

74LVC2G38

Dual 2-input NAND gate; open drain

Rev. 07 — 20 March 2009

Product data sheet

1. General description

The 74LVC2G38 provides a 2-input NAND function.

The outputs of the 74LVC2G38 devices are open-drain and can be connected to other open-drain outputs to implement active-LOW, wired-OR or active-HIGH wired-AND functions.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in a mixed 3.3 V and 5 V environment.

This device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

2. Features

- Wide supply voltage range from 1.65 V to 5.5 V
- 5 V tolerant outputs for interfacing with 5 V logic
- High noise immunity
- Complies with JEDEC standard:
 - ◆ JESD8-7 (1.65 V to 1.95 V)
 - ◆ JESD8-5 (2.3 V to 2.7 V)
 - ◆ JESD8B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - ◆ HBM EIA/JESD22-A114E exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V
- ± 24 mA output drive ($V_{CC} = 3.0$ V)
- CMOS low power consumption
- Open-drain outputs
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- Inputs accept 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	
74LVC2G38DP	-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
74LVC2G38DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74LVC2G38GT	-40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm	SOT833-1
74LVC2G38GD	-40 °C to +125 °C	XSON8U	plastic extremely thin small outline package; no leads; 8 terminals; UTLP based; body 3 × 2 × 0.5 mm	SOT996-2
74LVC2G38GM	-40 °C to +125 °C	XQFN8U	plastic extremely thin quad flat package; no leads; 8 terminals; UTLP based; body 1.6 × 1.6 × 0.5 mm	SOT902-1

4. Marking

Table 2. Marking codes

Type number	Marking code
74LVC2G38DP	Y38
74LVC2G38DC	Y38
74LVC2G38GT	Y38
74LVC2G38GD	Y38
74LVC2G38GM	Y38

