

# 74LVC3G04

## Triple inverter

Rev. 01 — 4 May 2004

Product data sheet

## 1. General description

The 74LVC3G04 is a high-performance, low-power, low-voltage, Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

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.

The 74LVC3G04 provides three inverting buffers.

## 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)
  - ◆ JESD8-B/JESD36 (2.7 V to 3.6 V).
- ESD protection:
  - ◆ HBM EIA/JESD22-A114-B 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
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- SOT505-2 and SOT765-1 package
- Specified from  $-40$  °C to  $+85$  °C and  $-40$  °C to  $+125$  °C.

**PHILIPS**

### 3. Quick reference data

**Table 1: Quick reference data**

$GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PHL}$ , $t_{PLH}$	propagation delay inputs nA to output nY	$V_{CC} = 1.8\text{ V}$ ; $C_L = 30\text{ pF}$ ; $R_L = 1\text{ k}\Omega$	-	3.5	-	ns
		$V_{CC} = 2.5\text{ V}$ ; $C_L = 30\text{ pF}$ ; $R_L = 500\ \Omega$	-	2.2	-	ns
		$V_{CC} = 2.7\text{ V}$ ; $C_L = 50\text{ pF}$ ; $R_L = 500\ \Omega$	-	2.7	-	ns
		$V_{CC} = 3.3\text{ V}$ ; $C_L = 50\text{ pF}$ ; $R_L = 500\ \Omega$	-	2.7	-	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 50\text{ pF}$ ; $R_L = 500\ \Omega$	-	1.9	-	ns
$C_I$	input capacitance		-	2.5	-	pF
$C_{PD}$	power dissipation capacitance	$V_{CC} = 3.3\text{ V}$	[1][2]	13.5	-	pF

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$N$  = total load switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

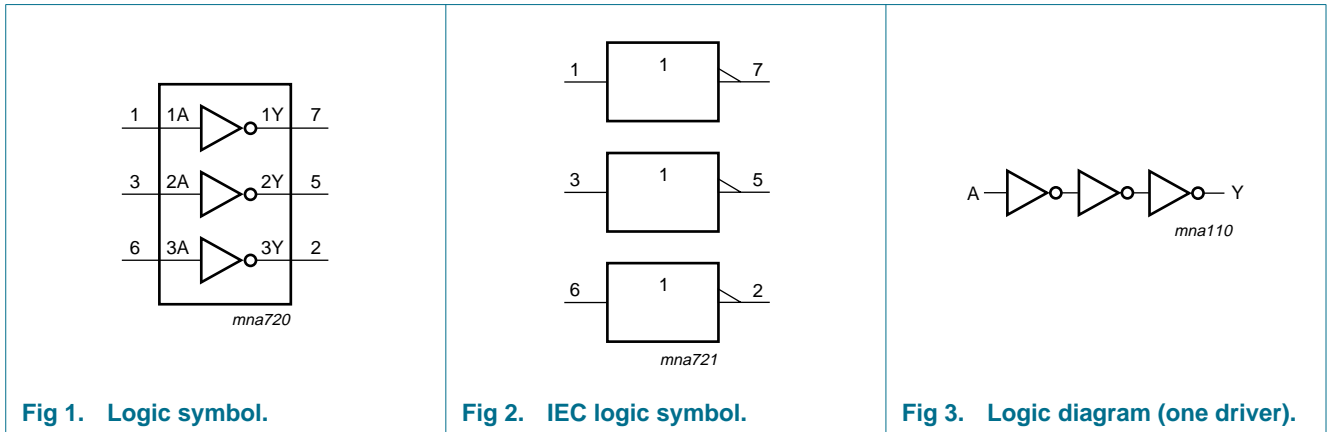
[2] The condition is  $V_I = GND$  to  $V_{CC}$ .

