DATA SHEET

74LVC2GU04
Dual inverter

Product specification
Supersedes data of 2004 May 24

2004 Sep 21

Philips
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Dual inverter 74LVC2GU04

FEATURES

- 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 EIA/JESD22-A114-B exceeds 2000 V
  - MM EIA/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
- Multiple package options
- Specified from –40 °C to +85 °C and –40 °C to +125 °C.

DESCRIPTION

The 74LVC2GU04 is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

Input can be driven from either 3.3 V or 5 V devices. These features allow the use of these devices in a mixed 3.3 V and 5 V environment.

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

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	propagation delay input nA to output nY	V_{CC} = 1.8 V; C_L = 30 pF; R_L = 1 kΩ	2.3	ns
		V_{CC} = 2.5 V; C_L = 30 pF; R_L = 500 Ω	1.8	ns
		V_{CC} = 2.7 V; C_L = 50 pF; R_L = 500 Ω	2.6	ns
		V_{CC} = 3.3 V; C_L = 50 pF; R_L = 500 Ω	2.3	ns
		V_{CC} = 5.0 V; C_L = 50 pF; R_L = 500 Ω	1.7	ns
C_I	input capacitance		5	pF
C_{PD}	power dissipation capacitance per gate	V_{CC} = 3.3 V; notes 1 and 2	7.8	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in µW).
   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 Volts;
   N = total load switching outputs;
   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.
2. The condition is V_I = GND to V_{CC}.

FUNCTION TABLE

See note 1.

INPUT	OUTPUT
nA	nY
L	H
H	L

Note

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

ORDERING INFORMATION

TYPE NUMBER	PACKAGE					
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE	MARKING
74LVC2GU04GW	–40 °C to +125 °C	6	SC-88	plastic	SOT363	YD
74LVC2GU04GV	–40 °C to +125 °C	6	SC-74	plastic	SOT457	VU4
74LVC2GU04GM	–40 °C to +125 °C	6	XSON6	plastic	SOT886	YD

PINNING

PIN	SYMBOL	DESCRIPTION
1	1A	data input
2	GND	ground (0 V)
3	2A	data input
4	2Y	data output
5	V_{CC}	supply voltage
6	1Y	data output

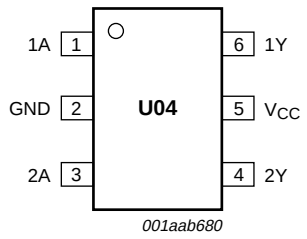
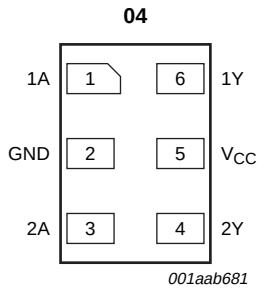


Fig.1 Pin configuration SC-88 and SC-74.



Transparent top view

Fig.2 Pin configuration XSON6.

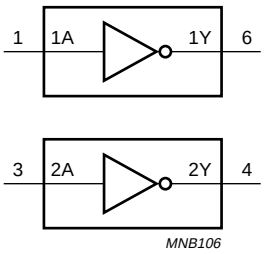


Fig.3 Logic symbol.

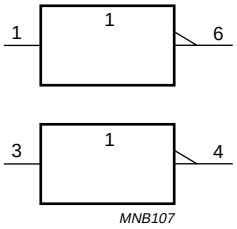


Fig.4 IEC logic symbol.

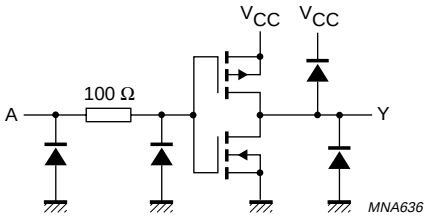


Fig.5 Logic diagram (one gate).