5. Functional diagram

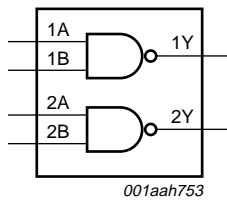


Fig 1. Logic symbol

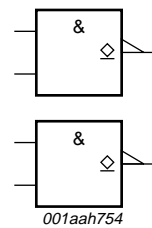


Fig 2. IEC logic symbol

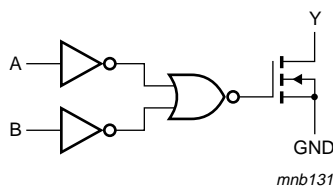
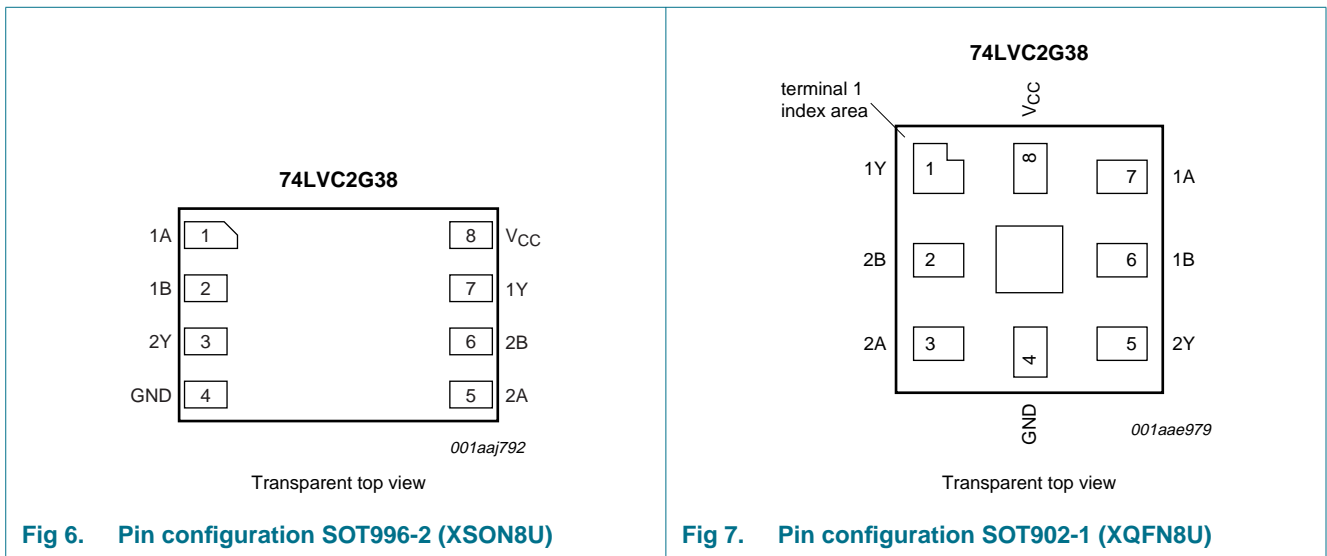
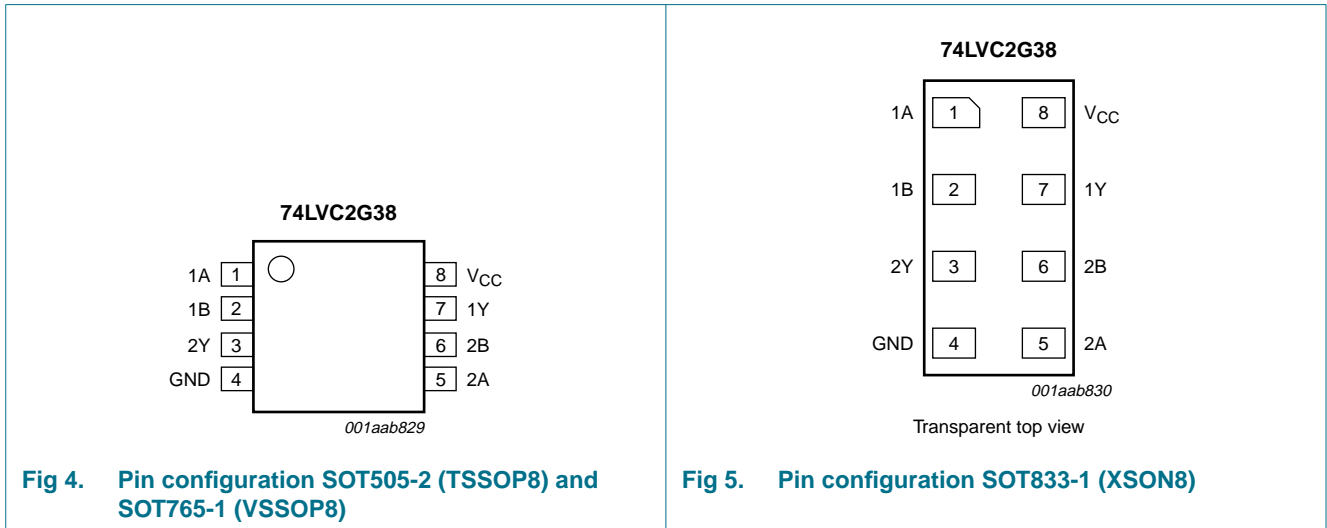


Fig 3. Functional diagram (one gate)

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 3. Pin description

Symbol	Pin		Description
	SOT505-2, SOT765-1, SOT833-1 and SOT996-2	SOT902-1	
1A, 2A	1, 5	7, 3	data input
1B, 2B	2, 6	6, 2	data input
GND	4	4	ground (0 V)
1Y, 2Y	7, 3	1, 5	data output
V _{CC}	8	8	supply voltage

7. Functional description

Table 4. Function table^[1]

Input		Output
nA	nB	nY
L	L	Z
L	H	Z
H	L	Z
H	H	L

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

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
V_I	input voltage		^[1] -0.5	+6.5	V
V_O	output voltage	Active mode	^{[1][2]} -0.5	+6.5	V
		Power-down mode	^{[1][2]} -0.5	+6.5	V
I_{IK}	input clamping current	$V_I < 0$ V	-50	-	mA
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	± 50	mA
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] -	300	mW

[1] The 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 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.

For XSON8, XSON8U and XQFN8U packages: above 45 °C the value of P_{tot} derates linearly with 2.4 mW/K.

9. Recommended operating conditions

Table 6. Operating conditions

Symbol	Parameter	Conditions	Min	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
		disable mode	0	5.5	V
		Power-down mode	0	5.5	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	Min	Typ	Max	Unit
$T_{amb} = -40\text{ °C to }+85\text{ °C}$ [1]						
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65 \times V_{CC}$	-	-	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	-	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0	-	-	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$0.7 \times V_{CC}$	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	-	-	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.7	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	0.8	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	$0.3 \times V_{CC}$	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = 100\ \mu\text{A}$; $V_{CC} = 1.65\text{ V to }5.5\text{ V}$	-	-	0.1	V
		$I_O = 4\text{ mA}$; $V_{CC} = 1.65\text{ V}$	-	0.08	0.45	V
		$I_O = 8\text{ mA}$; $V_{CC} = 2.3\text{ V}$	-	0.14	0.3	V
		$I_O = 12\text{ mA}$; $V_{CC} = 2.7\text{ V}$	-	0.19	0.4	V
		$I_O = 24\text{ mA}$; $V_{CC} = 3.0\text{ V}$	-	0.37	0.55	V
		$I_O = 32\text{ mA}$; $V_{CC} = 4.5\text{ V}$	-	0.43	0.55	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	± 5	μA
I_{OFF}	power-off leakage current	V_I or $V_O = 5.5\text{ V}$; $V_{CC} = 0\text{ V}$	-	± 0.1	± 10	μA
I_{CC}	supply current	$V_I = 5.5\text{ V}$ or GND; $V_{CC} = 1.65\text{ V to }5.5\text{ V}$; $I_O = 0\text{ A}$	-	0.1	10	μA
ΔI_{CC}	additional supply current	per pin; $V_I = V_{CC} - 0.6\text{ V}$; $I_O = 0\text{ A}$; $V_{CC} = 2.3\text{ V to }5.5\text{ V}$	-	5	500	μA
C_i	input capacitance		-	2.5	-	pF