### 4. Ordering information

**Table 2: Ordering information**

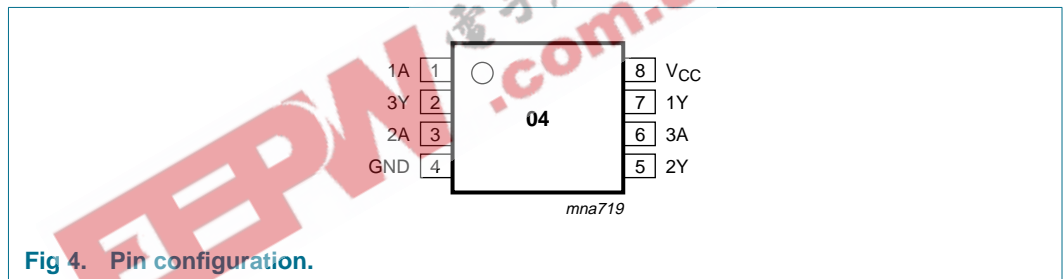
Type number	Package			Version
	Temperature range	Name	Description	
74LVC3G04DP	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74LVC3G04DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1

## 5. Functional diagram



## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3: Pin description

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

## 7. Functional description

### 7.1 Function table

Table 4: Function table [1]

Input	Output
nA	nY
L	H
H	L

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

## 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 diode current	$V_I < 0$ V	-	-50	mA
$V_I$	input voltage		[1] -0.5	+6.5	V
$I_{OK}$	output diode 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
$I_{CC}, I_{GND}$	$V_{CC}$ or GND current		-	±100	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	power dissipation	$T_{amb} = -40$ °C to +125 °C	-	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.

## 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
		Power-down mode; $V_{CC} = 0$ V	0	-	5.5	V
$T_{amb}$	operating ambient temperature		-40	-	+125	°C
$t_r, t_f$	input rise and fall times	$V_{CC} = 1.65$ V to 2.7 V	0	-	20	ns/V
		$V_{CC} = 2.7$ V to 5.5 V	0	-	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 $V_{IL}$				
		$I_O = 100\text{ }\mu\text{A}$ ; $V_{CC} = 1.65\text{ V to }5.5\text{ V}$	-	-	0.1	V
		$I_O = 4\text{ mA}$ ; $V_{CC} = 1.65\text{ V}$	-	-	0.45	V
		$I_O = 8\text{ mA}$ ; $V_{CC} = 2.3\text{ V}$	-	-	0.3	V
		$I_O = 12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	-	-	0.4	V
		$I_O = 24\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	-	-	0.55	V
		$I_O = 32\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	-	0.55	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
		$I_O = -4\text{ mA}$ ; $V_{CC} = 1.65\text{ V}$	1.2	-	-	V
		$I_O = -8\text{ mA}$ ; $V_{CC} = 2.3\text{ V}$	1.9	-	-	V
		$I_O = -12\text{ mA}$ ; $V_{CC} = 2.7\text{ V}$	2.2	-	-	V
		$I_O = -24\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	2.3	-	-	V
		$I_O = -32\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	3.8	-	-	V
$I_{LI}$	input leakage current	$V_I = 5.5\text{ V}$ or GND; $V_{CC} = 5.5\text{ V}$	-	$\pm 0.1$	$\pm 5$	$\mu\text{A}$
$I_{off}$	power-off leakage current	$V_I$ or $V_O = 5.5\text{ V}$ ; $V_{CC} = 0\text{ V}$	-	$\pm 0.1$	$\pm 10$	$\mu\text{A}$
$I_{CC}$	quiescent supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 5.5\text{ V}$	-	0.1	10	$\mu\text{A}$
$\Delta I_{CC}$	additional quiescent 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
<b><math>T_{amb} = -40\text{ °C to }+125\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

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.3 × V <sub>CC</sub>	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	-	-	0.70	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	-	-	0.60	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.80	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.80	V
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
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 5.5 V	-	-	±20	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	-	-	±20	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	40	μA
ΔI <sub>CC</sub>	additional quiescent supply current per pin	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	-	-	5000	μA

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.

