

# 74LVC2G38

Dual 2-input NAND gate; open drain

Rev. 05 — 4 September 2007

Product data sheet

## 1. General description

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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

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- 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
- $\pm 24$  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
74LVC2G38GM	-40 °C to +125 °C	XQFN8	plastic extremely thin quad flat package; no leads; 8 terminals; body 1.6 × 1.6 × 0.5 mm	SOT902-1

### 4. Marking

Table 2. Marking code

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

### 5. Functional diagram

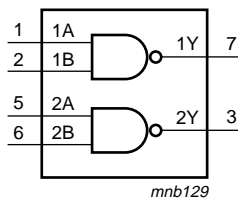


Fig 1. Logic symbol

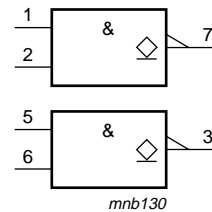


Fig 2. IEC logic symbol

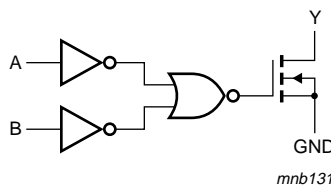


Fig 3. Functional diagram (one gate)

## 6. Pinning information

### 6.1 Pinning

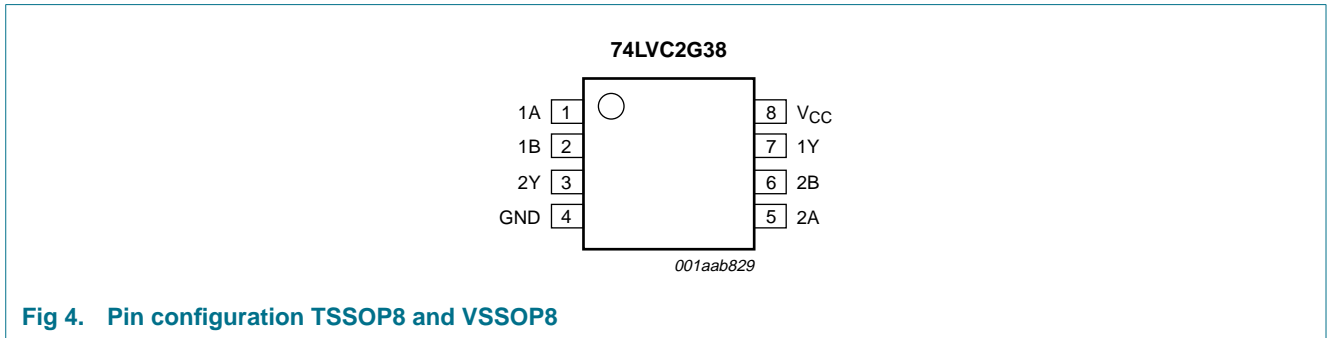


Fig 4. Pin configuration TSSOP8 and VSSOP8

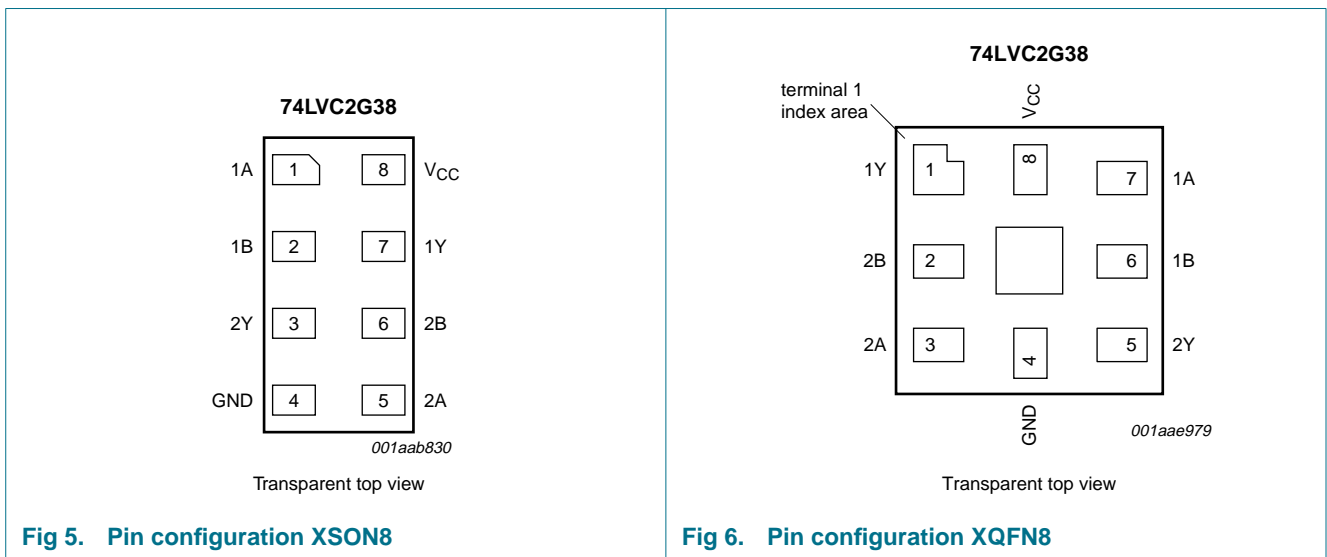


Fig 5. Pin configuration XSON8

Fig 6. Pin configuration XQFN8

### 6.2 Pin description

Table 3. Pin description

Symbol	Pin			Description
	TSSOP8, VSSOP8	XSON8	XQFN8	
1A	1	1	7	data input
1B	2	2	6	data input
2Y	3	3	5	data output
GND	4	4	4	ground (0 V)
2A	5	5	3	data input
2B	6	6	2	data input
1Y	7	7	1	data output
V <sub>CC</sub>	8	8	8	supply voltage

## 7. Functional description

Table 4. Function table<sup>[1]</sup>

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		<sup>[1]</sup> -0.5	+6.5	V
$V_O$	output voltage	Active mode	<sup>[1][2]</sup> -0.5	+6.5	V
		Power-down mode	<sup>[1][2]</sup> -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	-	$\pm 50$	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	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	<sup>[3]</sup> -	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 and XQFN8 packages: above 45 °C the value of  $P_{tot}$  derates linearly with 2.4 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