Table 7. Static characteristics ...continued

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +125 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}	-	-	V
		V _{CC} = 2.3 V to 2.7 V	1.7	-	-	V
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	V
		V _{CC} = 4.5 V to 5.5 V	0.7 × V _{CC}	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.65 V to 1.95 V	-	-	0.35 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V	-	-	0.7	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	V
		V _{CC} = 4.5 V to 5.5 V	-	-	0.3 × V _{CC}	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = 100 μA; V _{CC} = 1.65 V to 5.5 V	-	-	0.1	V
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.70	V
		I _O = 8 mA; V _{CC} = 2.3 V	-	-	0.45	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.60	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.80	V
		I _O = 32 mA; V _{CC} = 4.5 V	-	-	0.80	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	±20	μA
I _{OFF}	power-off leakage current	V _I or V _O = 5.5 V; V _{CC} = 0 V	-	-	±20	μA
I _{CC}	supply current	V _I = 5.5 V or GND; V _{CC} = 1.65 V to 5.5 V; I _O = 0 A	-	-	40	μA
ΔI _{CC}	additional supply current	per pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.3 V to 5.5 V	-	-	5000	μA

[1] All typical values are measured at T_{amb} = 25 °C.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground 0 V); for test circuit see [Figure 9](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ ^[1]	Max	Min	Max		
t _{PZL}	OFF-state to LOW propagation delay	nA, nB to nY; see Figure 8							
		V _{CC} = 1.65 V to 1.95 V	1.2	3.0	8.6	1.2	10.8	ns	
		V _{CC} = 2.3 V to 2.7 V	0.7	1.8	4.8	0.7	6.0	ns	
		V _{CC} = 2.7 V	0.7	2.5	4.4	0.7	5.5	ns	
		V _{CC} = 3.0 V to 3.6 V	0.7	2.1	4.1	0.7	5.2	ns	
		V _{CC} = 4.5 V to 5.5 V	0.5	1.5	3.3	0.5	4.2	ns	
t _{PLZ}	LOW to OFF-state propagation delay	nA, nB to nY; see Figure 8							
		V _{CC} = 1.65 V to 1.95 V	1.2	3.0	8.6	1.2	10.8	ns	
		V _{CC} = 2.3 V to 2.7 V	0.7	1.8	4.8	0.7	6.0	ns	
		V _{CC} = 2.7 V	0.7	2.5	4.4	0.7	5.5	ns	
		V _{CC} = 3.0 V to 3.6 V	0.7	2.1	4.1	0.7	5.2	ns	
		V _{CC} = 4.5 V to 5.5 V	0.5	1.5	3.3	0.5	4.2	ns	
C _{PD}	power dissipation capacitance	per gate; V _I = GND to V _{CC}	[2]	-	5	-	-	-	pF

[1] Typical values are measured at nominal V_{CC} and at T_{amb} = 25 °C.

[2] 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;

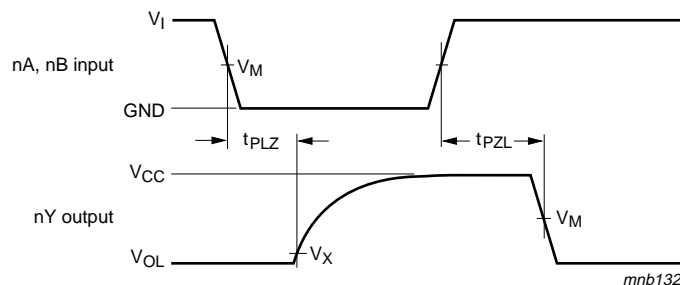
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

