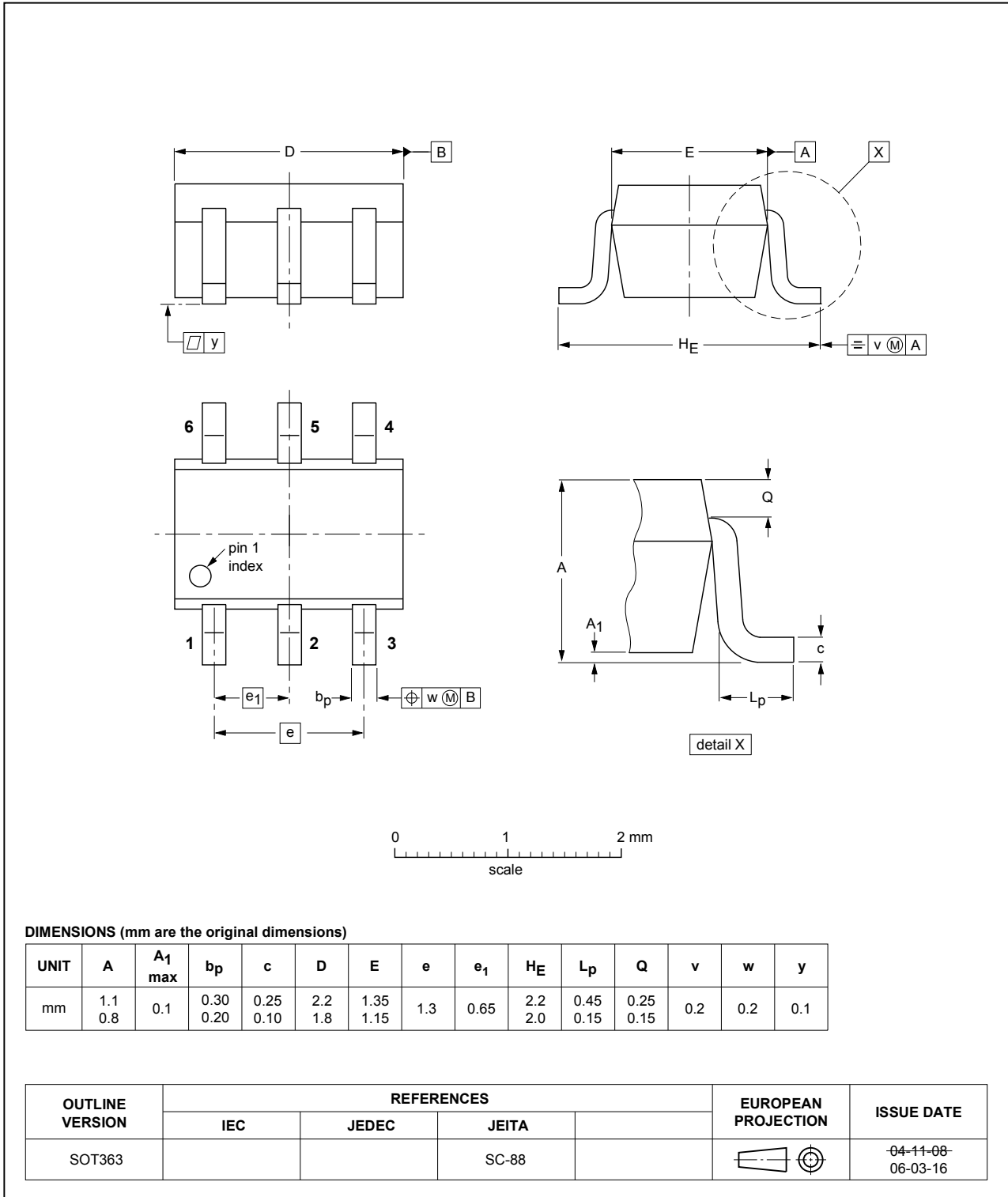


Fig. 13. Package outline SOT363 (SC-88)