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
		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
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math> [1]</b>						
$V_{IH}$	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; $V_{CC} = 0\text{ V to }5.5\text{ V}$	-	$\pm 0.1$	$\pm 5$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 5.5\text{ V}$ ; $V_{CC} = 0\text{ V}$	-	$\pm 0.1$	$\pm 10$	$\mu\text{A}$
$I_{CC}$	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	$\mu\text{A}$
$\Delta I_{CC}$	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	$\mu\text{A}$
$C_i$	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
<b><math>T_{amb} = -40\text{ }^{\circ}\text{C}</math> to <math>+125\text{ }^{\circ}\text{C}</math></b>						
$V_{IH}$	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 $V_{IL}$				
		$I_O = 100\text{ }\mu\text{A}$ ; $V_{CC} = 1.65\text{ V}$ to $5.5\text{ V}$	-	-	0.1	V
		$I_O = 4\text{ mA}$ ; $V_{CC} = 1.65\text{ V}$	-	-	0.70	V
		$I_O = 8\text{ mA}$ ; $V_{CC} = 2.3\text{ V}$	-	-	0.45	V
		$I_O = 12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	-	-	0.60	V
		$I_O = 24\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	-	-	0.80	V
		$I_O = 32\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	-	0.80	V
$I_I$	input leakage current	$V_I = 5.5\text{ V}$ or GND; $V_{CC} = 0\text{ V}$ to $5.5\text{ V}$	-	-	$\pm 20$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 5.5\text{ V}$ ; $V_{CC} = 0\text{ V}$	-	-	$\pm 20$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = 5.5\text{ V}$ or GND; $V_{CC} = 1.65\text{ V}$ to $5.5\text{ V}$ ; $I_O = 0\text{ A}$	-	-	40	$\mu\text{A}$
$\Delta I_{CC}$	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 $5.5\text{ V}$	-	-	5000	$\mu\text{A}$