RECOMMENDED 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
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

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	note 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; note 1	–0.5	V_{CC} + 0.5	V
I_O	output source or sink 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

Note

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

DC CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = –40 °C to +85 °C							
V_{IH}	HIGH-level input voltage		1.65 to 5.5	0.75 × V_{CC}	–	–	V
V_{IL}	LOW-level input voltage		1.65 to 5.5	–	–	0.25 × V_{CC}	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 µA	1.65 to 5.5	–	–	0.1	V
		I_O = 4 mA	1.65	–	–	0.45	V
		I_O = 8 mA	2.3	–	–	0.3	V
		I_O = 12 mA	2.7	–	–	0.4	V
		I_O = 24 mA	3.0	–	–	0.55	V
		I_O = 32 mA	4.5	–	–	0.55	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = –100 µA	1.65 to 5.5	V_{CC} – 0.1	–	–	V
		I_O = –4 mA	1.65	1.2	–	–	V
		I_O = –8 mA	2.3	1.9	–	–	V
		I_O = –12 mA	2.7	2.2	–	–	V
		I_O = –24 mA	3.0	2.3	–	–	V
		I_O = –32 mA	4.5	3.8	–	–	V
I_{LI}	input leakage current	V_I = 5.5 V or GND	5.5	–	±0.1	±5	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0 A	5.5	–	0.1	10	µA

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = −40 °C to +125 °C							
V_{IH}	HIGH-level input voltage		1.65 to 5.5	0.8 × V_{CC}	–	–	V
V_{IL}	LOW-level input voltage		1.65 to 5.5	–	–	0.2 × V_{CC}	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 µA	1.65 to 5.5	–	–	0.1	V
		I_O = 4 mA	1.65	–	–	0.70	V
		I_O = 8 mA	2.3	–	–	0.45	V
		I_O = 12 mA	2.7	–	–	0.60	V
		I_O = 24 mA	3.0	–	–	0.80	V
		I_O = 32 mA	4.5	–	–	0.80	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = −100 µA	1.65 to 5.5	V_{CC} − 0.1	–	–	V
		I_O = −4 mA	1.65	0.95	–	–	V
		I_O = −8 mA	2.3	1.7	–	–	V
		I_O = −12 mA	2.7	1.9	–	–	V
		I_O = −24 mA	3.0	2.0	–	–	V
		I_O = −32 mA	4.5	3.4	–	–	V
I_{LI}	input leakage current	V_I = 5.5 V or GND	5.5	–	–	±20	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0 A	5.5	–	–	40	µA

Note

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

AC CHARACTERISTICS

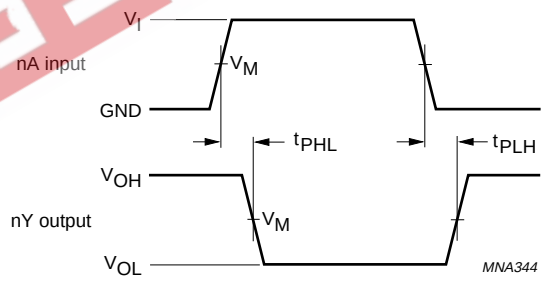
GND = 0 V.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = −40 °C to +85 °C							
t_{PHL}/t_{PLH}	propagation delay nA to nY	see Figs 6 and 7	1.65 to 1.95	0.5	2.3	5.0	ns
			2.3 to 2.7	0.3	1.8	4.0	ns
			2.7	0.3	2.6	4.5	ns
			3.0 to 3.6	0.3	2.3	3.7	ns
			4.5 to 5.5	0.3	1.7	3.0	ns
T_{amb} = −40 °C to +125 °C							
t_{PHL}/t_{PLH}	propagation delay nA to nY	see Figs 6 and 7	1.65 to 1.95	0.5	–	6.3	ns
			2.3 to 2.7	0.3	–	5.0	ns
			2.7	0.3	–	5.6	ns
			3.0 to 3.6	0.3	–	4.5	ns
			4.5 to 5.5	0.3	–	3.8	ns