Plastic surface-mounted package (TSOP6); 6 leads

SOT457

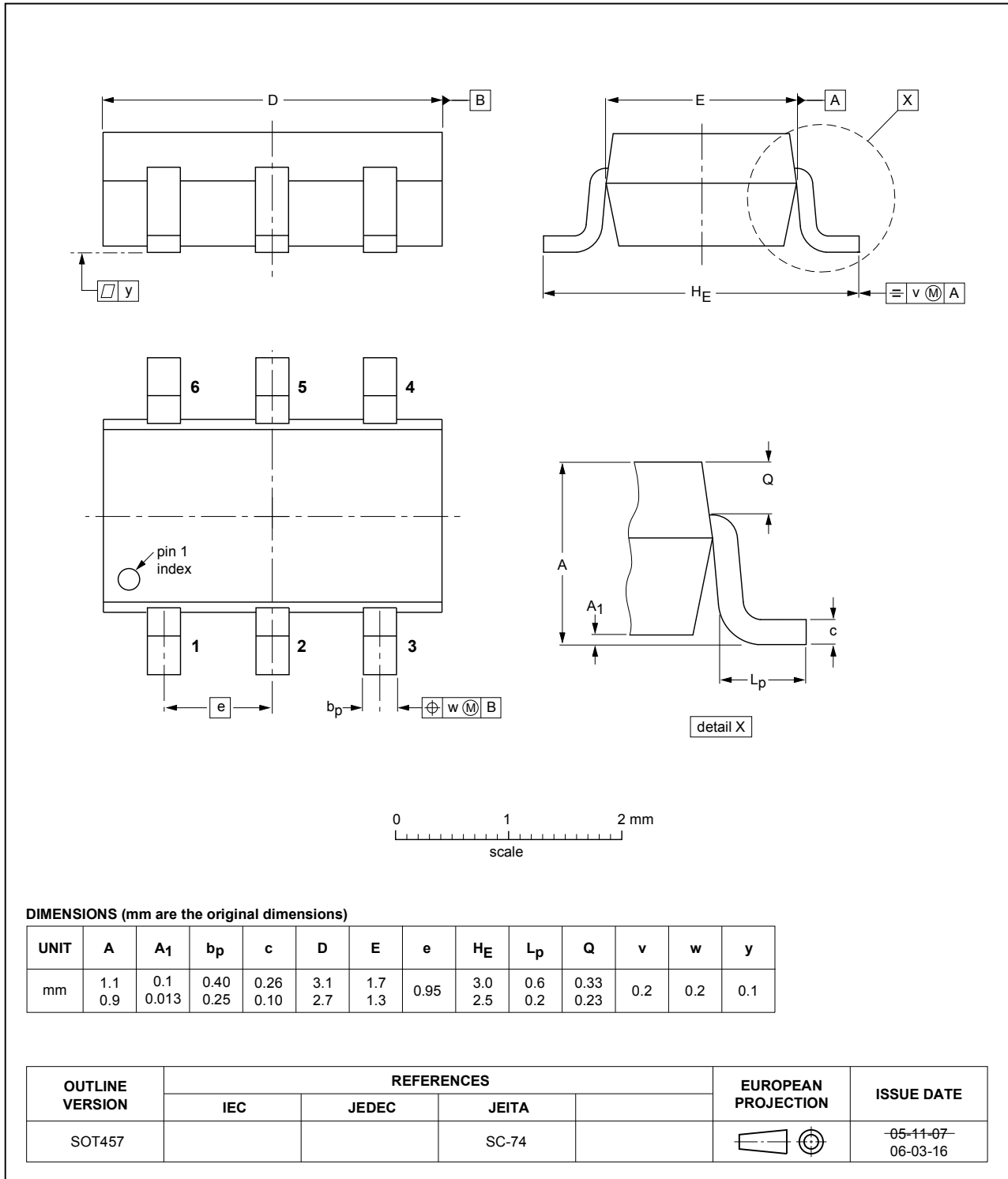


Fig. 14. Package outline SOT457 (TSOP6)

