

# 74LVC3G14

## Triple inverting Schmitt trigger with 5 V tolerant input

Rev. 05 — 5 October 2007

Product data sheet

### 1. General description

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The 74LVC3G14 provides three inverting buffers with Schmitt trigger action.

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. Schmitt trigger action at the inputs makes the circuit tolerant of slower input rise and fall time. 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 input/output for interfacing with 5 V logic
- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- $\pm 24$  mA output drive ( $V_{CC} = 3.0$  V)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- Unlimited rise and fall times
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °C and  $-40$  °C to  $+125$  °C.

### 3. Applications

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- Wave and pulse shaper for highly noisy environment
- Astable multivibrator
- Monostable multivibrator.

### 4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVC3G14DP	-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
74LVC3G14DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74LVC3G14GT	-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
74LVC3G14GM	-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

### 5. Marking

Table 2. Marking codes

Type number	Marking code
74LVC3G14DP	V14
74LVC3G14DC	V14
74LVC3G14GT	V14
74LVC3G14GM	V14

### 6. Functional diagram

mna740

**Fig 1. Logic symbol**

mna741

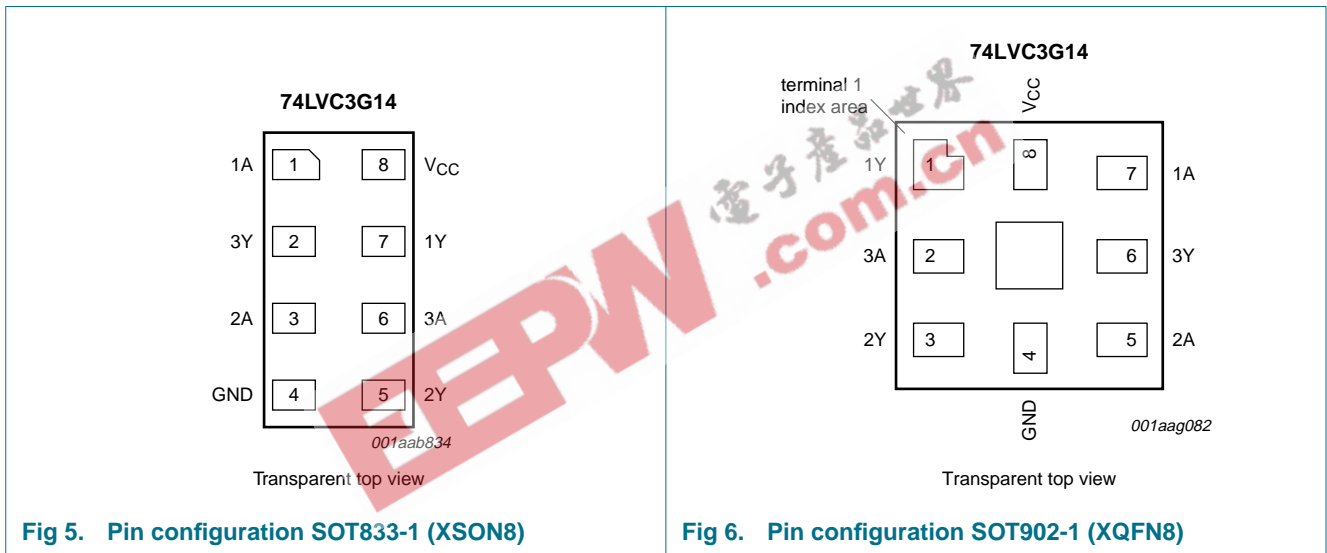
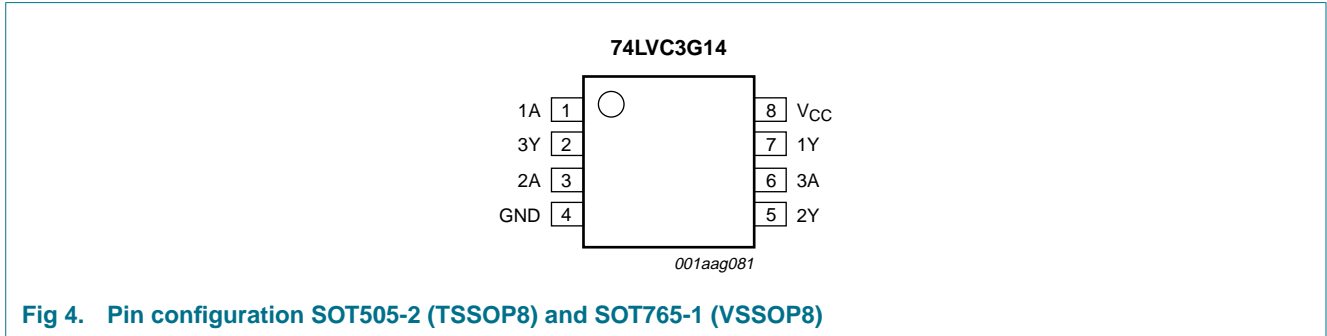
**Fig 2. IEC logic symbol**