## 11. Dynamic characteristics

**Table 8: Dynamic characteristics**GND = 0 V; for test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>							
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay input nA to output nY	see <a href="#">Figure 5</a>					
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	3.5	8.0	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	2.2	4.4	ns	
		V <sub>CC</sub> = 2.7 V	0.5	2.7	5.2	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	2.7	4.1	ns	
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	1.9	3.2	ns	
C <sub>PD</sub>	power dissipation capacitance	V <sub>CC</sub> = 3.3 V	[2] [3]	-	13.5	-	pF

**Table 8: Dynamic characteristics ...continued**  
 GND = 0 V; for test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay input nA to output nY	see <a href="#">Figure 5</a>				
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	-	9.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	-	5.4	ns
		V <sub>CC</sub> = 2.7 V	0.5	-	7.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.5	-	5.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.5	-	3.8	ns

[1] All typical values are measured at nominal V<sub>CC</sub> and 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;

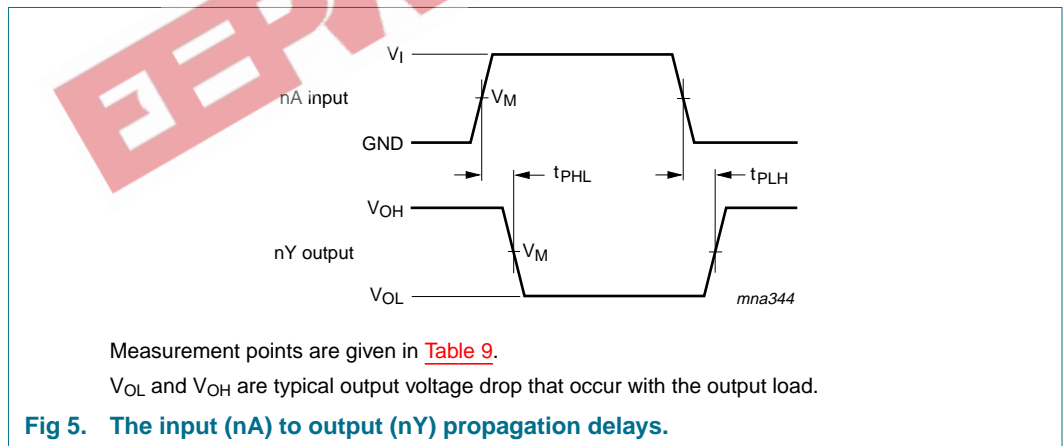
V<sub>CC</sub> = supply voltage in V;

N = total load switching outputs;

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

[3] The condition is V<sub>I</sub> = GND to V<sub>CC</sub>.

## 12. Waveforms



**Table 9: Measurement points**

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

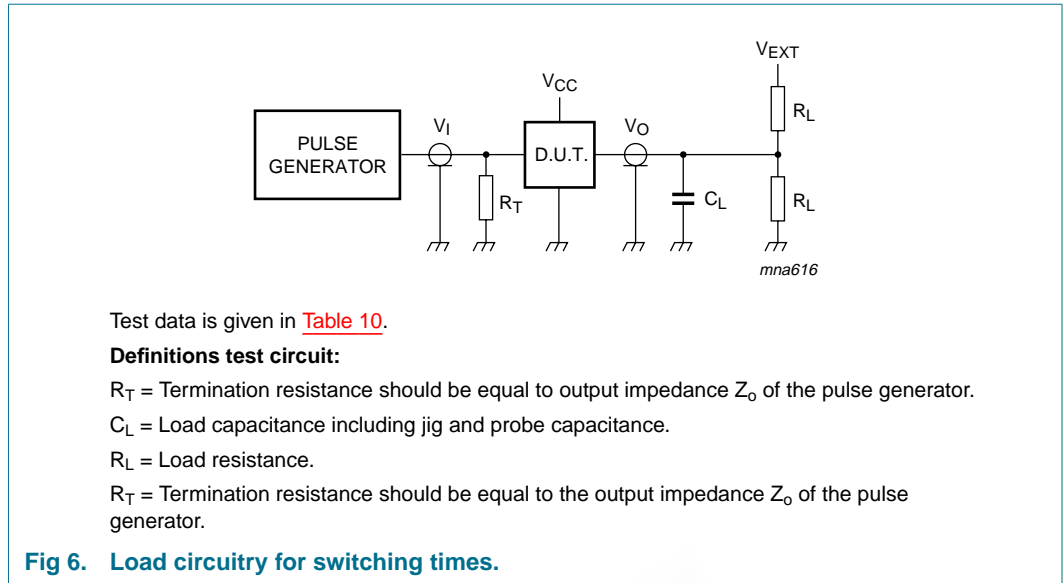


Table 10: Test data

Supply voltage	Input		Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r = t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1 k $\Omega$	open	GND	$2 \times V_{CC}$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	GND	$2 \times V_{CC}$
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	GND	6 V
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	GND	6 V
4.5 V to 5.5 V	$V_{CC}$	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	GND	$2 \times V_{CC}$