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

SOT886

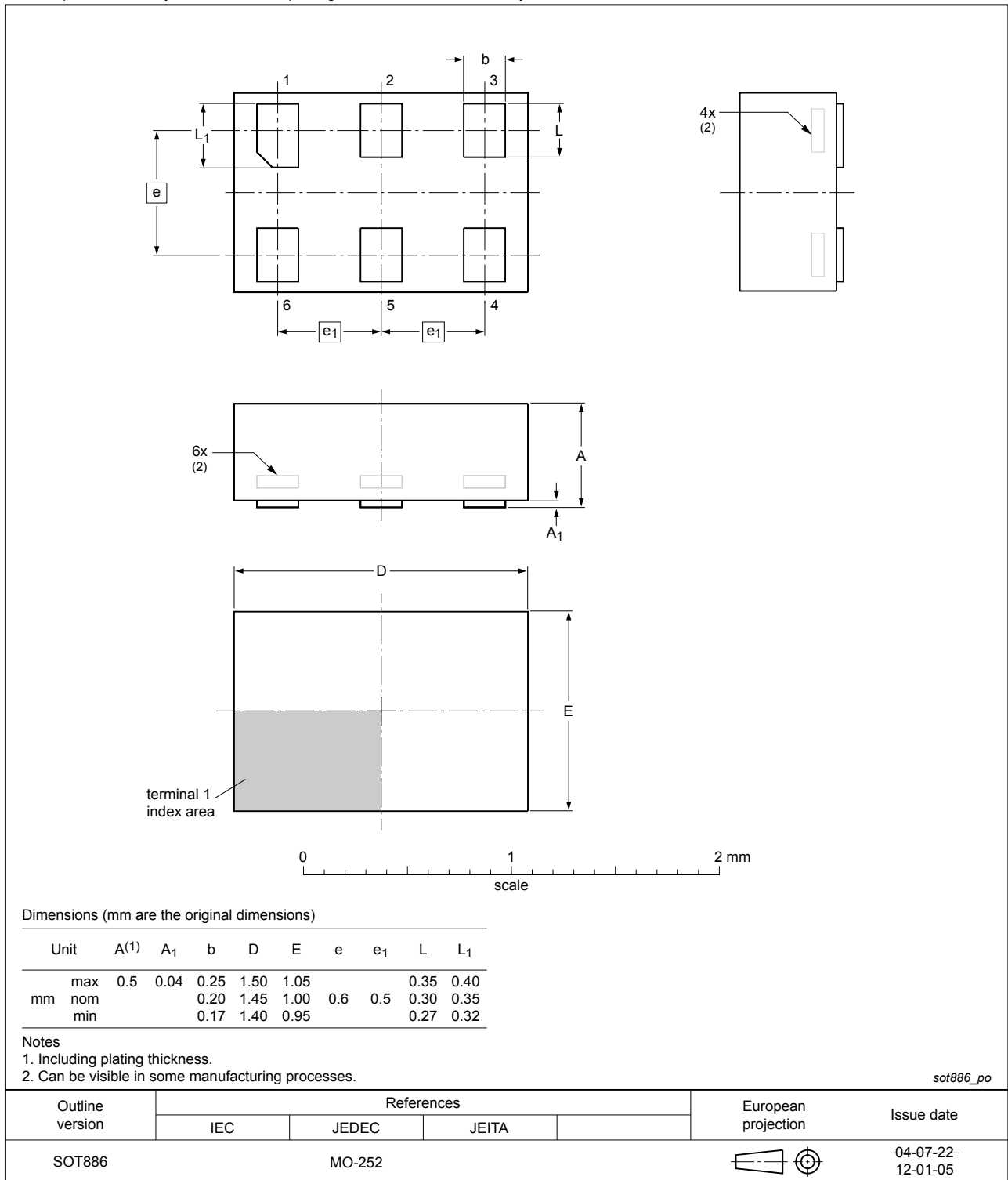


Fig. 15. Package outline SOT886 (XSON6)