[1] All typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground 0 V); for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ <sup>[1]</sup>	Max	Min	Max		
t <sub>PZL</sub>	OFF-state to LOW propagation delay	nA, nB to nY; see <a href="#">Figure 7</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.2	3.0	8.6	1.2	10.8	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7	1.8	4.8	0.7	6.0	ns	
		V <sub>CC</sub> = 2.7 V	0.7	2.5	4.4	0.7	5.5	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.7	2.1	4.1	0.7	5.2	ns	
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	1.5	3.3	0.5	4.2	ns	
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	nA, nB to nY; see <a href="#">Figure 7</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.2	3.0	8.6	1.2	10.8	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7	1.8	4.8	0.7	6.0	ns	
		V <sub>CC</sub> = 2.7 V	0.7	2.5	4.4	0.7	5.5	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.7	2.1	4.1	0.7	5.2	ns	
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	1.5	3.3	0.5	4.2	ns	
C <sub>PD</sub>	power dissipation capacitance	per gate; V <sub>I</sub> = GND to V <sub>CC</sub>	<a href="#">[2]</a>	-	5	-	-	-	pF

[1] Typical values are measured at nominal V<sub>CC</sub> and at T<sub>amb</sub> = 25 °C.

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

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

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

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

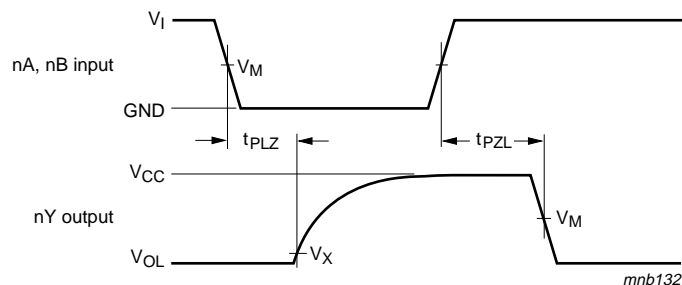
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

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

## 12. Waveforms

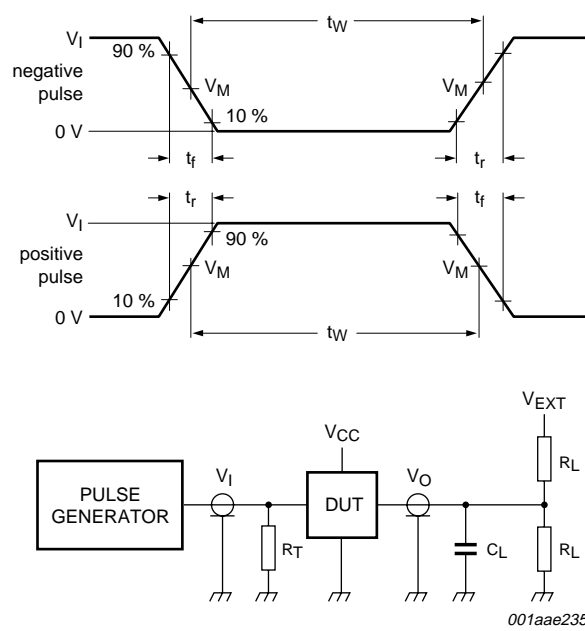


Measurement points are given in [Table 9](#)

**Fig 7. 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	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$0.5 \times V_{CC}$
2.3 V to 2.7 V	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$0.5 \times V_{CC}$
2.7 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	1.5 V
3.0 V to 3.6 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	1.5 V
4.5 V to 5.5 V	$0.5 \times V_{CC}$	$V_{OL} + 0.3 \text{ V}$	$0.5 \times V_{CC}$



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

Definitions for test circuit:

$R_L$  = Load resistor.

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

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

$V_{EXT}$  = Test voltage for switching times.