13. Package outline

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

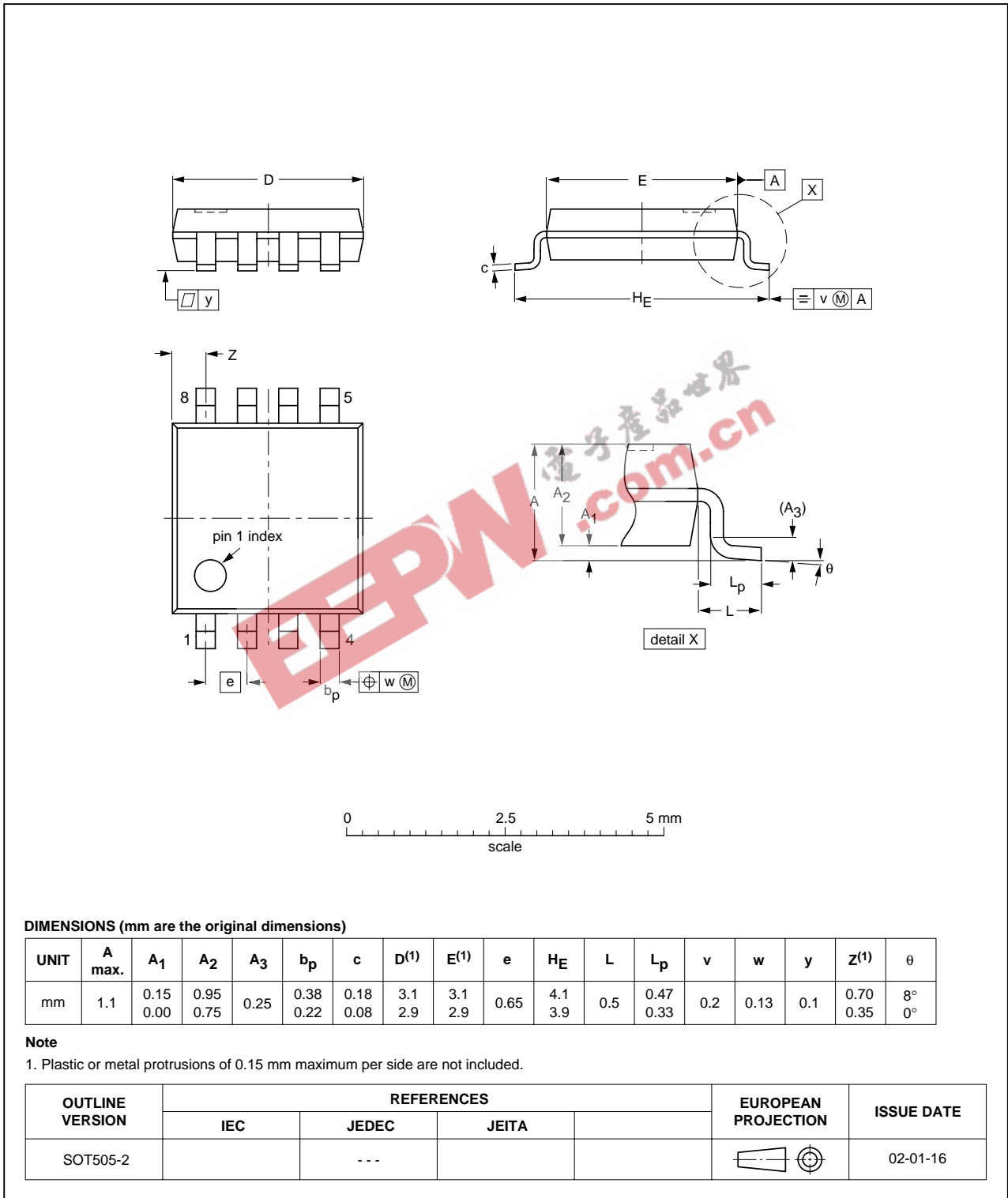


Fig 7. Package outline TSSOP8.