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

SOT891

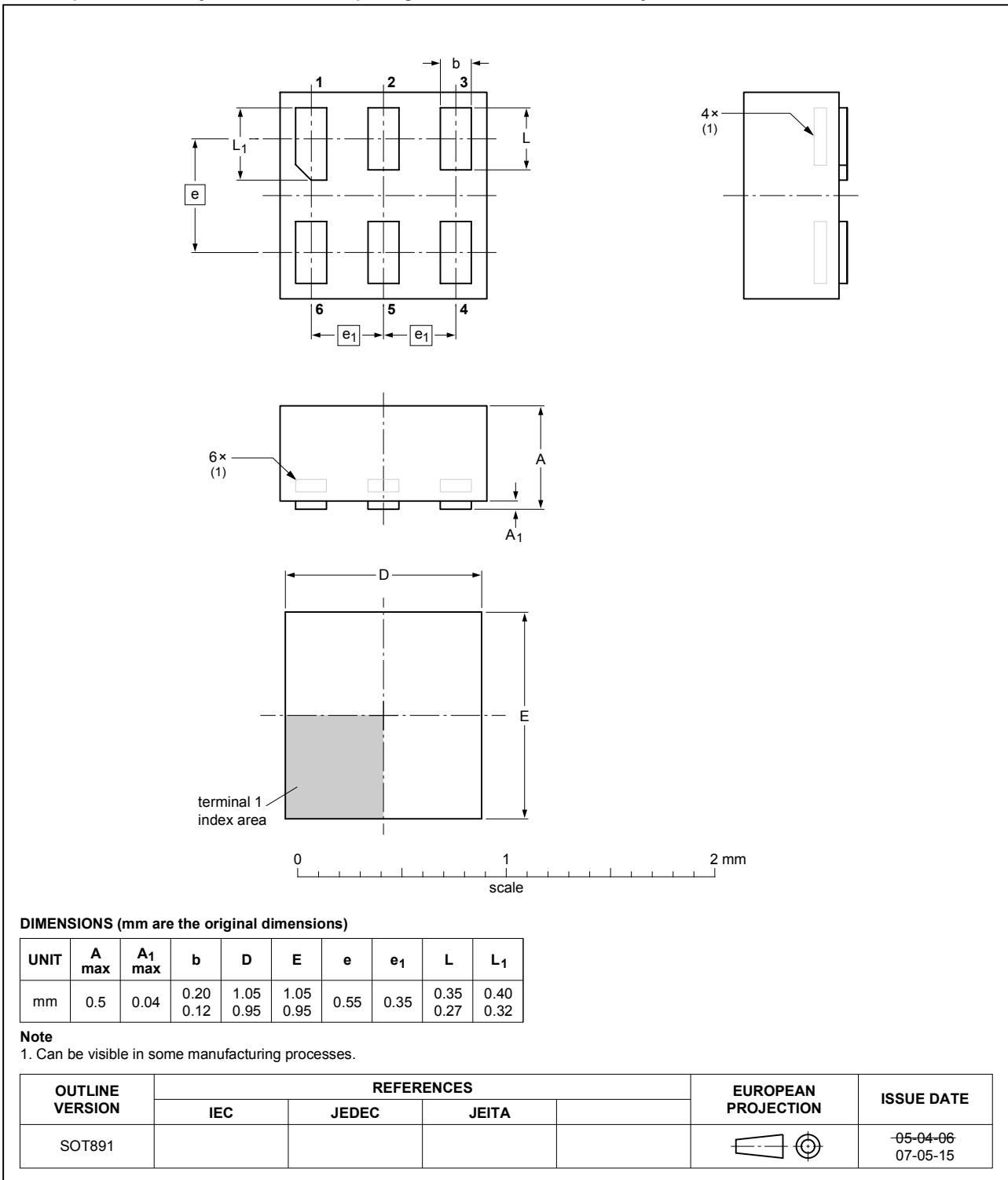


Fig. 16. Package outline SOT891 (XSON6)