12. Waveforms

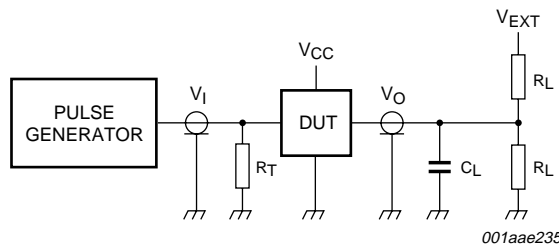
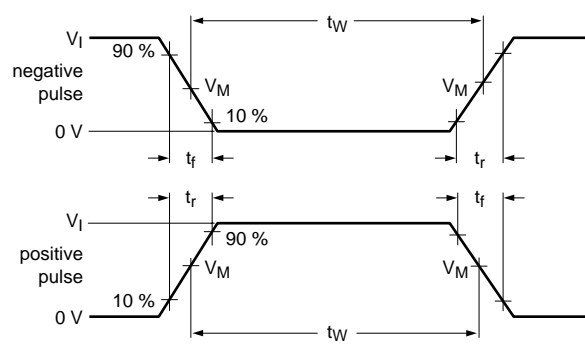


Measurement points are given in [Table 9](#)

Fig 8. Inputs nA and nB to output nY propagation delay times

Table 9. Measurement points

Supply voltage	Input	Output	
V _{CC}	V _M	V _X	V _M
1.65 V to 1.95 V	0.5 × V _{CC}	V _{OL} + 0.15 V	0.5 × V _{CC}
2.3 V to 2.7 V	0.5 × V _{CC}	V _{OL} + 0.15 V	0.5 × V _{CC}
2.7 V	1.5 V	V _{OL} + 0.3 V	1.5 V
3.0 V to 3.6 V	1.5 V	V _{OL} + 0.3 V	1.5 V
4.5 V to 5.5 V	0.5 × V _{CC}	V _{OL} + 0.3 V	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 output impedance Z_o of the pulse generator.

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

Fig 9. 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 _{PLZ} , t _{PZL}
1.65 V to 1.95 V	V _{CC}	≤ 2.0 ns	30 pF	1 kΩ	2 × V _{CC}
2.3 V to 2.7 V	V _{CC}	≤ 2.0 ns	30 pF	500 Ω	2 × V _{CC}
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	6 V
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	6 V
4.5 V to 5.5 V	V _{CC}	≤ 2.5 ns	50 pF	500 Ω	2 × V _{CC}