Fig 8. Load circuitry for 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	$V_{CC}$	$\leq 2.0 \text{ ns}$	30 pF	1 k $\Omega$	$2 \times V_{CC}$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0 \text{ ns}$	30 pF	500 $\Omega$	$2 \times V_{CC}$
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$	6 V
3.0 V to 3.6 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$	6 V
4.5 V to 5.5 V	$V_{CC}$	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$	$2 \times V_{CC}$



13. Package outline

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

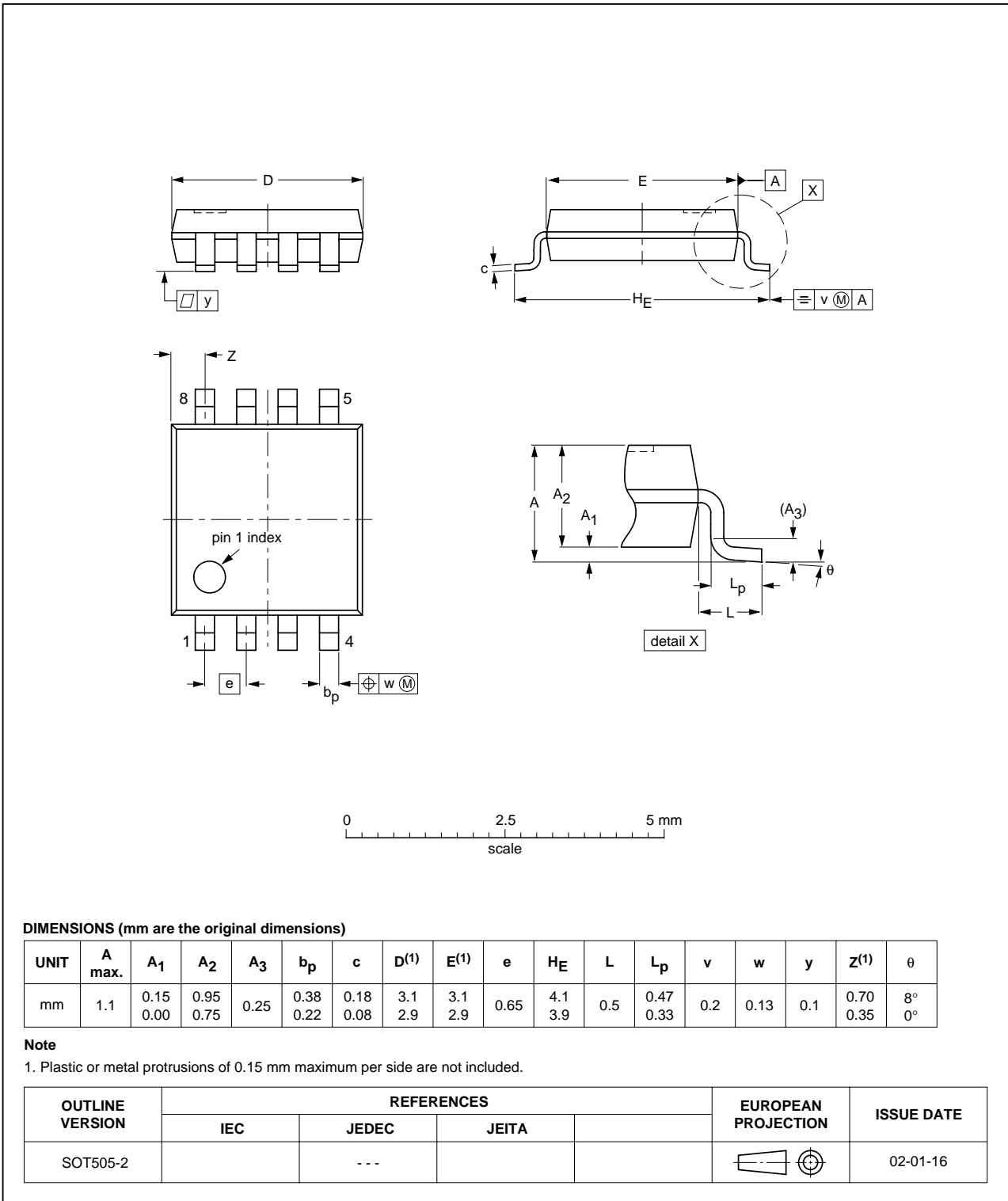


Fig 9. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

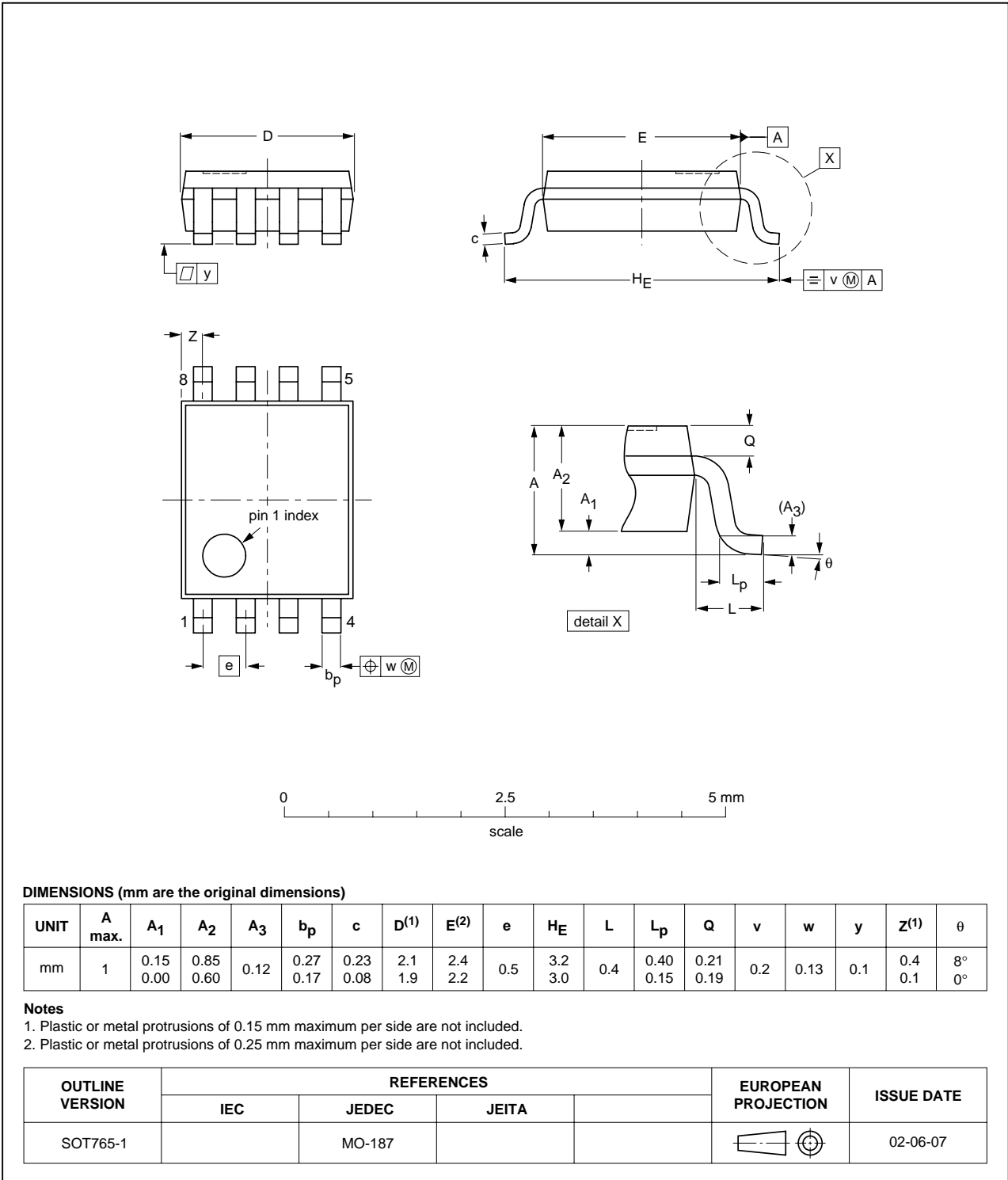


Fig 10. Package outline SOT765-1 (VSSOP8)