Note

1. All typical values are measured at nominal V_{CC} and T_{amb} = 25 °C.

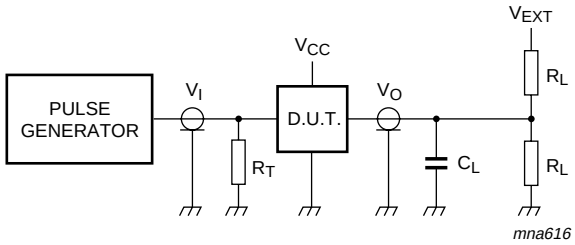
AC WAVEFORMS



V_{CC}	V_M	INPUT	
		V_I	$t_r = t_f$
1.65 V to 1.95 V	0.5 × V_{CC}	V_{CC}	≤ 2.0 ns
2.3 V to 2.7 V	0.5 × V_{CC}	V_{CC}	≤ 2.0 ns
2.7 V	1.5 V	2.7 V	≤ 2.5 ns
3.0 V to 3.6 V	1.5 V	2.7 V	≤ 2.5 ns
4.5 V to 5.5 V	0.5 × V_{CC}	V_{CC}	≤ 2.5 ns

V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

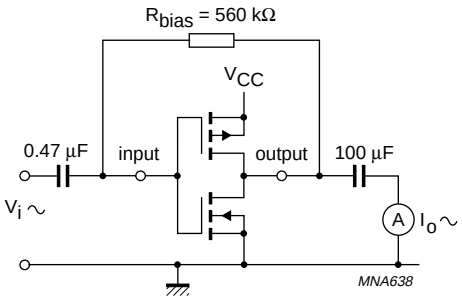
Fig.6 The input (nA) to output (nY) propagation delays.



V_{CC}	V_I	C_L	R_L	V_{EXT}
				t_{PLH}/t_{PHL}
1.65 V to 1.95 V	V_{CC}	30 pF	1 kΩ	open
2.3 V to 2.7 V	V_{CC}	30 pF	500 Ω	open
2.7 V	2.7 V	50 pF	500 Ω	open
3.0 V to 3.6 V	2.7 V	50 pF	500 Ω	open
4.5 V to 5.5 V	V_{CC}	50 pF	500 Ω	open

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 the output impedance Z_o of the pulse generator.

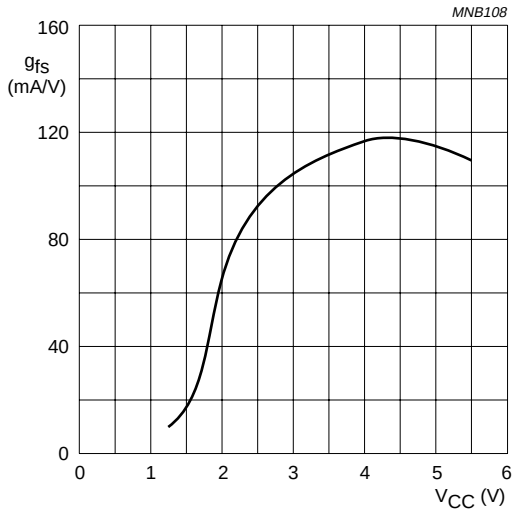
Fig.7 Load circuitry for switching times.



$g_{fs} = \frac{\Delta I_o}{\Delta V_i}$

f_i = 1 kHz.
V_O is constant.

Fig.8 Test set-up for measuring forward transconductance.



T_{amb} = 25 °C.

Fig.9 Typical forward transconductance as a function of supply voltage.

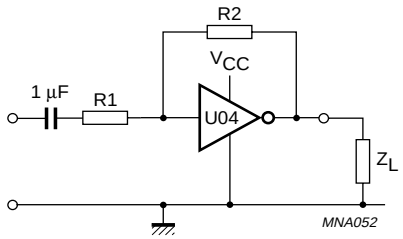
APPLICATION INFORMATION

Some applications for the 74LVC2GU04 are:

- Linear amplifier (see Fig.10)
- Crystal oscillator (see Fig.11).