13. Package outline

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

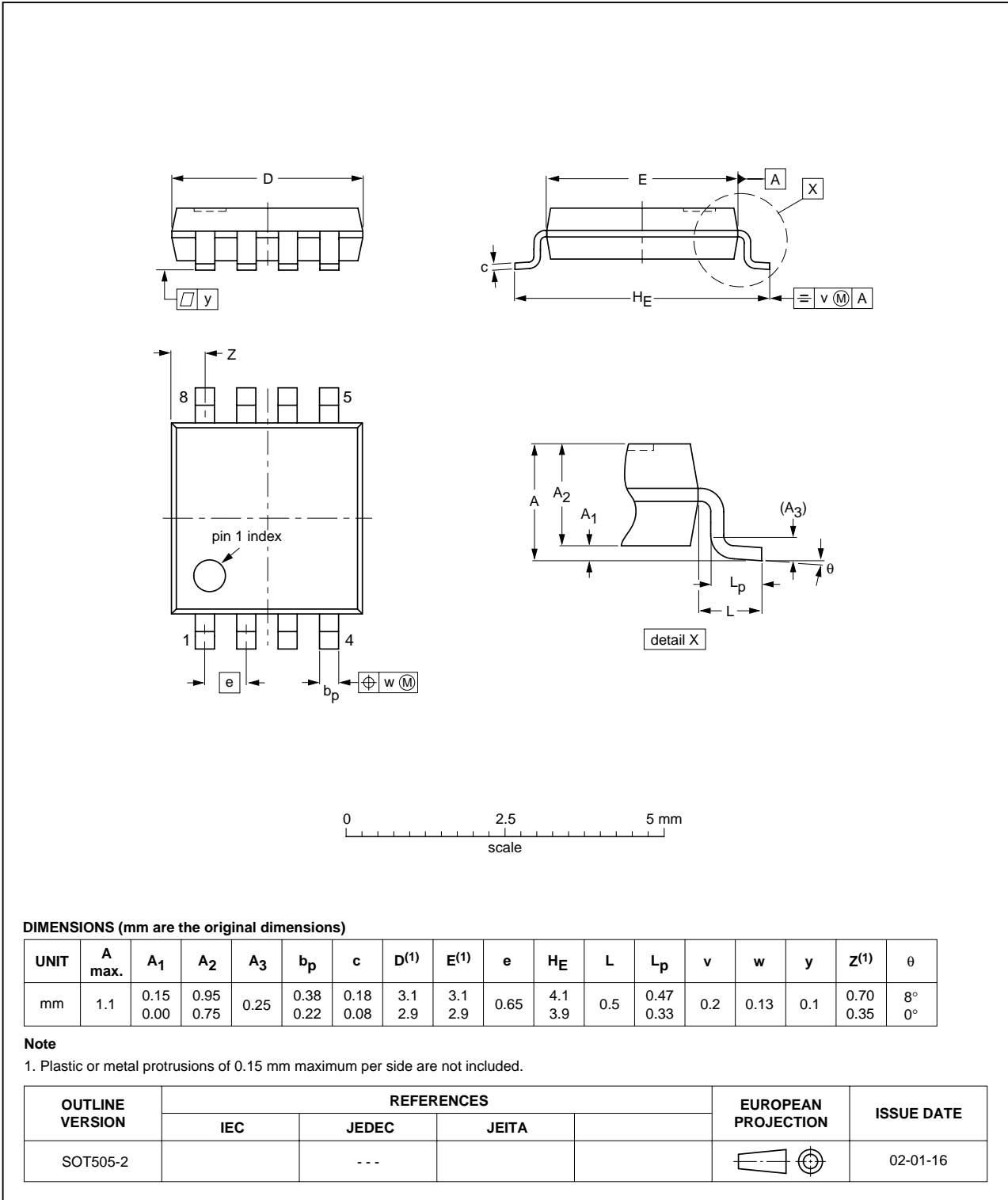


Fig 10. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

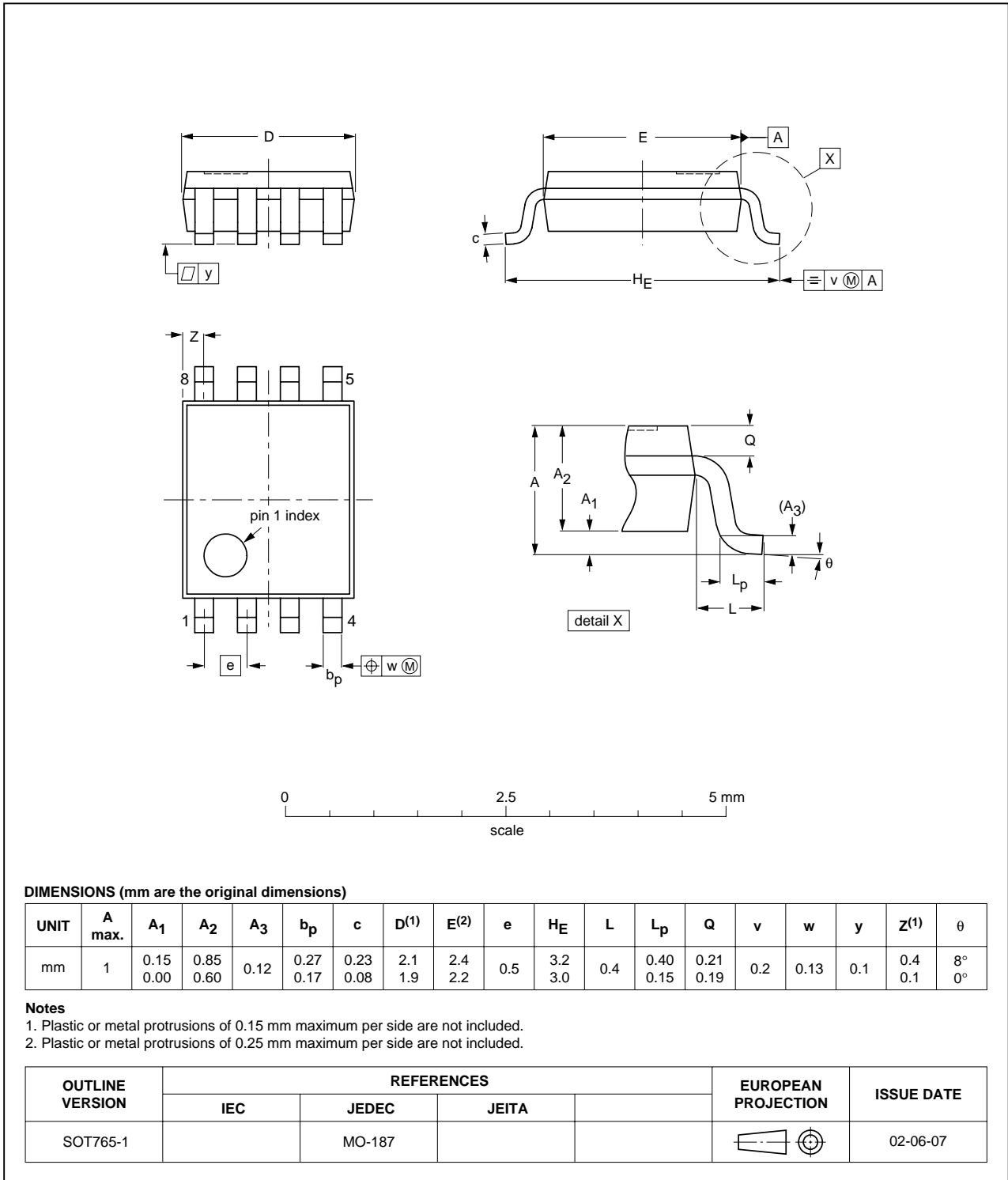