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

SOT833-1

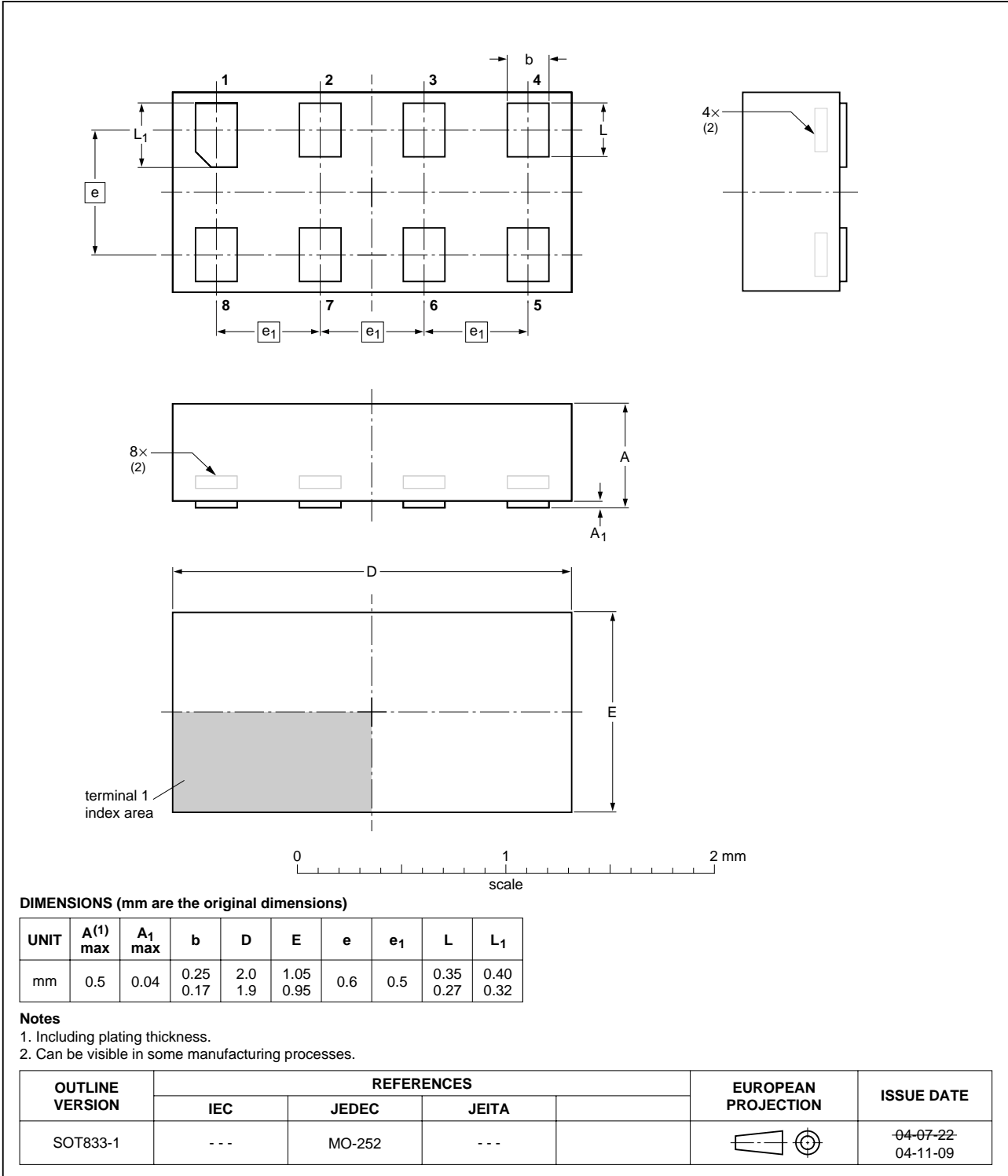


Fig 11. Package outline SOT833-1 (XSON8)

XQFN8: plastic extremely thin quad flat package; no leads; 8 terminals; body 1.6 x 1.6 x 0.5 mm