Remark to the application information.

All values given are typical values unless otherwise specified.

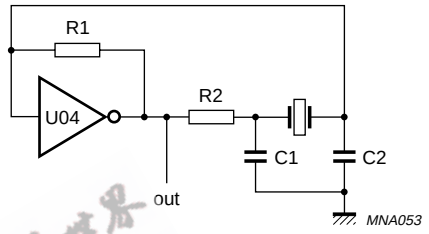


Z_L > 10 kΩ, R1 ≥ 3 kΩ and R2 ≤ 1 MΩ.
Open loop amplification: A_{OL} = 20 (typical).

Voltage amplification: $A_u = -\frac{A_{OL}}{1 + \frac{R1}{R2}(1 + A_{OL})}$

Maximum output voltage: $V_{O(p-p)} = V_{CC} - 1.5$ V centered at $0.5 \times V_{CC}$.
Unity gain bandwidth product: B = 5 MHz (typical).

Fig.10 Linear amplifier configuration.

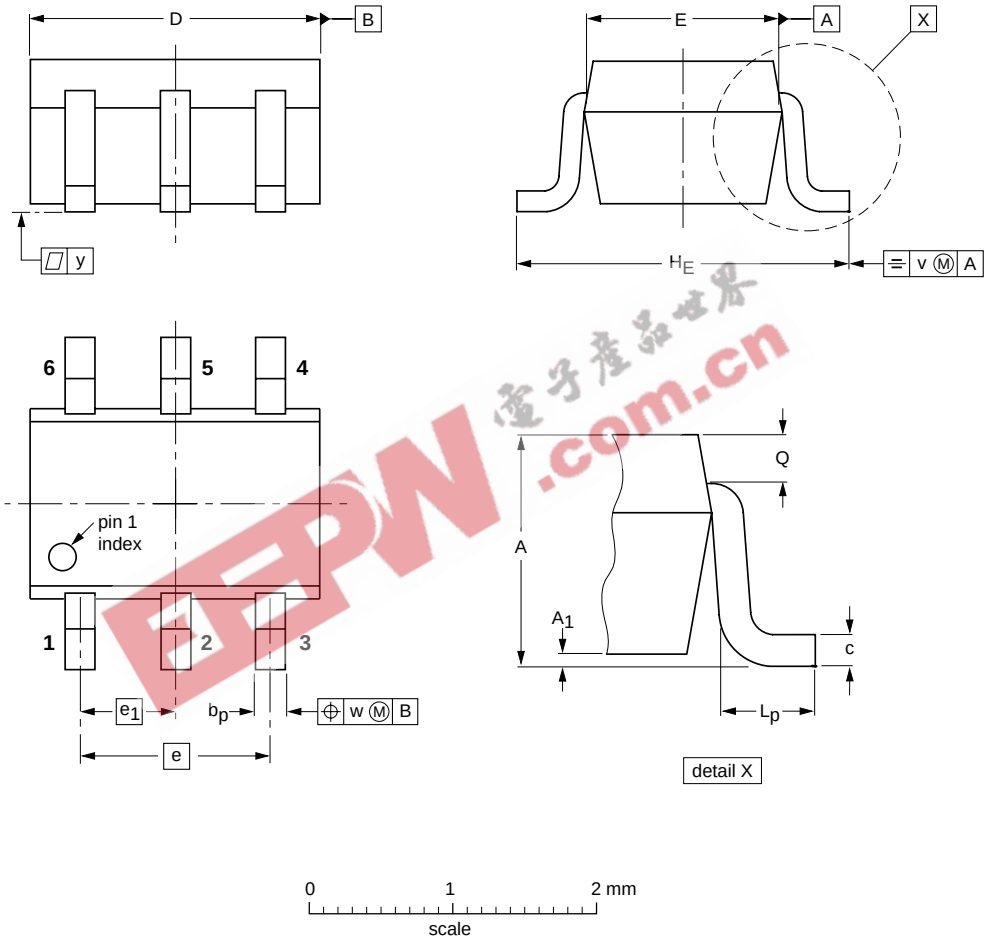


C1 = 47 pF (typical).
C2 = 22 pF (typical).
R1 = 1 MΩ to 10 MΩ (typical).
R2 optimum value depends on the frequency and required stability against changes in V_{CC} or average minimum I_{CC} (I_{CC} = 2 mA (typical) at V_{CC} = 3.3 V and f = 10 MHz).