mna025

**Fig 3. Logic diagram (one Schmitt trigger)**

## 7. Pinning information

### 7.1 Pinning



### 7.2 Pin description

Table 3. Pin description

Symbol (n = 1, 2, 3)	Pin		Description
	SOT505-2, SOT765-1 and SOT833-1	SOT902-1	
nA	1, 3, 6	7, 5, 2	data input
nY	7, 5, 2	1, 3, 6	data output
GND	4	4	ground (0 V)
V <sub>CC</sub>	8	8	supply voltage

## 8. Functional description

Table 4. Function table [1]

Input nA	Output nY
L	H
H	L

[1] H = HIGH voltage level; L = LOW voltage level

## 9. 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	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
$V_O$	output voltage	Active mode	[1][2] -0.5	$V_{CC} + 0.5$	V
		Power-down mode	[1][2] -0.5	+6.5	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
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[3] -	250	mW
$T_{stg}$	storage temperature		-65	+150	°C

[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 and VSSOP8 packages: above 110 °C the value of  $P_{tot}$  derates linearly with 8.0 mW/K.  
For XSON8 and XQFN8 packages: above 45 °C the value of  $P_{tot}$  derates linearly with 2.4 mW/K.

## 10. 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
		Power-down mode; $V_{CC} = 0$ V	0	-	5.5	V
$T_{amb}$	ambient temperature		-40	-	+125	°C

## 11. Static characteristics

**Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	V <sub>CC</sub> - 0.1	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.9	-	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.3	-	-	V
		I <sub>O</sub> = -32 mA; V <sub>CC</sub> = 4.5 V	3.8	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.3	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	±0.1	±5	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V	-	±0.1	±10	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 1.65 V to 5.5 V	-	0.1	10	μA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.3 V to 5.5 V	-	5	500	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	3.5	-	pF
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	V <sub>CC</sub> - 0.1	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	0.95	-	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.7	-	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	1.9	-	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.0	-	-	V
		I <sub>O</sub> = -32 mA; V <sub>CC</sub> = 4.5 V	3.4	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.7	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.45	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.8	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	±20	μA

**Table 7. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 5.5$ V; $V_{CC} = 0$ V	-	-	$\pm 20$	$\mu$ A
$I_{CC}$	supply current	$V_I = 5.5$ V or GND; $I_O = 0$ A; $V_{CC} = 1.65$ V to 5.5 V	-	-	40	$\mu$ A
$\Delta I_{CC}$	additional supply current	$V_I = V_{CC} - 0.6$ V; $I_O = 0$ A; $V_{CC} = 2.3$ V to 5.5 V	-	-	5000	$\mu$ A

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

**Table 8. Transfer 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 [1]	Max	Min	Max	
$V_{T+}$	positive-going threshold voltage	see <a href="#">Figure 9</a> and <a href="#">Figure 10</a>						
		$V_{CC} = 1.8$ V	0.70	1.10	1.50	0.70	1.70	V
		$V_{CC} = 2.3$ V	1.00	1.40	1.80	1.00	2.00	V
		$V_{CC} = 3.0$ V	1.30	1.76	2.20	1.30	2.40	V
		$V_{CC} = 4.5$ V	1.90	2.47	3.10	1.90	3.30	V
$V_{T-}$	negative-going threshold voltage	see <a href="#">Figure 9</a> and <a href="#">Figure 10</a>						
		$V_{CC} = 1.8$ V	0.25	0.61	0.90	0.25	1.10	V
		$V_{CC} = 2.3$ V	0.40	0.80	1.15	0.40	1.35	V
		$V_{CC} = 3.0$ V	0.60	1.04	1.50	0.60	1.70	V
		$V_{CC} = 4.5$ V	1.00	1.55	2.00	1.00	2.20	V
$V_H$ [2]	hysteresis voltage	see <a href="#">Figure 9</a> , <a href="#">Figure 10</a> and <a href="#">Figure 11</a>						
		$V_{CC} = 1.8$ V	0.15	0.49	1.00	0.15	1.20	V
		$V_{CC} = 2.3$ V	0.25	0.60	1.10	0.25	1.30	V
		$V_{CC} = 3.0$ V	0.40	0.73	1.20	0.40	1.40	V
		$V_{CC} = 4.5$ V	0.60	0.92	1.50	0.60	1.70	V
		$V_{CC} = 5.5$ V	0.70	1.02	1.70	0.70	1.90	V

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

[2]  $V_H = V_{T+} - V_{T-}$ .