Fig 11. Package outline SOT765-1 (VSSOP8)

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm

SOT833-1

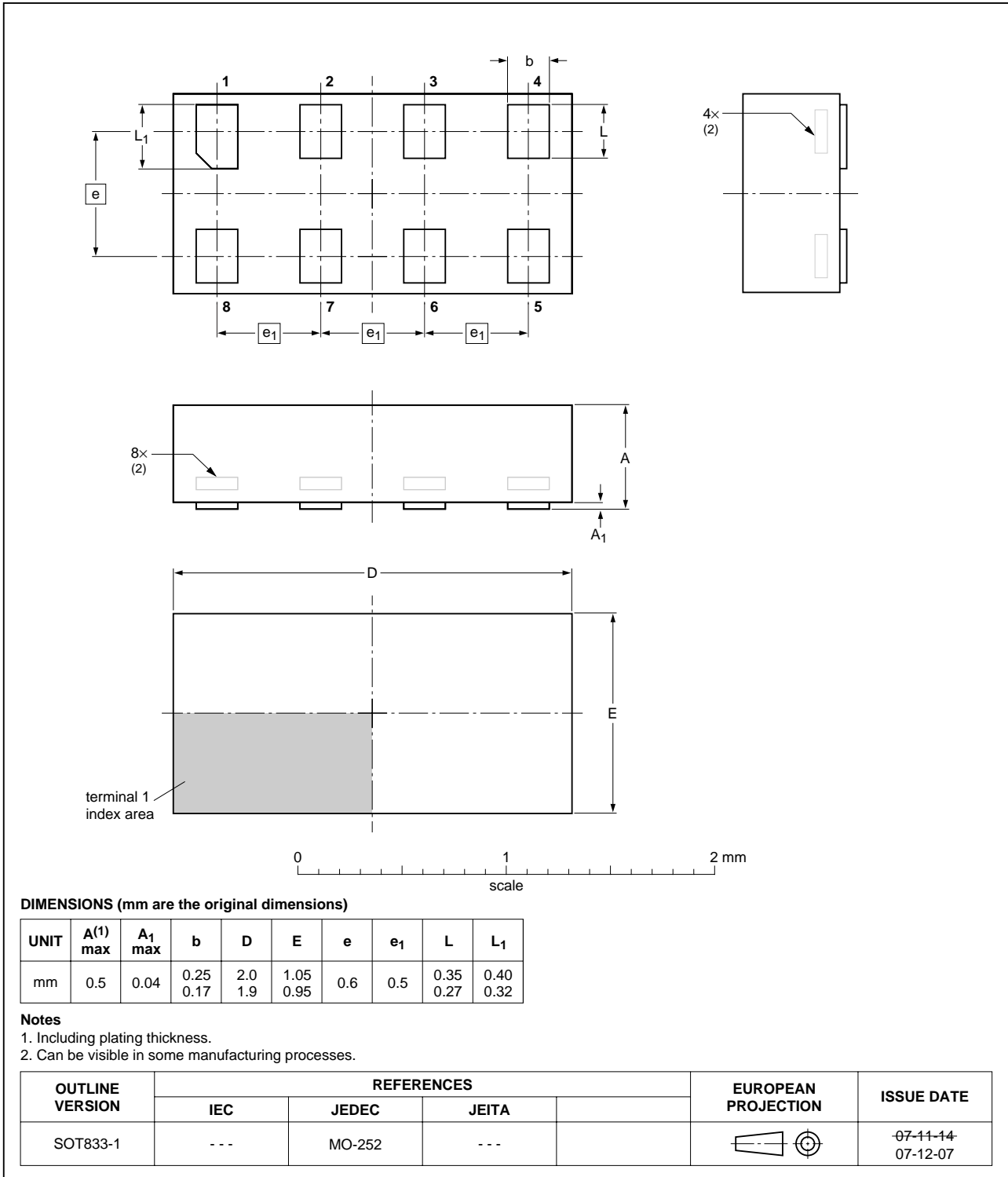


Fig 12. Package outline SOT833-1 (XSON8)