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

SOT1115

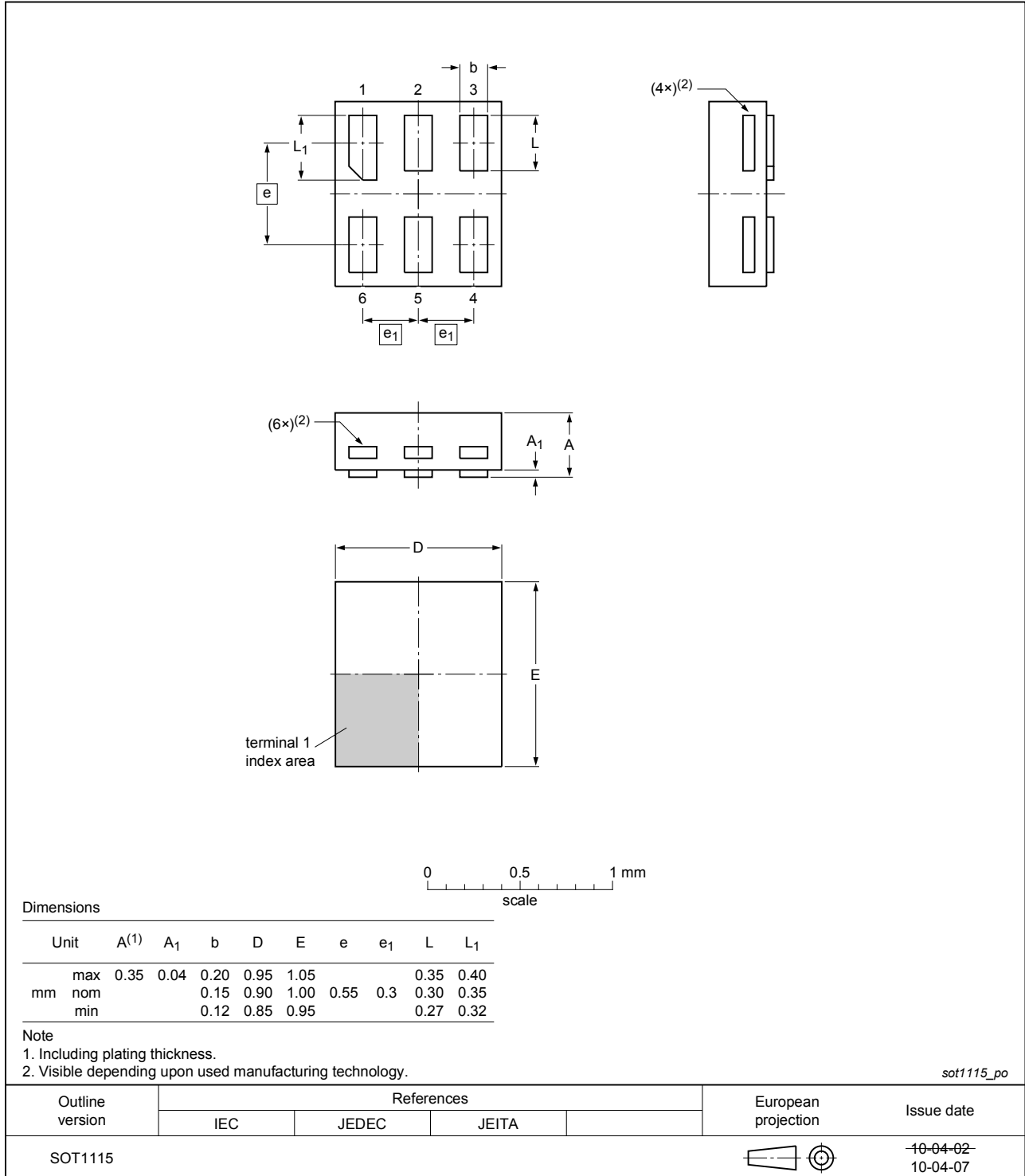


Fig. 17. Package outline SOT1115 (XSON6)