## 12. Dynamic characteristics

**Table 9. 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>pd</sub>	propagation delay	nA to nY; see <a href="#">Figure 7</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	4.2	11.0	1.0	12.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	3.0	6.5	0.5	7.2	ns
		V <sub>CC</sub> = 2.7 V	0.5	3.8	7.0	0.5	7.7	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	3.2	6.0	0.5	6.7	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	2.4	4.3	0.5	4.7	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 <sup>[3]</sup>	-	18.1	-	-	-	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;

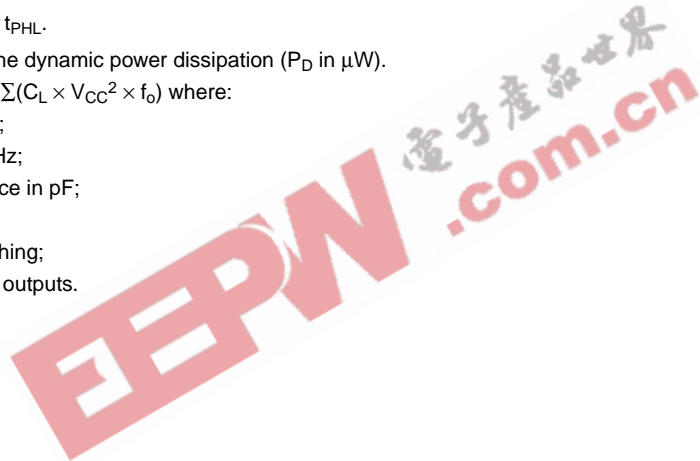
f<sub>o</sub> = output frequency in MHz;

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

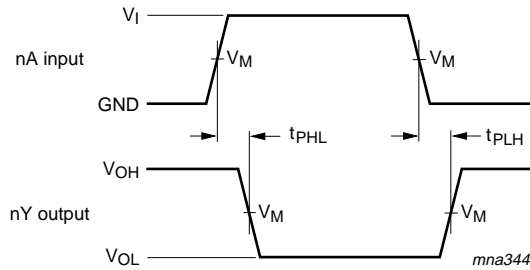
V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

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



13. Waveforms

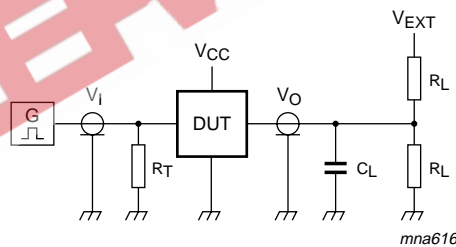


Measurement points are given in Table 10. VOL and VOH are typical output voltage levels that occur with the output load.

Fig 7. The data input (nA) to output (nY) propagation delays

Table 10. Measurement points

V <sub>CC</sub>	Input V <sub>M</sub>	Output 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 11. Definitions for test circuit:

RL = Load resistance.

CL = Load capacitance including jig and probe capacitance.

RT = Termination resistance should be equal to the output impedance Zo of the pulse generator.

VEXT = External voltage for measuring switching times.