XSON8U: plastic extremely thin small outline package; no leads;
8 terminals; UTLP based; body 3 x 2 x 0.5 mm

SOT996-2

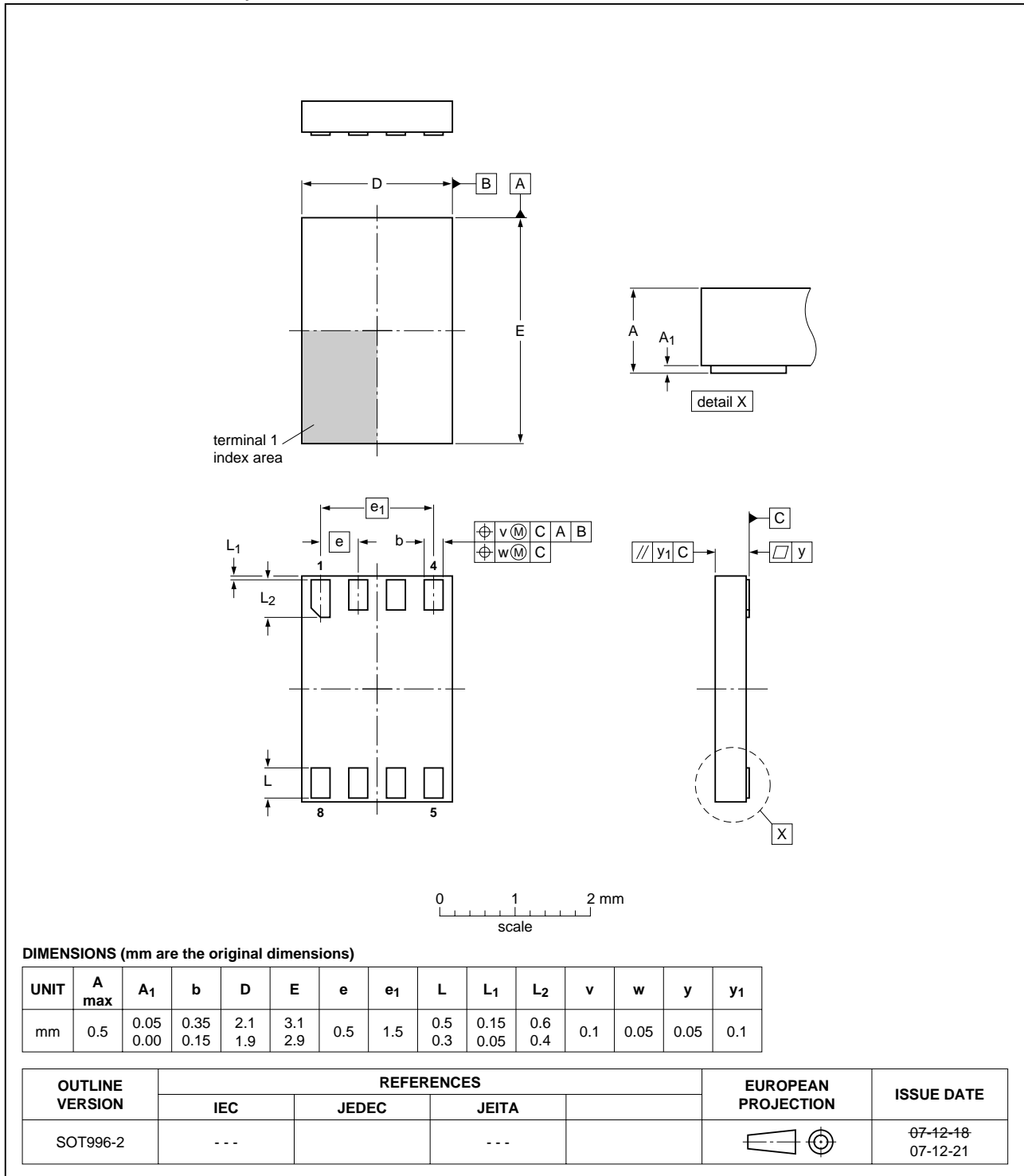


Fig 13. Package outline SOT996-2 (XSON8U)

XQFN8U: plastic extremely thin quad flat package; no leads; 8 terminals; UTLP based; body 1.6 x 1.6 x 0.5 mm