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

SOT1202

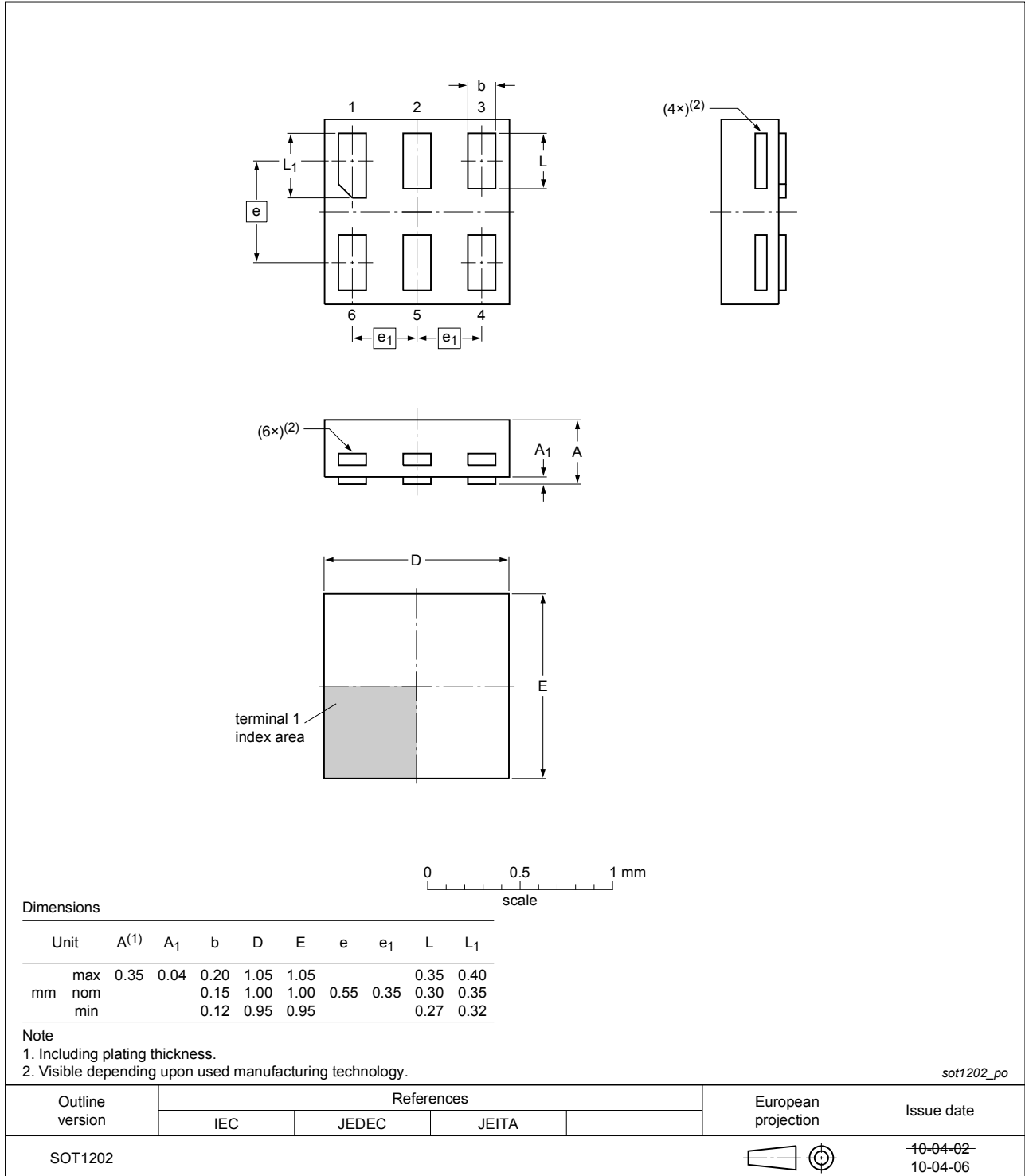


Fig. 18. Package outline SOT1202 (XSON6)

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.11 | 20181009 | Product data sheet | - | 74LVC2GU04 v.10 |
| 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. | | | |
| 74LVC2GU04 v.10 | 20170210 | Product data sheet | - | 74LVC2GU04 v.9 |
| Modifications: | <ul style="list-style-type: none"> Watermarks removed. | | | |
| 74LVC2GU04 v.9 | 20161215 | Product data sheet | - | 74LVC2GU04 v.8 |
| Modifications: | <ul style="list-style-type: none"> Table 7: The maximum limits for leakage current and supply current have changed. | | | |
| 74LVC2GU04 v.8 | 20120703 | Product data sheet | - | 74LVC2GU04 v.7 |
| Modifications: | <ul style="list-style-type: none"> Package outline drawing of SOT886 (Fig. 15) modified. | | | |
| 74LVC2GU04 v.7 | 20111128 | Product data sheet | - | 74LVC2GU04 v.6 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. | | | |
| 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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