DATA SHEET

74LVC1GU04
Inverter

Product specification
Supersedes data of 2004 Jun 28

2004 Sep 21

Philips
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Inverter 74LVC1GU04

FEATURES

- Wide supply voltage range from 1.65 V to 5.5 V
- High noise immunity
- ±24 mA output drive (V_{CC} = 3.0 V)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Input accepts voltages up to 5 V
- Multiple package options
- ESD protection:
  - HBM EIA/JESD22-A114-B exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from –40 °C to +85 °C and –40 °C to +125 °C.

DESCRIPTION

The 74LVC1GU04 is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

The input 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 all inputs makes the circuit tolerant for slower input rise and fall time.

The 74LVC1GU04 provides the inverting single state unbuffered function.

QUICK REFERENCE DATA

Ground = 0 V; T_{amb} = 25 °C; $t_r = t_f \leq 2.5$ ns.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	propagation delay A to Y	V_{CC} = 1.8 V; C_L = 30 pF; R_L = 1 kΩ	1.7	ns
		V_{CC} = 2.5 V; C_L = 30 pF; R_L = 500 Ω	1.3	ns
		V_{CC} = 2.7 V; C_L = 50 pF; R_L = 500 Ω	1.7	ns
		V_{CC} = 3.3 V; C_L = 50 pF; R_L = 500 Ω	1.6	ns
		V_{CC} = 5.0 V; C_L = 50 pF; R_L = 500 Ω	1.3	ns
C_I	input capacitance		6	pF
C_{PD}	power dissipation capacitance	V_{CC} = 3.3 V; notes 1 and 2	14.9	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 the outputs.
2. The condition is V_I = GND to V_{CC}.

FUNCTION TABLE

See note 1.

INPUT	OUTPUT
A	**Y**
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
74LVC1GU04GW	–40 °C to +125 °C	5	SC-88A	plastic	SOT353	VD
74LVC1GU04GV	–40 °C to +125 °C	5	SC-74A	plastic	SOT753	VU4
74LVC1GU04GM	–40 °C to +125 °C	6	XSON6	plastic	SOT886	VD

PINNING

PIN SC-88A; SC-74A	PIN XSON6	SYMBOL	DESCRIPTION
1	1	n.c.	not connected
2	2	A	data input A
3	3	GND	ground (0 V)
4	4	Y	data output Y
-	5	n.c.	not connected
5	6	V_{CC}	supply voltage

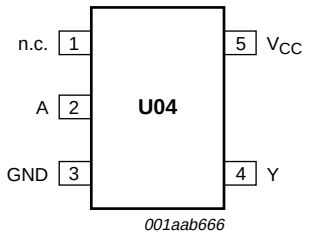
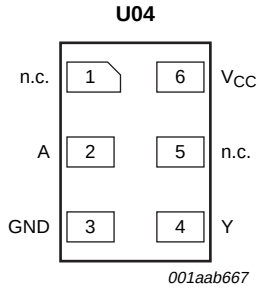


Fig.1 Pin configuration SC-88A and SC-77A.



Transparent top view

Fig.2 Pin configuration XSON6.

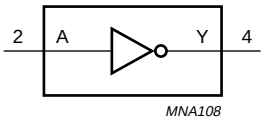


Fig.3 Logic symbol.

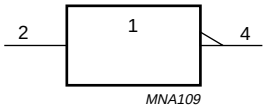


Fig.4 IEEE logic symbol.

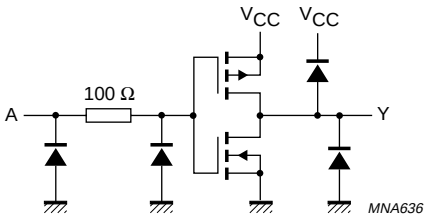


Fig.5 Logic diagram.

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		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; note 2	–	200	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. Above 55 °C the value of P_{tot} derates linearly with 4.5 mW/K.