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

SOT765-1

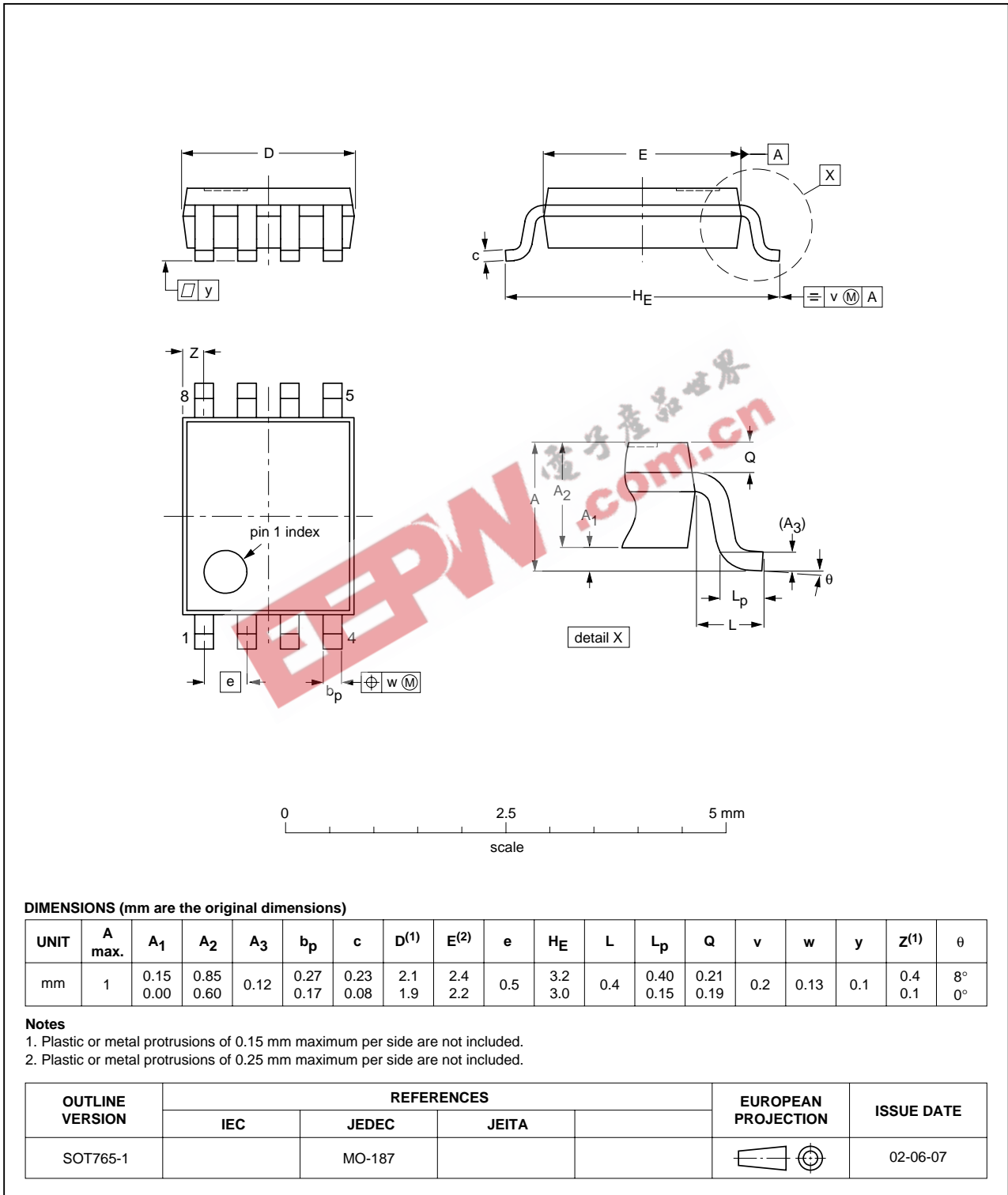


Fig 8. Package outline VSSOP8

## 14. Revision history

Table 11: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74LVC3G04_1	20040504	Product data	-	9397 750 13075	-

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## 15. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 16. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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