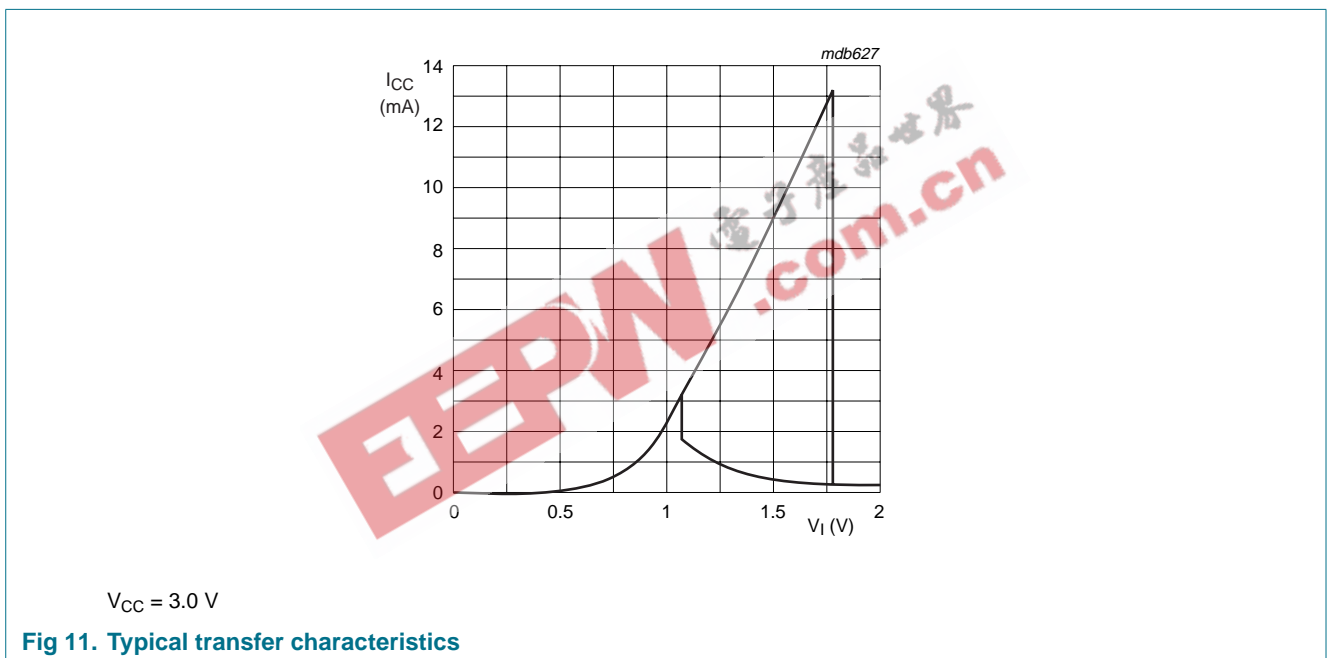
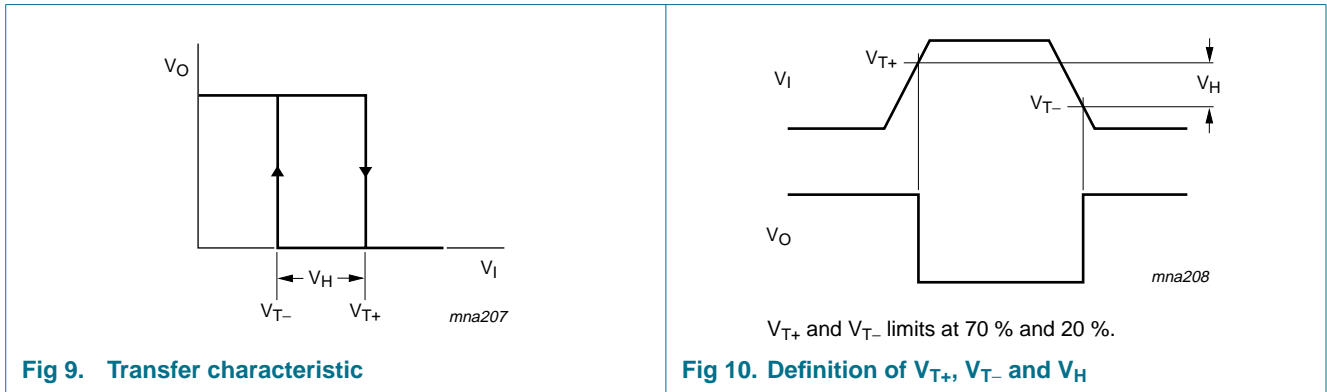
Fig 8. Load circuitry for switching times

Table 11. Test data

Supply voltage	Input	Load	V <sub>EXT</sub>
V <sub>CC</sub>	VI	CL	t <sub>PLH</sub> , t <sub>PHL</sub>
1.65 V to 1.95 V	V <sub>CC</sub>	30 pF	open
2.3 V to 2.7 V	V <sub>CC</sub>	30 pF	open
2.7 V	2.7 V	50 pF	open
3.0 V to 3.6 V	2.7 V	50 pF	open
4.5 V to 5.5 V	V <sub>CC</sub>	50 pF	open



14. Waveforms transfer characteristics



15. Application information

The slow input rise and fall times cause additional power dissipation, this can be calculated using the following formula:

$$P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC} \text{ where:}$$

$P_{add}$  = additional power dissipation ( $\mu\text{W}$ );

$f_i$  = input frequency (MHz);