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	$0.75 \times V_{CC}$	–	–	V
V_{IL}	LOW-level input voltage		1.65 to 5.5	–	–	$0.25 \times V_{CC}$	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	3.6	–	±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	$0.8 \times V_{CC}$	–	–	V
V_{IL}	LOW-level input voltage		1.65 to 5.5	–	–	$0.2 \times V_{CC}$	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	3.6	–	±0.1	±5	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0 A	5.5	–	–	200	μA

Note

1. All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.

AC CHARACTERISTICS

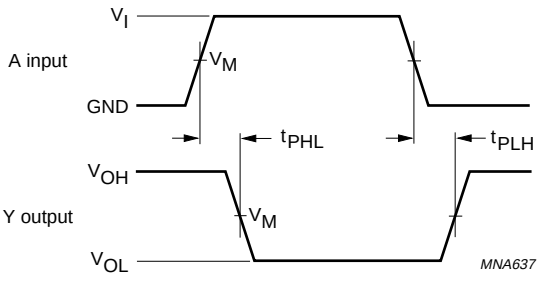
GND = 0 V; $t_r = t_f \leq 2.0$ ns.

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 A to Y	see Figs 6 and 9	1.65 to 1.95	0.3	1.7	5.0	ns
			2.3 to 2.7	0.3	1.3	4.0	ns
			2.7	0.5	1.7	5.0	ns
			3.0 to 3.6	0.5	1.6	3.7	ns
			4.5 to 5.5	0.5	1.3	3.0	ns
T_{amb} = −40 °C to +125 °C							
t_{PHL}/t_{PLH}	propagation delay A to Y	see Figs 6 and 9	1.65 to 1.95	0.3	–	6.5	ns
			2.3 to 2.7	0.3	–	5.5	ns
			2.7	0.5	–	6.5	ns
			3.0 to 3.6	0.5	–	5.0	ns
			4.5 to 5.5	0.5	–	4.0	ns

Note

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

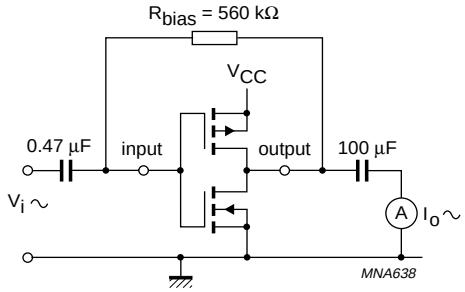
AC WAVEFORMS



V_{CC}	V_M	INPUT	
		V_I	$t_r = t_f$
1.65 V to 1.95 V	$0.5 \times V_{CC}$	V_{CC}	≤ 2.0 ns
2.3 V to 2.7 V	$0.5 \times V_{CC}$	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	$0.5 \times V_{CC}$	V_{CC}	≤ 2.5 ns

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

Fig.6 Input A to output Y propagation delay times.

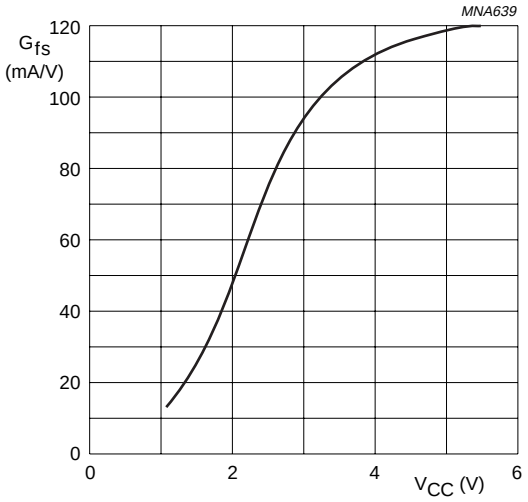


$$G_{fs} = \frac{\Delta I_o}{\Delta V_i}$$

f_i = 1 kHz.

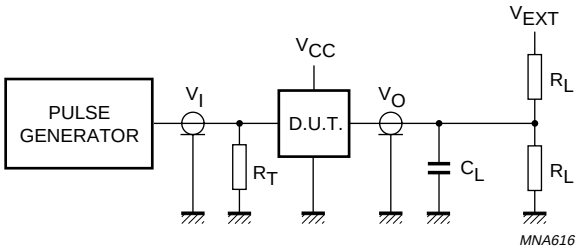
V_O is constant.

Fig.7 Test set-up for measuring forward transconductance.



T_{amb} = 25 °C.