SOT902-1

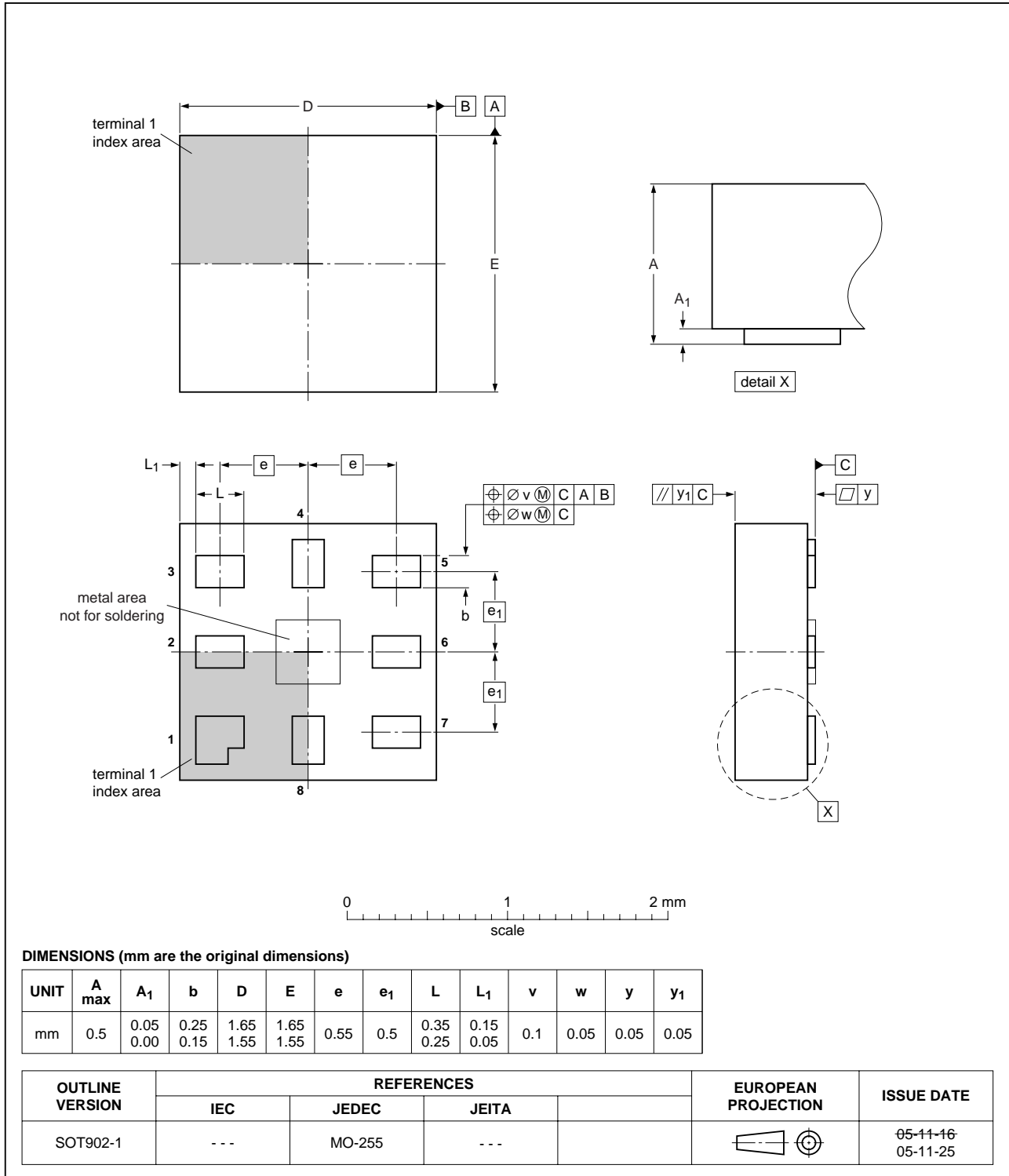


Fig 12. Package outline SOT902-1 (XQFN8)

## 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_5	20070904	Product data sheet	-	74LVC2G38_4
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>In <a href="#">Section 10 "Static characteristics"</a>, changed conditions for input leakage and supply current.</li> </ul>			
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 <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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 URL <http://www.nxp.com>.

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For sales office addresses, send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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