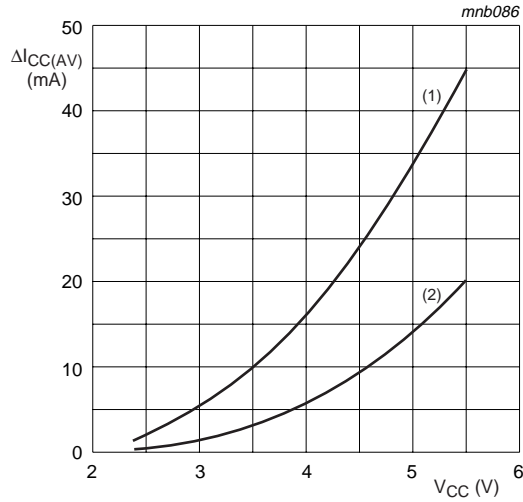
$t_r$  = input rise time (ns); 10 % to 90 %;

$t_f$  = input fall time (ns); 90 % to 10 %;

$\Delta I_{CC(AV)}$  = average additional supply current ( $\mu\text{A}$ ).

$\Delta I_{CC(AV)}$  differs with positive or negative input transitions, as shown in [Figure 12](#).

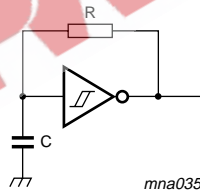
An example of a relaxation circuit using the 74LVC3G14 is shown in [Figure 13](#).



Linear change of V<sub>I</sub> between 0.8 V to 2.0 V. All values given are typical unless otherwise specified.

- (1) Positive-going edge.
- (2) Negative-going edge.