Fig.8 Typical forward transconductance as a function of supply voltage.



V_{CC}	V_I	C_L	R_L	V_{EXT}		
				t_{PLH}/t_{PHL}	t_{PZH}/t_{PHZ}	t_{PZL}/t_{PLZ}
1.65 V to 1.95 V	V_{CC}	30 pF	1 kΩ	open	GND	$2 \times V_{CC}$
2.3 V to 2.7 V	V_{CC}	30 pF	500 Ω	open	GND	$2 \times V_{CC}$
2.7 V	2.7 V	50 pF	500 Ω	open	GND	6 V
3.0 V to 3.6 V	2.7 V	50 pF	500 Ω	open	GND	6 V
4.5 V to 5.5 V	V_{CC}	50 pF	500 Ω	open	GND	$2 \times V_{CC}$

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.9 Load circuitry for switching times.

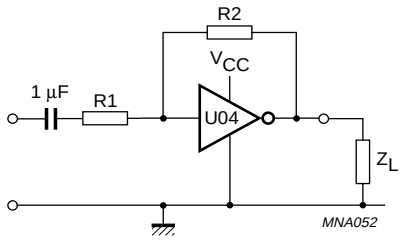
APPLICATION INFORMATION

Some applications for the 74LVC1GU04 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.

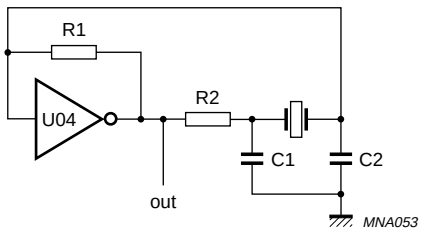
Open loop amplification: A_{OL} = 20 (typical value).

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

Maximum output voltage: $V_{o(p\text{-}p)} \approx V_{CC} - 1.5$ V centered at $0.5V_{CC}$

Unity gain bandwidth product: B = 5 MHz (typical value).

Fig.10 Used as a linear amplifier.



C1 = 47 pF (typical).

C2 = 22 pF (typical).

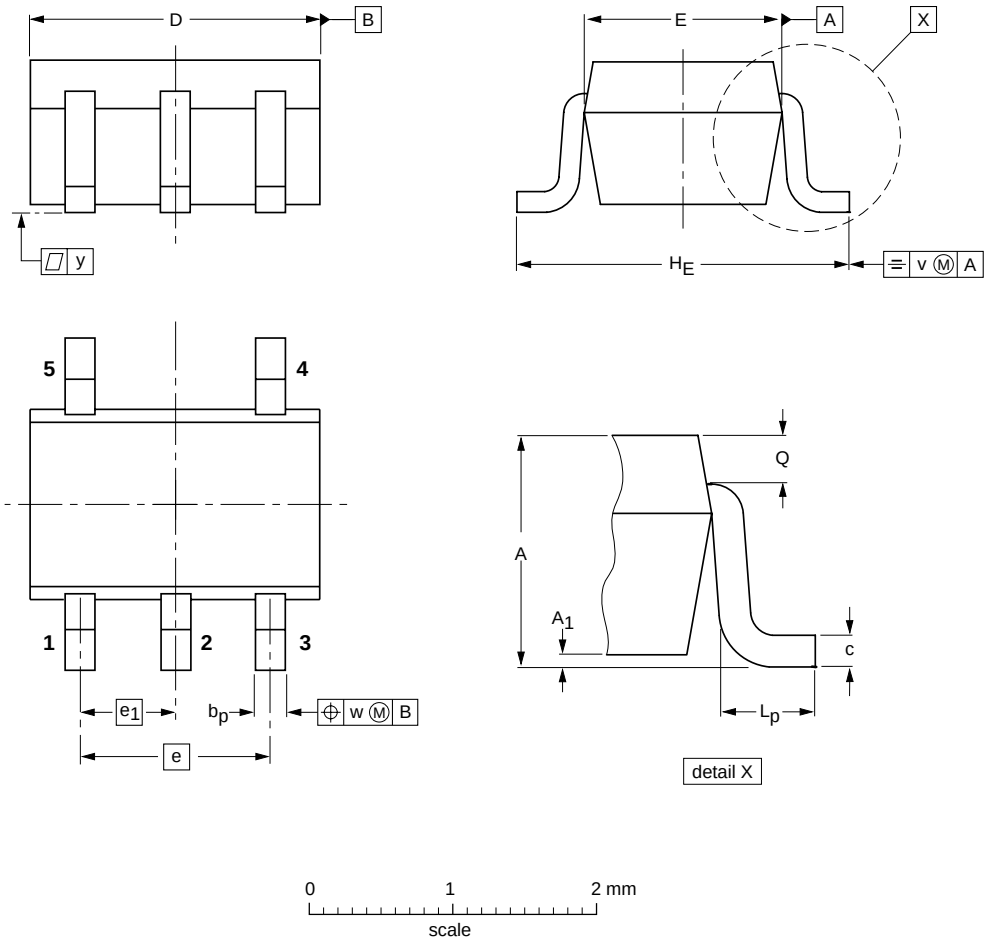
R1 = 1 to 10 MΩ (typical).