SOT902-1

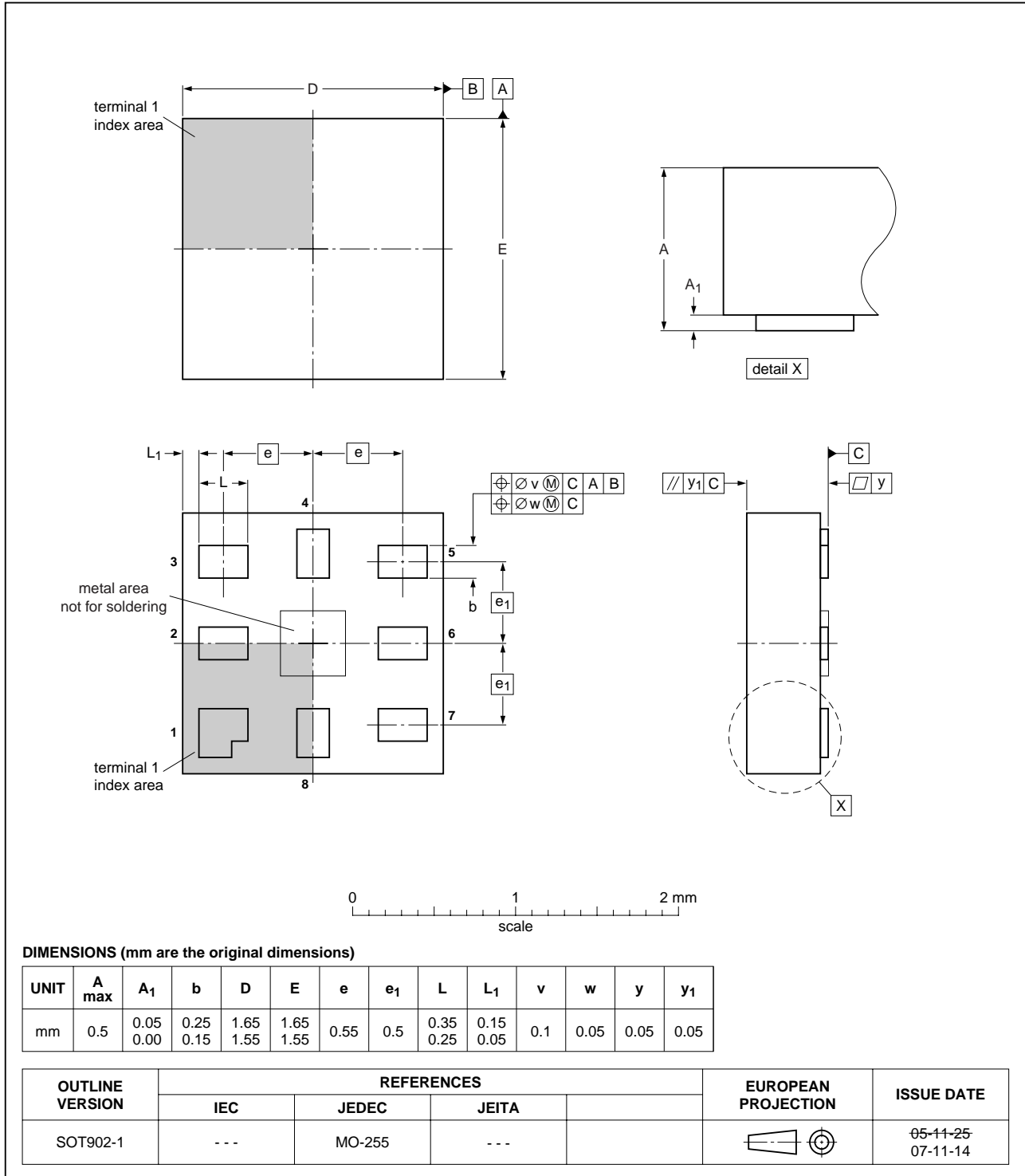


Fig 14. Package outline SOT902-1 (XQFN8U)

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
TTL	Transistor-Transistor Logic

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2G38_7	20090320	Product data sheet	-	74LVC2G38_6
Modifications:	<ul style="list-style-type: none"> Added type number 74LVC2G38GD (XSON8U package) 			
74LVC2G38_6	20080219	Product data sheet	-	74LVC2G38_5
74LVC2G38_5	20070904	Product data sheet	-	74LVC2G38_4
74LVC2G38_4	20060516	Product data sheet	-	74LVC2G38_3
74LVC2G38_3	20050201	Product specification	-	74LVC2G38_2
74LVC2G38_2	20041018	Product specification	-	74LVC2G38_1
74LVC2G38_1	20031027	Product specification	-	-

16. Legal information

16.1 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.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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[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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