Fig 12. ΔI<sub>CC(AV)</sub> as a function of V<sub>CC</sub>



$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$$

Fig 13. Relaxation oscillator

16. Package outline

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

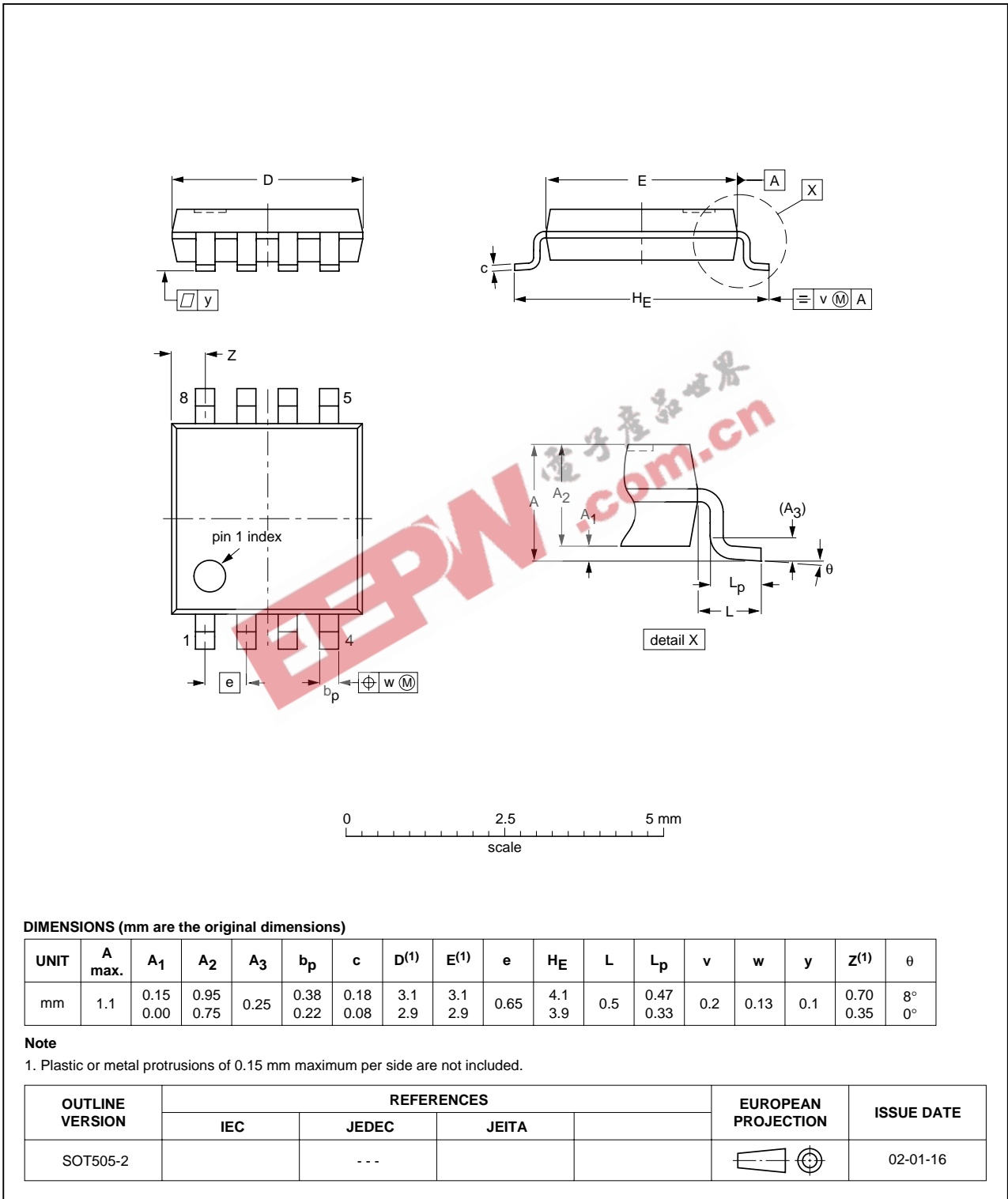


Fig 14. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

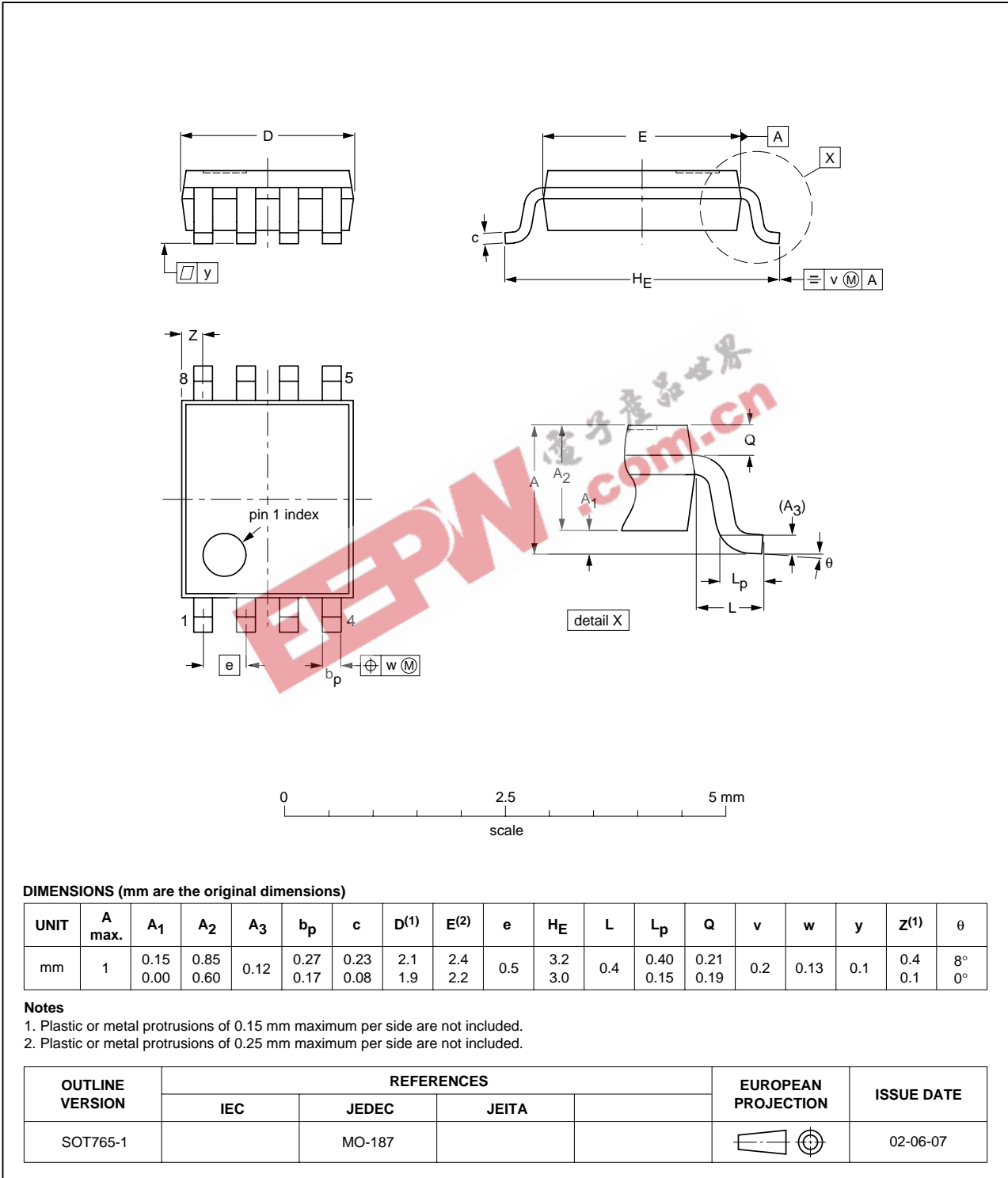


Fig 15. Package outline SOT765-1 (VSSOP8)