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; 5 leads **SOT353**

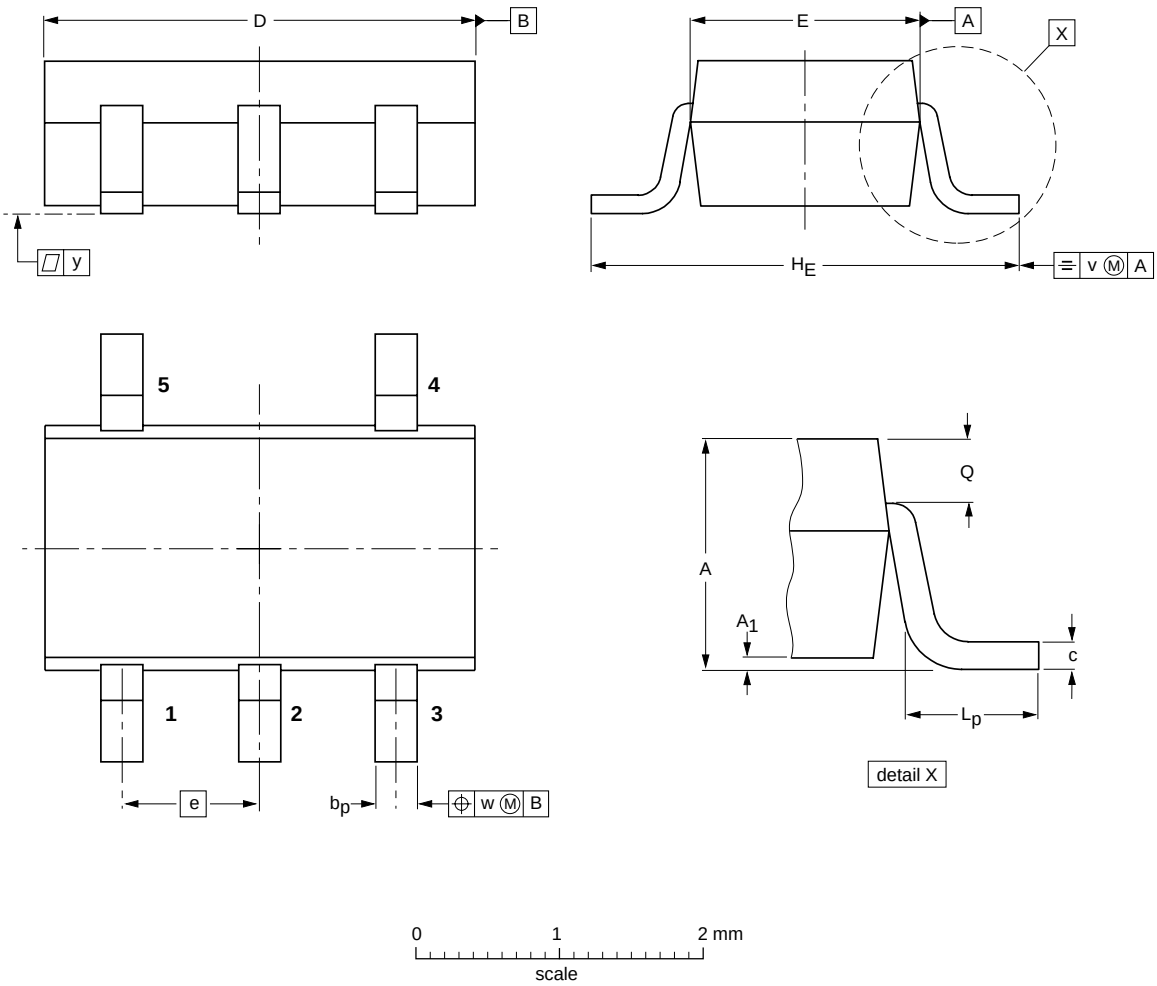


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E (2)	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			
SOT353			SC-88A			97-02-28

Plastic surface mounted package; 5 leads **SOT753**