Fig.11 Crystal oscillator configuration.

PACKAGE OUTLINES

Plastic surface mounted package; 6 leads **SOT363**

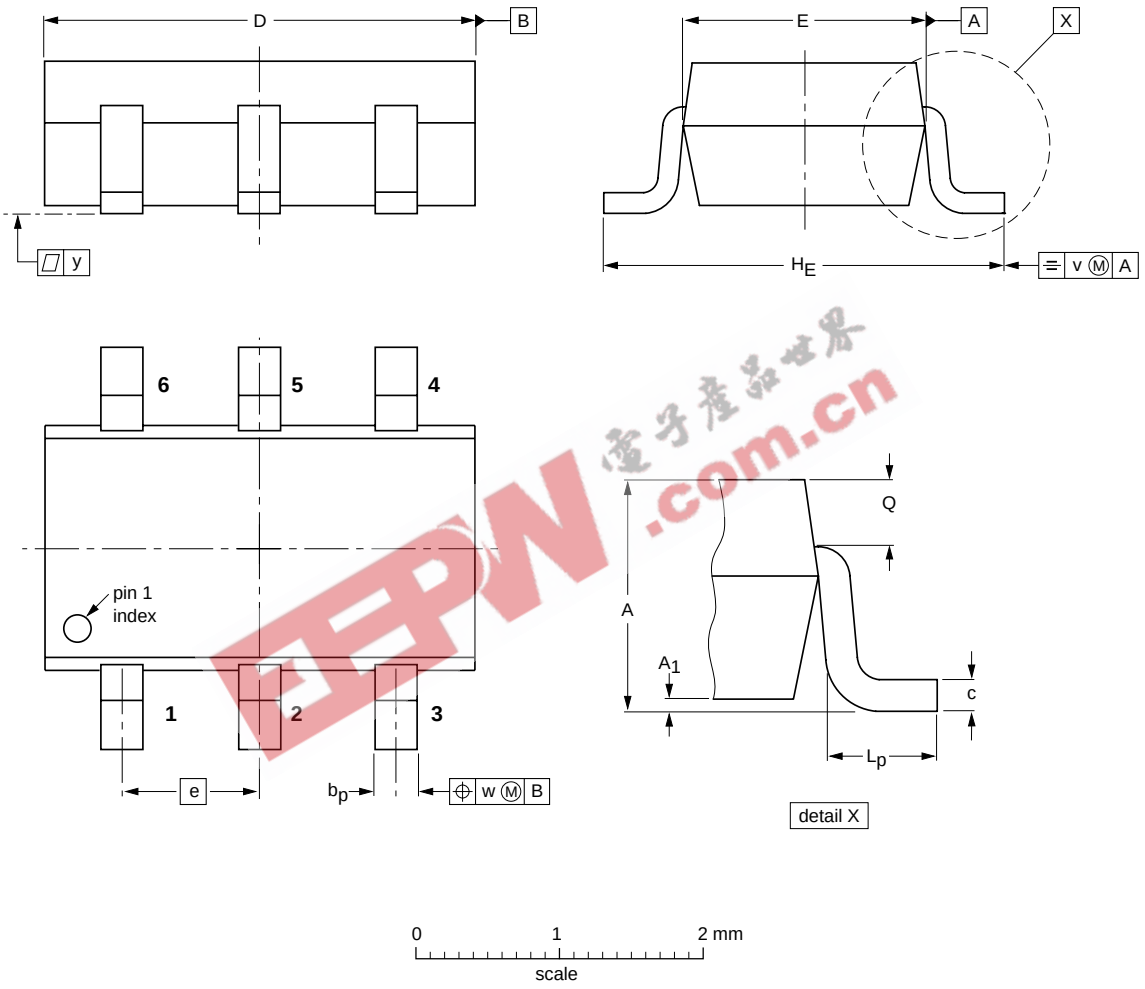


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT363			SC-88			97-02-28

Plastic surface mounted package; 6 leads **SOT457**

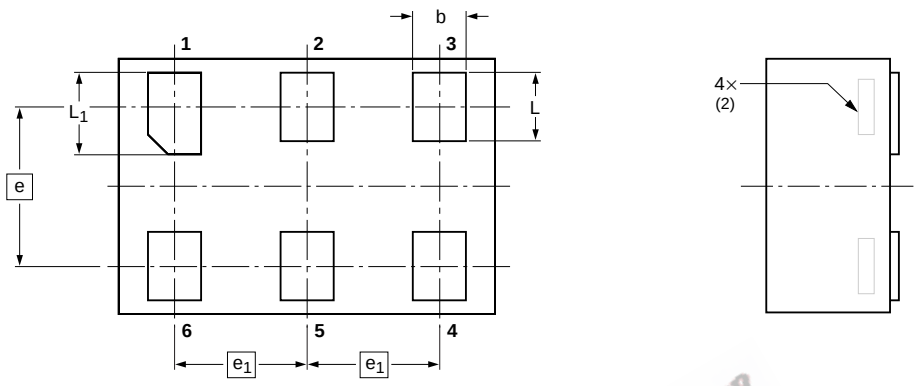


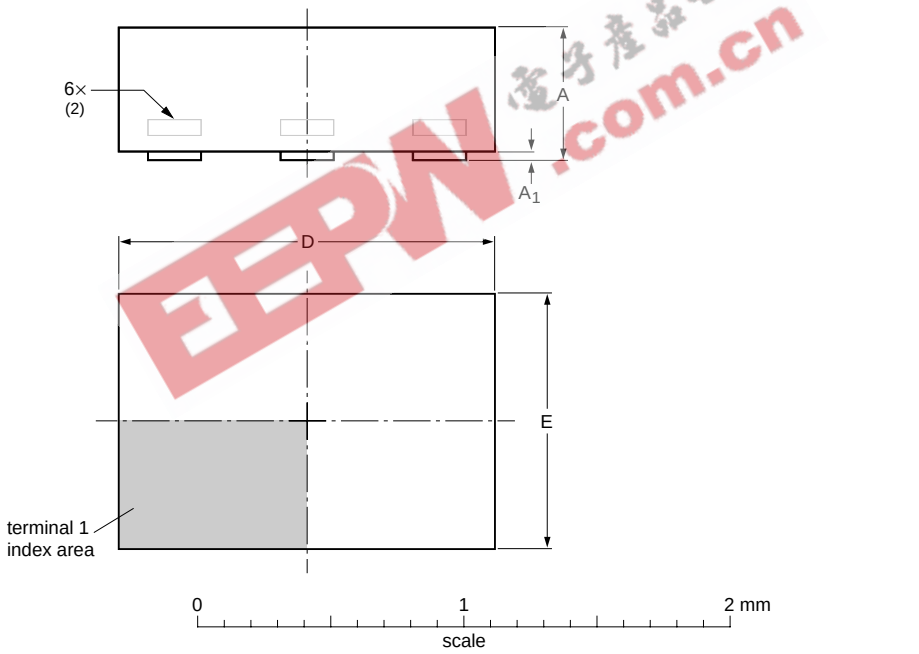
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT457			SC-74			~~97-02-28~~ 01-05-04

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm **SOT886**





DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max	A_1 max	b	D	E	e	e_1	L	L_1
mm	0.5	0.04	0.25 0.17	1.5 1.4	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-15~~ 04-07-22

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS[1]	PRODUCT STATUS[2][3]	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.

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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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