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

SOT833-1

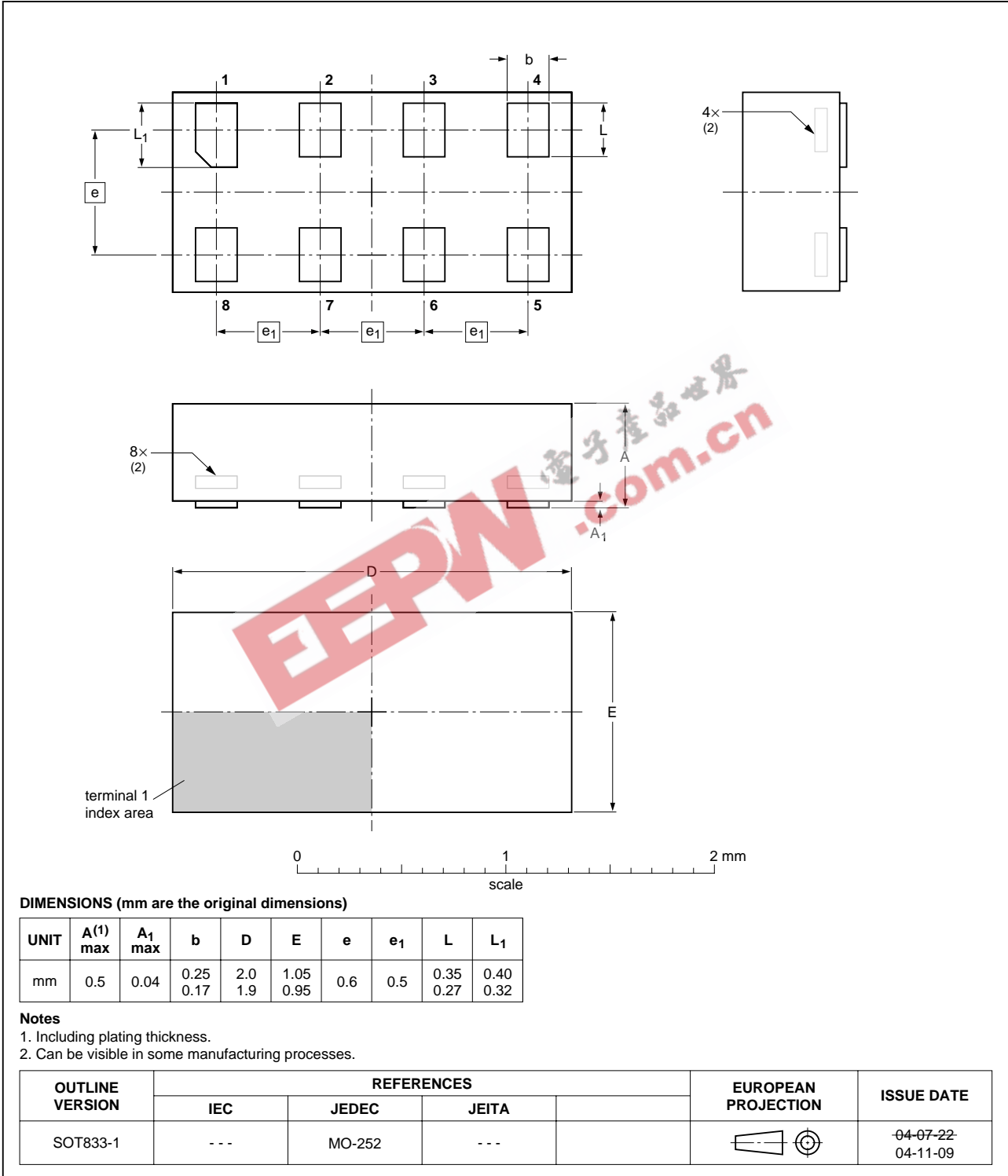


Fig 16. Package outline SOT833-1 (XSON8)