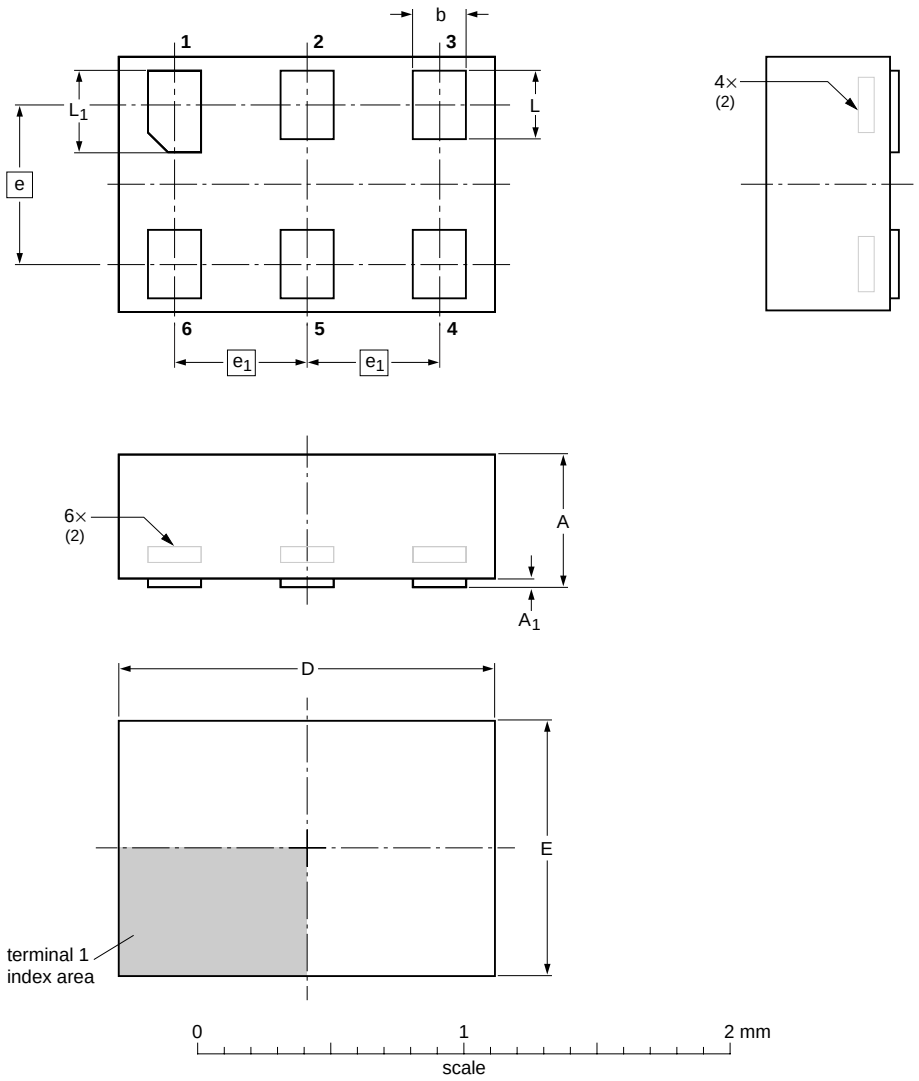


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.100 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	JEITA			
SOT753			SC-74A			02-04-16

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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