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

SOT902-1

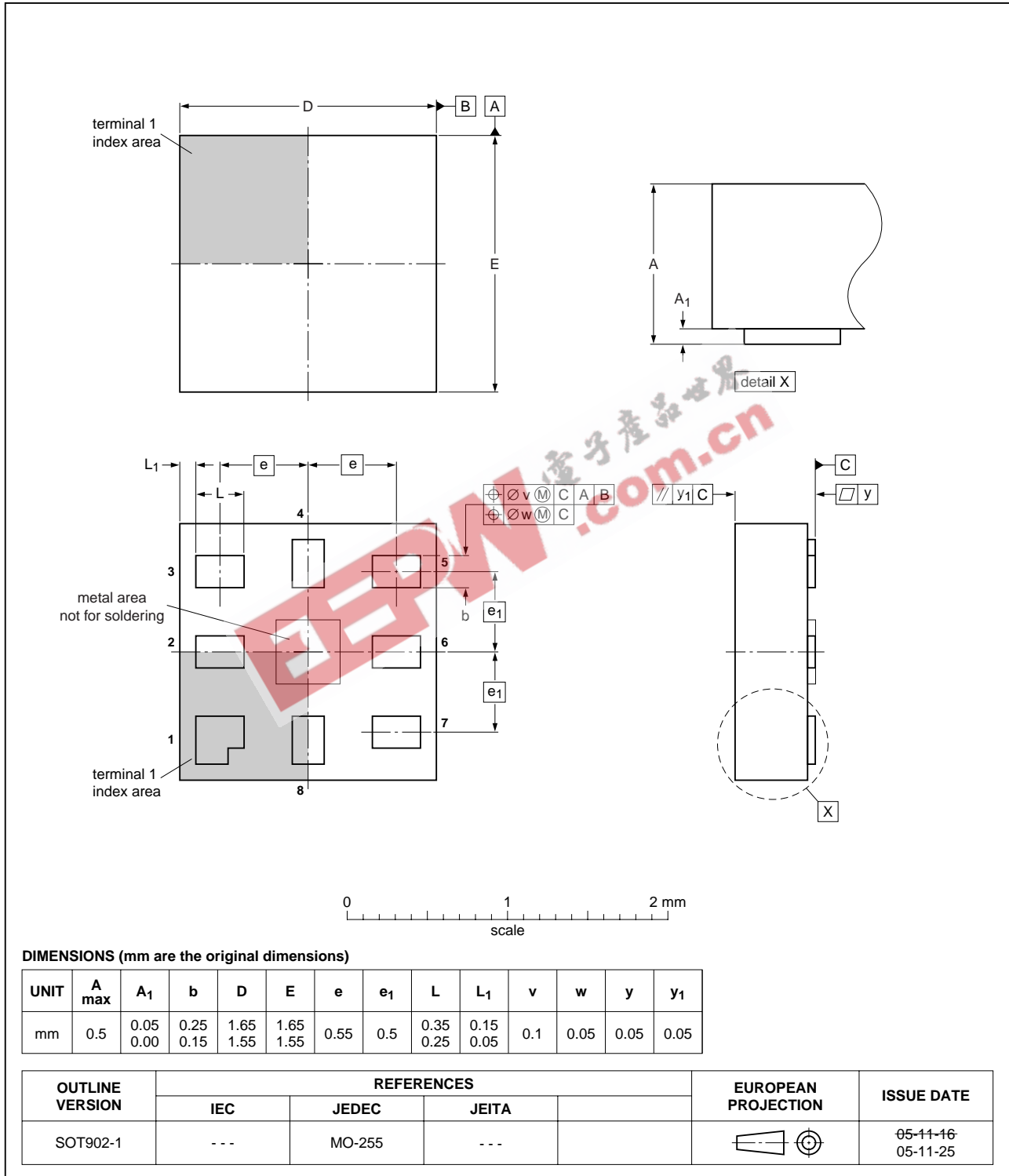


Fig 17. Package outline SOT902-1 (XQFN8)

## 17. Abbreviations

Table 12. 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

## 18. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC3G14_5	20071005	Product data sheet	-	74LVC3G14_4
Modifications:	<ul style="list-style-type: none"> <li>In <a href="#">Section 11 "Static characteristics"</a>, changed conditions for input leakage and supply current.</li> </ul>			
74LVC3G14_4	20070314	Product data sheet	-	74LVC3G14_3
74LVC3G14_3	20050131	Product data sheet	-	74LVC3G14_2
74LVC3G14_2	20041027	Product data sheet	-	74LVC3G14_1
74LVC3G14_1	20040510	Product data sheet	-	-

## 19. Legal information

### 19.1 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".

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